ANNUAL TELEVISION NUMBER

HUGO GERNSBACK, Editor

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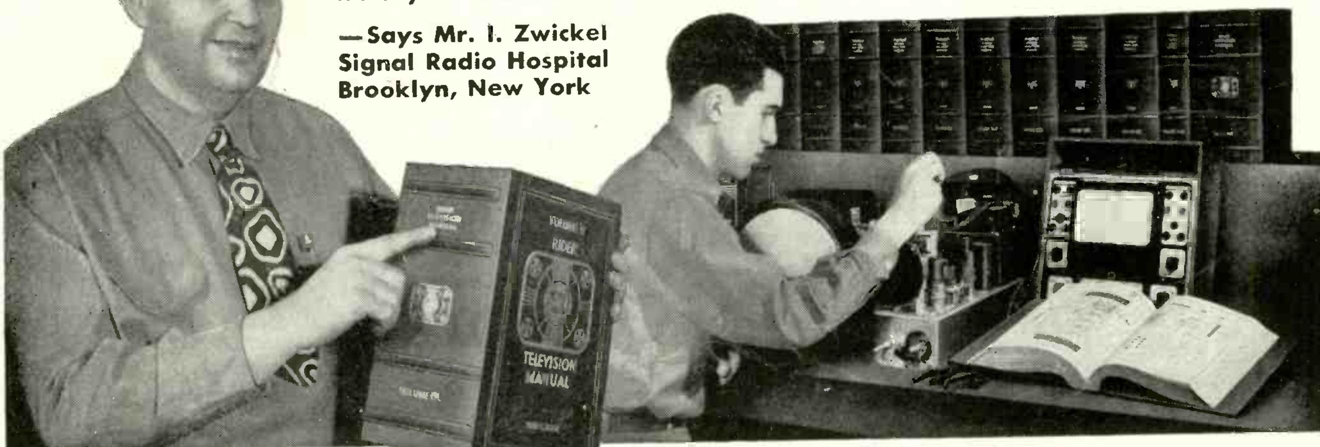

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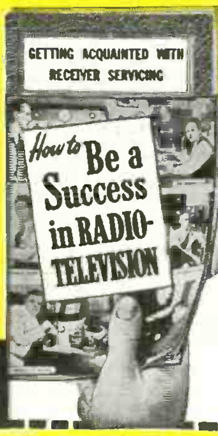

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Annual Television Number

Contents — **January, 1950**

ON THE COVER: Final tests on a televiser nearing the end of the assembly line at RCA's Camden, New Jersey, factory.

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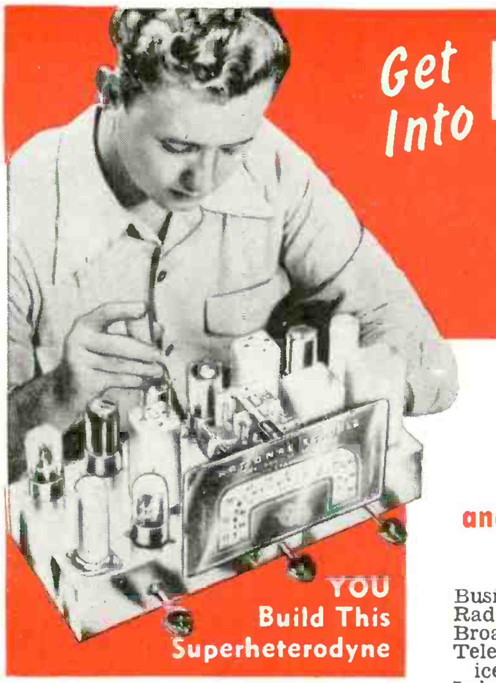

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Get Complete Training. You Receive and Keep All Equipment, Parts and Lessons. No Extra Charges.

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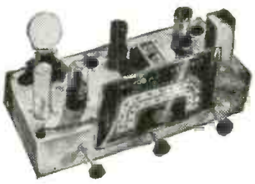
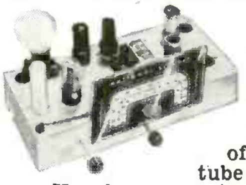


You construct the Transitron Signal Generator shown here, demonstrating Transitron principles in both R.F. and A.F. stages. You study negative type oscillators at firsthand.

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

T.R.F. RECEIVER



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

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Producing beat frequencies
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Application of visual tester in checking parts and circuits
Experiments with audio oscillators
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. . . and many, many others

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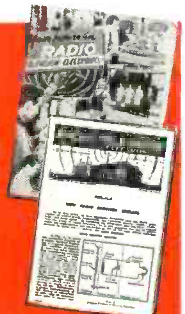

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YOU'LL BE SOLD ON *Sight*

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

Model TV-1201
Striking modern mahogany veneer table model with 12½″ tube and 2 six-inch oval speakers.
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Model TV 1225
A 12 picture tube and a 10″ speaker in a handsome mahogany console.
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Model TV-10W
Genuine mahogany table model with 10″ screen and 2 six-inch oval speakers.
$229.95

Model TV-7W
Unbeatable TV dollar value. 7″ screen with twin speakers. NC enlarging lens available, $16.95.
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Model TV-7M
Metal cabinet version of TV-7W. Ideal as "second set" for playroom, den or bedroom.
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(1) Latest flyback high voltage supply gives clear, bright pictures even in fringe areas. (2) Automatic frequency control locks picture in place. (3) Exceptionally wide video band-width for beautiful clarity of detail. (4) Front-of-panel focus control. (5) Coil switching assures equivalent of separate, high-Q tuned circuits for each channel. (6) Automatic gain control. (7) 3-stage 37 mc IF minimizes picture interference caused by other radio services. (8) Double-tuned RF bandpass circuits improve selectivity and image ratio. (9) Automatic Station Selector and fine tuning control.

Prices Slightly Higher West of the Rockies

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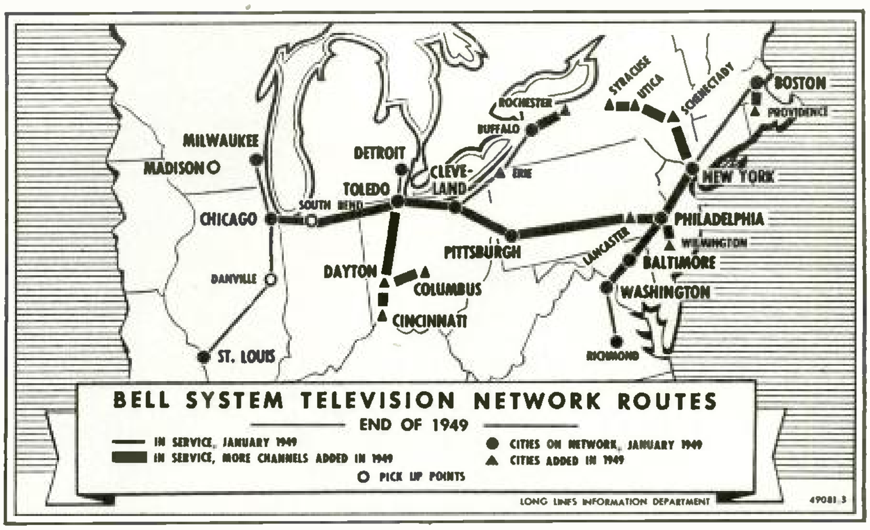


Map above shows the spread of television via co-axial cable network routes.

FREE TELEVISION in hotels was instituted last month in the Shelton Hotel, New York. According to William J. Knott, president of the owner corporation, the hotel is the first to offer TV to guests without charge. An RCA master antenna system is used, with individual antennas for each channel. The receivers were designed by Admiral and the installation was made by Tele-Ho-Tele Corp.

THE TELEVISION CONTEST

We received three tentative entries in our Simple Television Receiver Contest (announced in our May, 1949 issue), plus a few drawings and progress reports from persons who did not feel their work had reached the point where an entry would be possible.

The three entrants were invited to submit their receivers for inspection. Only one of them was actually forwarded, however. While its circuits were interesting, the picture it produced was definitely below entertainment level under New York conditions.

We are therefore forced to call off the contest for lack of suitable entries.

TVI-BURDENED AMATEURS will be aided by a new film announced last month by George Grammer, technical director of the American Radio Relay League. The film depicts corrective measures the amateur may take to eliminate bad effects on neighboring TV sets caused by his transmitter. Interference from other sources is pictured as well. Distribution will be through the more than 600 ARRL-affiliated radio clubs throughout the country. The film was made entirely under amateur auspices as part of a long-term program of cooperation among viewers, technicians, and amateurs conducted by ARRL.

AUSTRALIAN TELEVISION will operate with a 625-line standard. Under the present plan, television will be a government service, with stations to be erected first in the capital city of each of the six Australian states.

VIDEO-BROADCAST FILMS are not subject to review by a state censor, according to a decision rendered last month by the United States District Court against the Pennsylvania Board of Censors. Chief Judge William H. Kirkpatrick ruled that interference by the state would infringe on interstate commerce, a field covered by federal statutes. The ruling means that a film banned from the local theatres may still be shown to a much larger audience *via* the local television station. Provided the film is not profane, obscene, or indecent, no legal power exists to prevent the station from showing it, since federal law does not permit censorship.

HUGE RADAR CHAIN is being built by Canada, the government announced last month. The system will give warning against a possible attack by air against Canada's principal cities and on other important targets. The stations are expected to cost between 2.5 and 3.5 million dollars each.

BRITISH TELEVISION transmitting equipment is now being offered for sale to American television stations. Demonstrations of cameras, control equipment, and film projectors made by Pye, Ltd., were held in three major American cities last month. The equipment is made to RMA standards. B. J. Edwards, technical director of the British company, said that the firm wished to get the orders of the small portion of the market which cannot be served by American producers because of the large demand.

MOST POWERFUL RADIO in the world will be built by the U. S. Navy, according to a recent Defense Department announcement. Situated at Jim Creek, Wash., it will use its 1-megawatt output on low frequencies principally to send weather information to Navy units and installations throughout the Pacific area. The antenna will be suspended from one mountain top to another.

ELECTRONIC SIGHT may be a reality some day for the blind, reported Prof. Wendell J. S. Krieg of Northwestern University Medical School last month. Electrodes placed in or on the brain may be able to stimulate the motor points of muscles to make the lame walk and the seeing and hearing points to make the blind see and the deaf hear. To create sight the electrodes would have to be distributed in a prearranged pattern and some scanning method similar to that used in television probably would be necessary. It was emphasized that much remains to be done in basic research on the subject but that essentially the realization of practical results will merely be a technological step which, however, may take several years.

TRANSIT RADIO was called "an immoral, unwarranted invasion of personal liberty and privacy" last month in Washington, D. C., by R. A. Seeling, president of the local Transit Riders Association. The Public Utilities Commission was holding a hearing on radio receivers in trolleys and buses, which now operate under an arrangement with WWDC, a Washington radio station. A canvass of bus riders revealed mixed, but very much less strong, reactions.

WEATHER FORECASTS will be made with the aid of radar, the Army Signal Corps announced last month. A new radar station located at Fort Monmouth, N. J., will be able to predict the arrival of storms six to eight hours in advance. The equipment consists of a steel tower for the antenna and a ground building to house the storm detector scope and the remainder of the equipment.

E. E. SHUMAKER, former president of RCA Victor, died at his home in Merchantville, N. J., on November 2. At the time of his death he was vice-president of Electrical Research Products Co. and head of ERPI Classroom Films, Inc., both Western Electric subsidiaries. He was president of Victor Talking Machine Co. in 1930 when it merged with RCA and continued with the new company until 1932.

GUIDED MISSILES have been fired "by the scores," the Air Force announced last month after two years of secrecy. Two kinds of rockets are being used, the "GAPA," which is fired from the ground, and the "Firebird," designed to be launched from a plane to attack another aircraft. The missiles are being fired at Alamogordo, N. M. They are faster than the speed of sound and are radio-controlled. An Air Force spokesman said that this type of weapon was the "only foreseeable defense against the atomic bomb." W. E. Beall, vice-president of Boeing Aircraft, which makes the "GAPA," said that the developments might have far-reaching effects on future peace-purpose aircraft.

INSURED SERVICE POLICIES are now available to television service organizations, it was announced last month by M. C. Feldman & Co., New York insurance brokers. The dealer or service organization may issue renewal policies to set owners. The policies are insured to protect the customers, and the dealer pays the insurance company for each contract. The company requires the dealer to deposit 70% of his receipts from contracts in an escrow bank account, from which the bank usually turns back one twelfth of the amount per month. Careful scrutinies and continuing surveillance of the dealer's financial status are made by the insurer. The present arrangement does not take in small dealers and service companies, as the insurer requires a minimum of 500 policies. However, other insurance companies may enter the field and may be willing to set smaller minimums.

DR. FRANK BALDWIN JEWETT, former president and chairman of the board of Bell Telephone Laboratories, died on November 18 at the age of 70. For more than 40 years he had been an outstanding inventor and researcher for A. T. & T. and its affiliates.

Dr. Jewett joined the company's engineering staff in 1904 and subsequently became chief engineer, then a vice-president of A. T. & T. and of Western Electric. From 1925 to 1940 he served as president of Bell Telephone Laboratories and as board chairman from 1940 to 1944, when he retired. From 1939 to 1947 he headed the National Academy of Sciences, the first engineer ever to be elected its president. Dr. Jewett had just been awarded the 1950 medal of the Industrial Research Institute, Inc.

FELLOWSHIPS for graduate and internships for undergraduate students are offered by the Bureau of Standards to outstanding students. The Bureau's program permits the student to alternate periods of full-time study with practical experience in his chosen field.

TWO BEVATRONS, the world's most powerful atom smashers, have been ordered by the Atomic Energy Commission, it was announced last month. The magnets alone will have a 110-foot diameter and the accelerating chamber will be 400 feet around. One of the machines will be installed at the University of California radiation laboratory and the other at Brookhaven National Laboratory.

FIRE broke out last month in the Washington offices of the FCC resulting in the destruction of many documents. The fire was in the top three stories of the building.

Radio Corp. of America reported in a consolidated statement of income for the third quarter of 1949 and the first nine months of the year, with comparative figures for the corresponding period of 1948, as follows:

Total gross income from all sources amounted to $275,673,666 in the first nine months of 1949, compared with $256,968,537 in the same period of 1948, an increase of $18,705,129.

Net income, after all charges and taxes, was $14,095,186 for the first nine months of 1949, compared with $15,128,783 in 1948.

After payment of preferred dividends, net earnings applicable to the common stock for the first nine months of 1949 were 84½¢ per share, compared with 92¢ per share in the first nine months of 1948, a decrease of $1,033,597.

Motorola, Inc., Chicago, reported sales of $51,795,564 for the first nine months of 1949, against $39,848,775 for the same period of 1948. Net profit for the 1949 period amounted to $2,672,613, equal to $3.34 a share, compared with $2,215,914, or $2.77 a share, last year.

Net profit for the third quarter of the current year amounted to $764,377, or 96c a share, in sales of $17,973,196, against a net profit of $565,874, or 71c a share in sales of $12,930,235, a year before.

Electro Products Laboratories, Inc., has moved to its new plant at 4501 N. Ravenswood Avenue, Chicago, Ill.

These pioneer manufacturers of Electro battery eliminators for radios have recently introduced a new-type, d.c. power supply with conduction cooling. Expanded production facilities also offer improved delivery on the Pressuregraph and Syncromarker for accurate measurement and recording of dynamic and static pressures in engines and pumps, and the Dynamic Micrometer for accurately measuring dynamic or static displacement vibration or movement of any metal body.

Raytheon Mfg. Co. has transferred the merchandising of Raytheon mobile radiophones from its Belmont Radio Division, Chicago, to Raytheon's main plant at Waltham, Mass. The entire mobile radiophone operation will be under the direction of RAY C. ELLIS, vice president in charge of Raytheon's Equipment Sales Division. Production and service will continue at the Chicago plant until the equipment is in full production at Waltham. Delivery schedules and full service to all customers will be assured during the transfer period.

Although this move was planned several months ago, recent developments have proved that it will be most advantageous for both Raytheon and users of the equipment. Belmont Radio can now concentrate on the manufacture of its 1950 line of television receivers. Also, during recent months, Raytheon has expended over $1 million in improving its engineering, production, and testing facilities at the Waltham location.

International Resistance Co. of Philadelphia, played host to 65 sales representatives at a three-day sales conference in Hershey, Pa. By car, train, and plane, sales representatives from Canada and all over the United States journeyed to the Chocolate Town's famous Hershey Hotel for fun, games, and a thorough indoctrination in IRC's new products and sales plans.

Following the three-day conference, the entire conclave traveled by special bus to the IRC factory in Philadelphia for luncheon and a guided tour of the plant. Final activity of the sales session was a farewell party in Philadelphia's Broadwood Hotel.

Sylvania Television expanded to Western video markets with appointments of distributors in six major cities. C. K. "LARRY" BAGG, sales manager, started a Western business tour to set up distributorships in Los Angeles, San Francisco, Denver, Salt Lake City, Portland, and Seattle. More than 15 Eastern cities already have Sylvania distributors.

Sylvania Television sets are manufactured by Colonial Radio Corp., Buffalo, a wholly owned subsidiary of Sylvania Electric Products, Inc., New York. Nine Sylvania models in 10-, 12½-, and 16-inch table, console, and console combinations, the latter with three-speed record changers, all with built-in antennas, were already introduced in all the important east-coast television markets.

The Parts Distributors Show of 1950 announces that the show will be held on May 23, 24, and 25 at the Stevens Hotel in Chicago.

Show Manager PRINCE emphasized that there is to be no exclusive time in Exhibition Hall for any one group of distributors and that the hall is to be open from 10 am to 6 pm for all distributors who do business with exhibitor companies.

In keeping with show regulations, service technicians, hams, and the general public will not be admitted to the exhibition.

Emphasis at this year's show will be on a comprehensive educational program for radio parts distributors, including seminars and discussion sessions on such subjects of jobber interest, ways and means of stimulating sales, market research, cost accounting, and inventory control.

Radio Inventions, Inc., has announced that its president, JOHN V. L. HOGAN, has moved his office from 730 Fifth Avenue to 155 Perry Street, New York, and is devoting his full time and energy to the supervision of research and development work. To identify all the activities of the organization as closely as possible with him, the name of the corporation was changed as of September 21, 1949, to **Hogan Laboratories, Inc.** Personnel, location, telephone numbers, and corporate organization all remain just as they were before.

Heathkits ARE LABORATORY ENGINEERED . . .

Heathkits are engineered in one of the most completely equipped laboratories for instrument development in the United States.

The NEW V-4 Heathkit VACUUM TUBE VOLTMETER KIT

Features

- Meter scale 17% longer than average 4½" meter.
- Modern streamline 200 ua meter.
- New modern streamline styling.
- Burn-out proof meter circuit.
- 24 Complete ranges.
- Isolated probe for dynamic testing.
- Most beautiful VTVM in America.
- Accessory probes (extra) extend ranges to 10,000 Volts and 100 Megacycles.
- Uses 1% precision ceramic divider resistors.
- Modern push-pull electronic voltmeter circuit.
- Electronic AC circuit. No current drawing rectifiers.
- Shatterproof plastic meter face.

The new Heathkit Model V-4 Vacuum Tube Voltmeter has dozens of improvements. A new modern streamlined 200 microampere meter has Alnico V magnet for fast, accurate readings. The new electronic AC voltmeter circuit incorporates an entire new balance control which eliminates contact potential and provides greater accuracy. New simplified switches for quicker assembly. New snap-in battery mounting is on the chassis for easy replacement.

The Heathkit VTVM is the only kit giving all the ranges. Check them — DC and AC full scale linear ranges of 0-3V, 0-10V, 0-30V, 0-100V, 0-300V, 0-1000V and can be extended to 0-3000V and 0-10,000V DC with accessory probe at slight extra cost. Electronic ohmmeter has six ranges measuring resistance accurately from .1 ohm to one billion ohms. Meter pointer can be offset to zero center for FM alignment.

The DC probe is isolated for dynamic measurements. Has db scale for making gain and other audio measurements.

The new instruction manual features pictorial diagrams and step-by-step instructions for easy assembly. The Heathkit VTVM is complete with every part — 110V transformer operated with test leads, tubes, light aluminum cabinet for portability, giant 4½" 200 microamp meter and complete instruction manual.

Order now and enjoy it this entire season. Shipping weight 8 lbs., Model V-4

$24.50

THE FINEST VTVM KIT AVAILABLE FOR THIS PRICE.

Accessory: 10,000V high voltage probe, No. 310, $4.50.
Accessory: RF crystal diode probe kit extends RF range to 100 Mc., No. 309, $6.50.

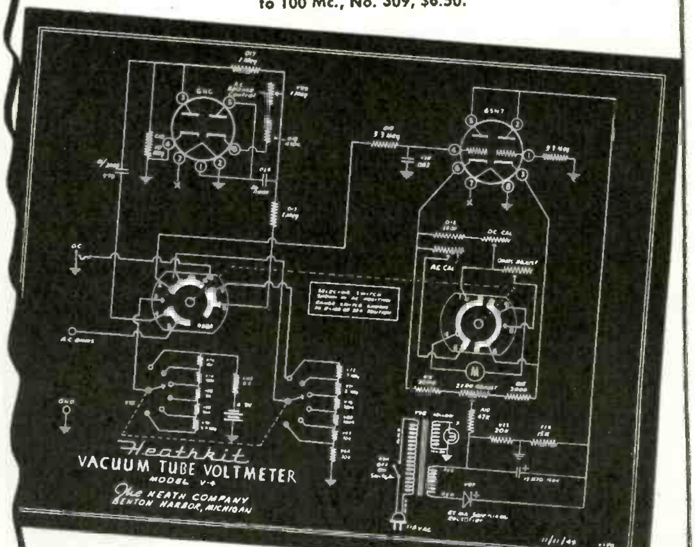
New Heathkit HANDITESTER KIT

Features

- 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.

A precision portable volt-ohm-milliammeter. An ideal instrument for students, radio service, experimenters, hobbyists, electricians, mechanics, etc. Rugged 400 ua meter movement. Twelve complete ranges, precision dividers for accuracy. Easily assembled from complete instructions and pictorial diagrams. An hour of assembly saves one-half the cost. Order today. Model M-1. Shipping wgt., 2 lbs.

$13.50



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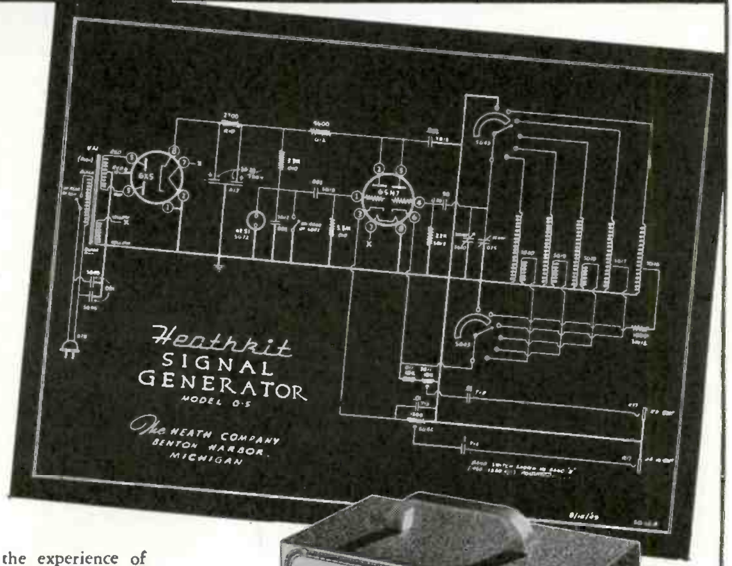
Heathkits ENABLE THE BUILDER



New 1950 VERNIER TUNING RF *Heathkit* SIGNAL GENERATOR KIT

Features

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

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

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

$19.50

$34.50

Heathkit SINE AND SQUARE WAVE AUDIO GENERATOR KIT

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 two-color panel, grey crackle aluminum cabinet. The detailed instructions make assembly an interesting and instructive few hours. Shipping weight, 12 lbs. Model G-2.

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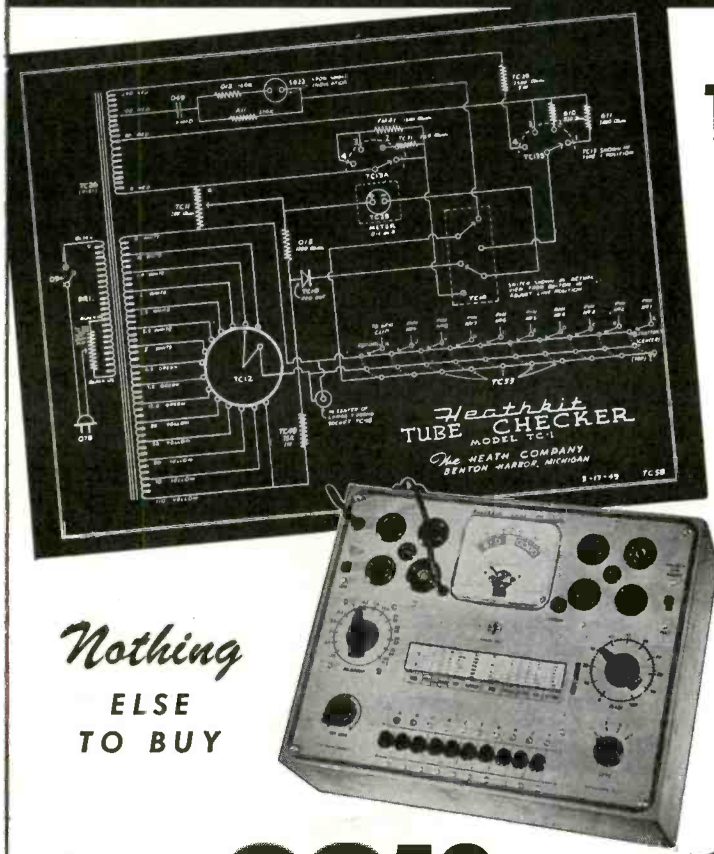
TO USE THE *Best* OF WORKMANSHIP



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. 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 miniatures.

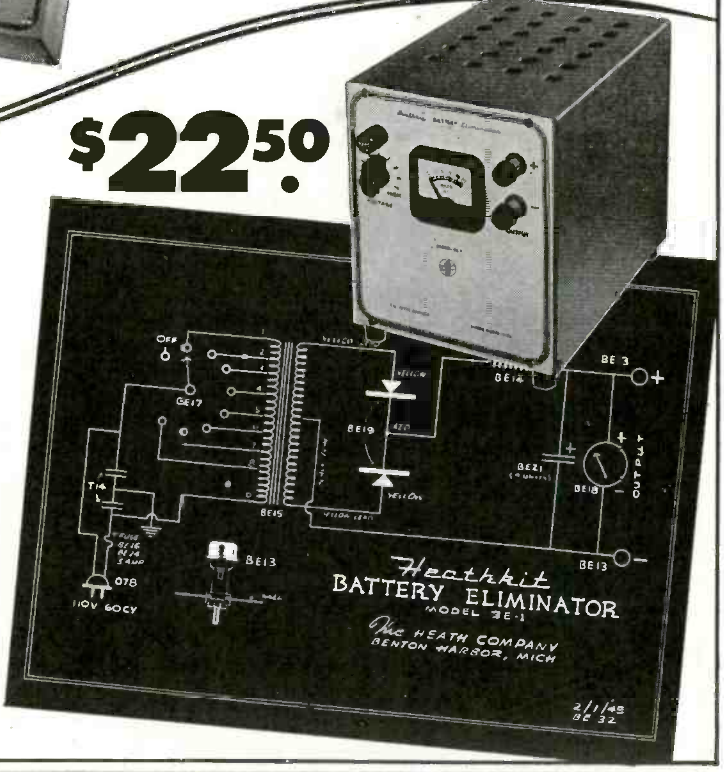
Check the features and you will realize that this Heathkit has all the features you want. Speed, simplicity, beauty, protection against obsolescence. The most modern type of tester — measures each element — beautiful Bad-Good scale, high quality meter — the best of parts — rugged oversize 110V. 60 cycle 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 two-thirds and yet retains all the quality — this tube checker will pay for itself in a few weeks — better build it now.

Complete with detailed instructions, all parts, cabinet, roller chart, ready to wire up and operate. Shipping weight, 12 lbs. Model TC-1.

Nothing ELSE TO BUY

Only $29.50

$22.50



Heathkit BATTERY ELIMINATOR KIT

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 wgt., 19 lbs.

Model BE-1

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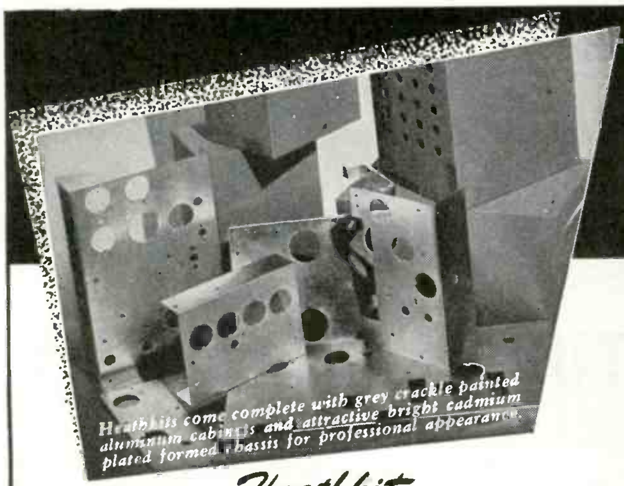
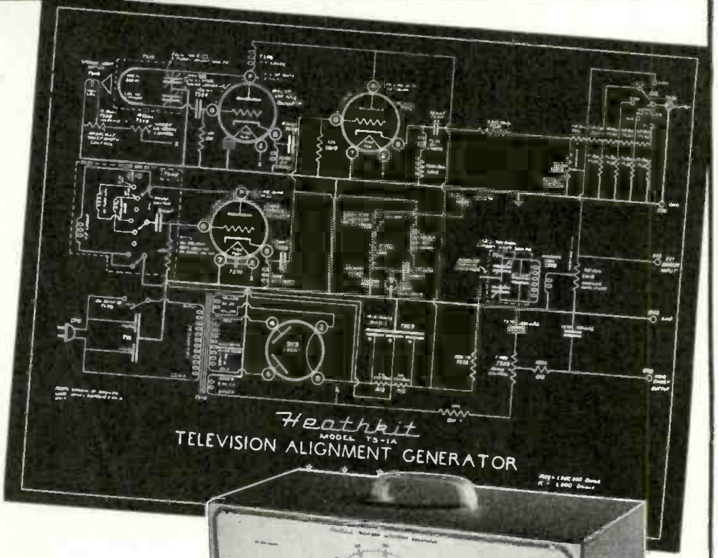
Heathkits ELIMINATE



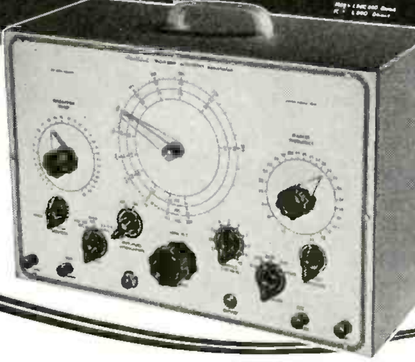


Heathkit TELEVISION ALIGNMENT GENERATOR KIT

Everything you want in a television alignment generator. A wide band sweep generator covering all TV frequencies 0 to 46 — 54 to 100 — 174 to 220 Megacycles, a marker indicator covering 19 to 42 Megacycles, AM modulation for RF alignment — variable calibrated sweep width 0-30 Mc. — mechanical driven inductive sweep. Husky 110V. 60 cycle power transformer operated — step type output attentuator with 10,000 to 1 range — high output on all ranges — band switching for each range — vernier driven main calibrated dial with over 45 inches of calibration — vernier driven calibrated indicator marker tuning. Large grey crackle cabinet 16⅛" x 10⅝" x 7-3/16". Phase control for single trace adjustment. Uses three high frequency triodes plus 5Y3 rectifier — split stator tuning condensers for greater efficiency and accuracy at high frequencies — this Heathkit is complete and adequate for every alignment need and is supplied with every part — cabinet, calibrated panel, all coils and condensers wound, calibrated and adjusted, tubes, transformer, test leads — every part with instruction manual for assembly and use. Actually three instruments in one — TV sweep generator — TV AM generator and TV marker indicator.

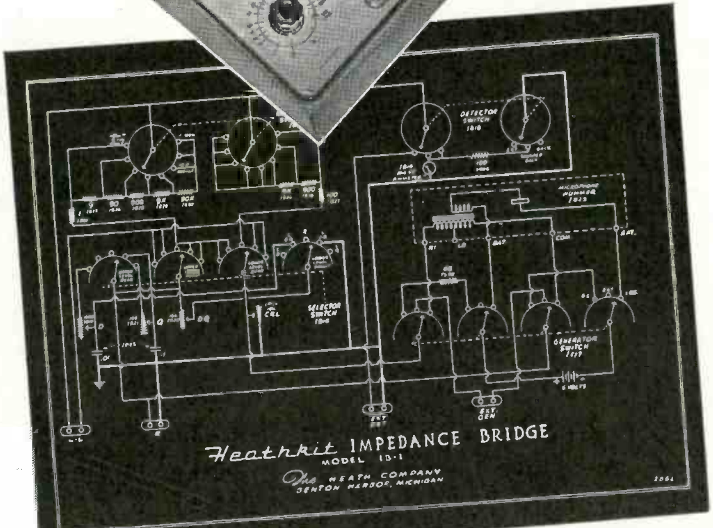
$39.50

Shipping weight 20 lbs.
Model TS-1A



$69.50

Shipping weight 15 lbs.
Model IB-1



New Heathkit IMPEDANCE BRIDGE KIT

A LABORATORY INSTRUMENT NOW WITHIN THE PRICE RANGE OF ALL

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

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

An impedance bridge for everyone — the most useful instrument of all, which heretofore has been out of the price range of serious experimenters and service shops. Now at the lowest price possible. All highest quality parts. General Radio main calibrated control. General Radio 1000 cycle hummer. Mallory ceramic switches with 60 degree indexing — 200 microamp 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 cailbrated 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.

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DIFFICULT METAL FABRICATION....

NEW *Heathkit* SIGNAL TRACER AND UNIVERSAL TEST SPEAKER KIT

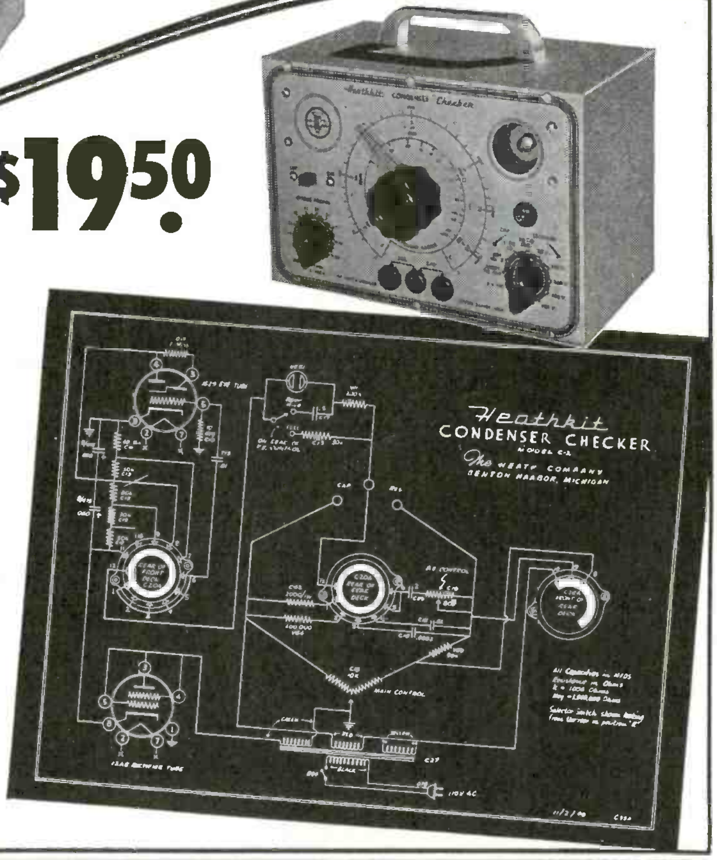
The popular Heathkit Signal Tracer has now been combined with a universal test speaker at no increase in price. The same high quality tracer follows signal from antenna to speaker, locates intermittents, defective parts quicker, saves valuable service time, gives greater income per service hour. Works 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 tests 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. Model T-2.

$19.50

Nothing ELSE TO BUY

$19.50

Heathkit CONDENSER CHECKER KIT



Features

- Power factor scale
- Measures resistance
- Measures leakage
- Checks paper-mica-electrolytics
- Bridge type circuit
- Magic eye indicator
- 110V. 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 instruction 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 weight, 7 lbs. Model C-2.

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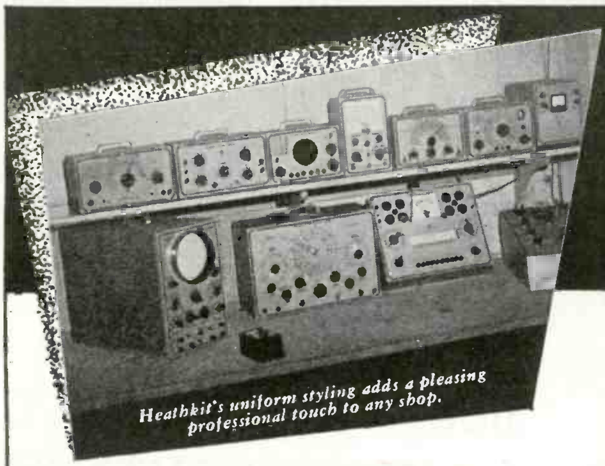


Heathkit's uniform styling adds a pleasing professional touch to any shop.

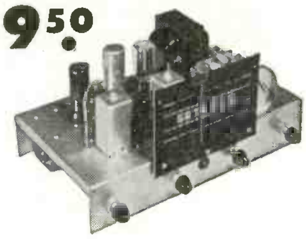
Heathkits PROVIDE PROFESSIONAL LABORATORY APPEARANCE

New Heathkit BROADCAST AND 3 BAND SUPERHETERODYNE RECEIVER KIT

Two new Heathkit Superheterodynes featuring the best of design and material. Beautiful six inch slide rule dials — 110 V. 60 cy. AC power transformer operated—metal cased filters—quality output transformers, dual iron core metal can IF transformers — two gang tuning condenser. The chassis is provided with phono-radio switch—110 V. outlet for changer motor and phono pickup jack. Each kit is complete with all parts and detailed instruction booklet. Pictorial diagrams and step-by-step instructions make assembly quick and easy.

BROADCAST MODEL BR-1
550 to 1600 Kc.

$19.50



Ideal AC operated superheterodyne receiver for home use or replacement in console cabinet. Comes complete with attractive metal panel for cabinet mounting. Modern circuit uses 12K8 converter, 12SH7 input IF stage, 12C8 output IF stage and first audio 12A6 beam power output stage, 5Y3 rectifier. Excellent sensitivity for distant reception with selectivity which effectively separates adjacent stations.

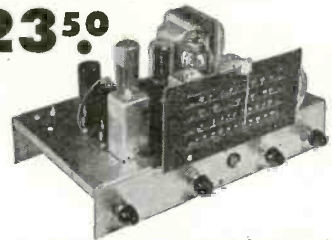
The husky 110 V. cased power transformer is conservatively rated for long life.

The illuminated six inch slide rule dial is accurately calibrated for DX reception. Enjoy the pleasure of assembling your own fine home receiver. Has tone, volume, tuning and phono-radio controls. Chassis size 2¼" x 7" x 12½" Comes complete with all parts including quality output transformer to 3.4 ohm voice coil, tubes, instruction manual, etc. (less speaker). Shipping Wt., 10 lbs. No. BR-1 Receiver $19.50.

No. 335 Communications Type Table Model Metal Cabinet.................$4.50
No. 320 High Quality 5" PM Speaker for above.................2.75

3 BAND MODEL AR-1
550 Kc. to 20 Mc.

$23.50



Enjoy the thrill of world wide short wave reception with this fine new AC operated Heathkit 3 band superheterodyne — amazing sensitivity 15 microvolt or better on all bands. Continuous coverage 550 Kc. to over 20 Mc. Easy to build with complete step-by-step instructions and pictorial diagram. Attractive accurately calibrated six inch slide rule dial for easy tuning. Six tubes with one dual purpose tube gives seven tube performance. Beam power output tube gives over 3 watts output.

Separately assembled coil turret with band switch eliminates difficult construction. Conservatively rated 110 V. power transformer supplies full operating voltages to all tubes for maximum reception. Has band switch, tuning, volume, tone and phono-radio controls. Chassis size 2¼" x 7" x 12½" — supplied complete — punched chassis — tubes — controls — transformers (quality output to 3.4 ohm voice coil) — all small parts — hardware and instructions (less speaker). Shipping Wt., 10 lbs. No. AR-1 Receiver $23.50.

No. 335 Communications Type Table Model Metal Cabinet.................$4.50
No. 320 High Quality 5" PM Speaker for above.................2.75

Heathkit PUSH-PULL HIGH FIDELITY AMPLIFIER KIT

$12.50

Build this high fidelity push-pull amplifier and save two-thirds the cost—has two preamplifier stages, phase inverter stage and push-pull beam power output stage. Comes complete with six tubes—quality output transformer (to 3-4 ohm voice coil) tone and volume controls—varnish impregnated cased 110V. power transformer and detailed instruction manual and all small parts. Six watt output with output flat within 1½ db between 50 and 15000 cycles. Build this amplifier now and enjoy it for years.

Shipping Wt. 7| lbs. Model A-4
12" PM Speaker for above..........$6.95

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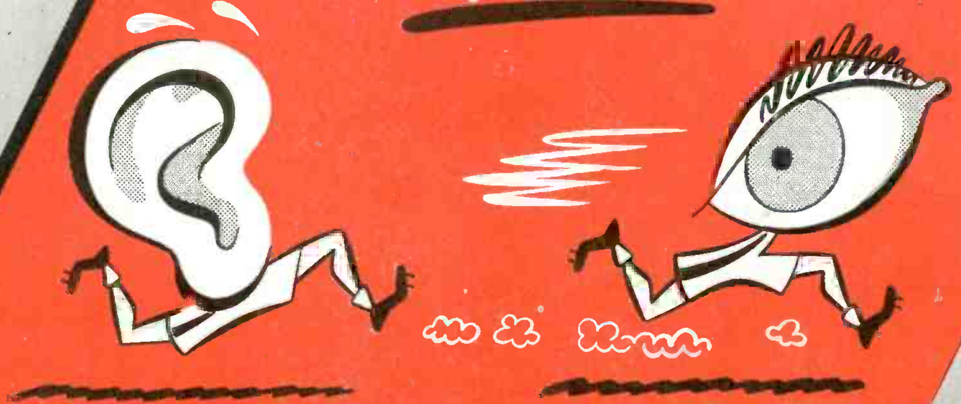
THE EYE IS QUICKER THAN THE EAR



IF you service TV, you know this. Customers are quick to *see* imperfections. Much slower to *hear* them. Therefore *premium-quality* Hytron receiving tubes for the tougher TV jobs. *At no extra cost!* You gain also: Through fewer expensive service call-backs. Better customer satisfaction and confidence. More profits.

How does Hytron do it? By working closely with leading TV set manufacturers. By endless striving to better already superior performance. By improved design . . . processing . . . inspection . . . testing.

Try Hytron TV receiving tubes: 1X2, 6AG5, 6AL5, 6AU6, 6BG6G, 6BQ6GT, 6J6, 6SN7GT, 12SN7GT, etc. You pay no more for Hytron. But *see* the difference yourself . . . on the TV screen . . . on your cash register.

OLDEST MANUFACTURER SPECIALIZING IN RECEIVING TUBES

HYTRON

RADIO AND ELECTRONICS CORP.

MAIN OFFICE: SALEM, MASSACHUSETTS

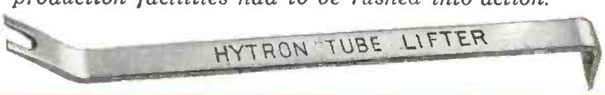
49c net

OUR APOLOGIES! We knew these Hytron shop tools would be popular . . .

because they are designed "by servicemen, for servicemen." But we didn't dream they would be so popular. That you needed them so badly. First production runs of both Soldering Aids and Tube Lifters melted away like snow in the red hot demand. New, more adequate production facilities had to be rushed into action.

NOW YOU CAN HAVE THEM

Sorry, if you were one of the unlucky ones who had to wait. Your Hytron jobber should now have both Soldering Aids and Tube Lifters in stock. If he hasn't, please drop us a line.



15c net

A HYTRON TOOL — by SERVICEMEN for SERVICEMEN

ALSO AT YOUR HYTRON JOBBER'S . . .

TUBE TAPER 5c net

7-PIN MINIATURE STRAIGHTENER . . 55c net

9-PIN MINIATURE STRAIGHTENER 55c net

AUTO RADIO TOOL 24c net

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Better Pay

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A New Car

Greater Security

Happy Vacations and Travel

Get Your FCC Ticket Jobs leading to $3,000 to $7,500 (Average Pay Reported by FCC Nationwide Survey) **are opening up right now for FCC Licensed Radiomen**

Add Technical Training to Your Practical Experience and

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It's EASY if you use CIRE Simplified Training and Coaching AT HOME in SPARE TIME

Get your license easily and quickly and be ready for the jobs open to ticket holders that lead to $3000 to $7500. CIRE training is the only planned course of coaching and training that leads directly to an FCC license.

YOUR FCC TICKET IS ALWAYS RECOGNIZED IN ALL RADIO FIELDS AS PROOF OF YOUR TECHNICAL ABILITY

CIRE Job-Finding Service Brings Amazing Offers of Jobs

"Have found and accepted a position at KWAD in Wadena, Minn.

I am indebted to CIRE for I secured this position through the help of the CIRE Job-Finding Service. I had six other offers from stations receiving my employment application and CIRE reference. I am sincerely under obligation to you."

Student No. 2760 AT

"I am working at WRJM as transmitter engineer, and I received this position in response to one of the employment applications sent me upon completion of my course and the receiving of my Diploma. I received my 1st class Radiotelephone License on March 2, 1949. I want to express my sincere appreciation to the staff of CIRE."

Student No. 2608 AT

"I now hold ticket Number P-10-3787, and holding the license has helped me to obtain the type of job I've always dreamed of having. Yes, thanks to CIRE, I am now working for CAA as Radio Maintenance Technician, at a far better salary than I've ever had before. I am deeply grateful."

Student No. 3319N12

CLEVELAND INSTITUTE OF RADIO ELECTRONICS

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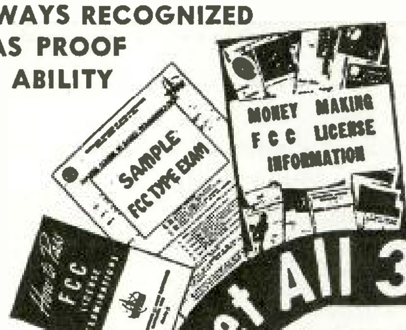
2. Tells How We Guarantee to Train and Coach You Until You Get Your FCC License.
3. Tells How Our Amazing Job-FINDING Service Helps You Get the Better-Paying Radio Job Our Training Prepares You to Hold.



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I want to know how I can get my FCC ticket in a few short weeks by training at home in spare time. Send me your FREE booklet "Money Making FCC License Information," as well as a sample FCC-type exam and FREE booklet, "How to Pass FCC License Examinations," (does not cover exams for Amateur License).

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Address ....

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

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Television in 1975

. . . What progress will television make during the next 25 years? . . .

By HUGO GERNSBACK

AS we round the half-century mark we can use this important milestone as a vantage point from which to speculate on what the next quarter century will mean to the progress of television.

Looking back, we are struck with the fact that there have been very few actually new developments during the past 25 years televisionwise. All the elements we have in television today were—with few exceptions—known 25 years ago.

The cathode-ray tube and all-mechanical televisers were both well advanced at that time. A tremendous amount of work, of course, had to be done to coordinate and make practical the theoretical knowledge which had been accumulated over the years. We in television, 25 years ago, had a pretty good idea what television could and would do by 1950. We knew that its realization was merely a matter of engineering and ironing out a multiplicity of "bugs". All these difficulties have been solved brilliantly.

How far will the television receiver of 1975 have advanced? I believe a fairly good estimate can be made from our 1950 vantage point, profiting by our past experience.

COLOR: It is a safe bet that every 1975 television receiver will have color. At present engineers mainly are concerned with the three-color system. Our opinion is that color television 25 years hence will be either the so-called electronic-color or an optical-electronic color system. It is doubtful that it will be of the mechanical type.

It is quite possible also that by that time we will have *four-color television* instead of the present three colors used. Anyone who has seen a magazine cover produced both in three colors and by a four-color process—such as is used, for instance, on the front cover of this magazine—knows the much greater color definition achieved.

THREE DIMENSIONAL PICTURES: The pictures on your television screen today are uniformly flat and without depth. If you look at a baseball game or other sports, it is sometimes hard to see what is going on. In boxing or wrestling, for instance, it may be impossible to tell in what part of the ring the contestants move. This is because the television picture has no perspective. That is what is missing in present-day television reproduction.

We know now that three-dimensional television is possible. It is also known that it is a much less difficult problem than, for instance, three-dimensional movies. We believe that the 1975 receiver will be fully three-dimensional, making all the figures stand life-like out in space.

AERIALS: We are now at just the beginning of practical television—at what some engineers facetiously call the crystal-detector-headphone stage of television. One of the handicaps of today's receivers is, of course, the outdoor aerial. These aerials, not only disfigure houses (whether private or apartment), but are expensive. They must be looked after frequently because of poor connections, and a heavy rain or snow storm often plays havoc with the installation. You may rest assured that the 1975 television installation will not require an outdoor antenna. The sensitivity of the receiver will have been increased vastly, and the television antenna (whatever it is at that period) will be right in the set itself. Television receiver history will be merely repeat radio set history. In radio, too, we started out with outdoor aerials, but today almost every receiver has its own built-in antenna.

Incidentally, television receiver cabinets in the next 25 years will become considerably smaller and lighter than they are today. Our present television sets, particularly table models, are much too cumbersome, much too heavy, and consequently expensive.

GHOSTLESS SETS: Present-day television receivers are bedeviled with a multiplicity of ghosts. In some locations this condition is particularly bad and, on some channels, almost impossible to eradicate. We may think of these exasperating ghosts merely as children's sicknesses—simply another nuisance that we are even now beginning to eradicate. When it comes to ghosts *in color*, the situation becomes even worse. We may be sure, therefore, that in 1975 television ghosts will be only a memory. By that time *automatic electronic ghost* elimination will be standard in all sets. Just as FM radio eliminated static and other extraneous noises in our radio sets, so the television set of 1975 will have found an electronic answer to the ghost problem.

CONTROLS: Television sets of today remind us forcibly of the radio sets of the early 1920's which sometimes had as many as 15 knobs on the front panel. The multiplicity of controls on the present-day television set reflects the comparative youth of television. It is possible even now to build a television receiver with a single knob although high production costs make it commercially impractical as yet. The 1975 television set, it is safe to predict, will also have a single knob for off-and-on and for sound control; perhaps by pushing the knob in or pulling it out you can vary the brilliance and contrast of the picture to the desired degree.

Incidentally, the average table model of 1975 will probably have 12 tubes or fewer. It will perhaps have both FM and AM reception if desired. In that case we would, of course, have more than one control.

THE PROBLEM OF COLOR TV

By LEE de FOREST

Some straightforward views on an important decision the FCC must soon make, written by the "Father of Radio"

COLOR television, as an idea and aspiration, is almost as old as mechanical television itself. That grand old TV pioneer, John Logie Baird demonstrated in England a crude form as early as 1928. He employed, of course, the whirling disc with two color filters, one red and the other a combination of green and blue colors.[1]

A year later Dr. Herbert E. Ives of the Bell Telephone Laboratory, also using a perforated disc, demonstrated a somewhat similar color television system.[2]

In 1931 a German engineer, Ahronheim, devised a color system using a 12-color filter disc in conjunction with a scanning disc.[3]

In February, 1930, a patent on color television was issued to Ray D. Kell, assigned to the General Electric Co. It also employed a double, spiral, scanning disc and only two colors instead of all three primaries.[4]

In the early thirties the electron beam swept all such mechanical whirling dervishes into the discard, and would-be TV colorists began to devise ways and means for tinting monotonous monochrome kinescope pictures with all the hues and shadings of the rainbow.

Today's colorists

Until today the question paramount in the minds of all television-minded citizens, owners (or prospective owners) of kinescope sets, is COLOR! How soon will color TV be available and at what retail cost? Opinions differ widely. CBS is vociferous in its claims that it has thoroughly demonstrated the merits of its mechanical, sequential, subtractive color system; and a dozen TV-set or gadget manufacturers announce their readiness to supply the public with motor-driven tricolor discs at low prices for CBS-type polychrome reception.

RCA has recently given some remarkable demonstrations of its all-electronic color system before the FCC and selected guests. The writer has witnessed these and has gone on record as saying that in fidelity of colors of every hue and shade when seen on direct-view screens, it leaves nothing to the imagination. Projected images, however, lack as yet desirable brilliance.

The system of Color Television, Inc., of San Francisco, like that of RCA, uses three separate pickup devices, all in a single camera, combining at the receiver the color images by optical projection from three separate cathode-ray tubes with different phosphors, red, green, and blue.

All three of the above color systems now operate within the 6-mc band, as required last year by the Federal Communications Commission, so all are applicable to our existing v.h.f. television channels. In the 1946 demonstrations both CBS and RCA systems required bands of 12 mc or more, thereby restricting their proposed operations to the u.h.f. channels not yet authorized by FCC.

Both organizations now claim that their present 6-mc-bandwidth pictures are essentially as satisfactory as those demonstrated in 1946. This has been questioned. In view of the fact that the widespread successful commercial employment of the proposed u.h.f. channels has not yet been proven (and in the minds of many experts will never be satisfactory in many localities and during certain seasonal and weather conditions), the wisdom of FCC in stipulating that color must fit existing v.h.f. channels is clear and is generally approved.

The Radio Manufacturers Association has recently laid down requirements for any future acceptable color television system; these are carefully thought out, clearly logical, and designed for the greatest benefit to the television industry and the public now and in the future.

Compatability a must

Foremost of their *sine qua non* conditions, a positive must, is that of compatibility. This simply means that whatever system of color is finally to receive the green light from FCC must be one whose color telecasts can be received on any existing standard black-and-white receiver, and must be equal in quality to any monochrome TV picture today. Any color system that cannot comply with this fundamental requirement should not be authorized. If the introduction of color telecasting means that any number of today's 3,000,000 TV receivers cannot receive a particular program (in monochrome), the television viewing audience will be reduced by just that number of receivers.

The potential prosperity of the television industry, broadcasters, and set manufacturers alike, demands that the television audience be built up as fast as possible. We cannot wisely permit anything which will compel any fraction of the existing audience to switch off their sets. Only the inferior quality of a program's content itself should induce a viewer to turn to some other channel! He should not be forced to do so by the technical limitations of his present TV set. *Any other policy will spell disaster to this growing industry.*

We cannot afford, in the interests of a small favored minority who can afford to purchase converters for color, to penalize others less favored, or to reduce the number of available programs for that vast majority who, for one cause or another, are not equipped for color viewing.

The logic of this position of RMA is unassailable. I think I can speak authoritatively on this topic. For the past two years I have been quietly at work on a mechanical television system, requiring no color wheel which limits the service as does the CBS system to 7- or 10-inch kinescopes. In place of the outlandishly large color wheel and the requirement of circuit changes to provide a frame frequency of 144 (instead of 30) per second and a reduced number of lines, I place before any kinescope face, even of 16-inch diameter, a three-color mosaic screen. It oscillates in an orbital, circular movement less than 1 inch in

[1] A description of Baird's arrangement appears in *Television Simplified*, by Milton Kiver.

[2] March-April, 1931, issue of *Television News*.

[3] July-August, 1931. *Television News*.

[4] November-December, 1931. *Television News*. The same issue contains an article by Wolf S. Pajes on a color TV system using electronic light valves.

diameter, 30 times per second, so that each picture element is viewed through one of the three prime colors on the mosaic filter screen every 1/30 second. Nothing could be more simple or cost less than such a color adapter, readily slid in front of the kinescope face for color viewing and withdrawn for monochrome programs. The mosaic shuttle must, of course, oscillate or circulate in synchronism with a similar one properly located in the light beam from the image to the pickup camera (flying-spot or image-dissector type). This requirement is readily met; the small driving motors are of only 10 watts power.

But this system, like the mechanical system of CBS, was not, at the time of the FCC hearings, compatible. Used with a black-and-white receiver tuned to the color transmission, a rapidly shifting veil or pattern appeared, superimposed over the monochrome picture from the color transmitter. This has since been eliminated by a device which is quite simple, whereby the image may be seen on a black-and-white kinescope, like any present monochrome-transmitted picture. Therefore it was not submitted, in the form it had at that time, to the Federal Communications Commission at the recent color television hearings in Washington.

Politics and pressure

It is highly regrettable that politics has pushed its ugly head into the color-television picture; nor is it too difficult to imagine just why certain solons have taken it upon themselves to attempt to force FCC into a premature, ill-considered decision authorizing any particular existing color TV system for early commercial introduction and exploitation. (As logically should the Western Union seek a ruling by FCC that only the new zirconium spotlight, admittedly superior, should be used as the accepted illuminant in all television studios!)

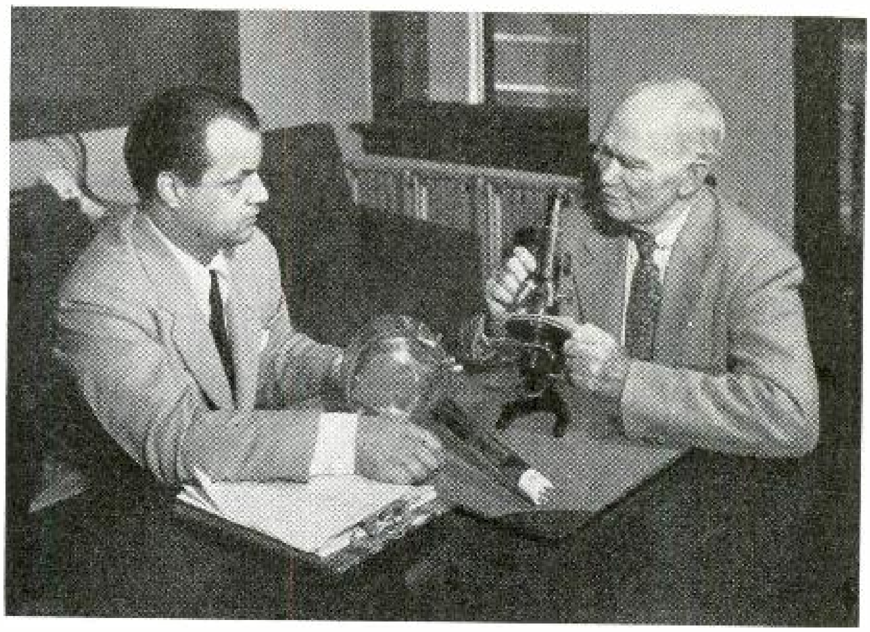
Color television should not be *forced* upon the industry, nor on the public. As is admitted by all proponents of this or that color system (with one single exception), the fruit is not yet ripe on the tree of knowledge. Let us have more time to perfect this highly complex facility—to iron out a mess of wrinkles and imperfections. The industry has only now struck its stride. Much of it is yet deeply in the red, financially. We need at least three years more of growth and unimpeded prosperity while the wizards of electrons and circuitry are dressing up their polychrome babies.

I think no fixed time for color-system acceptance should now be placed on any calendar. Let us wait until black-and-white market saturation has been reached. Then will be the proper time to introduce to an eager, accepting audience of at least 5,000,000 set owners an RMA-standardized color television system—one which is absolutely compatible and one which will not reduce the viewing audience by a single set nor by a single hour of employment or enjoyment. Also the color-television receiver should cost little more than the better class of monochrome sets, or color converters should be available at the very minimum of expense. Then, and not until then, let us have color television.

One thing is clear: no color adapter should be limited to 7- or 10-inch kinescopes, nor to projection types of receivers. For the past year the trend has been increasingly toward the larger direct-view sets, 12-, 16-, 19-inch kinescopes. Any color system limited to smaller tubes or to dim projected images should not be considered, for obviously they will have scant public acceptance. Owners of the larger sets must not be debarred from color nor compelled to buy completely new receivers for color television enjoyment.

More rather than less emphasis should be placed on compatibility, as month by month more hundred-thousands of receivers roll off the assembly lines. Did I not sincerely believe this, I would be emphatically advocating the advantages of my own color system over all others in evidence today. But RCA, at least, has proven the practicability of compatibility. Let other aspirants do the same. We want no brake applied to the television chariot, today or tomorrow.

Color television in 6 mc must proceed upon a lasting foundation of proper standards, excellent performance, and complete compatibility with existing receivers, *with no changes in their chassis for black-and-white reception of color programs.*



The author, Dr. Lee de Forest, with U. A. Sanabria of American Television, Inc.

Such logical considerations will render abortive the high-pressure methods now so evident, seeking to force a half-sized or midget color system upon industry and public. The simple fact that a certain system "is operative today" by no means rules out the obvious fact that some other color system may be operative in a far better fashion two or three or four year or more from now.

Hurry vs delay

Delay in immediate acceptance of any system today would, we are told, "result in a double loss for the public, because millions more of black-and-white receivers lacking provision for adaption and conversion will have been purchased." But why increase the cost of our present chassis and cabinets for the purpose of converting to any one system which may, probably will, be obsolete and discarded within the next three years? Public loss will be safeguarded by watchful waiting—not by jumping into a 10-inch bag be it ever so colorful.

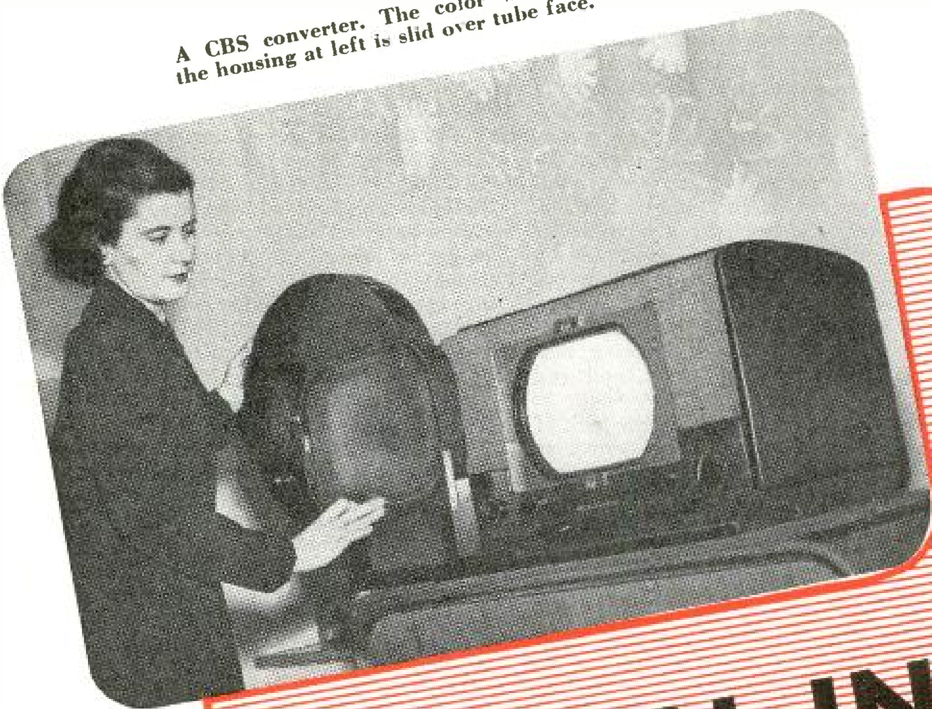
The RCA color system is a triumph of clever electronic engineering. (It is described elsewhere in this issue.—*Editor*) At present, however, RCA color receivers are too costly compared to monochrome, and their converters are scarcely less so. The engineers are hard at work to simplify and cheapen these devices, and it is reasonable to expect revolutionary improvements and drastic cost cuts during the next two years. Other systems may do the same, or better. By all means, then, let us control our natural impatience to view color perfection on our screens. Delay today will pay rich dividends, in color and costs, tomorrow, or possibly day after tomorrow.

And in the meantime, let the FCC at once lift its arbitrary "freeze" on further extension of v.h.f. video transmitters so that every section of the country may enjoy as rapidly as possible the immeasurable benefits of television reception. The duty of the Commission to act speedily in this is incomparably more imperative than to decree that color television shall be quickly commercialized.

tions. Whereas heretofore only a mere pilots in penetrating deep into enemy homes.

JANUARY, 1950

A CBS converter. The color wheel in the housing at left is slid over tube face.



TELEVISION IN COLOR

By FRED SHUNAMAN

IS color television a rainbow-hued mirage or a reality already visible on the horizon? When and how will it be achieved? There is little agreement among experts on the first question. To answer the second, a number of organizations and individuals have proposed or demonstrated systems which they hold to be the most practical. Probably the most important are those of the Columbia Broadcasting System and the Radio Corporation of America. Both are modifications of color systems demonstrated to the FCC a few years ago.[1]

CBS uses a mechanical system of whirling color wheels. A transparent disc divided into segments of the three primary colors—red, green, and blue—revolves in front of the television camera. When the red segment comes between the scene and the camera, the lens picks up chiefly the red light. The same is true of the other two primary colors.

A similar disc whirls in front of the receiver screen. (See Fig. 1 and the photo at the head of this article.) The receiver disc is synchronized with that at the transmitter: when, for example, the red field is being received, the red section of the disc is ahead of it. The image seen by the viewer is then red.

The successive primaries are flashed on the eye at the rate of 144 per second, and persistence of vision blends them into one full-color picture. All color being made up of these three primaries, a color between red and blue, for example, transmits some red and some blue light; the mixture of the two in the eye of the viewer reproduces the original color because of persistence of vision.

The practical realization is not as simple as that, of course. Problems of interlacing, flicker, and fringing, among others, arise.

CBS has obtained its best results with 48 complete pictures (144 color fields) per second. The number of scanning lines per picture is 405, instead of the 525 in standard black-and-white receivers. This feature was considered necessary to reduce the transmitting bandwidth to the standard 6 mc, but makes the system "incompatible" with today's black-and-white receivers, which require modification to receive transmissions in both color and black-and-white. Slight alteration of the sweep circuits is sufficient, and a simple switch can be installed to permit operation on 525 or 405 lines.

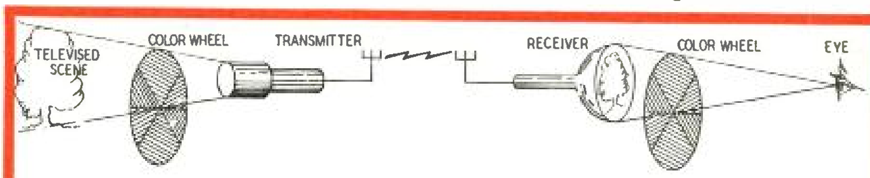


Fig. 1—CBS system uses a color wheel at the transmitter and one at the receiver.

The RCA approach

RCA uses a camera with three lenses and three electronic systems—in effect three cameras in one—to pick up the reds, greens, and blues. To transmit over an r.f. band not more than 6 mc wide, each color in the new system "shares time" with the others. Red, green, and blue are transmitted in turn over a video band approximately 4 mc wide. Fig. 2 is a block diagram of the system.

The time-sharing feature of the new system is made possible by *sampling*, a method originally developed for multiplex pulse communications systems.

The sampling system works like this: As the scanning spot swings across the subject, the output of each of the three color cameras is "tapped" 3,800,000 times per second. Each of these sampling periods is so short that it produces a narrow d.c. pulse whose voltage represents the strength of that color at the exact spot being televised (Fig. 3-a).

The electrical pulse representing each color sample goes to a low-pass filter. This filter broadens these sharp d.c. pulses into a displaced (Fig. 3-b) alternating current (a.c. with a d.c. component), which flows in one direction twice as long as in the other. Thus the alternation whose peak voltage is the same as that of the pulse occupies two-thirds of the cycle. The filter cuts off all frequencies above 2 mc.

The three color samples in b, d, and f of Fig. 3 are combined in the composite wave of Fig. 3-h. This composite signal looks like a single sine wave from which retrieving the three color components would seem a hopeless task. But a look at b, d, and f reveals that, at the instant each color wave is at its peak (the instant of sampling), the other two are passing through zero. Neither red nor blue can affect the green signal at the green peak, so a sample of the composite wave taken at that instant gives the exact strength of the green signal.

The great advantage of the composite wave is that it can be of the same bandwidth as the sampling signal. Thus we get three 3.8-mc signals on a single 3.8-mc channel, instead of on one three times as wide. In a 525-line picture, each color is sampled more than 7,000 times per line. These samples are staggered so that when the second line is scanned, the sample of each color is taken midway between the samples of that color on the line above.

Bypassed mixed highs

To this composite wave is added the fine-detail modulation between 2 and 4 mc, which has been picked up in parallel from all three cameras and passed on together in what RCA calls the bypassed mixed-highs system. The complete signal then goes through the low-pass (4-mc) filter and is applied to the modulator of a conventional v.h.f. or u.h.f. transmitter. Fig. 4 gives an excellent—though quantitatively inexact—picture of the video signal as it leaves that filter, and illustrates how a secondary color like yellow is made up of pulses from two primaries. Fine-detail modulation from the mixed highs is also present but has been omitted because of the difficulty of representing it in a diagram.

The receiving system

The receiver is standard right up to the video detector (Fig. 5). At that point a sampler synchronized with the one at the transmitter takes short samples of the composite signal at the instants of red, green, and blue peaks, passing each color to its own video amplifier.

Color is restored by using three kinescopes whose phosphors glow in the three primary colors. Their outputs are mixed—either for direct viewing as in Fig. 6 or projection as in Fig. 7—with the help of *dichroic* mirrors. These are plates of glass on which a microsopically thin metallic film has been deposited to make them reflect one primary color and pass another.

The scanning is interlaced, with 60 fields per second, as in standard black-and-white. Fig. 8 illustrates the method by showing a few lines of each field.

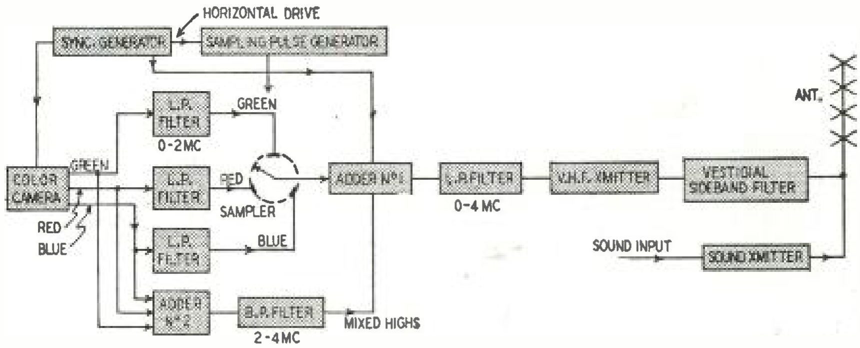


Fig. 2—Block diagram shows how the RCA system operates at the transmitter end.

The colored "dots" represented by the letters are actually short colored dashes which overlap each other about 50%. Lines 1, 3, 5, etc., are scanned in the first field. Then the even-numbered lines are scanned, with the dots so displaced as to fall halfway between those of the same color in the line above them. The odd and even lines are again scanned in the third and fourth fields, with the dots filling in the spaces left in the first and second scannings. (Note the absence of G in the initial space of lines 2 and 3 in the top half of Fig. 8, and its presence in the same spaces in the lower half of the figure.)

Four fields are required for a complete picture, instead of two as in black-and-white. Thus there are 15 pictures per second.

The interlaced scanning permits greater definition than would otherwise be possible. The finest detail which would affect the image would be one which would be a peak value at one dot and zero at the next dot of the same color. This would represent a frequency of half 3.8, or 1.9 mc. But since the second line scans points halfway between those of the first line, detail which goes from maximum to zero in *half* the distance between successive color dots is reproduced. This is made clear in Fig. 9. The solid lines represent the three colors as they are distributed over a small part of line 1, and the dotted lines the same colors in line 2. The overlap of color is well illustrated in this figure.

Fine detail is reproduced by the bypassed mixed-highs system, first developed several years ago without the bypass feature for the older simultaneous system. Fine detail (frequencies between 2 and 4 mc) is taken from all three of the camera sections, bypassed around the sampler, and added to the sampled signal (Fig. 2). It is detected in the receiver, then bypassed around the sampler and added to the red and green video signals, experience having proven that the eye is more sensitive to these colors than to blue. While these mixed highs cannot be said to be color-sensitive, in actual practice they add to the fine definition without subtracting noticeably from the color fidelity. Receivers constructed to use the mixed highs are like those of Fig. 5, with the addition of low-pass 0-2-mc filters in each color video circuit, a 2-4-mc band-pass filter for the mixed highs, and adders in the green and red video circuits.

Other systems

A few other contenders have entered claims, but so far have not demonstrated their systems to the FCC. Chief

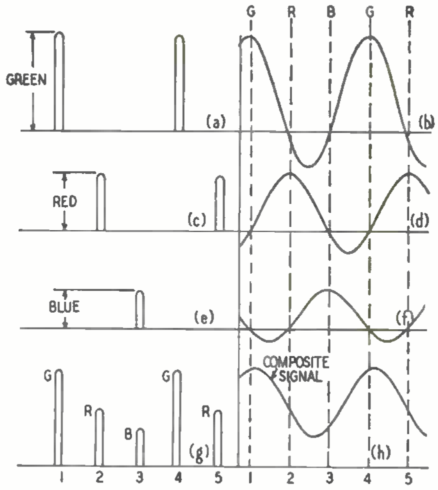


Fig. 3—The sampling system takes pulses of each color, integrating them.

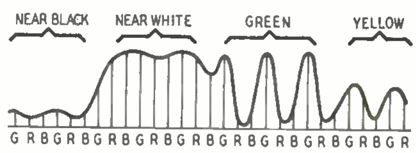


Fig. 4—Signal after passing through 4-mc filter. This is applied to modulator.

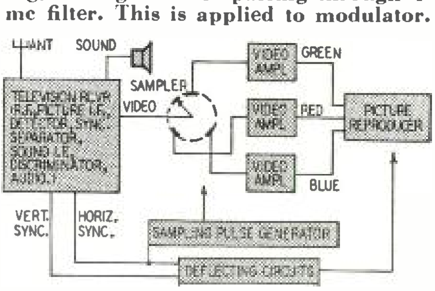


Fig. 5—The receiver contains synchronized sampler and three kinescope tubes.

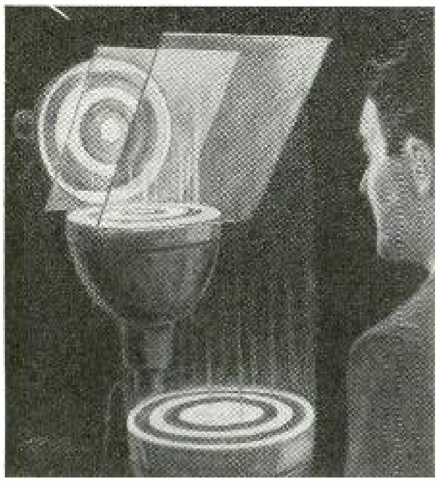


Fig. 6—A direct-view RCA color system.

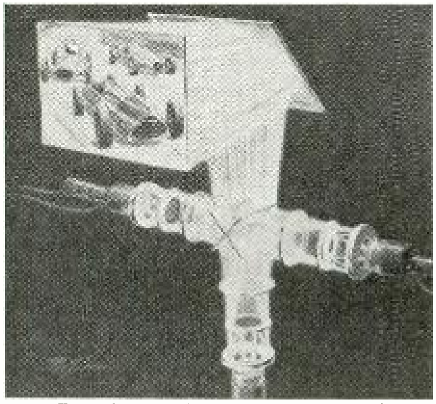


Fig. 7—Three-tube projection receiver.

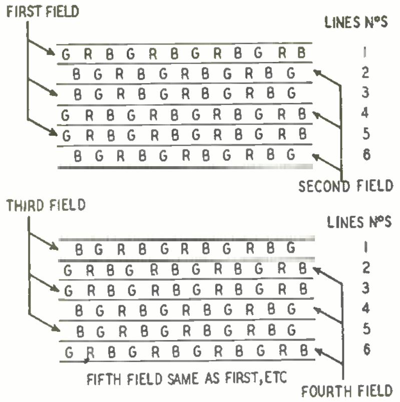


Fig. 8—How three colors are interlaced.

of these is Color Television, Inc., of San Francisco. Based on patent No. 2,200,285, issued to R. Lorenzen, and Nos. 2,389,645 and 2,389,646, granted to George E. Sleeper, its colors "share space" on the transmitting and receiving tube screens, instead of sharing time or spectrum width.[4] Three lenses and three color filters are placed in front of the pickup tube (Fig. 10) which may be an ordinary image orthicon. These are so positioned that three separate primary-color images of the scene being televised are formed, as in the blocks A, B, and C of Fig. 10. Scanning in the transmitting and receiving cathode-ray tubes is the same as in black-and-white, with one-third of each scanning line in a different color field. The kinescope may be a special tube with the three picture areas coated with red, green, and blue phosphors, or it may be a white-light tube. If a white-light tube, filters are again placed ahead of each section to transmit only the correct primary. In any case, the three images are combined with lenses and projected as a single picture.

A somewhat similar system called Thomascolor was described a few years ago, but has not been heard from during the present color hearings.

"Subtractive" color

Skiatron Corp., which has a large-screen system operating with an ultrasonic cell, points out that the rotating-disc color system "can easily be applied to the Skiatron and supersonic methods[5], and the disc can be made very small by inserting it near the optical imaging system where the whole light energy is restricted to a small cross section." Fig. 11 shows such a setup, with the color picture projected on a large screen. The same system could be used with the Skiatron tube, which also modulates a beam of light from a local source. According to Dr. Rosenthal, inventor of the tube, the Skiatron is also adapted to a "subtractive" color system, in which the light is projected through three Skiatron-tube screens (whose opacity rather than brilliance is varied by the signal). The screens are lined up so the light goes through them *in series*, and each screen carries an opacity picture corresponding to one field of a three-color system (minus red, minus green, and minus blue). This method, which will have to wait for further development of the Skiatron tube, should make for greater optical efficiency in color projection. Dr. Rosenthal points out that Kodachrome and Technicolor both use subtractive methods and that additive systems have been partially abandoned in the photographic field.

Still another method, known as the Geer system, also from California, has put forward its claims. The details released on it are somewhat reminiscent

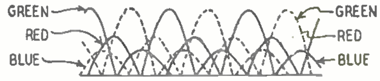


Fig. 9—Overlap of colors is shown here

of the Du Mont Trichromoscope[6], a tube with three electron guns and a face made up of minute three-sided pyramids, each side of which is coated with a phosphor in one of the three

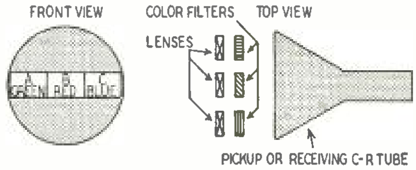


Fig. 10—Three separate images on tube.

primary colors. This tube would reproduce a picture in full color right on the cathode-ray tube screen, with no mixing.

Other systems of color television have been suggested—or hinted at—but whether for reasons of insufficient development or patent protection, few details have been given.

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2 **PPM—New Technique,** Fred Shunaman, *Radio-Craft*, February, 1946, page 314. **Pulse Code Modulation,** Fred Shunaman, February, 1948, page 28.

3 **Simultaneous Color Television.** Kell, Sziklai, Ballard, Schroeder, Wendt and Fredenall, *Proceedings of the I.R.E.*, September, 1947, page 864.

4 **Color Television,** *Radio-Craft*, July, 1947, page 24.

5 **Television Projection Methods,** Dr. A. H. Rosenthal, *Radio-Electronics*, March, 1949, page 36.

6 **Color Television.** *Radio-Craft*, July, 1947, page 24.

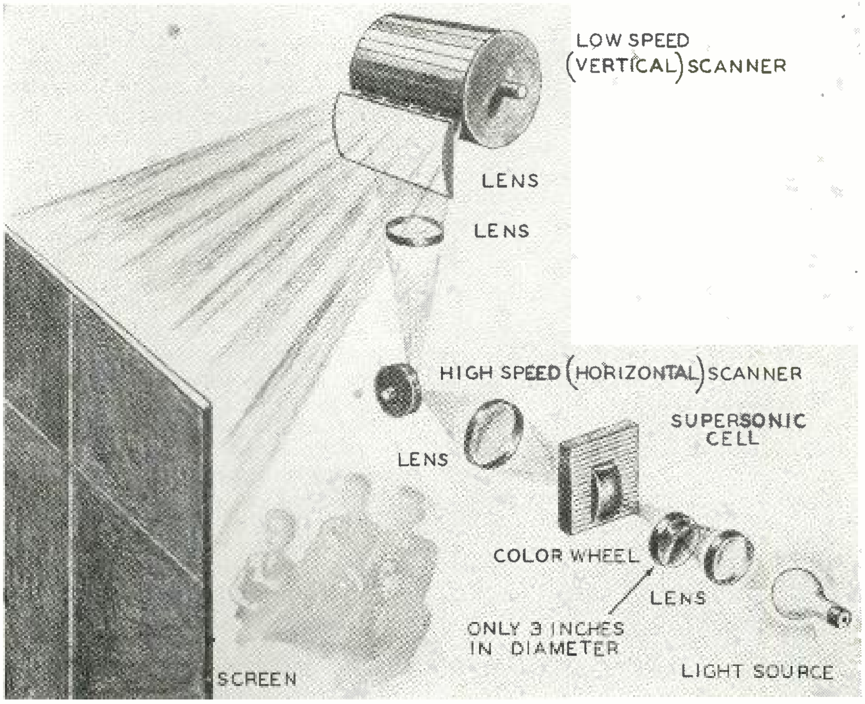


Fig. 11—Skiatron Corp. proposes adaptation of CBS color wheel to its projector.

Mass Production Television Tests

MORE than 1,000 parts, assembled with rivets, screws, and more than 500 crimping and soldering operations, go into the average television receiver, according to officials at RCA Victor's Camden, N. J., plant, where our cover picture was taken. Receivers flow off the production lines as steadily and relentlessly as the tides. Yet, despite the complexity of each set, faulty receivers are rarities. Television service technicians have been impressed with the dependability of *good* television sets over relatively long periods of use. A set several times as complicated as a standard radio, theoretically should break down several times as often, but in practice this ratio is not even approached.

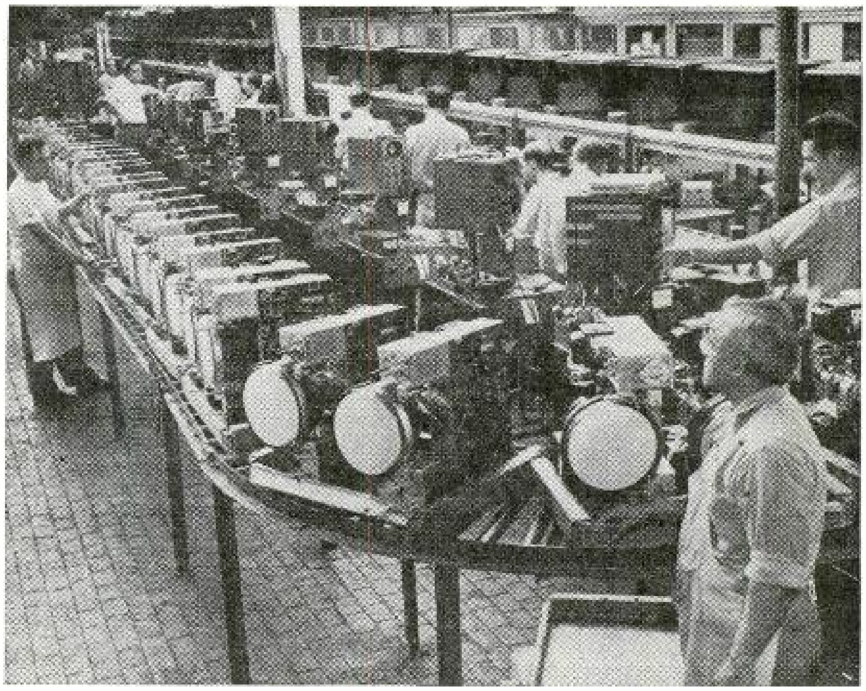
The reason is thorough and consistent production testing, say the RCA men. The very practical basis for this policy is recognition that faults can be corrected far more easily while the set is in production than after it has been completed and shipped and put into operation.

Master signals, generated by special equipment comparable to two complete television transmitters and valued at more than $200,000, are sent to individual test positions by some 40 miles of specially shielded co-axial cable strung through the Camden plant. This equipment, probably the world's largest signal generator, is capable of supplying every type of signal required in television testing. More than 200 oscilloscopes and about the same number of VoltOhmysts are also used in the various tests.

Testing, however, must begin even before the material going into the receiver reaches the production lines. The purchasing department's Quality Control Section sample-checks every batch of parts, reel of wire, or shipment of solder received. *The easiest place to catch trouble in a receiver is before the defective part is installed.*

Eight inspectors seated among the production workers on each chassis assembly line inspect for mechanical defects every part of each partially completed receiver as it flows past. In this mechanical inspection, every receiver coming off the chassis production line is gone over twice by the inspecting personnel.

As the chassis move along the assembly line, they are slid off into the booths of the *circuit checkers* for the first test on the completed receiver. Here all circuits and components are checked with the aid of VoltOhmysts for continuity of wiring and electrical values of components.



Partially completed television receivers travel down the factory production line.

The next phase of the inspecting and checking routine through which every receiver passes is the *hot check* or preliminary operation test. In it the set produces a test pattern on an auxiliary oscilloscope connected to the receiver circuits with clips. The testers inspect the test pattern for faults which might indicate a defective set.

In the *alignment test*, the i.f. and r.f. circuits are aligned and checked for proper waveshape response and sensitivity. Here all variable controls are adjusted—there are 42 specific circuit adjustments to be made. A *deflection* test checks deflection adjustments to make sure that all picture characteristics meet the required technical standards.

The characteristics studied and brought into line include focusing, spot size, linearity, resolution, distribution, centering, size, and over-all sensitivity. The picture characteristics of the television image are checked as exactly as a photographer checks the characteristics of his masterpieces.

Mechanical inspection is not forgotten in these finished receivers. The service technician, used to checking microphonic tubes, is quick to note the large rubber hammer with which all chassis are struck smartly to make certain that solder joints are secure and the set is not noisy under vibration.

Not until the chassis has successfully gone through this entire routine is it permitted to go on down the line to the point where the picture-tube face is cleaned and it is fitted into its cabinet and sent to the final operating test.

Separate quality-control testers are continually at work sampling the output and putting selected receivers through rigorous examinations. At least 10% of the output is checked by the quality-control testers.

"Quality must be the watchword" is the slogan continually expounded to the testing staff by the plant manager. "Not only the reputation of the brand name, but the very strength of the industry depends on thoroughness of inspection. Viewed from this light, it is an investment in the continuity and growth of television operations—as wise an investment as can be made."

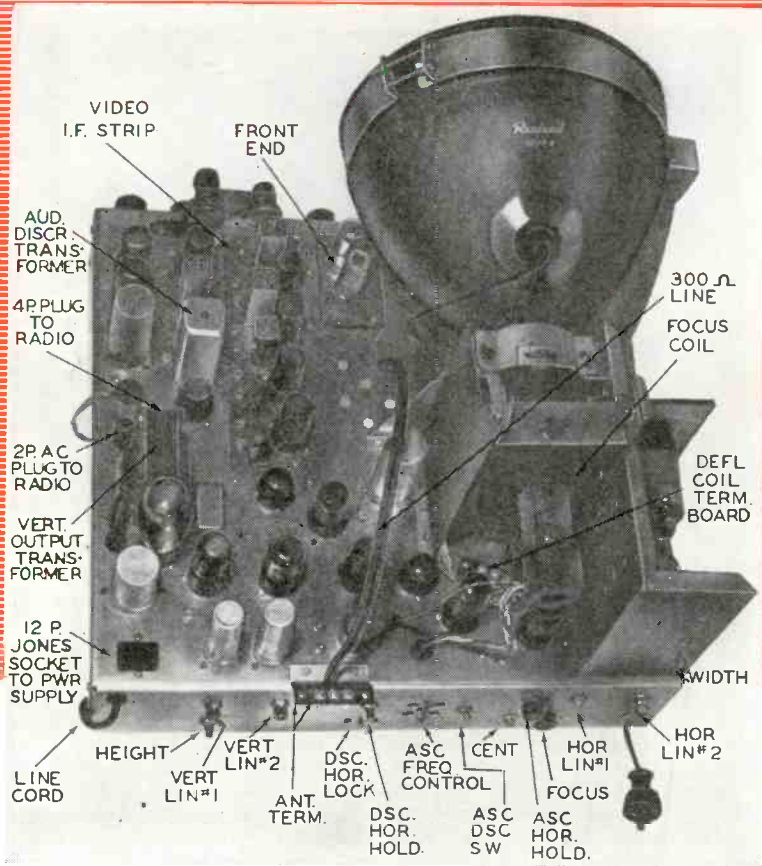
A De Luxe Televiser

Part I

Entire sections or single components of this televiser can be used to improve the performance of kits and obsolete receivers

By

CHARLES A. VACCARO



Top view of completed 10-inch TV receiver. Position of major parts is shown.

DO you want to make a discriminator transformer to convert the detector of your TV receiver from a slope detector to a true FM discriminator? Or a 12-channel front-end for the receiver that has provisions for only 5 channels? Perhaps you only want to make a small trimmer capacitor that can hang in the wiring where you need it, or know how to stabilize your present horizontal multivibrator, or go the limit and build a complete quality TV receiver. This information, plus much more, will be included in a series of articles covering the construction, adjustments, and alignments of a 10-inch TV receiver. This receiver can be constructed with a little extra time over that required to assemble and wire a kit.

Complete data will be supplied for the construction of all r.f. and i.f. coils and transformers, subassemblies, resistor-capacitor boards, etc.

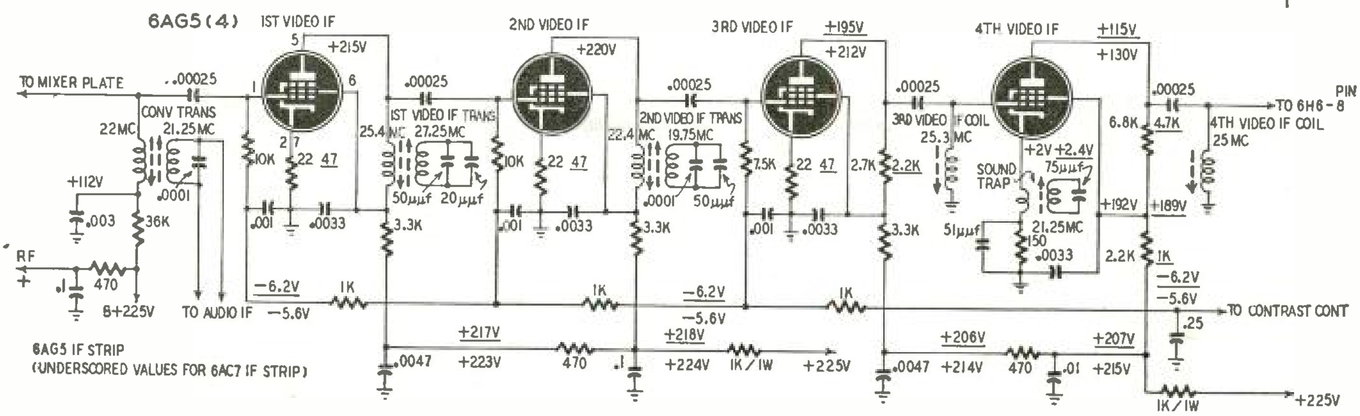
It is not my intention to convince the reader that building this receiver will save money, because the saving (even though it is considerable compared to the cost of good commercial models) is small compared to the amount of work involved. However, for those who want the best possible picture and sound quality, the resulting receiver will be more than gratifying.

Besides receiving all of New York City stations with excellent results, this receiver pulls in WFIL-TV and WPTZ in Philadelphia, Pa., WNHC in New Haven, Conn., and on several occasions it has received WNBW in Washington, D. C., WMAR-TV in Baltimore, Md., and WRGB in Schenectady, N. Y., when connected to a simple folded dipole oriented toward New York City—25 miles to the south.

The receiver is intended as a console model; however, other variations will be covered later. A separate power supply chassis is used to facilitate handling of the receiver chassis and for other reasons to be described. The audio amplifier drives a 12-inch PM speaker. Provisions have been made in the chassis for the inclusion of an AM-FM-phono chassis or any combination of these functions in the console cabinet. Sturdy tubes have been selected and the circuits designed to give long and reliable service.

The photos show methods of wiring and construction. The use of hookup wire is confined almost exclusively to the heater and plate-supply circuits. Most of the components are mounted on terminal boards which are used in all stages except the front end to insure uniform results. It should not be necessary to "de-bug" the set if directions and layouts are followed.

Other than the usual construction and wiring tools, it will be helpful to have access to a 3- or 4-inch vise,



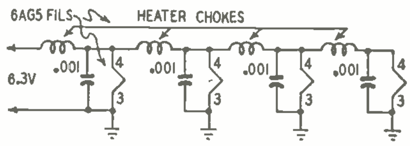


Fig. 1—Schematic diagram of the 6AG5 video i.f. strip. Use underscored values where shown for the 6AC7 amplifier strip. Heater circuit is shown at right.

socket punch, small eyelet punch, circle cutter, electric drill, two steel or angle-iron bars, and a couple of C-clamps which can be used with the vise for bending aluminum.

The alignment data to be given will be based on the assumption that the builder has access to an ordinary AM signal generator capable of delivering modulated and accurately calibrated r.f. up to 28 mc (preferably on fundamentals), and some type of output meter such as a high-resistance voltmeter, v.t.v.m., or scope. Additional alignment data will also be presented for use with sweep generator and scope.

Video i.f. strip.

The video i.f. strip is the heart of the picture. If this is not good, there is not much that can be done preceding or following it to produce a good picture. The schematic diagram, Fig. 1, gives a good idea of the circuit function. The mixer coil is the first on the i.f. strip. Across it are both the audio i.f. and video i.f. frequencies. The audio i.f. is inductively coupled to it by a circuit tuned to 21.25 mc, while the video i.f. is capacitance-coupled to the first video i.f. amplifier tube. Capacitance coupling is used between all the video i.f. stages; stagger-tuned, partially loaded, coils are used to help reproduce the full bandwidth of the transmitted picture signal. Traps are included to remove adjacent-channel audio and video interference and a 21.25-mc cathode trap prevents any of the audio i.f. signal riding through and interfering with the picture.

Gain of the i.f. strip (and picture contrast) is controlled by varying the bias to the first three amplifiers.

Two interchangeable video i.f. strips will be described. One uses 6AG5 and the other 6AC7 tubes. The 6AC7 amplifier has more gain but the miniature 6AG5's may have to be used if additional space is needed for the coils obtainable. The 6AG5 i.f. strip is shown in Fig. 1. Underscored values and voltages are for the 6AC7 strip. The 6AC7 i.f. strip will be shown in the complete schematic later in the series.

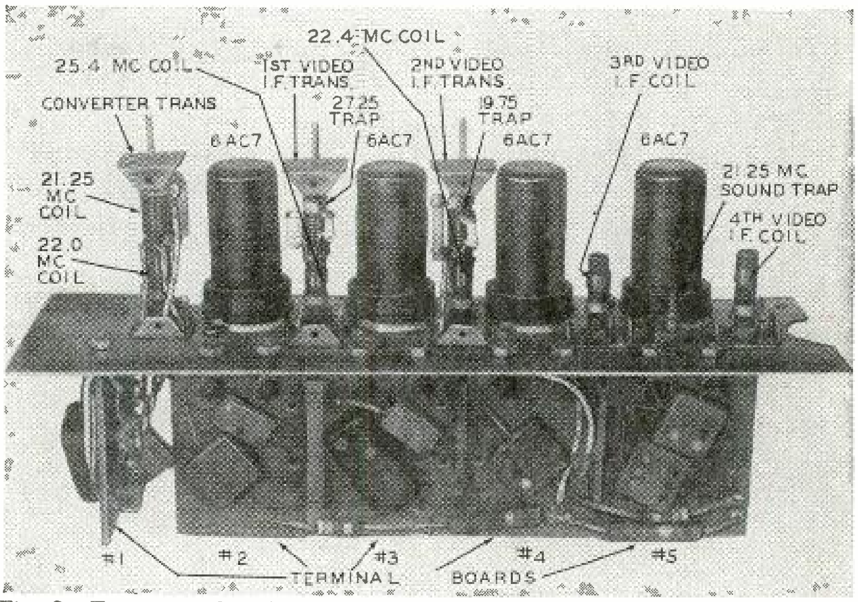


Fig. 2—Top view of 6AC7 video i.f. strip shows construction of transformers.

Because the size of the coils may be the deciding factor as to which of the i.f. strips will be constructed, they will be covered first.

The video i.f. coils and transformers shown in Figs. 2 and 3 were made from surplus coils remodeled to suit my purpose. When purchased, they contained a ceramic coil form 1¾ inches long, but otherwise appeared the same

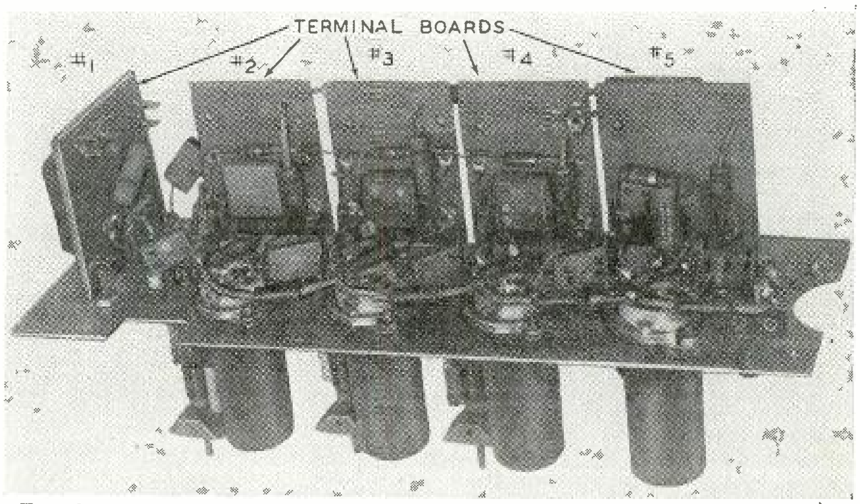


Fig. 3—Neat wiring with short leads reduces trouble in video i.f. strips.

as the double-tuned coils in the photos. The ceramic form and all the parts cemented to it were removed by soaking the assembly in lacquer thinner. All the parts were used except the ceramic form which was replaced by a 9/32-inch bakelite tube cut to the dimensions indicated in Fig. 4.

Drill a 5/64-inch hole through the cen-

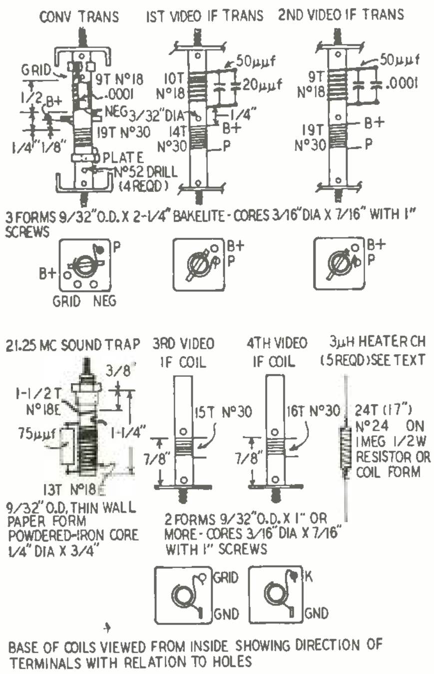


Fig. 4—I.f. transformers and coils are wound as indicated in drawings.

ter of each of the forms. Then cut five pieces of 3/32-inch bakelite rod 3/4-inch long and force these through the 5/64-inch holes so they project equally on each side of the form. Additional holes can be drilled near the ends of the bakelite forms to help the cement get a better hold and also 3/8-inch from each end to allow for inspection of the powdered-iron core. The mounting plate for some of the coils will require additional holes. These are drilled just large enough for the stranded insulated leads to pass through.

Replace the terminal clamps on the forms; coat the ends of the forms with cement and push them into the bottom mounting plates so that they line up as indicated in Fig. 4; then let the cement dry.

Use Formex insulated wire for all the coils. All the lower (plate-circuit) windings on the coils are started by first stripping and tinning approximately 1 inch of the wire. Wrap the wire around one side of the center bakelite rod, and then flow in some solder to form a solid terminal for the flexible lead to be added later. Finish winding the lower coil, following accurately the turns specified and the dimensions given from center and fasten the free end to the lower terminal clamp.

Wind the heavier No. 18-wire trap coils on a form slightly smaller than 9/32 inch in diameter. Then transfer the windings to the coil forms. Slip on the upper terminal clamp and solder the top end of the coil to it. Spread the coil out to the proper dimension and solder the capacitor to it. The bottom end of this coil is then self-supporting. Solder stranded, insulated wire, leads to the terminals as required to extend 2 or 3 inches beyond the lower edge of the coil mounting. Coat the coils with coil dope or with Duco household cement, and they are now ready for installation.

It does not matter which direction you wind the coils except that the two on each form must agree. In other words, if the top end of the lower coil is started around the form in one direction, the top end of the upper form must be started in the same direction.

Two other types of transformers used satisfactorily are being described in the event the surplus coil mentioned cannot be obtained. One is made as described except that a Palnut-type coil fastener is used at each end of the tubing to fasten the cores and for mounting. A round hole is then drilled in the i.f. strip plate instead of the semi-rectangular type and additional holes are drilled for the wires on the side of the larger hole. Terminal clamps are made of soft, lead-coated metal and the rest of the coil follows the same pattern as for those previously described. The third type is a one-hole-mounting, single-core type similar to the sound trap coil. Any of these may be used if the diameter and length dimensions are not changed.

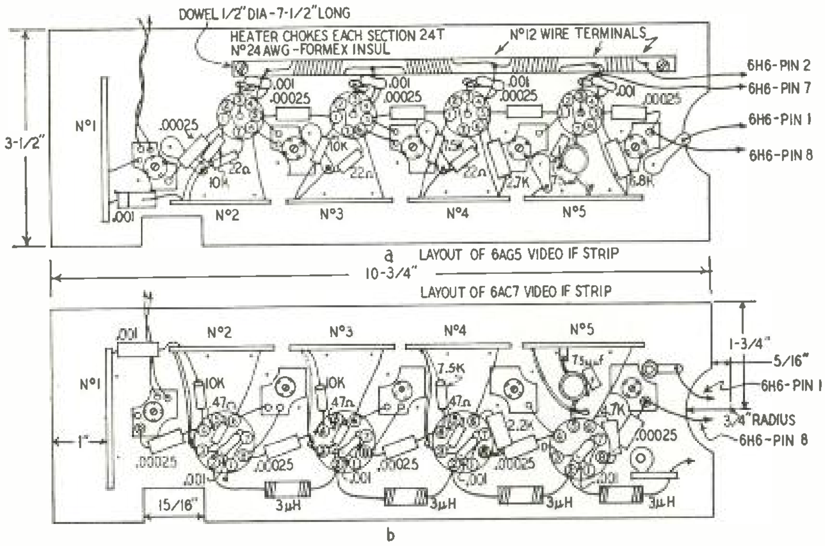


Fig. 5—Pictorial diagrams of 6AG5 and 6AC7 strips. Latter is at the bottom.

The sound trap is wound on 9/32 O.D. thin-wall paper tubing. Extend the tubing to the proper length; then round off a 5-40 nut to give a snug fit in the upper end of the form. Screw the powdered-iron core into the nut and cement the nut into the top of the form. Another nut and lockwasher are used to provide enough tension to lock the core in place after adjustments are made.

Each of the 3-μh heater-circuit r.f. chokes for the 6AC7 strip consists of 17 inches of No. 24 AWG Formex insulated wire wound as tightly as possible on a 1-megohm, 1/2-watt resistor or an equivalent form. The wire is soldered to the pigtail at each end and the coil coated with coil dope or cement. Make five of these as one will be used in the front end. If you use 6AG5's in the i.f. amplifier, four of the chokes can be wound on a single form as shown on Fig. 5-a.

Making the terminal boards

Cut out the five boards from 3/32-inch, laminated bakelite and drill holes as shown in Figs. 6-a, -b, -c. Note that double-eyelet type terminals were used. Where only a single-eyelet type was needed, one side was clipped off. Single-eyelet terminals can be used, but having all the wires on one post may be inconvenient. If a rivet punch of the size required for the terminals is not available, a suitable substitute can be made by filing the end of a blunt round punch or any other piece of metal. The terminals are applied by fastening the home-made punch in a vise, holding the terminal board with the terminal in the hole in the direction required, and tapping with a hammer until the eyelet folds over on the other side. The terminals being flat, bend their ends up 90 degrees with a wood chisel or sharp screwdriver after mounting them.

Wire the components to the boards as shown in Figs. 6-d, and -e. Note that boards Nos. 2, 3, 4, and 5 for the i.f. strip using 6AC7's are mounted on the opposite side from that illustrated using 6AG5's. The holes are drilled in the same places, but the terminals and components that are shown on the near side in Figs. 8-e are mounted on the far side and those shown on the far side are mounted on the near side for the strip using 6AC7's. Components such as the 1,000-ohm resistors shown from board to board are not connected to the circuit until the boards are in-

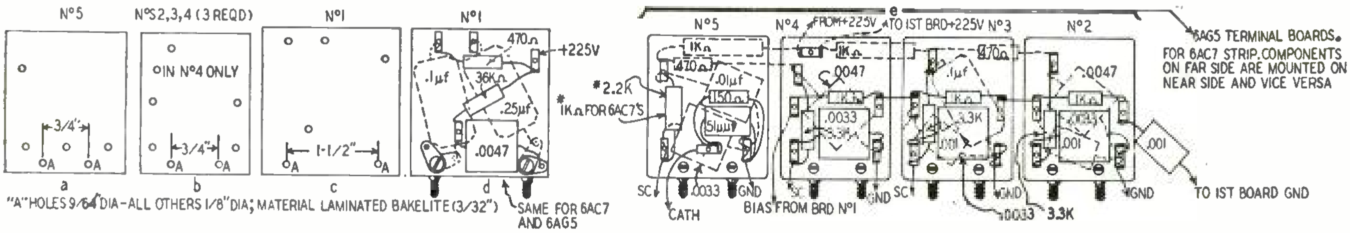


Fig. 6—Terminal boards are cut and drilled as shown. This method of construction makes trouble shooting easy.

stalled on the i.f. strip. After the components are wired on the boards, fasten two spade bolts to the bottom of each, using 5/16 x 6-32 machine screws and 6-32 nuts and lockwashers. Place a 6-32 nut on each of the spade bolts, and the boards are ready for installation.

Cut the i.f. strip plate 3½ x 10¾ inches from .050 ST aluminum, as indicated in Fig. 5-a for the 6AG5's or Fig. 5-b for the 6AC7's. This plate can be polished to give it a neat appearance after drilling is completed by using a very fine emery cloth or a piece of crocus cloth. Now assemble the tube sockets, terminal boards, etc., to the plate, but leave out the i.f. coils. Solder in the resistors, capacitors, heater chokes, and jumpers, following closely the partial layouts and referring to the schematic. Solder the decoupling resistors and capacitors on the rear from board to board, continuing until the wiring is completed. Wire in the cathode trap, install and wire the leads from the i.f. coils, and the i.f. strip is complete. Recheck the wiring and soldered connections.

The two-tube tuner will be described in the next installment of this series of articles.

Parts list for I.F. Strip

Resistors: 1—36,000, 5—1 000 ohms, 1 watt; 2—10,000, 1—7,500, 1—6 800 3—3,300, 1—2,700, 1—2,200, 3—470, 1—150, 3—22 ohms, ½ watt.
Capacitors: 1—0.25, 2—0.1, 3—.01 µf, 450 volts, paper; 2—.0047, 4—.0033, 1—.003, 5—.00025 µf, mica; 1—.00002, 2—.00005, 1—.000051, 1—.000075 µf, ceramic.
Miscellaneous: 4—sockets (octals for 6AC7 or 7-pin miniatures for 6AG5 i.f. amplifier); sheet of 3/16-inch laminated bakelite, permeability-tuned coil forms, spade lugs, eyelet-type soldering lugs, hookup wire, etc.

NEW FLAT PLASTIC LENS

A new thin, flat plastic lens for enlarging the television image on home receivers is the latest accessory for TV fans. It operates on the Fresnel principle of magnification and is known as the Magna-Screen. Weighing but a few pounds, it is easily attached to any type of receiver by means of brackets supplied with the lens. It is adjustable and can be quickly changed to give any desired degree of magnification within its scope. The Magna-Screen is free from edge distortion and provides glareless viewing of the image at a reasonably wide angle.

The lens operates on a principle similar to the Fresnel lens used in lighthouses. Its magnifying power is based on the fact that carefully designed optical prisms or ridges are impressed in the plastic from a master die, each prismatic line corresponding to a segment of the curved surface of a thick glass lens of the usual type.

How the rays of light are refracted through the successive ridges or prisms in the lens is shown in the diagram. As the circular ridges or prisms approach the outer edge of the lens their angle becomes steeper, whereas toward the center of the lens the prismatic ridges flatten out until they are nearly flat. In this manner the lens is able to pick up rays of light from all angles and redirect them beyond the lens to form an enlarged (virtual or apparent) image, which is viewed by the observer.

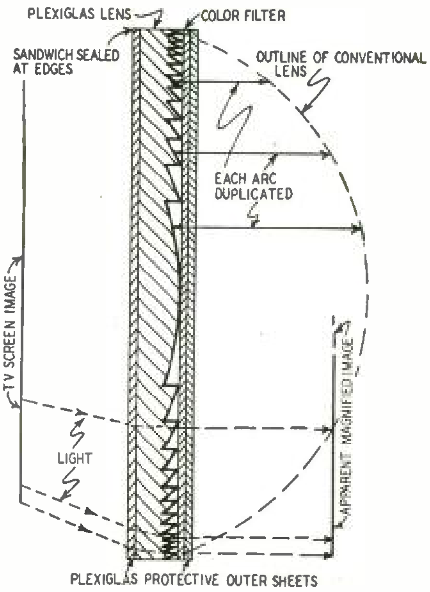
The magnifying element of the screen is formed from a sheet of thin plastic, into which hundreds of the prismatic grooves are pressed. In the assembly there is a green filter which eliminates glare, together with protective outer sheets of plastic (Plexiglas), the whole unit being sealed at the edges. When used with a 10-inch television tube, the image can be enlarged up to the size normally received on a 16-inch-diameter tube.

Plastic lenses of this type are made by cutting ridges into a brass or other suitable metal mold, which is heated and pressed into the plastic sheet. The grooves are very fine in some parts of the lens, running as high as 200 or more to the inch. The circular rings or grooves can be seen when looking at the screen; but when placed in front of a TV picture tube, the lines are not visible, because of the smoothing out or resolving effect of the overlapping rays of light.

These new flat plastic lenses are designed for gathering the light from a given source, such as the bright image on a TV picture tube, and are not suited for use as projection lenses. They do have the valuable property of spreading the light evenly across the field of vision. A defect met with in many simple lenses, that of spherical aberration, is thus practically eliminated in the new thin plastic lenses.

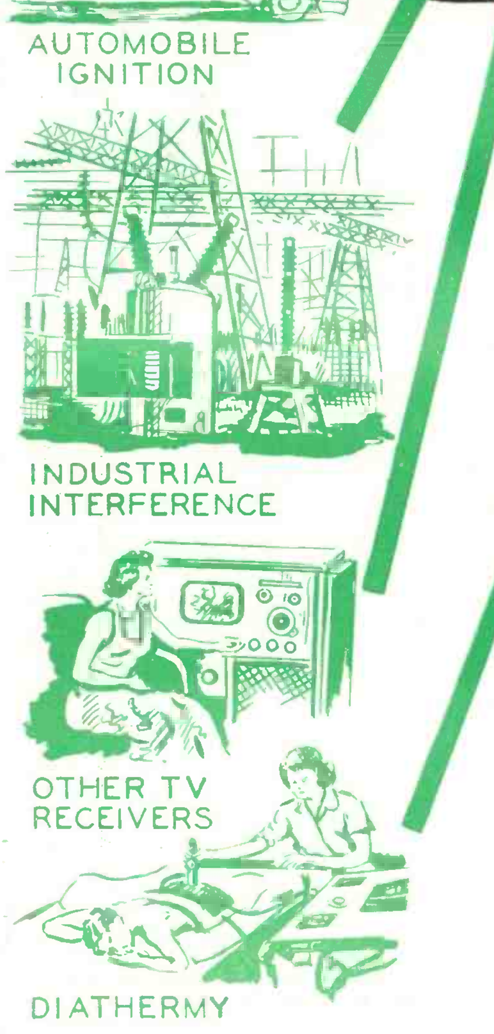
The Magna-Screen is mounted in a neat wooden frame and comes in three sizes: 8 x 10 inches for sets with 7-inch tubes, 9 x 12 inches for 7- and 10-inch tubes, and 11 x 16½ inches for sets with 10- and 12-inch tubes. The brackets supplied with the lens permit using it on any table set, and it is available mounted on a floor stand for use with console TV receivers.

The Magna-Screen is made of Rohm & Haas Plexiglas, an optically-clear, extremely strong, light-weight acrylic plastic, by the Plastic Division of the Willson Camera Co.



Construction of the Magna-Screen is shown in this cross-section drawing.

TV INTERFERENCE PROBLEMS



By **WILLIAM L. KISER***

THERE are many excellent television installation and maintenance crews, technically qualified and having the necessary equipment for finding the causes of interference. On the other hand, there are service technicians who merely advise the consumer that the interference is due to "outside r.f. radiation" and advise him to communicate with the Federal Communications Commission.

A large number of letters received by the Commission state that the complaint is being made on the advice of a service technician. Some add that they are doubtful as to the technician's qualifications and ability. These doubts are confirmed when the FCC engineer investigates the case and the technician is called back—on the engineer's advice —to install a wavetrap or make some other modification which removes the interference.

The consumer cannot avoid the correct conclusion that the technician should have been able to diagnose the condition and correct it, and feels, justifiably, that he is paying for inferior servicing.

From a long-range view, this type of servicing does not benefit the television industry nor does it encourage set owners to renew servicing contracts.

Except in extreme cases, it is the responsibility of the service technician to clear interference. If he is not able to do so, the matter should be referred direct to the receiver manufacturer.

* Radio Engineer, Federal Communications Commission, New York, N. Y.

Two types of interference to television reception cause difficulty for the service technician. These are interference of the *same* frequency as that on which the program material is televised, and interference of a frequency *different* from that of the television carrier.

In the first type, the interference can be cleared only by suppressing or eliminating it at the source. In the second type, the interference can be cleared only by modification of the set.

Most complaints received at the New York Federal Communications Commission office are due to the second variety.

I.f. and image interference

As in all superheterodyne circuits, there are three frequencies to contend with: the frequency to which the receiver is adjusted (and the only frequency in which the user is interested), the image frequency, and the intermediate frequency. The latter two sometimes prove to be a headache in design and service.

For instance, the image frequency for channel 2 on most receivers is between 102 and 107 mc. Frequencies between 88 and 108 mc are assigned exclusively to FM broadcasting stations.

Point-to-point radiotelegraph services are assigned to frequencies in the lower part of the i.f. band. If the receiver is insufficiently shielded, these signals may cause interference.

Interference due to poor image rejection is continuous and is observed only on certain channels. Interference due to poor i.f. rejection may be continuous or intermittent and can be observed on all channels.

A mistake made by many technicians is taking the receiver back to the service shop. Not only is it a waste of time and money, but the receiver rarely can be correctly adjusted to reject interference unless the adjustment is made while the interference is taking place. A communications receiver capable of tuning through the intermediate frequencies is of great assistance to the technician when servicing a receiver which is being interfered with because of poor i.f. rejection. First, it will tell him whether or not the interfering signal is in or near the i.f. band, and, second, whether the receiver requires i.f. traps or added shielding, if the signal causing the interference is being transmitted on or near the i.f.

Poor locations

The service technician who agrees to service receivers installed in close proximity to the transmitting sites of point-to-point radiotelegraph stations is in for a lot of trouble, since some of the transmitters at these sites are operating on frequencies in the lower part of the i.f. band and have power outputs ranging between 1 and 50 kw. Special shielding and trapping often help, and a highly efficient antenna and well matched transmission line are necessities. Trapping is rarely completely effective, however, because most of these transmitters use beamed transmission and change power output or shift frequency at unannounced intervals to take advantage of propagation conditions. Reception in such areas is hardly ever perfect, despite all precautions.

Interference from signals on the television station frequency may be due to radiation from the local oscillators of nearby television receivers or to harmonics of FM receiver oscillators. Industrial r.f. heating apparatus and medical diathermy equipment can give trouble in this way too, but those signals are rapidly disappearing into one of the three assigned "noise" bands.

Ideally no receiver should radiate, but nearly all do, some more than others. Since the worst interference from other sets occurs in thickly populated areas, especially in apartment houses, this type of interference might be classified as resulting from a poor location.

The problem of eliminating it is one for the manufacturer, not ordinarily for the technician. However, it usually saves time and confusion if the technician at least locates the source of the trouble for his customer. The offending set can usually be identified by making simple on-off tests with nearby receivers. Sometimes a slight reorientation of the antenna helps.

The "amateur alibi"

The first thought of many technicians and set owners who know of an amateur in the neighborhood is to blame all interference on him. It cannot be overemphasized that the amateur is to blame only when he is transmitting excessive harmonics or other spurious emissions that are on the same frequency as a local television station and thereby cause harmful interference when the complainant's receiver is tuned to that frequency.

In spite of this, amateurs with 60 and 70 db of harmonic attenuation are being taken to task every day. It has been the observation of Commission engineers that most amateurs are willing to cooperate with both the consumer and the service technician. However, in some cases, this cooperation is precluded when the consumer is informed by the serviceman that the interference is due entirely to the operation of the amateur station. Investigations by Commission engineers, have time and again proven conclusively to the set owner that the amateur is operating within his rights and that the apparent interference is due to inadequate design features in the television receiver.

The first TVI complaint may serve to inform the amateur of his rights. In a typical case, a TV antenna 10 feet from a 10-meter ham antenna carried TVI down to the receiver. The ham was notified. He and the service technician got together. With transmitter on-off tests the technician found that most of the interference could be eliminated with a high-pass filter attenuating all frequencies below the TV bands. Addition at the receiver of a trap adjusted to the amateur's fundamental frequency completed the job. The amateur will usually cooperate with technicians investigating complaints in nearby receivers. But he knows that *the responsibility is not his* if he has reduced harmonics and spurious emissions from his transmitter to the extent that they do not cause interference on the same frequency as that of a local television station. He is *not obliged* to conduct further tests. Nor is he to be blamed if his irritation at the number of future unfounded accusations causes him to lose patience and refuse any aid at all. That is one excellent reason for making a genuine investigation of the interference source and not jumping at the nearest "easy" solution.

Some service technicians attempt to analyze the causes of interference by telephone conversations or calling at the customer's home at times when the interference is not observed. The only way to make a proper analysis is to observe the interference while the receiver is installed in the consumer's home. This may involve working evening hours in some cases, but it will certainly reduce the number of future service calls during the day.

Some conclusions

A very large part of the whole interference problem lies right in the lap of the manufacturers. It is not a matter of "blame" as such, for few receivers have been deliberately designed poorly. By the standards of other types of home radio equipment, TV sets in general are well made. But interference makes a much bigger impression on the eye than it does on the ear—a fact that calls for higher future standards.

It is possible to design a receiver that will reject all interference not on the same frequency as the desired station. For reasons of cost and because the amount and degree of interference was perhaps underestimated, manufacturers have erred somewhat on the side of insufficient rejection. That this is recognized by the manufacturers themselves is evident in the improvements in receivers during the last year.

There are upward of 1,000,000 television receivers in the United States, and there will probably be twice this number in another year. This is a tremendous field for television sales and service and to service television receivers properly will require fast and efficient servicing personnel.

It is hoped that the interference problem may be alleviated to some extent by the tremendous and continued improvement in receiver design made by certain companies on their later models as compared to the receivers on the market a year or so ago.

TELEVISION DX REPORTS

Apparently propagation conditions have not been favorable to long-distance television reception. Just three letters reporting genuine dx have appeared in response to our queries in the November issue.

One is a copy of a report written by H. A. Wenzel of Quincy, Ill., to KPIX, San Francisco, Calif., reporting reception on the evening of May 20, 1949. The signal from KPIX was almost as strong as that from KSD-TV in St. Louis, Mo., about 100 miles from Quincy, which Mr. Wenzel watches regularly. Other distant stations were also unusually strong on that night, but none could be identified. The receiver was a Motorola VT-107.

Paul O. Kirikamm, WNBK video engineer, Columbia Station, Ohio, sent in a log showing frequent reception of stations over 100 miles away and of two over 1,000 miles distant. Both of the latter were heard on May 21, 1949. One was KLEE-TV, Houston, Tex., 1,325 miles away; the other was WKY-TV in Oklahoma City, Okla., at a distance of about 1,200 miles. Reception was good to fair in both cases. The antenna was a picture-wire folded dipole on a wooden crossarm, 50 feet above ground. Interestingly, Mr. Kirikamm adds a note that he installed a commercial folded dipole and reflector in July, after which about 90% of his former dx reception disappeared! His receiver is a 10-inch Emerson.

A report from W. W. Wilcox in Richmond, Va., tells us that he picked up WKY-TV, Oklahoma City, Okla., on June 22, 1949. A Western Auto antenna was used with a Truetone receiver. He reports, too, reception of WMCT, Memphis, Tenn., and stations in Baltimore, Washington, D. C., and Pennsylvania.

Revamping a 630-Type TV Set

How to add a larger tube, a.g.c., and a better a.f. section

By M. HARVEY GERNSBACK

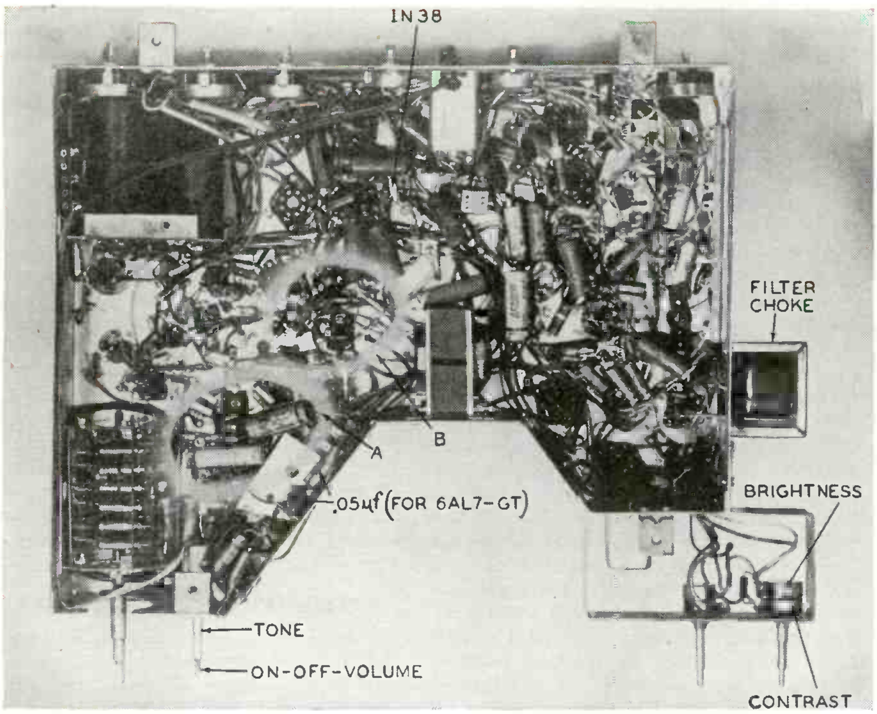


Photo of the parts under the chassis with some of the major parts pointed out.

LIKE so many experimenters I've never been completely satisfied with standard radio sets. Every one I've ever bought wound up with numerous "improvements," some of which actually improved and others —well, they were fun doing. Television hasn't changed things for me. After having used a TV set of the 630 type for several weeks, that old feeling returned. I had to make improvements!

Before muttering "gilding the lily," let's take a look at the 630. It's a good set, no doubt about it. But it has some weaknesses.

First of all, the 10-inch tube is a little too small for viewing comfort. So we decided to replace it with a 16AP4. This meant 12,000 to 13,000 volts in place of the existing 9,000-volt high-voltage supply. It also meant modification of the vertical and horizontal sweeps to produce a picture with a maximum size of 14⅝ by 11 inches.

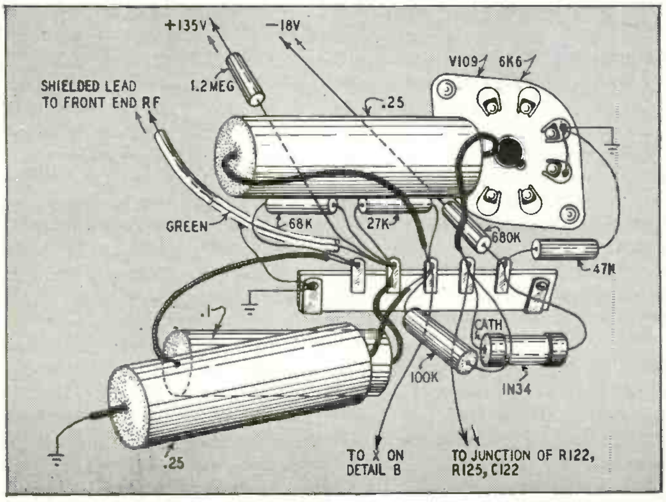
Another bad omission in the 630 is automatic gain control (in effect, automatic contrast control) the video equivalent of sound radio's a.v.c. Automatic gain control (a.g.c.) means less fiddling with the contrast control as you tune from station to station and a great reduction in flickering or blinking of the picture when airplanes are flying nearby—an effect caused by reflection of TV waves from the plane's surface. We decided to add a.g.c. to our set.

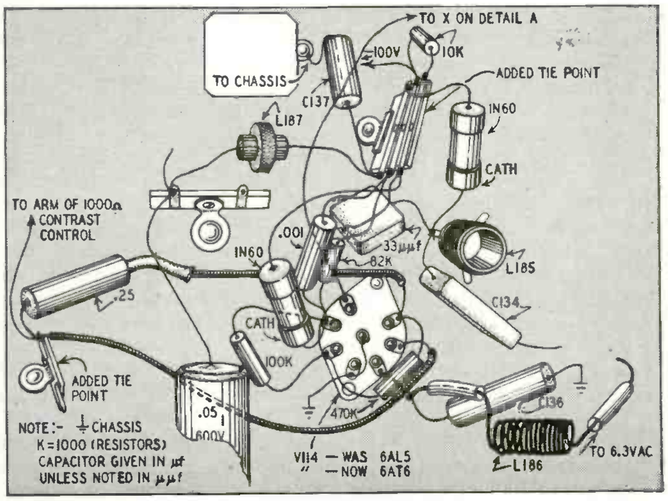
A third shortcoming of the 630 (like most TV sets) is its audio amplifier. The sound output is little better than that of an a.c.-d.c. table radio. We decided to add a 12-inch speaker and revamp the audio stages to incorporate a large amount of negative feedback. This would bring the audio system up to the capabilities of the FM sound i.f. and discriminator circuits of the 630.

As a final touch we decided to add a 6AL7-GT tuning indicator tube to make proper setting of the fine tuning control easy.

Adding the 16AP4

There are several ways to raise the high voltage to 12,500 volts. Several parts manufacturers make horizontal output transformers for this purpose. Some require the use of an extra 1B3-GT high-voltage rectifier in a voltage-doubler circuit. We decided to use one of the newer units which develop the high voltage without the use of a doubler and its extra rectifier. The unit (a Guthman 77J1) is a new development in powdered-iron-core transformers. Although the manufacturer pro-





These are drawings of sections A and B in the photo of the underchassis above. They show where the parts are placed.

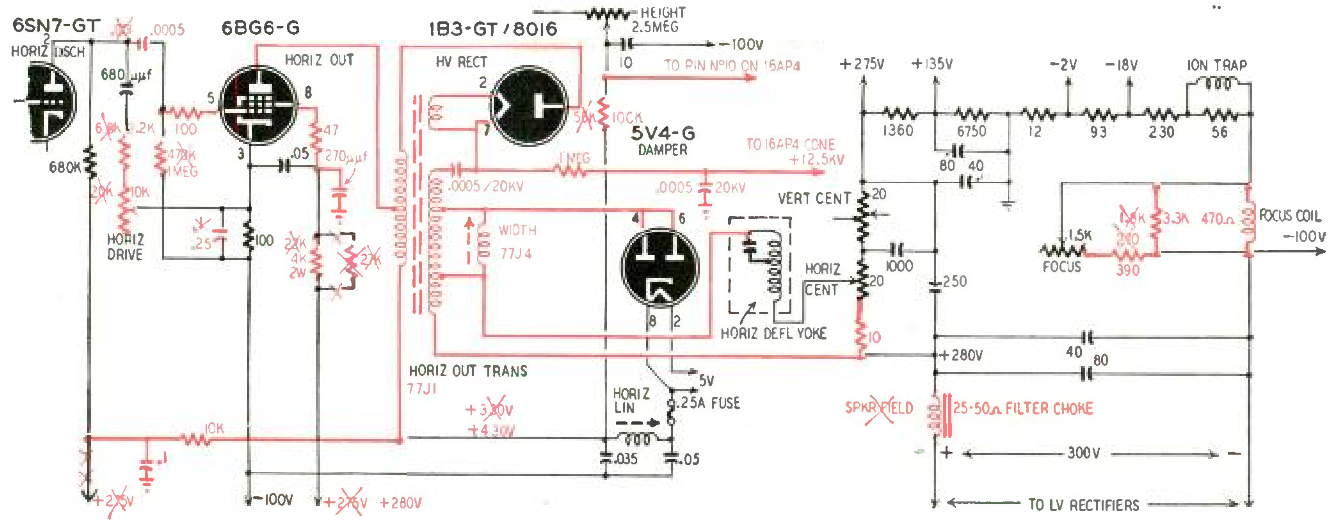


Fig. 1—This diagram shows the changes made in the horizontal sweep, high-voltage, and focusing circuits of the 630.

vides an instruction sheet for connecting this unit, other circuit changes had to be made to get the proper high voltage and sufficient horizontal sweep. The revised circuit is shown in Fig. 1. The changes are indicated in color in the diagram. Where values have been changed, the old is shown crossed out and the new printed in color. The value of the 680-μμf capacitor in the horizontal drive control circuit is critical. Small changes affect horizontal linearity at the edges of the picture and also have a considerable effect on the maximum value of the high voltage. In my set the proper value was found to be 600 μμf. The 10-ohm resistor in series with the horizontal centering potentiometer permits proper horizontal centering. Replacing the old 20-ohm potentiometer with a 30-ohm unit will have the same effect. However, it is difficult to remove the old unit.

The 16AP4 uses the same socket as the 10BP4. The only change in socket wiring is to return the lead from pin 10 to the slider on the height control as shown in Fig. 1. The 12.5-kv lead connects to the metal cone of the 16AP4 at its lip. If you use one of the vinyl insulating sleeves made to cover the tube, connect the high voltage to the snap-on connector on the sleeve and fold the sleeve contact strip over the lip of the tube. The tube may be mounted on the chassis by using one of several special brackets made for the purpose.

The new horizontal output transformer will not work with the old width control coil. A special matching width

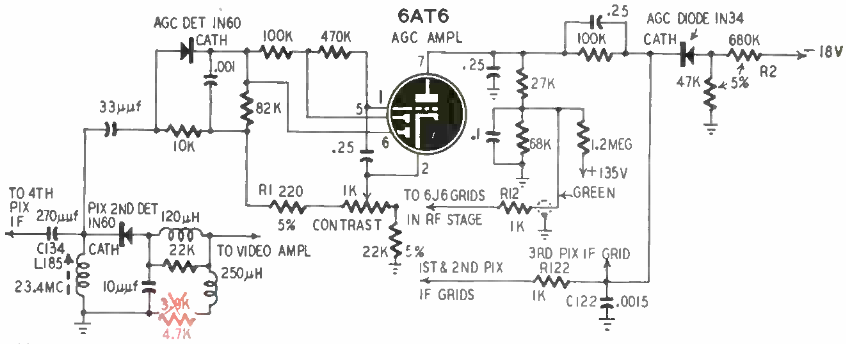


Fig. 2—This a.g.c. circuit improves the performance of 630-type chassis.

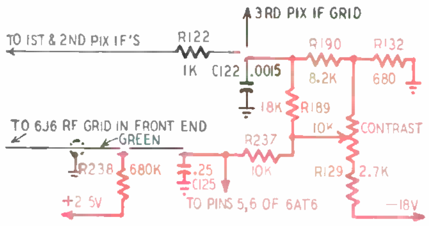


Fig. 3—Revisions for contrast control circuit. Colored parts were eliminated.

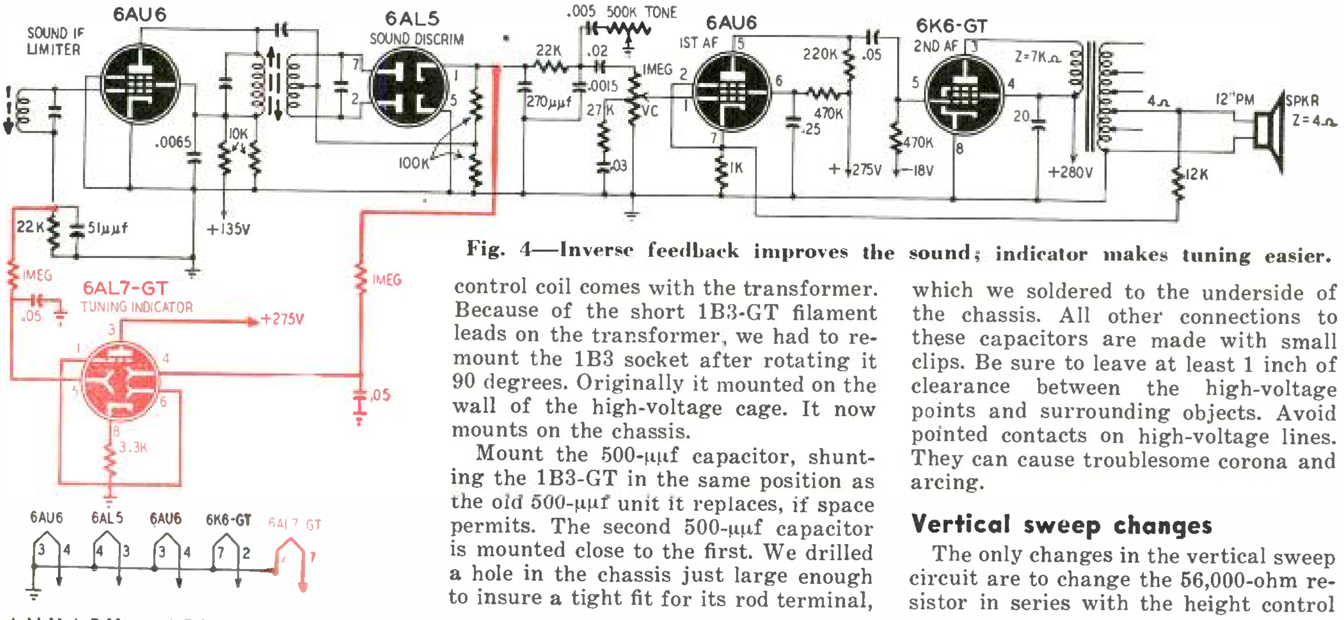


Fig. 4—Inverse feedback improves the sound; indicator makes tuning easier.

control coil comes with the transformer. Because of the short 1B3-GT filament leads on the transformer, we had to remount the 1B3 socket after rotating it 90 degrees. Originally it mounted on the wall of the high-voltage cage. It now mounts on the chassis.

Mount the 500-μμf capacitor, shunting the 1B3-GT in the same position as the old 500-μμf unit it replaces, if space permits. The second 500-μμf capacitor is mounted close to the first. We drilled a hole in the chassis just large enough to insure a tight fit for its rod terminal, which we soldered to the underside of the chassis. All other connections to these capacitors are made with small clips. Be sure to leave at least 1 inch of clearance between the high-voltage points and surrounding objects. Avoid pointed contacts on high-voltage lines. They can cause troublesome corona and arcing.

Vertical sweep changes

The only changes in the vertical sweep circuit are to change the 56,000-ohm resistor in series with the height control to 100,000 ohms (see Fig. 1), the 2,700-ohm (1,800 in some sets) fixed cathode bias resistor of the 6K6 vertical output tube to 1,500-ohms, and the 10,000-ohm 6K6 plate dropping resistor to 1,000 ohms.

The 16AP4 requires a more powerful focusing coil. Use one similar to the RCA 202D2 which has a d.c. resistance of 470 ohms. See Fig. 1 for changes in resistors associated with the focus coil circuit.

The A.G.C. system

The a.g.c. system (Fig. 2) is a modification of the circuit used by RCA in more expensive versions of the 630 (the 8TV41 and the 648PTK). The carrier amplitude of a TV transmitter varies with changes in picture content, so an ordinary a.g.c. operating to maintain a constant carrier amplitude (as in radio a.v.c. systems) is not suitable. However, the peaks of the synchronizing pulses which accompany all TV transmissions are at a uniform maximum amplitude level corresponding to 100% modulation (the so-called blacker-than-black level of video signal). These peaks can therefore be used to operate a video a.g.c.

Part of the video i.f. is tapped off the second video detector and rectified by the 1N60 crystal which operates as a peak rectifier at the horizontal sync frequency (15,750 cycles). Its rectified output is thus proportional to the peak carrier amplitude of the received signal. If the signal fades, the rectified output decreases; if it increases in strength, the rectified voltage increases. This rectifier will also rectify the peaks of noise pulses in the same way. Thus a noise burst could cause the a.g.c to function, reducing gain and blanking out the picture. To reduce this effect the diodes of the 6AT6 are connected as a two-stage noise limiter or clipper. To further protect against noise pulses the rectified d.c. goes through an integrating network (in effect a low-pass filter) made up of the 470,000-ohm resistor and the 0.25-μf capacitor in the grid circuit of the 6AT6. The d.c. output from the integrator is too small to be used to control the i.f.-r.f. gain. In addition, the voltage becomes more positive with increasing signal strength. For a.g.c. it is amplified and inverted by direct coupling to the 6AT6 triode grid. The 6AT6 operates with its cathode at about –100 volts and its plate between 0 and –33 volts, depending on received carrier strength. This voltage is used to control grid bias of the r.f. and i.f. amplifiers.

With a weak signal the 6AT6 cathode bias causes it to operate with almost no plate current. Consequently there is little voltage drop across the 68,000-and 27,000-ohm plate load resistors and the plate is nearly at zero potential. The available r.f.-i.f. bias control voltage is also nearly zero. In the presence of a strong signal the rectified output of the 1N60 opposes the 6AT6 fixed bias, causing plate current flow and a voltage drop across the plate load resistors. The 6AT6 plate goes increasingly negative as signal strength increases. This negative voltage is applied to the grids of the r.f. and i.f. amplifier tubes to control gain.

The r.f. amplifier uses a 6J6 triode while the i.f. video amplifier uses 6AG5 variable-mu pentodes. Because the control-grid characteristics of these two types are not the same, the bias voltages applied to them must be different. For maximum signal-to-noise ratio on weak signals, the r.f. bias should be held at zero for all signals below the level which causes overloading of the first i.f. amplifier. This is the reason for the inclusion of the 1N34 and the connection of the r.f. bias return to B-plus (135 volts) through the 1.2-megohm resistor. This resistor establishes a bucking delay-bias voltage on the r.f. bias bus which holds the r.f. grid at zero until the signal has increased a.g.c. bias sufficiently to overcome the delay voltage. Thereafter the r.f. bias increases with the drop across the 6AT6 plate load. The i.f. bias bus is connected in the 1N34 circuit. On weak signals the 1N34 cathode (which is at the same potential as the 6AT6 plate) is positive with respect to its plate and does not conduct. The i.f. bias then follows the variations in 6AT6 plate voltage. When the received signal exceeds a certain value, the 1N34 cathode becomes more negative than its plate. The 1N34 then conducts, causing a voltage drop in the series 100,000-ohm resistor. This drop limits the maximum value of i.f. bias developed to about -3 volts at even the strongest signal inputs. The r.f. bias is not limited in this way and increases with increasing signal strength to a maximum of about -6 volts. Fig. 3 shows the 630 contrast control circuit *before* the modication with removed parts shown in color.

Germanium diodes are used in the a.g.c. circuit to avoid adding another tube socket to the set and to eliminate additional heater current drain on the set. The pictorial details A and B show placement of the new wiring and parts for the added a.g.c. circuit. Since the 6AT6 a.g.c. amplifier is an extra tube, one tube had to be eliminated from the original 630. The 6AL5 video detector and d.c. restorer was replaced by two germanium diodes. Two 1N34's can be used with little reduction in performance although we used a 1N60 detector and a 1N38 d.c. restorer.

The old dual volume-contrast control is converted to a volume-tone control (an RCA dual control No. 74048 from a 9T270 receiver is the replacement). The single brightness control is replaced with a dual contrast-brightness control (another RCA replacement part, No. 71971 from a 648 PTK receiver). If these controls are not available, use individual controls. The values of R1 and R2 are critical. If possible, measure voltages with a v.t.v.m. after wiring is completed. With the set operating, but no signal coming in, r.f. bias should be about –23 volts with contrast at minimum and zero with contrast at maximum. The i.f. bias should be –6.8 and –1 volts and 6AT6 plate voltage –33 and –0.3 volts at minimum and maximum settings, respectively, of the contrast control.

L185 must be realigned after the alterations are completed. If a sweep generator and 'scope are not available, feed in an AM signal of exactly 23.4 mc at the antenna terminals with selector set for channel 13. Connect a v.t.v.m. across the 4,700-ohm load of the 1N60 video detector. Adjust L185 for maximum output.

The audio system

The revised audio amplifier is shown in Fig. 4. Power output is unchanged; but frequency response is flattened to within 1 db from 100 to 12,000 cycles, and distortion is reduced by a factor of 10 to 1 through use of 20 db of negative feedback between the speaker voice coil and the first a.f. stage cathode. The large amount of feedback reduces audio gain to one-tenth of its original value. To make up the lost gain, the 6AT6 first audio stage is replaced with a 6AU6 pentode using cathode bias. (Save the 6AT6 for the a.g.c. amplifier.) The values of coupling capacitors and grid resistors are also changed to improve frequency response.

A new and larger output transformer (a Peerless S-472-X) was added to improve tone quality. The unit was a compromise between a high-quality transformer and a cheap replacement type. If the audio amplifier squeals after the rewiring is completed, reverse the primary leads of the output transformer to change the phase of the feedback. The original speaker was replaced with a 12-inch, permanent-magnet speaker with a 4-ohm voice coil. The field coil of the old speaker had been used as the set's filter choke. A heavy-duty, 25-ohm, open-frame choke mounted on one wall of the chassis replaced it. The last change in the a.f. system was to eliminate the two parallel 2,200-ohm resistors in the 6K6 B-plus line and return the B-plus line to the low-voltage side of the filter choke instead of to the 5U4-G cathodes. This change reduced hum markedly. An optional addition is the tone control shown in the schematic. This is a simple high-cut affair.

While the improved audio is not a high-fidelity system, it's flattened frequency response and greatly reduced distortion puts it in the "near high-fidelity" class within the limits of its 2 watts of output. And it's a tremendous improvement over the original.

Tuning eye

As a final touch we added a 6AL7-GT tuning-eye tube to the sound i.f. system (see Fig. 4). This tube gives visual indication when the fine-tuning control is properly adjusted for best sound. The tuning indicator is in the sound channel because sound tuning is sharper than video tuning.

With all these changes, the old 630 can stand up to most 1950 receivers and look down on the audio channels of many.

Theory and Practice of Intercarrier TV

Part I—An explanation of how intercarrier operates

By SEYMOUR D. USLAN*

TODAY'S television receivers have two principal systems of obtaining a sound i.f. The older (and still conventional) method is to beat both sound and video carriers against the local oscillator signal and obtain separate intermediate frequencies, each to be amplified by its own i.f. strip. From the mixer on, in other words, there are really two separate receivers.

The newer intercarrier system offers a saving in the total number of stages in the set and greatly reduces the bad effects of oscillator drift. It is based on the fact that all channels have video and sound carriers exactly 4.5 mc apart. The principle is to treat the video i.f. carrier as a "local oscillator" and to beat the audio i.f. carrier against it to obtain a 4.5-mc difference frequency. Since the 4.5-mc interval is wholly controlled by the expensive and precise circuits of the transmitter (of which the FCC requires great accuracy), the 4.5-mc beat is always exactly 4.5 mc; and, provided the receiver is accepting the television signal at all, it is impossible to detune the audio by local-oscillator drift or mishandling of controls.

The diagram of Fig. 1 compares the two systems in convenient block form. For illustration, let us assume the receiver is tuned to channel 2.

The 55.25-mc video carrier and the 59.75-mc sound carrier enter the receiver, go through the r.f. amplifier, and enter the mixer, where they beat with the local oscillator. So far, both receivers are alike, which is shown by placing the similar stages outside the dashed enclosure.

In both receivers two beat frequencies are obtained, the difference between the sound carrier and the oscillator, and that between the video carrier and the oscillator. In the conventional set (upper diagram), these two beats are sent into separate i.f.-amplifier strings, one tuned to 25.75 mc and the other to 21.25 mc. From the first i.f. amplifier on, each section, sound and picture, is treated as a separate receiver.

The intercarrier scheme

The intercarrier receiver is a double-superheterodyne as far as the sound signal is concerned. The two r.f. signals pass through the r.f. amplifier and mixer, just as in the standard set, and beat against the local oscillator to produce the two i.f. signals. But here the big difference begins.

Refer to the lower block diagram of Fig. 1. Instead of entering two separate i.f. strips, the two i.f. signals enter a single i.f. amplifier. Its band width is 6 mc (ideally) so that it can accept both signals and all the desired sidebands. The two i.f. signals are still exactly 4.5 mc apart.

After amplification, the two signals reach the second detector. This is called the video detector in conventional receivers, since it deals with the video i.f. only; but in intercarrier it deals with the sound signal as well, and is often called simply the second detector.

This diode detector rectifies the two signals and passes them to the video amplifiers. The video i.f. is an AM signal, so the detected result is the composite picture signal, ready for amplification and application to the C-R-tube grid and the sync separators. The sound i.f. is FM, however; therefore, rectifying it yields no audio signal.

A detector and a mixer are similar, both being nonlinear circuit elements. The two frequencies passing through the second detector, the sound i.f., and video i.f., mix and produce a beat note equal to their difference, 4.5 mc. This 4.5-mc signal is frequency-modulated exactly the same as the original sound r.f. and i.f. signals were. The frequency of the beat at any instant depends on the frequency of the video i.f. (constant at 25.75 mc) and of the sound i.f. (21.25 mc, frequency-modulated ± 25 kc).

A 4.5-mc trap removes the new 4.5-mc sound i.f. signal from the video fed to the picture tube. The trap is usually a double-tuned transformer, the secondary of which carries the 4.5 mc FM to a sound i.f. amplifier, after which it is detected and the audio amplified for the loudspeaker. Any small amount of AM remaining on the sound FM signal as the result of the mixing in the second detector is removed by the FM detector.

Carrier amplitude relationship

The most important point about this system is the required amplitude relationship between the video i.f. and the sound i.f. carriers at the input to the video detector. The amplitude of the FM sound i.f. carrier must be *much less* than that of the video i.f. carrier to have the 4.5-mc beat note contain mostly FM and very little video (AM) modulation.

When two unmodulated r.f. signals are mixed and detected, the resultant signal has frequency equal to the difference between the two *and an amplitude equal to that of the smaller signal.*

Now suppose we mix an AM signal and an unmodulated r.f. signal. This is the heterodyning process used in AM superheterodynes, where the local oscillator is the unmodulated signal. The

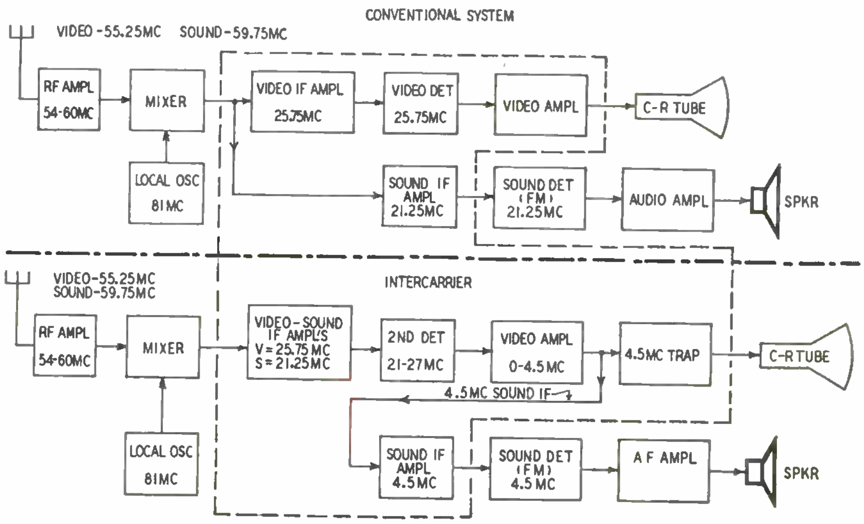


Fig. 1—Block diagrams compare two systems. Receivers are tuned to channel 2.

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oscillator signal must be much stronger than the input r.f. if the i.f. is to contain approximately the same degree of modulation as the r.f. carrier did. If the oscillator is weak, the modulation percentage of the resultant i.f. is low. If the oscillator is very weak, the i.f. may contain practically no amplitude modulation at all.

In mixing an FM signal and unmodulated r.f. the situation is very different. No matter what the relative strengths of the signals, the beat note is frequency-modulated to the *same degree* as the input FM signal. That means that variations in frequency of any one signal in a mixing process will result in the same frequency variations in the beat. The amplitude of the beat is, however, mainly dependent upon the *weaker* of the two input signals,

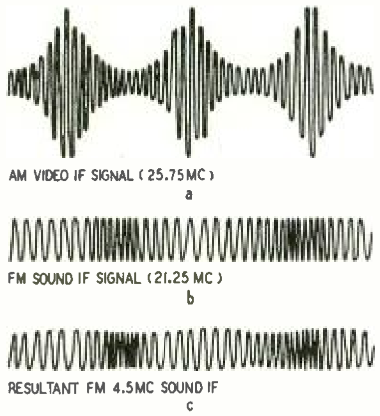


Fig. 2—Video and sound i.f.'s (a and b) mix in the second detector to produce the 4.5-mc FM signal shown at c.

no matter which one is frequency-modulated.

We now come to the process of mixing the AM video i.f. and the FM sound i.f. in the second detector. The first object is to obtain a beat note which is frequency-modulated to the same degree as the original r.f. and the 21.25-mc sound i.f. As demonstrated a few paragraphs back, the only requirement is that the video i.f. frequency remain constant, so there is no problem here.

The second object is to keep the 4.5-mc beat note as free of AM as possible. The answer to this problem is to keep the amplitude of the 21.25-mc sound i.f. *low* compared with that of the video i.f. At the second detector of an intercarrier receiver, the sound i.f. is the equivalent of a local oscillator signal and the video i.f. is the equivalent of an AM signal in a broadcast set. To reproduce the amplitude modulation, the oscillator signal (or the sound i.f. in this case) must be much stronger than the incoming AM signal (the video i.f. here). The sound i.f. is actually made *much weaker.* As a result, little or none of the AM appears in the 4.5-mc beat. The FM is still there, of course, so the beat can be amplified and detected as a simple low-frequency FM carrier.

Fig. 2 gives a rough picture of the waves with which we are concerned. At *a* appears the video-modulated AM i.f. At *b* is the FM sound i.f., whose amplitude is much lower. At *c* is the 4.5-mc beat note. It is frequency-modulated like the wave at *b*, and its amplitude is approximately equal to that at *b*, following the rule that the amplitude of a beat depends on the strength of the weaker of the two original signals. Notice that while the beat at *c* has some AM, there is not very much. What there is will be washed out in the discriminator or ratio detector.

I.f. response curves

Fig. 3 is a drawing of standard and intercarrier over-all i.f. responses. The right side slopes in the usual manner and accounts for the video i.f. signal and its vestigial sideband. This is the same for both receiver types.

Curve 1 at the left is found in the video i.f. response of standard receivers. Traps tuned to the sound i.f. frequency remove the unwanted signal from the video channel, and curve 1 shows a sharp dip at the sound frequency as a result of the traps. The small peak at the left appears in most receivers using traps.

Curve 2 is the standard intercarrier response, in which the sound i.f. frequency is greatly attenuated by the slope of the response, but not trapped

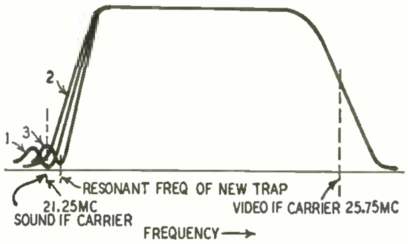


Fig. 3—Standard-receiver i.f. response (1) and two for intercarrier (2 and 3).

out entirely. Standard i.f. transformers need be broad-banded only a little more than usual to include the sound frequency, especially as its level must be kept low to prevent the 4.5-mc, second-detector beat from being amplitude-modulated.

Curve 2 has the disadvantage that it is not symmetrical on either side of the center frequency of the sound i.f., so that the FM is slope-detected, with resulting distortion of both sound and picture. To prevent distortion, the sound i.f. amplitude must be limited to from 5 to 7.5% of the picture i.f.

Curve 3 cures this fault by providing a peak at the sound i.f. frequency. Though the peak looks narrow, the swing of the FM is only 50 kc, about 1% of the video bandwidth; therefore, the peak effectively provides a flat-top response for the sound signal. The peak is obtained by inserting in the i.f. amplifiers, a trap tuned slightly *above* the sound i.f. The peak slightly below trap resonance results from the same tuned-circuit action that produces the peak in curve 1. The amplitude of the sound carrier can now be increased to about 15% of the picture signal without distortion, and the FM detector can take care of the resulting AM on the 4.5-mc sound beat.

TRANSMISSION-LINE CONSTANTS

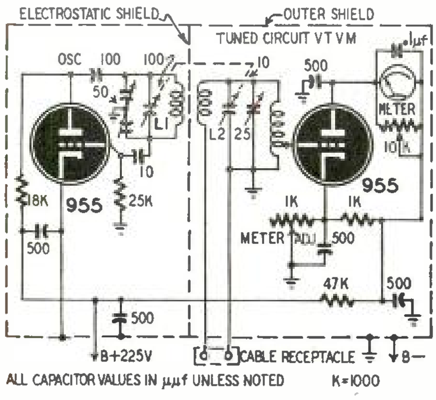
By ROBERT F. SCOTT

SOLID-DIELECTRIC co-axial and polyethylene-ribbon transmission lines are rapidly replacing open-wire types used in connecting antenna systems to receivers and to transmitters running up to 1 kilowatt input. These types of lines are used almost exclusively on television and FM receiving antennas. This is particularly true where the slight increase in transmission loss is overshadowed by ease of installation and added flexibility. They are also used as filters, wavetraps, impedance-matching devices, delay lines, and attenuating circuits.

Commercial transmission lines are currently available, with impedances of 35, 50, and 70 ohms in single-conductor types; 75, 90, and 300 ohms for twinax and twisted-pair types; and 75, 150, and 300 ohms for ribbon types.

The characteristics or surge impedance of a single-conductor co-ax or ribbon line is determined by its inductance and capacitance. Both these factors are governed by the diameters of the conductors and the spacing between them. The impedance of twinax or two-conductor types is much more complex because the diameters of the inner conductors, the diameter and dielectric constant of the insulating material, the center-to-center spacing of the inner conductors, the ratio of the dielectric diameter to conductor spacing, and the ratio of the conductor spacing to conductor diameter are all governing factors.

Electromagnetic waves are slowed down from their normal 186,000 miles-per-second velocity when they pass through solid dielectrics. Therefore, a single cycle of a given frequency will not travel as far on an insulated transmission line as it would on a line in free space during the same period of time. For this reason, one wavelength at any given frequency will be shorter on an insulated transmission line than on a line in free space. Because it is often necessary to cut a transmission line to a given wavelength, we must



This circuit measures velocity factor.

know the relationship between actual physical wavelength and the electrical wavelength. Manufacturers of various types of transmission lines have simplified calculations for the user by comparing the velocity of electromagnetic waves through the dielectrics they use to the velocity of waves in free space. This ratio, expressed as a percentage, is called the *velocity factor* or *velocity of propagation.*

The circuit shown in the diagram was developed for measuring velocity of propagation (V.P.) in transmission lines. This device, described in detail in the July, 1946, issue of *Electronics*, consists of a 95–105-mc oscillator and a v.t.v.m. resonance indicator. The oscillatory circuit consists of L1 and its shunt capacitors. The indicator has a similar tuned circuit ganged to that of the oscillator. The bottom end of L2 is open and connected to a receptacle for the transmission line to be tested. The circuits are designed to track but they do not do so until the lower end of L2 is returned to ground by shorting the receptacle. When a transmission line is connected to the receptacle, it will have negligible impedance when it is an odd number of quarter-wavelengths long at the oscillator frequency. The velocity factor V.P., in percent, is then equal to 2/3f, where f is the test frequency. For example: If a 1½-meter length of co-axial line resonates at 97.5 mc, V.P. = ⅔ × 97.5 mc = 65%.

According to Bach ("The Trombone T," *CQ*, March and April, 1947), the electrical and actual physical wavelengths are equal when the currents in the two conductors are in phase; as in a folded dipole. When they are out of phase, as in a matching stub or trap, the electromagnetic field passes through the dielectric and the physical length is reduced by the velocity factor.

Because insulated transmission lines are becoming more popular as new devices are developed and new applications found, two tables have been prepared giving pertinent characteristics of most of the available types of cables. Table I lists characteristics of the RG-/U co-axial cables. The velocity-of-propagation factor is 65% for RG-21/U attenuating co-ax and 65.9% for the others. Capacitance ratings in micro-microfarads per foot and attenuation in decibels for each 100-foot length will prove valuable in selecting cable for a particular job. Conductor and outside diameters are given as an aid to identifying unmarked cables. The color of the jacket may be a useful factor in identifying unmarked co-axial cable. Black jackets are used on RG-5/U, -8/U, -11/U, -13/U, -15/U, -22/U, -34/U, -57/U, -58/U, -58A/U, -59/U, and -62/U; grey on RG-6/U, -9/U, -9A/U, -10/U, -12/U, -14/U, -17/U, -18/U, -19/U, -20/U, -21/U, -42/U, and -74/U; while RG-29/U, 54A/U, -55/U, and -71/U have brown or natural polyethylene outer jackets. Table II covers the popular types of ribbon-type lines.

Most observers have probably wondered why some polyethelyne insulation is almost clear or milky-white and other types are dark brown. We found the answer in the July, 1949, issue of *Amphenol Engineering News.* Ultra-violet rays from the sun cause natural polyethelyne to become suntanned so it begins to crack and break up. After blue, red, black, brown, and orange pigments were used, the present brown was found to have the lowest power factor and will stand up better than the other types tested, for a period of approximately 15½ months. After this time, the line begins to crack and should be replaced. Natural polyethelyne has a lower power factor than the brown type when it is first put into service, but the brown is better after two or three months and remains so for its life span of approximately 16 months.

The choice of co-axial or ribbon-type transmission lines depends on a number of factors. For example, co-axial lines are recommended as TV lead-ins when the line passes through a high-noise area. The type of cable matters little in strong-signal areas so long as its impedance is correct. In fringe areas it will be necessary to select the cable with the lowest attenuation factor. Obviously, if it is necessary to insert a specified amount of loss in a 52-ohm line, all you need do is insert a length of RG-21/U cut to give the desired amount of attenuation at the center frequency.

TABLE I

Imp. (Ohms)	RG-/U	Cap. Ft. (uuf)	Center cond.	O.D. (inches)	Loss in Decibels Per 100 Feet — Megacycles							
					1	4	8	30	60	100	200	400
35	83	35	#10	0.450								
51	9,9A	30	7-21	0.420	0.130	0.295	0.450	1.000	1.50	2.10	3.30	4.50
52	10	29.5	7-21	0.475	0.130	0.295	0.450	1.000	1.50	2.10	3.30	4.50
52	8	29.5	7-21	0.405	0.130	0.295	0.450	1.000	1.50	2.10	3.30	4.50
52	14	29.5	#10	0.545	0.80	0.180	0.290	0.635	1.00	1.40	2.15	3.35
52	17	29.5	0.188	0.975	0.038	0.100	0.155	0.380	0.60	0.85	1.30	2.10
52	18	29.5	0.188	0.945	0.038	0.100	0.155	0.380	0.60	0.85	1.30	2.10
52	19	29.5	0.250	1.120	0.030	0.078	0.122	0.300	0.49	0.70	1.10	1.75
52	20	29.5	0.250	1.195	0.030	0.078	0.122	0.300	0.49	0.70	1.10	1.70
52	58A	28.5	7-29	0.195								
52	74	29.5	#10	0.615	0.080	0.180	0.290	0.635	1.00	1.40	2.15	3.35
52.5	5	28.5	#16	0.332	0.200	0.440	0.650	1.370	2.00	2.65	3.85	5.60
53	21[1]	29.0	#16N	0.332	1.300	2.650	3.800	7.800	11.60	14.00	20.00	34.00
53.5	29	28.5	#20	0.184	0.240	0.560	0.860	1.950	3.00	4.10	6.20	9.50
53.5	55	28.5	#20	0.206	0.240	0.560	0.860	1.950	3.00	4.10	6.20	9.50
53.5	58	28.5	#20	0.195	0.240	0.560	0.869	1.950	3.00	4.10	6.20	9.50
58	54A	26.5	7-0152	0.250								
71	34	21.5	7-21	0.625	0.115	0.270	0.410	0.940	1.40	1.90	2.85	4.35
72	****	21.5	#9	0.870	0.020	0.058	0.100	0.275	0.46	0.70	1.15	2.00
73	59	21	#22CW	0.343	0.260	0.590	0.880	1.900	2.80	3.75	5.60	8.30
74	13	20.5	7-26T	0.420	0.115	0.270	0.410	0.940	1.40	1.90	2.85	4.35
75	11	20.5	7-26T	0.405	0.115	0.270	0.410	0.940	1.40	1.90	2.85	4.35
75	12	20.5	7-26T	0.475	0.115	0.270	0.410	0.940	1.40	1.90	2.85	4.35
76	6	20	#21CW	0.332	0.200	0.440	0.650	1.370	2.00	2.65	3.85	5.60
76	15	20	#21CW	0.545	0.080	0.200	0.310	0.730	1.10	1.50	2.40	3.65
93	62	13.5	#22CW	0.242	0.280	0.570	0.810	1.600	2.30	3.05	4.40	6.30
93	71	13.5	#22CW	0.250	0.280	0.570	0.810	1.600	2.30	3.05	4.50	6.30
95	22	16.0	***	0.405	0.220	0.500	0.750	1.700	2.50	3.40	5.20	8.30
95	57	17	**	0.645	0.180	0.410*	0.620	1.400	2.13	2.90	4.60	7.30

All cables have velocity factor of 65.9% except RG-21/U. CW—Copperweld.
Notes: [1]—Special attenuating cable. Velocity factor 65%. ****—Amphenol number 21-125.
N—Nichrome conductor. ***—Twin conductors; each seven strands of .0152-inch copper.
T—Tinned copper. **—Twin conductor; each seven strands of No. 21.

TABLE II
RIBBON-TYPE TRANSMISSION LINES

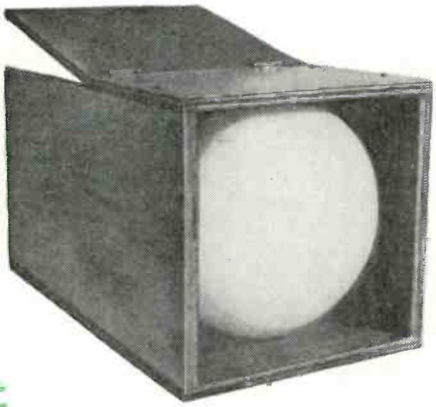
Imp. (Ohms)	Amphenol Number	V.P. %	Max. Width	Loss In Decibels Per 100 Feet — Megacycles								
				3.5	7.0	14.0	28.0	50.0	100	144	200	400
75[1]	14-080	68	9/64	0.37	0.64	1.10	1.90	3.00		6.8		
75[2]	14-023	71	5/16	0.29	0.49	0.82	1.40	2.10		4.8		
150[1]	14-079	77	3/16	0.20	0.35	0.60	1.00	1.60		3.5		
150	14-279			0.24	0.35	0.52	0.76	1.05	1.55	1.90	2.59	3.38
300[1]	14-056	82	13/32	0.19	0.28	0.43	0.61	0.85	1.25	1.52	1.82	2.70
300[3]	14-076	84		0.155	0.23	0.34	0.50	0.69	1.00	1.24	1.48	2.18
300[4]	14-271	84		0.19	0.28	0.43	0.61	0.85	1.25	1.52	1.82	2.70

Notes: [1]—7-28 copper conductors. [3]—7-26 copper conductors, tubular transmitting cable.
[2]—7-21 copper conductors. [4]—7-28 copper conductors, tubular transmitting cable.

Television in Every Room

Parts from the junk collection put together to make a pair of remote television viewing units

By Martin Clifford*



The 9LP7 in a plywood housing.

RADIOMEN are junkmen. Every radioman worthy of the name has cached away boxes full of radio parts—some new, some old, but none of which are going to be thrown out, not if he has anything to say about it. Those parts are valuable! But, when we received an ultimatum from the "better half" that closets are meant for storing clothes, not as a repository for useless broken-down radio parts, something drastic had to be done. The parts took up the larger part of only three closets, but women are *so* unpredictable. We had to *do* something to justify their existence—something big and important to impress a certain unappreciative person with just what could be done with "junk" . . . something like television in *every* room, operated by a master control.

That was it! Master-slave television (it even *sounded* good) with the master unit in the livingroom bookcase and remotely controlled 12-inch sets all over the house.

Of course there was a hitch, right at the beginning, as there is in all ambitious projects. To have master-slave television you have to have a master unit, a complete television receiver in *good* working order. To avoid wholly unnecessary arguments, we decided not to touch the existing TV receiver, but to buy an economical TV set that would be light in weight, small in size, yet capable of supplying a strong composite video signal. The Pilot 3-inch a.c.-d.c. Candid TV fitted this description admirably. The video signal was in excess of 35 volts peak-to-peak, enough to swing a projection tube. The front end was continuous tuning, with a switching arrangement to avoid the FM bands.

The first raid on our precious collection of miscellaneous parts, maligned by the name "junk," yielded a derelict Ansley, minus the front end and completely innocent of picture or sound stages. There was a yoke, but no focus coil.

Let's inventory just what we did have. There was a low-voltage supply (Fig. 1) mounted on its own chassis. Also, as we see in Fig. 2, a separate chassis holding the vertical oscillator and output stage, horizontal a.f.c., horizontal oscillator and horizontal output, and, thank goodness, the high-voltage supply *in working order*. And now the big problem—how to tie all this stuff together and make it work to produce pictures.

The first obvious solution was to connect the low-voltage supply to the rest of the slave unit. Since these units were on separate chassis, they could easily be connected by cables using octal male and female plugs. To be able to add more circuits if desired, a small chassis (that junk box again) of the type shown in Fig. 3 was used. Octal sockets were mounted on all four sides, and all socket pins of the same number tied together (pin No. 1 of socket No. 1 to pin No. 1 of socket No. 2 to pin No. 1 of socket No. 3, etc). This was repeated with all the pins, ad nauseam. It looked like a crow's nest, but came in mighty handy. A high-impedance focus coil was shunted across the power supply through a 5,000-ohm wire-wound pot (Fig. 1).

We decided to proceed with caution. The entire slave unit (still not connected to the master) was turned on and some random voltage checks taken. These were far, far from manufacturer's recommendations. The meter

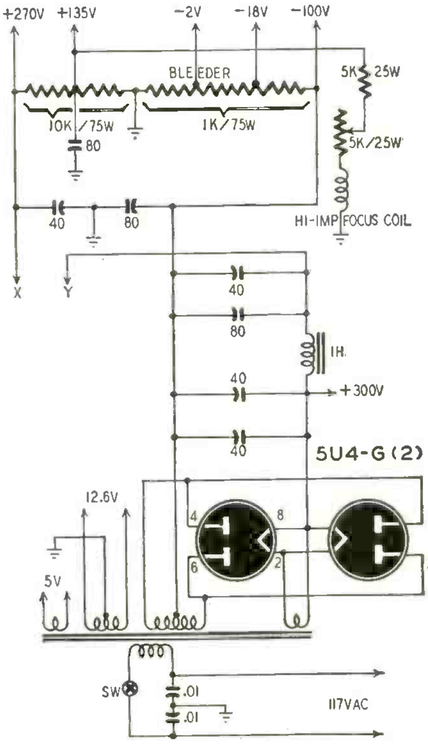


Fig. 1—Low-voltage plate power supply.

*Instructor, Pierce School of Radio & Television, New York, N. Y.

was suspected and a new one tried. Same readings. Then the light of understanding began to glow! The low-voltage supply was designed to operate an *entire* TV set, but we were loading it with just the sweep units. Not enough current was flowing through the bleeder-type voltage divider. That was easy to fix. The bleeder, having fixed taps, was ripped out and replaced by a 10,000-ohm resistor to supply various amounts of B-plus, and a 1,000-ohm unit for the required negative voltages. Both resistors were 75-watters, and both of them had several sliding taps for the various voltages needed.

Caution was still called for. The slave was connected to the C-R tube and the high-impedance focus coil current adjusted until a sharp raster appeared. Suspicious! Things were going along too easily! When everything looks right it must be wrong.

The last and final, the *conclusive* step, was to tie the slave to the master. To avoid the necessity of building a cathode follower for the picture signal, master and slave units were placed side by side, keeping picture leads short. The two units were turned on. The master unit (the Pilot) worked fine, just as the manufacturer had said it would. And the slave? Well, there was something vague and nebulous moving across the screen. It wasn't a picture. It couldn't be focused. It couldn't even be stopped. Something was wrong . . . but what was it?

Theoretically, it should have worked. The circuits were correct. The voltages were okay. Something very simple had been omitted—like forgetting to connect the chassis of the master to the slave chassis! Again that was easy to fix—or was it? A nice heavy metal braid tentatively touched from the master chassis to the slave chassis produced the biggest display of fireworks we had seen in a long time. Now what? Again something simple. You just can't tie the chassis of an a.c.-d.c. TV receiver (hot chassis) to an a.c. receiver. It was easy to put the hot chassis at ground potential. Just reverse the line plug. But did we get pictures. As you probably suspected—no!

Textbooks were hurriedly consulted, and a 'scope was just as quickly pressed into service. The second sync amplifier used in the slave called for a positive sync pulse, and what were we feeding in? Negative pulses! Negative pulses that would allow the vertical and horizontal oscillators to run free. No wonder the hold controls seemed to have no effect. A quick cure was to shift the wire carrying the sync pulses from the plate of the 6AU6 sync amplifier and separator to the grid of the same tube in the master receiver unit shown in Fig. 4.

Things immediately began to look better. The picture stopped running vertically and horizontally. It stopped running long enough to show a prize fight . . . with the contestants in *negative* picture phase. But naturally. Why didn't we think of that before? The

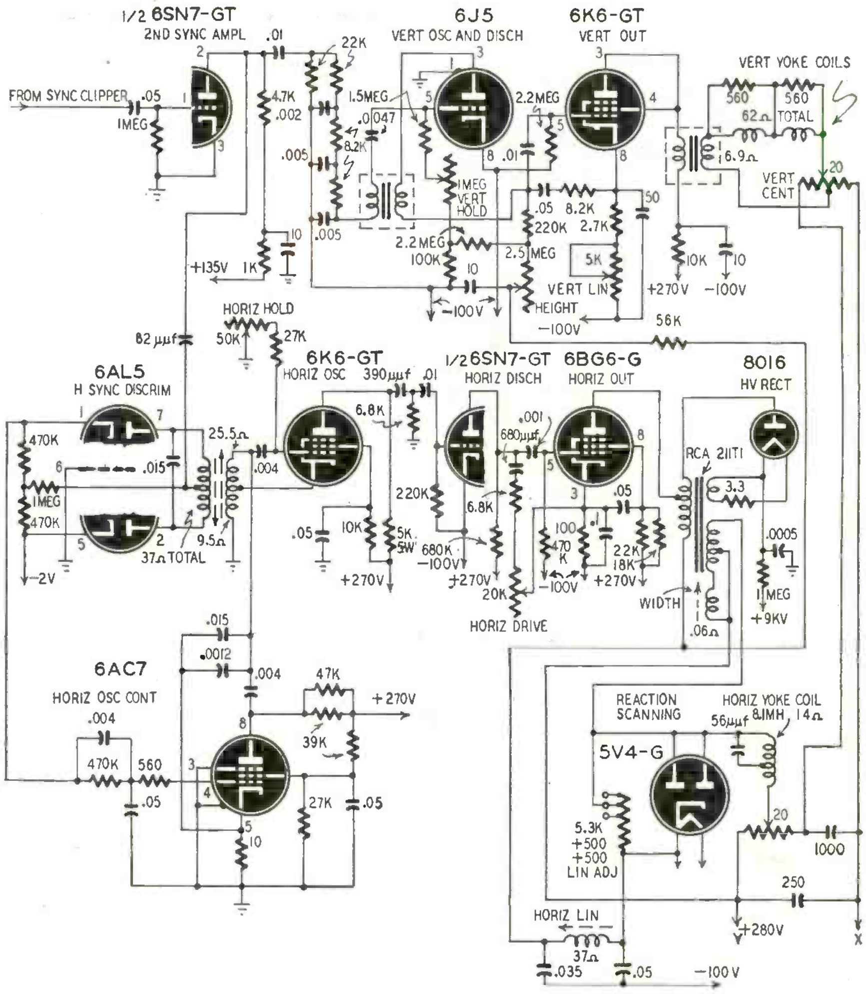


Fig. 2—Vertical oscillator and output stages, horizontal a.f.c., oscillator, and output stages shown above were all on a single chassis, and in working order.

Pilot had its video fed into the cathode, and we were taking that same signal and sending it into the grid of the slave tube. All we had to do, to get proper picture phase, was to reverse the video detector in the master, a 1N34 crystal.

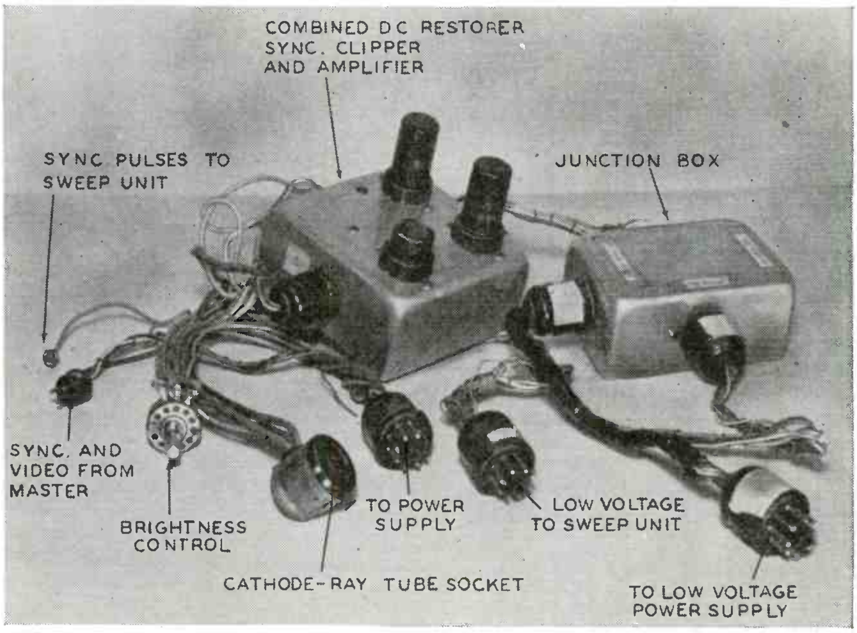


Fig. 3—This maze of cables and plugs connects the various units together. Be sure to label everything unmistakably to avoid that nervous breakdown later on.

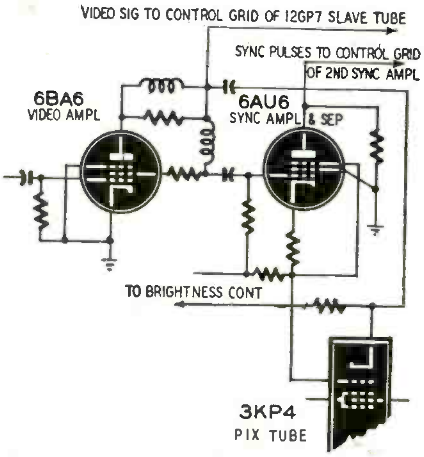


Fig. 4—A portion of the Pilot receiver.

Reversing the crystal gave us correct picture phase, but wrong pulse polarity again. Back went the sync take-off to the plate of the 6AU6.

Now the slave unit worked well, but not quite well enough. The picture would run vertically, and sometimes slip horizontally, especially on weak signals. This time that junk box was attacked with vim and vigor. Out came a chassis, miscellaneous resistors and capacitors, a few tubes. An additional sync amplifier and clipper stage had been born. (See Fig. 5.) Now the slave worked as it should. We had master-slave TV with only one drawback. The plug and cable department had become somewhat complex, as a look at Fig. 3 will prove!

A second remote unit

But that was just *one* slave unit. As long as luck and the junk box held out, more slaves could be built. Packed at the top of the closet was a 12-inch *electrostatic* radar tube. Maybe something could be done with that and a little auxiliary equipment.

The second slave called for only a modest expenditure of cash for r.f. power supply. All the rest of the unit was made of parts that had never expected to see the bottom of a chassis again.

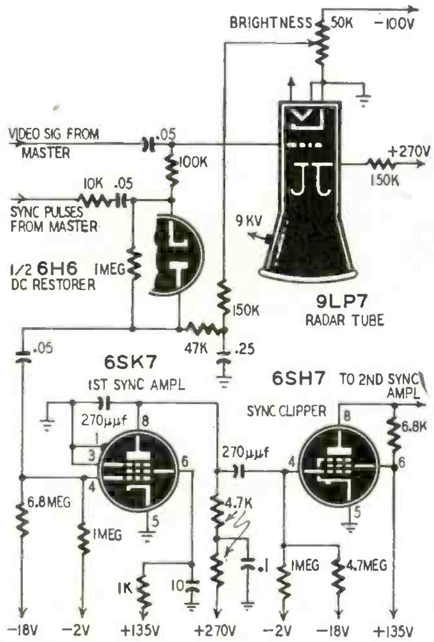


Fig. 5—The sync amplifier and clipper.

circuit, few changes being necessary.

The electrostatic slave, the final circuit for which is in Fig. 6, proved once again, and very definitely, that there is a vast difference between reading television theory and applying it. Not that the electrostatic slave didn't work. It did. Surprisingly, that's what the trouble was. The first pattern received produced the famous "venetian-blind" effect, typical indication of lack of horizontal sync. Varying the horizontal hold

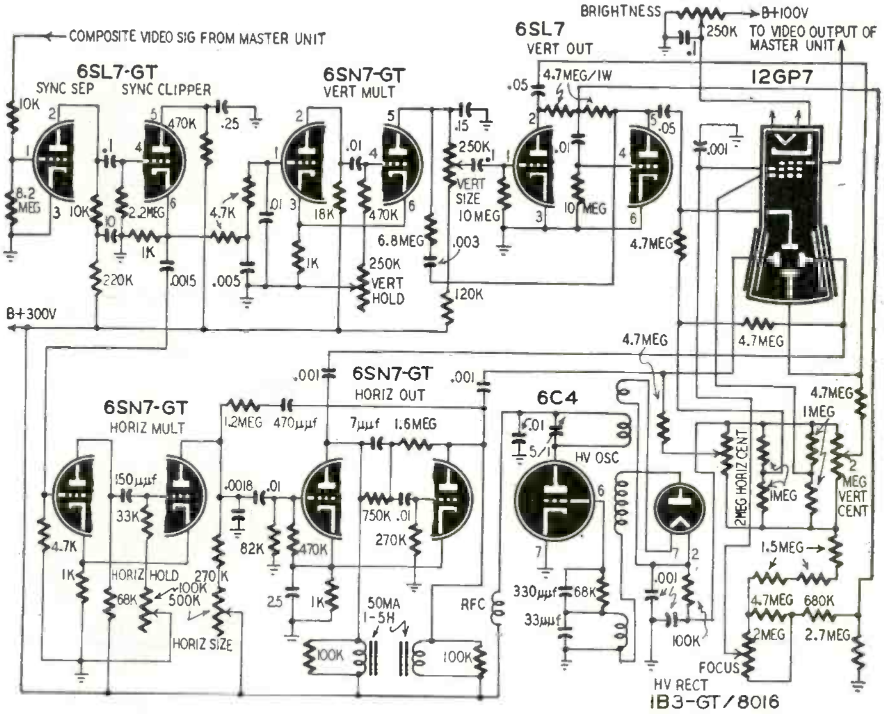
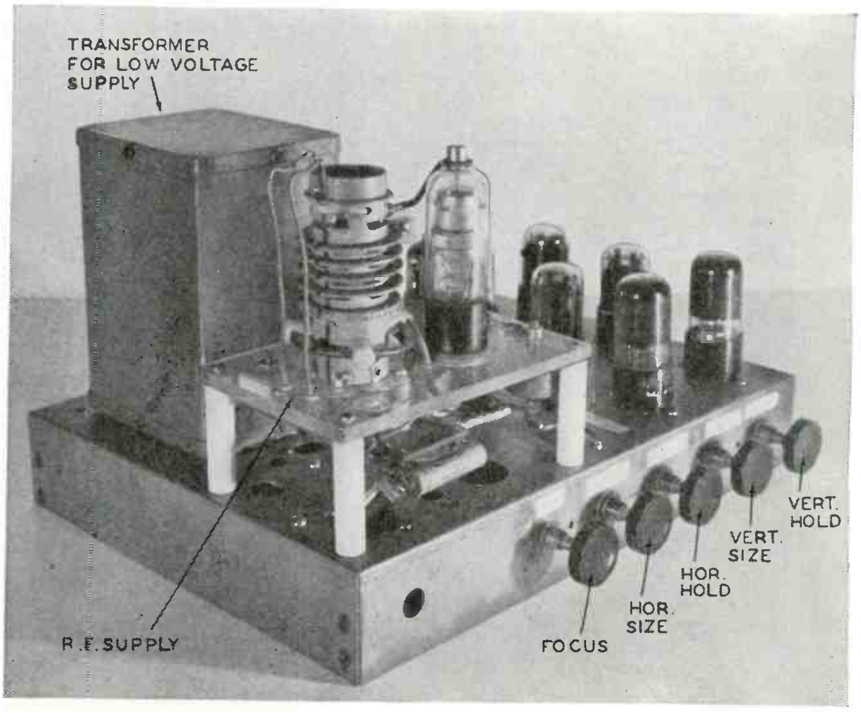


Fig. 6—Final circuit of the slave using the electrostatic 12GP7 cathode-ray tube.

Some experimenting was done on an original circuit, which began to approach that of one of the Belmont models so closely that finally the pencil drawings were thrown away and the original features drawn in on the schematic diagram of a standard Belmont



This chassis contains the circuits for the electrostatic slave diagrammed above. The r.f. power supply is built on a small plastic chassis for good insulation.

control gave us the first sight of a test pattern—running vertically. Adjusting the vertical hold control cured that. All that remained was to adjust the focus control to get a nice, clear, sharp, and —here was the gimmick—very, very small picture.

Small? That picture looked positively lost! There it was, modestly confining itself to the tiniest possible space when it had the entire area of a 12-inch screen to play around in. We could have substituted a 7-inch electrostatic tube, but the thought of the caustic comment it would arouse prevented taking the easy way out. The picture had to be made bigger, and not by a magnifying lens either.

The problem was precise, and so were the answers. To get a bigger picture, the sawtooth voltage from the balanced deflection amplifiers had to be made bigger, lots bigger, without sacrificing linearity. That was just the first step. Next on the agenda was reducing the high voltage on the C-R tube from about 8 to 6 kv. This meant loss of brilliance, but it also meant a beam that wasn't so stiff and could be moved across and up and down with greater ease.

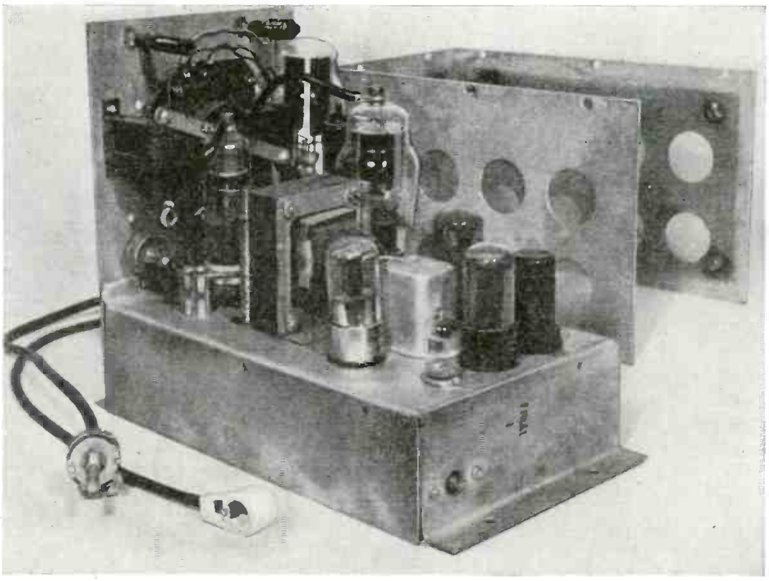
The vertical deflection amplifier was tackled first. The best we could hope for was to *approach* the amplification factor of the tube we used originally, a 6SN7 with a mu of 20. This called for increasingly larger values of plate load resistor. The quarter-megohm units originally used in the plate circuits of the 6SN7 vertical amplifier were removed and replaced with 1-megohm resistors. This was fine, except for one thing. The plate voltage on the tube had almost disappeared. A (v.t.) voltmeter check showed practically the entire supply voltage across the plate load. More voltage was needed. Fortunately the high-voltage bleeder was available, giving us up to 6 kv if we wanted it. We stopped at approximately 1,200 volts up the bleeder. The picture was still not quite big enough. The plate load resistors were increased until we hit almost 5 megohms. Still the picture wasn't big enough, not even with 1,200 volts supply and 5-megohm plate load. A quick check with the tube manual showed that a 6SL7 had an amplification factor of 70 compared to 20 for the 6SN7. Only a few minor circuit changes were needed to accommodate the 6SL7, and the pix on the screen became large as life—but not as natural. The aspect ratio favored the vertical side far too much.

Now all we had to do (so we thought!) was to make the same changes in the horizontal deflection amplifier, and then everything would be wonderful. It just didn't work out that way. The picture expanded horizontally all right, horizontally and horribly. The horizontal sawtooth was being amplified, and greatly distorted in the process. New tactics were called for. The final solution for large horizontal sawtooth voltage on the plates of the 6SN7 balanced load resistors with small receiver-type chokes. The low d.c. resistance of the chokes put almost the full supply voltage on the plates of the 6SN7 balanced horizontal deflection amplifier. We had our cake and could eat it too. At the horizontal frequency of 15,750 c.p.s., the plates of the 6SN7 thought they were looking into a very respectably sized impedance—the choke coils, whose inductance probably approached 5 henries. The d.c. drop across the choke-resistor plate load was small, but the sawtooth voltage developed across it was large.

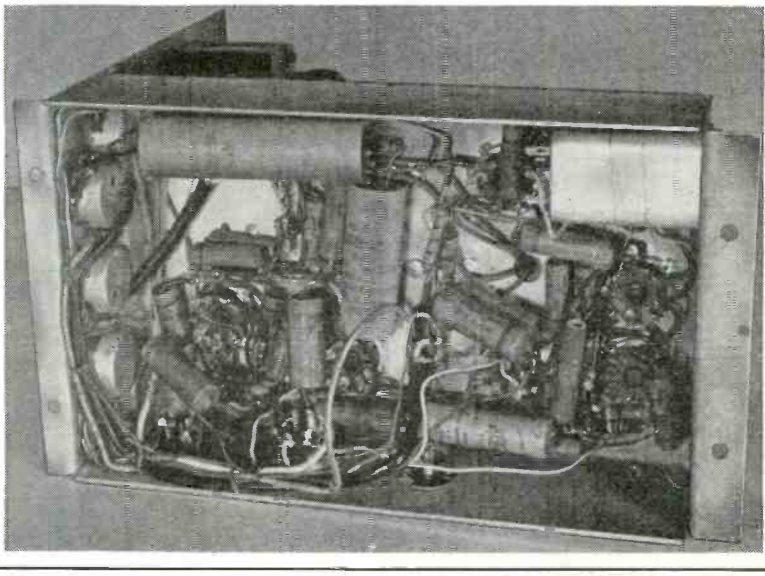
Next step—to devise cathode-follower coupling units and separate the slaves from the master. (We also thought of widely spaced open-wire lines at high impedance.) But that step was never taken though we may do it yet.

Of course, with the master and *two* slaves working, the total number of connecting wires, cables, metal braid, did make things seem a bit sloppy. But to have built two slaves (and successfully, too) and then to be told, "It still looks like a pile of junk to me. Just keep that mess out of the livingroom." And after all that hard work, physical and mental! Women are *so* unpredictable!

This is the power supply which furnishes low plate voltages for the tubes.



The derelict Ansley unit was modified as described in text for the 9-inch slave.



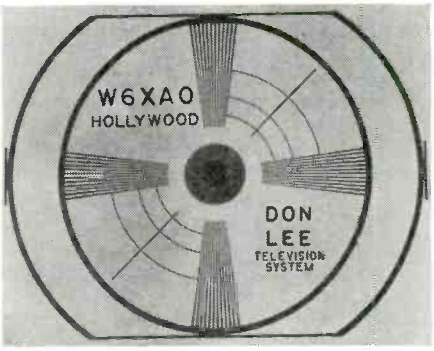
This view of the Ansley chassis after surgery is unimpressive—but it works!

Illustrated TV Station List

Complete roster of operating stations. The identification-pattern photographs should be especially helpful to dx-ers

Note 1

Note 2



Note 3

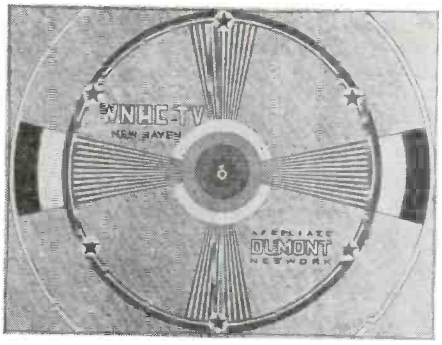
Note 2

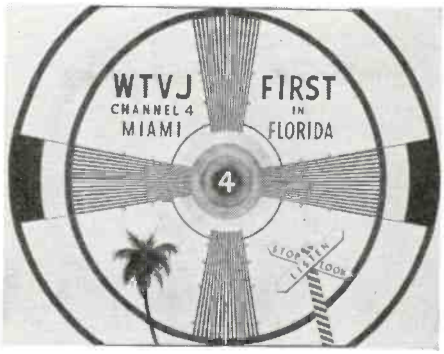
List corrected to November 15, 1949

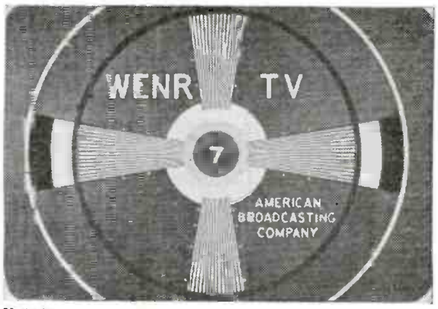
ARIZONA		
*Phoenix	KPHO-TV	
CALIFORNIA		
Los Angeles	KFI-TV	9
Los Angeles	KLAC-TV	13
Los Angeles	KNBH	4
Los Angeles	KTLA	5
Los Angeles	KTSL	2
Los Angeles	KTTV	11
Los Angeles	KECA-TV	7
San Diego	KFMB-TV	8
San Francisco	KGO-TV	7
San Francisco	KPIX	5

* Stations not yet operating at time list was compiled.

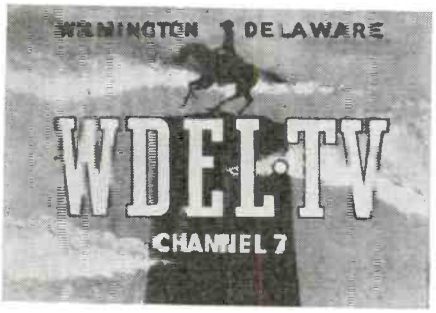
Note 2

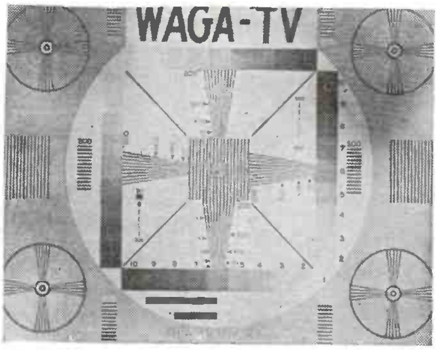




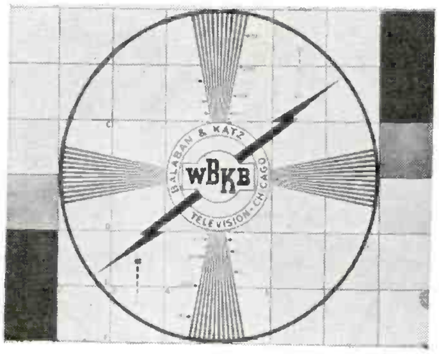


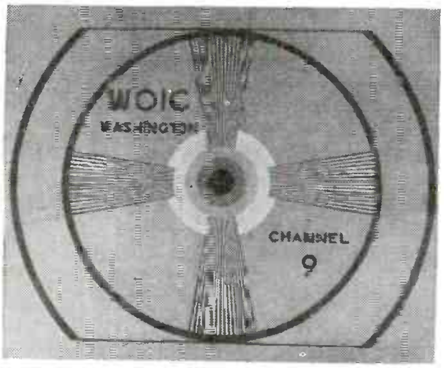
Note 5

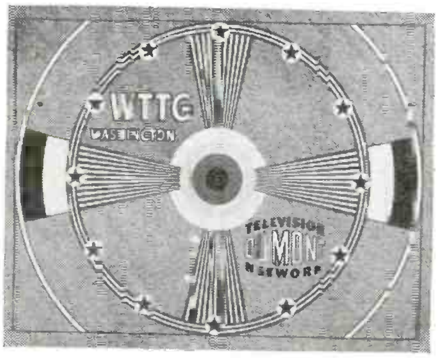




Note 4

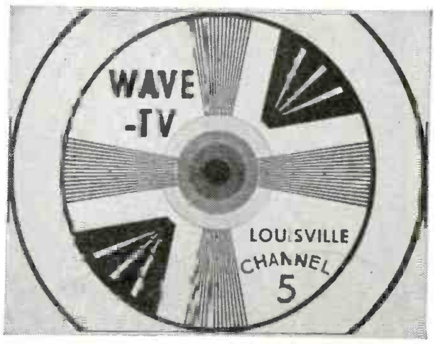


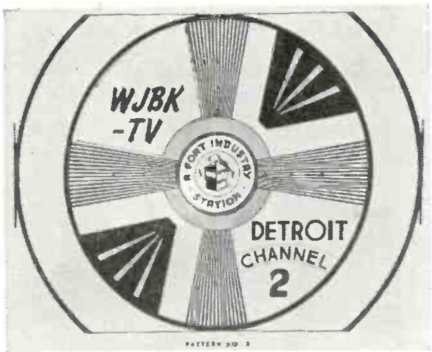


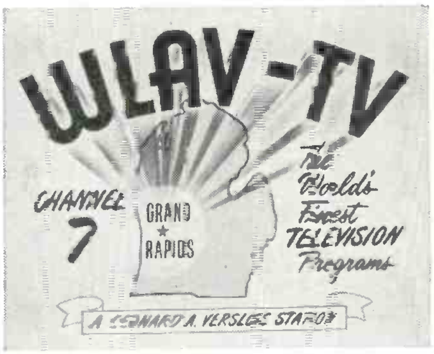


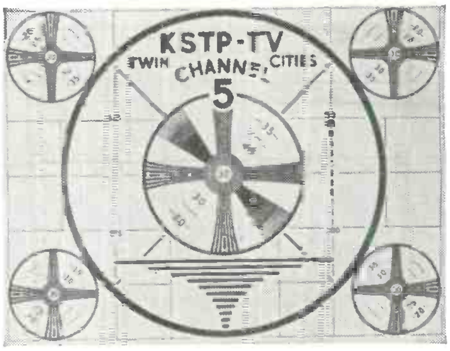
San Francisco	KRON-TV	4
CONNECTICUT		
New Haven	WNHC-TV	6
DELAWARE		
Wilmington	WDEL-TV	7
DISTRICT OF COLUMBIA		
Washington	WMAL-TV	7
Washington	WNBW	4
Washington	WOIC	9
Washington	WTTG	5
FLORIDA		
Jacksonville	WMBR-TV	4
Miami	WTVJ	4
GEORGIA		
Atlanta	WAGA-TV	5
Atlanta	WSB-TV	8
ILLINOIS		
Chicago	WBKB	4
Chicago	WENR-TV	7
Chicago	WGN-TV	9
Chicago	WNBQ	5
INDIANA		
*Bloomington	WTTV	10
Indianapolis	WFBM-TV	6
IOWA		
Davenport	WOC-TV	5
KENTUCKY		
Louisville	WAVE-TV	5

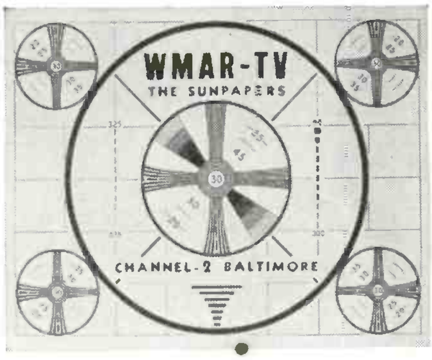
* Stations not yet operating at time list was compiled.



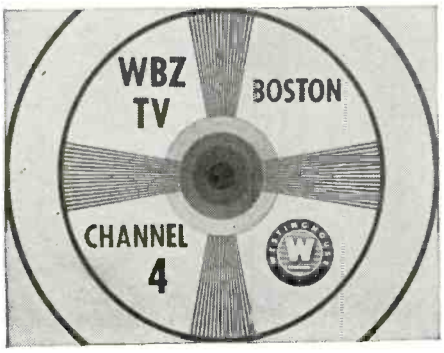


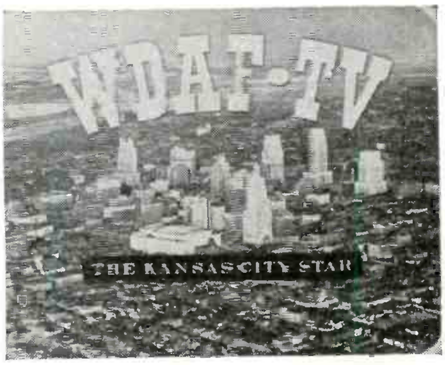


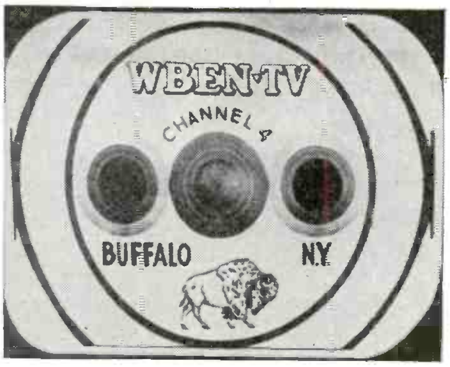


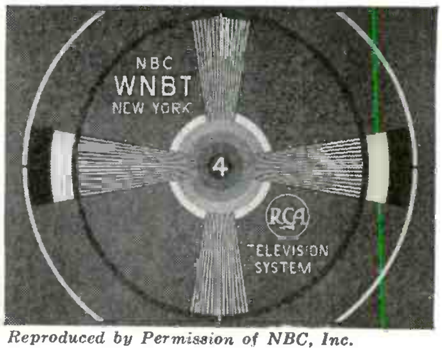


LOUISIANA		
New Orleans	WDSU-TV	6
MARYLAND		
Baltimore	WAAM	13
Baltimore	WMAR-TV	2
Baltimore	WBAL-TV	11
MASSACHUSETTS		
Boston	WBZ-TV	4
Boston	WNAC-TV	7
MICHIGAN		
Detroit	WJBK-TV	2
Detroit	WWJ-TV	4
Detroit	WXYZ-TV	7
Grand Rapids	WLAV-TV	7
MINNESOTA		
Minneapolis	KSTP-TV	5
Minneapolis	WTCN-TV	4
MISSOURI		
Kansas City	WDAF-TV	4
St. Louis	KSD-TV	5
NEBRASKA		
Omaha	WOW-TV	6
Omaha	KMTV	3
NEW JERSEY		
Newark	WATV	13









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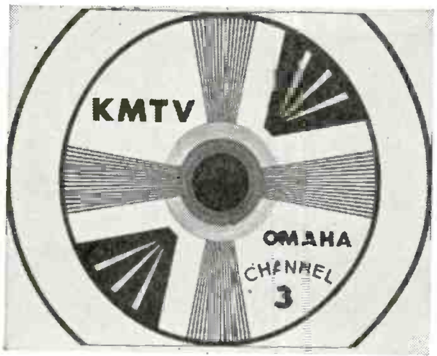
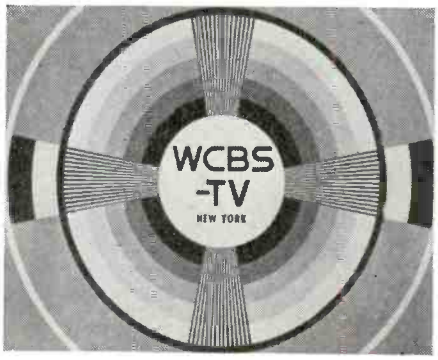
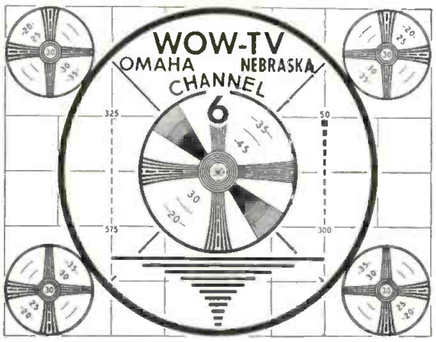
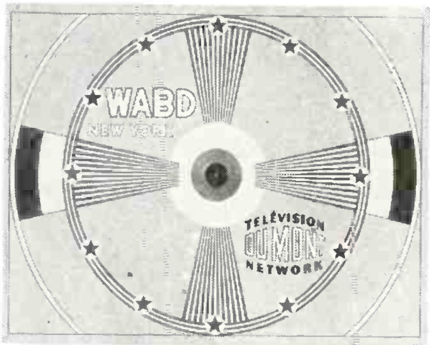
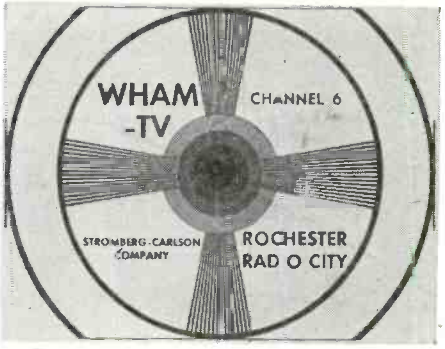
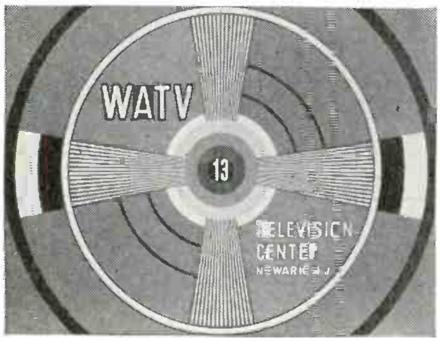


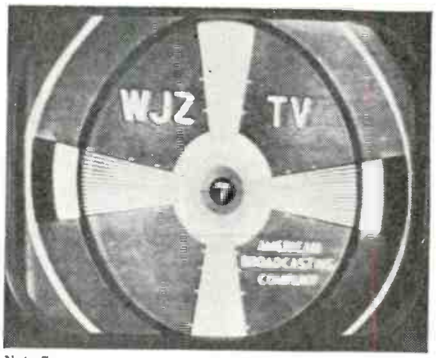




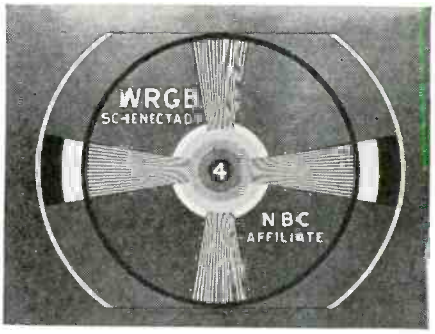






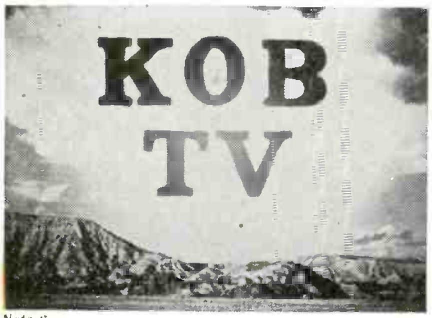


Note 7



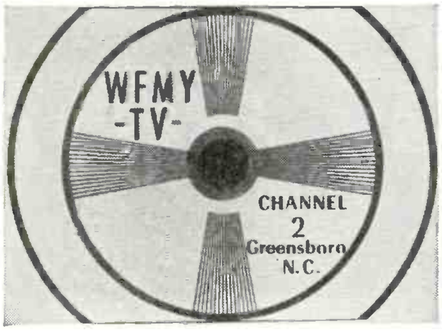
NEW MEXICO		
Albuquerque	KOB-TV	4
NEW YORK		
*Binghamton	WNBF-TV	12
Buffalo	WBEN-TV	4
New York City	WABD	5
New York City	WCBS-TV	2
New York City	WJZ-TV	7
New York City	WNBT	4
New York City	WOR-TV	9
New York City	WPIX	11
Rochester	WHAM-TV	6
Schenectady	WRGB	4
Syracuse	WHEN	8

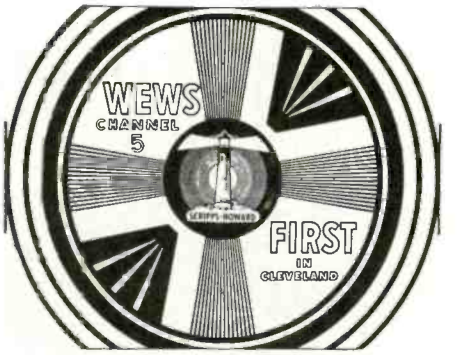
* Stations not yet operating at time list was compiled.

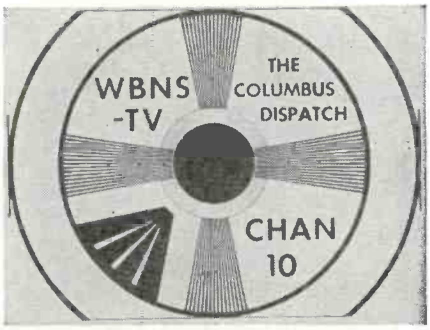


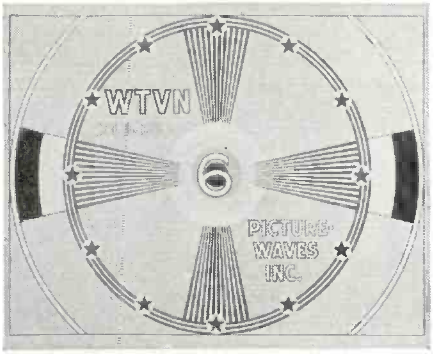
Note 6

Note 8



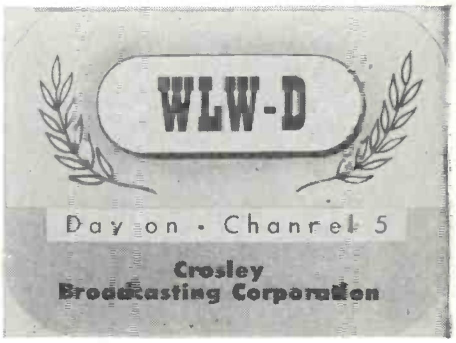


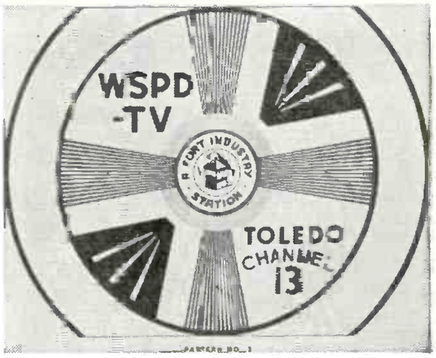


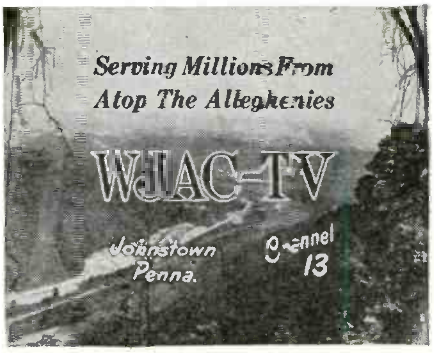


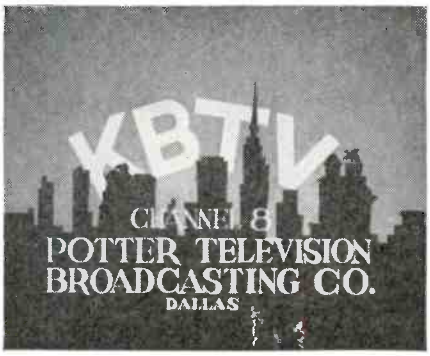
*Utica	WKTV	
NORTH CAROLINA		
Charlotte	WBTV	3
Greensboro	WFMY-TV	2
OHIO		
Cincinnati	WCPO-TV	7
Cincinnati	WKRC-TV	11
Cincinnati	WLW-T	4
Cleveland	WEWS	5
Cleveland	WNBK	4
Cleveland	WXEL	
Columbus	WBNS-TV	10
Columbus	WLW-C	3
Columbus	WTVN	6
Dayton	WHIO-TV	13
Dayton	WLW-D	5
Toledo	WSPD-TV	13

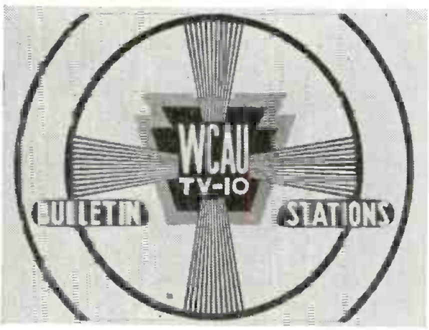
* Stations not yet operating at time list was compiled.



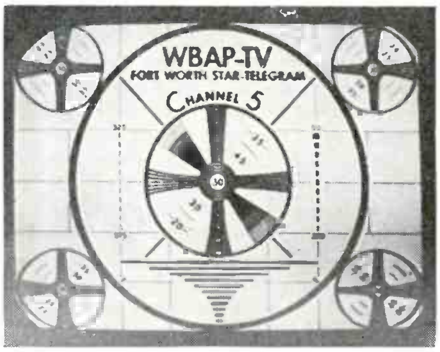








Note 9

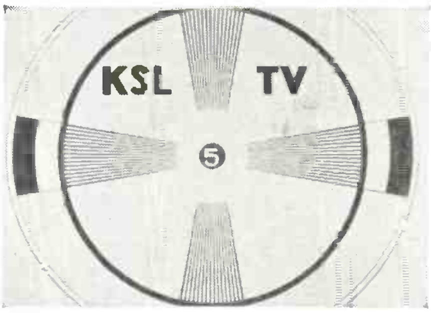


OKLAHOMA		
Oklahoma City	WKY-TV	4
Tulsa	KOTV	6
PENNSYLVANIA		
Erie	WICU	12
Johnstown	WJAC-TV	13
Lancaster	WGAL-TV	4
Philadelphia	WCAU-TV	10
Philadelphia	WFIL-TV	6
Philadelphia	WPTZ	3
Pittsburgh	WDTV	3
RHODE ISLAND		
Providence	WJAR-TV	11
TENNESSEE		
Memphis	WMCT	4
TEXAS		
Dallas	KBTV	8
*Dallas	KRLD-TV	4
Fort Worth	WBAP-TV	5
Houston	KLEE-TV	2
*San Antonio	WOAI-TV	4
UTAH		
Salt Lake City	KDYL-TV	4
Salt Lake City	KSL-TV	5
VIRGINIA		
Richmond	WTVR	6
WASHINGTON		
Seattle	KING-TV	5
WEST VIRGINIA		
Huntington	WSAZ-TV	5
WISCONSIN		
Milwaukee	WTMJ-TV	3

* Stations not yet operating at time list was compiled.

IDENTIFICATION NOTES

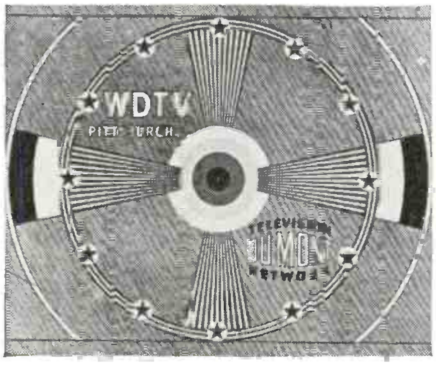
1. Birmingham, Ala.
2. Los Angeles, Calif.
3. Changed to KTSL, Hollywood, Calif.
4. Atlanta, Ga.
5. Chicago, Ill.
6. Albuquerque, N. M.
7. New York, N. Y.
8. Charlotte, N. C.
9. Philadelphia, Pa.
10. Salt Lake City, Utah
11. Richmond, Va.



Note 10

Note 9

Note 11



Television Queries Answered

By DAVE GNESSIN

In the August, 1949, issue of RADIO-ELECTRONICS we ran a feature "Television Queries Answered," by Dave Gnessin, comprising representative queries on general TV subjects. The response from the readers shows sufficient demand for extension of that type of information, so we are presenting a second group of questions and answers.

Remember that these are not regular Question Box inquiries, which are covered in our regular department. The questions in this article are unique on two counts: they deal only with television; and they are of a general nature, of interest to many others than the reader submitting them.

Waves on Co-ax

? *RADIO-ELECTRONICS has published many suggestions for using stubs or tinfoil strips to tune or detune TV antenna leads. They're probably fine for 300-ohm lines. But what about those of us with 72-ohm co-axial lines? In my noisy location I have to use co-ax. How can I tune out standing waves on my line? Or shall I assume that co-ax doesn't have standing waves?—A. D., Miami Beach, Florida.*

A. You're quite correct in your assumption that standing waves may exist to some extent on co-axial cable. Coupling methods would have to be quite perfect for every trace of standing waves to be eliminated. There is a simple aid for that particular type of installation. (See Fig. 1.) At the antenna binding post, connect between the inner conductor and outside braid a small 3–30-μμfd ceramic trimming capacitor. Leave it permanently attached to the antenna terminals if you tune only one station with trouble.

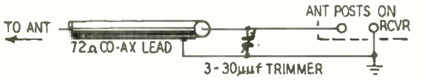


Fig. 1—"Matching stub" for co-ax lead.

Tune in that station properly, then adjust the trimmer for brightest picture. This automatically indicates optimum impedance match with consequent minimum standing waves on line. The trimmer setting won't help the condition on other channels, so reserve it for the worst channel, or make a compromise adjustment.

Open Line or Co-ax

? *There's been so much advice to switch to co-axial lead-in to reduce noise that I tried it on my TV set. It is no better. If anything, the noise is worse. Why?—F. C., Alameda, Cal.*

A. There might be several things wrong. First, the impedance match must be correct. Co-ax is generally of less than 100 ohms impedance, while twin is usually in the order of 300 ohms. You will lose efficiency if you connect a 75-ohm line to a 300-ohm antenna. Likewise you will suffer when connecting a 75-ohm line to a 300-ohm receiver input. Provision must be made for a correct impedance match, both at the antenna and at the receiver.

Theoretically, this could be done at the antenna end by using a quarter-wave matching section (see RADIO-ELECTRONICS, April, 1949, page 50, for full details). Practically, this would be of little value if you are receiving several channels. Instead use an antenna whose impedance is correct for the lead-in (a straight instead of a folded dipole for 75-ohm line, for instance).

At the receiver end most sets have a connection for 300-ohm line, balanced to ground. This means that the antenna coil is tapped and grounded at the center. In that case, simply ground the outer shield of the co-ax, or, better still, disconnect one of the leads from the end of the coil and run it from the antenna post of the set to the grounded center of the coil instead of the end (as in Fig. 2-a). Half a 300-ohm coil will have an impedance of about 75 ohms. If the antenna coil has no ground tap, tap it about the middle and hook up a circuit as in Fig. 2-b. Secondly, the outside conductor of the co-ax must be

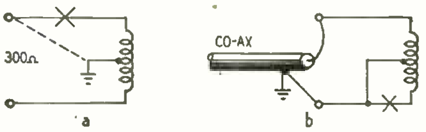


Fig. 2—Attaching co-ax to TV receiver.

positively grounded, at least to the chassis of the set; otherwise the outside braid becomes a regular conductor.

Try to discover whether the noise is being picked up by the lead-in, however. The most perfect co-ax in the world won't help you if the antenna itself is in the noise field. While a small TV set on the roof itself is the only perfect way of finding out, analyze the types of noise you are getting and apply a lot of common sense.

Finally, the inevitable attenuation of the signal due to inherent losses in the co-ax might cause such weak output as to make reception worse than originally available with Twin-Lead. Consequently co-ax should be used mostly in zones of comparatively strong signals. Obviously this method of impedance matching cannot be used on receivers having a balanced, push-pull r.f. amplifier like that used in the RCA 630TS and similar sets.

Optical Distortion

? *My television set is a Philco 48-2500 (projection type). It's rather expensive, and I don't want to have it repaired unless absolutely necessary. My complaint is that there are dull shadows on the lower right and left corners of the screen. These shadows are present even when only a test pattern is sent. None of the front or rear panel controls seem to have an effect. Is there a remedy?—N. T., Los Alamos, N. M.*

A. Checking with the factory I find this classified as optical difficulty rather than electrical. The adjustments on the optical housing will have to be aligned. Be careful to avoid touching the mirror faces. *This is a job for a qualified technician.*

Wrong Aspect Ratio

? *I have a 630TS RCA receiver. The raster covers about one-third of the mask vertically. The aspect ratio is about 6 to 2. The width operates perfectly. What can I do to make the height and linearity control make the raster cover the mask vertically?—M. G. F., Leesville, Louisiana.*

A. It's quite obvious your trouble is in the vertical circuit, somewhere between 6J5 vertical oscillator discharge stage, through vertical output 6K6-GT to vertical deflection yoke. This includes only the two tubes mentioned, two transformers, one yoke, and miscellaneous capacitors and resistors (Fig. 5). Try the following:

Check the height and linearity controls (disconnected). They should be 2.5 megohms and 5,000 ohms, respectively, with smooth resistance transition throughout. Then check the two tubes.

This next step is most important, *since I'll give you two to one that this is your trouble:* Check the vertical output transformer (entirely disconnected) for leakage between windings, and to case. In each case the resistance should be infinite. If no cure has been found thus far, then each resistor and capacitor in the circuit described should be checked against the diagram for value and leakage. Finally (Heaven help you) the yoke should be checked. This is normal correct servicing procedure.

(Readers are invited to submit questions on TV addressed to Television Forum, RADIO-ELECTRONICS, 25 West Broadway, New York 7, N. Y. Those of general interest will be answered in future forum articles as space permits and interest demands.)

Choosing a TV Receiver

What to seek for and what to avoid in a televiser

By SOL D. PRENSKY*

THE ordinary citizen who decides that the time has come to buy a television receiver finds plenty of types from which to choose—his big problem is trying to make up his mind as to just which model of which brand is ideal for him. The usual set buyer is not willing to plunge into the technical mysteries of TV; he has neither the time nor the background, to say nothing of the inclination. To make matters even more confusing, he is beset by a clatter of exaggerated advertising blurbs shouting about this "miraculous" feature or that "magical wonder" of a particular receiver. And he is often led in wrong—and conflicting—directions by outright misstatements made by ignorant or dishonest salesmen.

There is only one really good way to decide which receiver you want, and that is to observe and try out a number of them, preferably right in your own locality. But to make a really sound decision one must know what to look for; and that is what we shall point out in this article. In addition, we'll try to clear up a few of the misconceptions that have been repeated so often they are beginning to sound plausible.

Picture size, picture quality, accuracy of tuning, reserve sensitivity, your chances for good installation and service—all these are important points to keep in mind when looking around for a good television receiver.

Picture size

One of the major selling points of receivers, and rightly so, is the size of the picture, because large pictures can be more comfortably viewed than small ones. There has been much confusion, however, over this apparently simple point because manufacturers have tended lately to measure picture size in square inches and to give different square-inch figures for sets with the same size viewing tube.

Even when the simpler figure of tube diameter is used for size, there are still as many as nine different sizes of picture tubes in commercial use at present, having diameters of 7, 8, 10, 12, 12½, 15, 16, 19, and 20 inches.

To arrive at a sensible basis for comparing picture size, another point should be kept in mind: the face of the viewing tube is circular, while the transmitted TV picture is rectangular—like a standard motion picture. This means that, if a square-corner rectangular mask is used, as Fig. 1-a shows, a good deal of the tube-face area is wasted. Note, however, that the entire transmitted picture is seen.

A larger picture may be shown on the same tube if the electronic circuits are adjusted to enlarge the image. Note in Fig. 1-b that the tube size is the same as in Fig. 1-a, but that there is less wasted space. The picture has been blown up, and the mask in front of the tube has rounded corners. The picture may be blown up more if desired (and if the receiver circuits permit it), until the entire tube face is covered with picture, leaving no wasted area. The picture in Fig. 1-c appears circular.

But, whenever the picture is blown up to fill more of the screen area than is the case in Fig. 1-a, *parts of the picture are lost.* Many receivers are made with round-corner masks like that in Fig. 1-b, and, therefore, only unimportant corners are lost. Circular-screen receivers give a bigger picture with any size of tube, but Fig. 1-c shows you how much of the picture you *can't see.*

This explains why two receivers may have, say, a 10-inch tube, but one may have a "52-square-inch" picture and the other a "60-square-inch" screen. Sixty sounds like a bigger figure—but you pay the price of missing some of the televised action. You are getting no bargain when you buy a "wide-screen" receiver or one with a "big circular screen."

When comparing picture sizes, it is helpful to think of the various tube diameters as falling into five main groups, the 7-inch group (the smallest practical and including 7 and 8-inch tubes); the 10-inch group; the 12-inch group (including 12 and 12½-inch tubes); the 15-inch group (including 15-inch and 16-inch tubes); and the largest direct-view, the 19-inch group (including 19 and 20-inch tubes).

Whether you would rather have a large picture and miss some of the scene, or a smaller picture but see it all, is, of course, up to you. Obviously, if cost doesn't matter much, simply choose a set with the largest size pic-

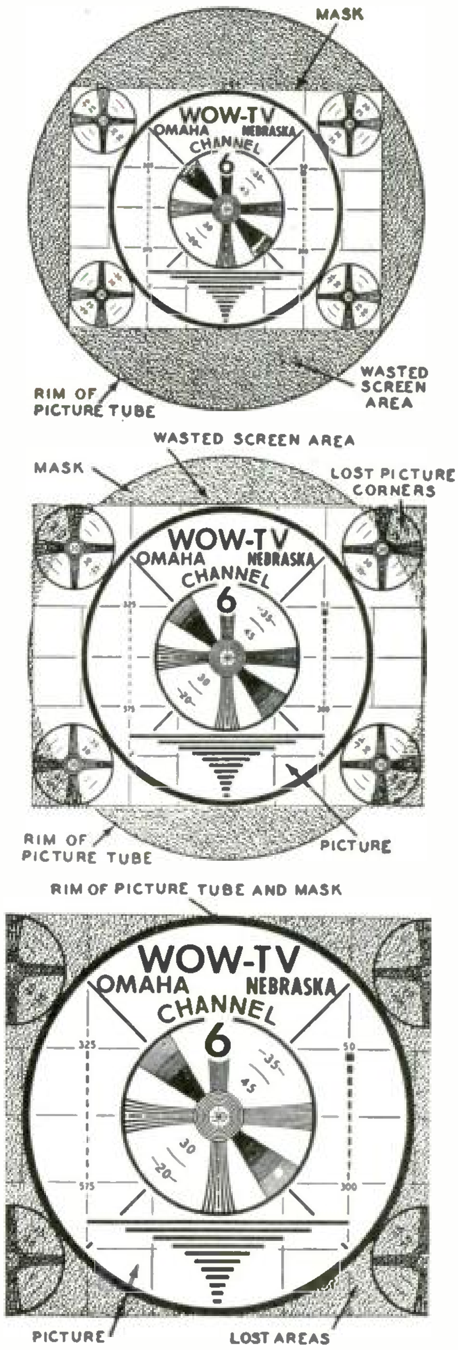


Fig. 1—Rectangular mask (a) shows entire pictures; rounded corners increase image size (b). Circular mask (c) gives large image but blanks much of border.

* Co-author, with Ricardo Muniz, of forthcoming book "Electronic Test Equipment for AM, FM and TV Circuits" (Van Nostrand).

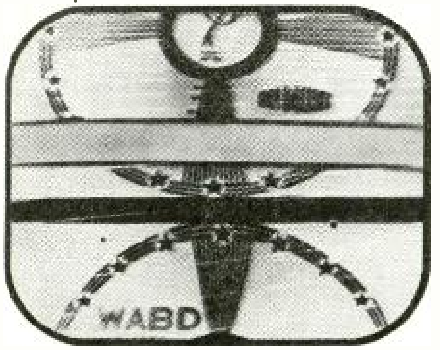


Fig. 2—Improper setting of vertical hold control or poor vertical stability.

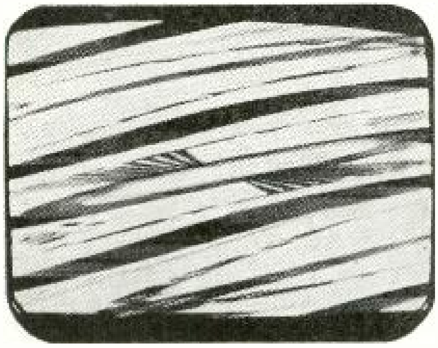


Fig. 3—Poor horizontal stability causes picture to shift to right or left.

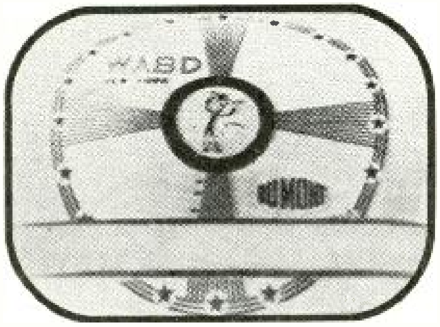


Fig. 4—Poor linearity causes distortion of circle and unequal wedge length.

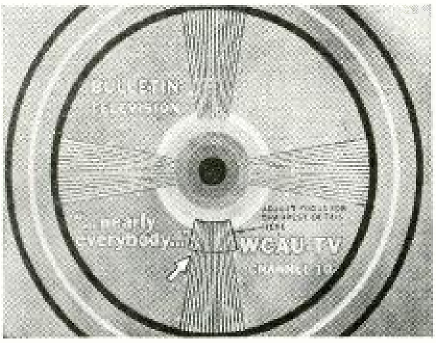


Fig. 5—Check receiver resolution by length of individual lines in wedge.

ture and see both a large picture and all of it. In any case, however, keep your eye on the actual tube diameter as the price-determining factor in picture size.

Picture quality

Three factors are foremost in judging how pleasing the picture is. First of all, the image should stand still—it should not "jitter" or move from side to side or up and down. Second, it should not be distorted—a straight line should look straight and a circle should look circular rather than oval. And third, you should be able to see almost as much detail as in a 16-mm movie.

Steadiness will come only when the controls are adjusted correctly. If the VERTICAL HOLD and HORIZONTAL HOLD controls are on the front panel, adjust them until the picture does not move after first adjusting the FINE TUNING control, if any, for the loudest and clearest sound. Let the set operate for a while; then switch to another channel. Immediately switch back to the original channel and readjust the FINE TUNING control if necessary. The picture should be steady again—if it moved when you switched, retuning should have made it jump back into its proper position and stay there. On a good receiver, the HOLD controls should not have to be adjusted oftener than once per sitting—sometimes not more than once every week or so, if that often.

Fig. 2 shows a test pattern on a set with an incorrectly adjusted VERTICAL HOLD. The image moves upward or downward or may stand still in the position shown. Fig. 3 shows a receiver that needs HORIZONTAL HOLD adjustment. If these controls are set and the picture doesn't stay put for long periods of time, the receiver probably isn't acceptable.

Picture distortion is best judged when a test pattern is on.. Fig. 4 shows one that is badly distorted. The circle looks like an egg and the vertical wedges, which should have the same height, are quite different. All receivers have rear-chassis adjustments that should be able to clear up distortion, but don't buy a set until you see it or an identical one properly adjusted so there is no distortion. Don't mind too much, however, if some of the station test patterns have circles that are slightly egg-shaped. If the receiver is adjusted for a perfect circle on one station, others may not look perfect because of slight differences in station equipment. An out-of-true circle is the easiest thing to detect; where the circle is only slightly out-of-round, chances are the deviation will not noticeably affect the quality of an ordinary program.

To check detail clarity (also called *resolution*), tune in a station and adjust the FOCUS control (if on the front panel) for best sharpness near the center of the screen. If there is a test pattern on, look at the black and white lines that make up the vertical wedges. You should be able to see the lines distinctly as they come closer together, down to within a small fraction of an inch of the end of each wedge. The critical area is outlined in Fig. 5. Notice also the corresponding areas on the horizontal wedges.

If you are watching a program, notice small familiar objects and the eyes of the characters to get an idea of the picture's clarity. Compare the clarity of details on various sets and don't be satisfied with anything but the best.

Many people say that one set is more "powerful" than another — meaning that it pulls in weak stations better. The correct term for this "pulling power" is ***sensitivity.*** Sets do vary in sensitivity, and you must select one that will fit your needs.

The signals broadcast from a television transmitter may arrive at your location either strong or weak. Just as the light from a lamp gets weaker as you go farther away from it; so does the signal from the station, so you may therefore need a sensitive receiver. Like light, the waves can be blocked by intervening buildings and hills. If you are behind such a barrier, you will consequently get a weak signal. If, on the other hand, your receiving antenna is close to the transmitter (within, say, 5 miles or so) and there are no obstructions between it and the transmitting antenna, you won't have to worry much about sensitivity.

The antenna or aerial is very important. A sensitive set with a poor antenna will usually not pick up weak signals as well as an average receiver with a good antenna. *Indoor antennas in general are poor antennas.* They may suffice in very good locations, but they are never as effective as even a simple outdoor antenna. Don't let anyone sell you a receiver if you can't put up an outdoor antenna—unless you know there are other sets in your location that work well with indoor aerials. In any case, try to choose a sensitive receiver for use with an indoor antenna.

It's very hard to judge receiver sensitivity because results depend so much on your location and the kind of antenna used. If, however, your neighbor gets good reception—a clear picture without little dancing white spots ("snow") all over it—probably the same kind of receiver and antenna will give you good results too.

Installation and service

Some television receivers nowadays are said to need no installation—you just plug them in and turn them on. In a very good location it may be possible to do just that, but don't count on it. Such sets have built-in antennas. A built-in antenna may not work as well as the indoor type because it can't be positioned for best results without moving the receiver itself. Don't forget that in any but excellent locations, you may need an outdoor antenna with any set. If your landlord will not permit an antenna on the roof, you must, of course, be satisfied with one of the indoor models. But if you can have an outdoor aerial, by all means use one!

When you buy a set, you are usually offered a contract for installation and a year's service. On the whole, these contracts are a good idea and may save a lot of money if you have frequent trouble. More and more independent service technicians are qualifying themselves for TV work, and you may well elect to "pay when served"—have an independent shop make your installation and do your repairs, paying each time for the work done. However, it is probably more economical to buy a service contract with your set, for you will probably pay less over the first year than if you depended on independent technicians.

Not all service contractors do perfect installation jobs. Most contracts allow you to call for service whenever something is wrong, but ordinarily *no more than one antenna installation is allowed* without extra charges. For that reason, be on hand when the installation men come; when they are finished, request them to demonstrate the set. Make sure you are satisfied with the reception and *don't take any excuses if the picture is poor on any channel.* If the installers will not remedy poor reception, refuse to sign any set receipt or work certificate. Call or write the contractor *immediately.* If you are told a certain station simply cannot be received well in your locality, check at once with several set-owning neighbors; if any of them can receive it, the statement is false. Insist on your right to a good installation job!

'Tain't so!

There are some points on which so many people are misinformed that fiction seems more plausible than truth. Here are some typical ones.

Can large-screen sets give the same picture detail as small-screen receivers? Yes. If the receiver's circuits are correctly designed, a big screen will produce just as fine a picture as a small one. You must sit farther away from it, however, to make the picture elements blend together and give you the effect of a continuous whole.

Do all TV receivers tune in FM broadcasts? No. Television sound is itself of an FM character, but so-called FM stations can be heard only if the TV receiver has additional elements for the purpose. Most do not. If you want to receive FM broadcasts, buy a set with an "FM band" on it.

Has there been any revolutionary new development in TV recently that should be part of any receiver I buy? No. Certain features like metal picture tubes, circular screens, built-in antennas, "daylight" screens, and so on, have certain advantages, either in cost reduction or in performance. None of them are "revolutionary." You can judge whether they add to performance, by comparing with sets that don't have them.

Will u.h.f. television obsolete my set? No. If u.h.f. bands are used in your locality, you will be able to get a converter; and if v.h.f. (Channels 2-13) is used in your area, it will remain in use.

Will color TV obsolete my set? No. Despite the present furor over color, experts predict it will take several years to establish it commercially.

Will an indoor antenna give me as good reception as a full-priced outdoor installation? Positively no, despite advertising claims to the contrary, unless you live very close to the transmitter and the receiver is placed in a particularly fortunate position in the room—and even then it may not give satisfactory results.

Electronic Magnification for Existing Receivers

By WILBUR J. HANTZ

A NUMBER of technicians have asked if they can add "electronic magnification" to existing sets. Many recent commercial television receivers have made it an important feature in their advertising, and attachments have been marketed which are intended to "zoom" the picture up to more than double size.

In electronic magnification, the horizontal and vertical amplification is increased so that the transmitted image is larger than the tube. The whole screen is then covered with a circular picture. Corners are lost; but the part that does appear is much larger than before, and none of the screen area is wasted. A switch permits the viewer to select either the standard picture or the electronic "closeup."

Most standard receivers can be modified to include electronic magnification. Fig. 1 shows a typical horizontal sweep circuit (the one in the General Electric model 803). The deflection amplifier is a single 6BG6-G; it is coupled through a matching transformer to the deflection coils of the 10-inch cathode-ray tube. The 6AS7-G damps out the small oscillations caused by the return trace's shock-exciting the coils. The linearity control in the 6AS7-G grid circuit varies the shape of the sweep-voltage wave.

The width of the picture is adjusted by the variable-iron-core inductor L, which is normally set for less than the maximum possible horizontal sweep voltage so that the picture stays within the mask. If we place a s.p.s.t. switch across the inductor to short it out, maximum voltage will reach the deflection coils and the picture width will increase to fill the entire screen horizontally. (Some receivers may not have enough horizontal sweep output for this. A refinement on those that do would be to switch in a second width-control inductor, which could be adjusted to optimum for the expanded picture.—*Editor*)

Fig. 2 shows a typical vertical sweep. The 6SN7-GT is a multivibrator, the output of which (and therefore the sweep voltage) is varied by the height-control potentiometer, which varies the applied B-voltage. The voltage applied to the screen of the 6V6 vertical amplifier is varied as well.

If resistor R is shunted across the height-control potentiometer, the net resistance decreases; more B-voltage is applied to the circuit and the vertical sweep increases, covering the entire height of the tube. (Again, if the maximum output of the particular receiver is sufficient.—*Editor*) The 51,000-ohm value worked with the G-E receiver, but experiment will determine the correct value for others. Making R variable will give an auxiliary height control for use with the expanded picture.

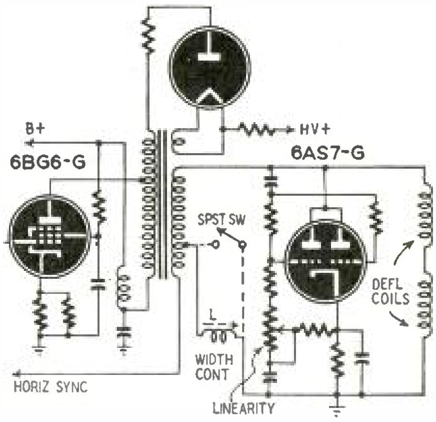


Fig. 1—Modification of the horizontal sweep circuits of General Electric 803.

The two switches should, of course, be combined into a single d.p.s.t., or—as in some receivers—a relay can be used, with its energizing current controlled by a switch at the end of a piece of lamp cord, permitting control of the picture from the viewer's chair.

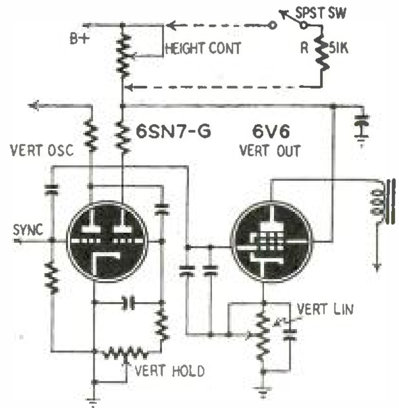


Fig. 2—Shunting a resistor across the height control to increase the height.

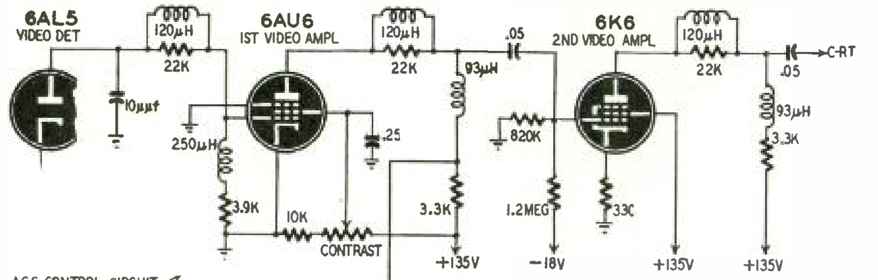
The same system can be used with electrostatic-deflection receivers if there is enough drive.

For best results, the rectangular mask should be removed from the receiver.

Interesting Television Circuits

The newer television receivers feature a number of circuits not present a year ago

A NUMBER of improvements and modifications have appeared in TV receivers during the past year. One of these is a new type of automatic gain (contrast) control. This circuit is commonly called "keyed a.g.c.," although some prefer to call the system *pulsed* or *gated* a.g.c. The circuit shown in Fig. 1 is that of a keyed a.g.c. adapter kit made by Tech-Master for installation in 630-type TV receivers. Similar circuits are used in the Radio Craftsmen model RC 100, Admiral 20A1, 20B1, and 21A1; and in other makes and models. The Tech-Master adapter components are enclosed in broken lines; the other components are in the 630 chassis.



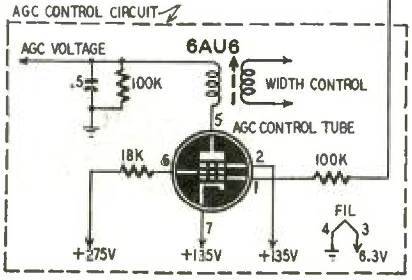


Fig. 1—Circuit of Tech-Master's a.g.c. adapter kit for 630-type TV chassis.

The a.g.c. control tube develops a negative control voltage whose value is determined by the amplitude of the transmitted sync pulse level. The grid of this tube is fed with positive sync pulses from the plate circuit of the first video amplifier.

A second winding on a special width control is the source of 300-volt, 15,-750-cycle pulses which are applied to the plate of the a.g.c. control tube. This tube remains cut off except during the positive half-cycles. Therefore noise cannot disturb the circuit except during this conductive period or approximately 5% of the total time. When the tube is conducting, the current through it and voltage drop across the 100,000-ohm 6AU6 plate load resistor are determined by the amplitude of the sync pulses. The negative voltage developed across the resistor is filtered by the 0.5-μf capacitor and fed to the grids of the a.g.c. controlled tubes. Direct coupling is used between the video detector and video amplifier, and between the video amplifier and the a.g.c. tube so that the sync pulses will have a d.c. component.

The contrast control is removed from the r.f.-i.f. bias circuit and is placed in the voltage divider circuit to vary screen-grid voltage to the 6AU6 video amplifier.

This system of automatic gain control makes possible a fast a.g.c. filter network immune to noise and fast fading or flutter due to reflections from aircraft. It is claimed that flutter up to 120 c.p.s.—equivalent to aircraft speed of 600 m.p.h.—is eliminated.

Interstation squelch control, automatic picture-size stabilization, and interlace stabilization are new features of the Motorola 12VK15 and 16VK7 TV receivers using the TS-16 and TS-30 chassis.

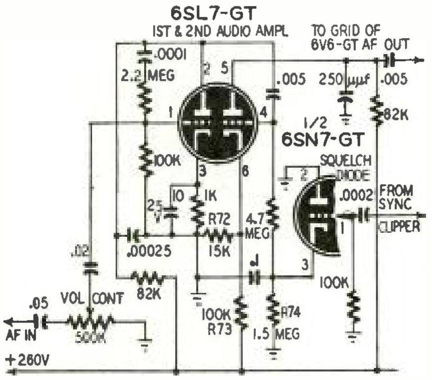


Fig. 2—Motorola's interstation squelch.

The interstation squelch control circuit is shown in Fig. 2. When a signal is tuned in, sync signals are fed to the squelch diode where an average of 12 volts is developed across the 1.5-megohm cathode resistor R-74. The second a.f. amplifier is normally biased to cutoff because its cathode returns to a sufficiently positive point on voltage divider R-72-R-73. R-74 being in series with the amplifier's grid return, any voltage developed across it will unblock the amplifier and permit it to amplify the a.f. signal and feed it to the grid of the 6V6-GT power amplifier. When no signal is being received, the voltage across R-74 is zero, the amplifier is cut off, and the set is silent. The values of R-72 and R-73 are chosen so the amplifier cuts off shortly after the signal becomes unusable.

A voltage regulator

The picture stabilization circuit (Fig. 3) is actually an electronic voltage regulator at the output of the high-voltage power supply. The high-voltage output being constant for loads between zero and 200 microamperes, the voltage does not rise when the picture changes from light to dark. This also prevents the voltage from rising and causing arc-over, corona discharges, or filter failure when the C-R tube is out of its socket.

The usual combination high-voltage power and horizontal output transformer is not used. Instead, high-impedance deflection coils are direct-coupled to the plates of the parallel 6Y6-G horizontal output tubes.

The horizontal damper tube, a 35Z5-GT, has its heater voltage fed through a three-winding isolation transformer. The third winding is connected to the grid of a 6BG6-G pulse amplifier which drives a flyback-type, high-voltage transformer.

Triode V-10B, the high-voltage regulator tube, has its grid connected across a 68,000-ohm resistor R-133 in the negative leg of the high-voltage supply. The plate of this tube gets its voltage from the 6BG6-G screen supply. When the C-R tube draws more current, its second anode voltage usually drops. In this circuit, the increased C-R tube current makes greater the drop across R-133 so that the grid of the regulator tube goes more negative and its plate draws less current. This raises the screen voltage of the 6BG6-G and causes the tube to develop a higher voltage across the primary of the high-voltage transformer.

The interlace stabilizer (Fig. 4) is designed around a high-level vertical blocking oscillator. The feedback winding on the transformer is so tuned by a .005-μf capacitor that the retrace time is equal for successive cycles. High output voltage was obtained by selecting such values for C-106 and R-90 that their combination would result in a short time constant. The short-time integrating network R-86,

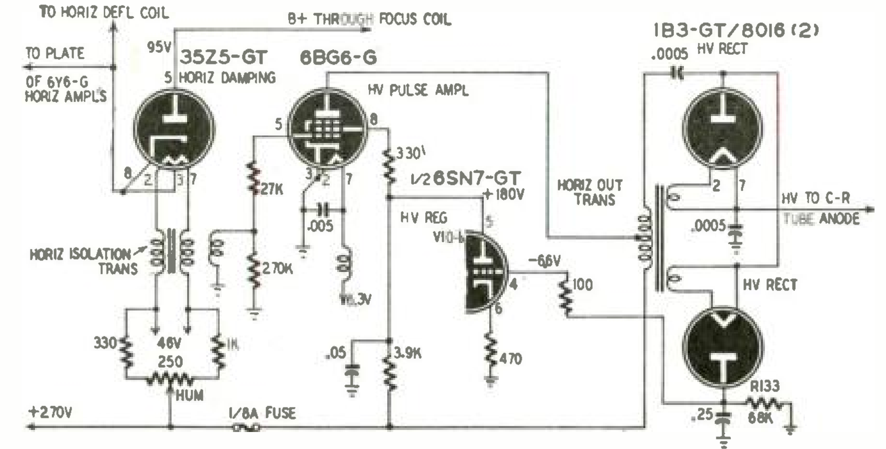


Fig. 3—Voltage regulation of the high-tension power supply stabilizes picture.

C-103, C-102, R-85, and C-104 is an additional aid to perfect vertical timing.

The 110-volt distorted output of the blocking oscillator is linearized and reduced to a 30-volt sawtooth by R-91, R-92, and C-107 between the blocking oscillator and vertical output stages. An unbypassed cathode resistor in the output circuit further improves the shape of the sawtooth. This circuit so stabilizes the vertical deflection circuit that the hold and size controls have been placed on the back of the set.

Most television receivers have two or more low-voltage supplies to deliver voltages to the deflection, audio, r.f., and i.f. circuits. Philco has eliminated the usual 150-volt supply in their 50-1104, 50-1105, 50-1106, and other models by connecting the mixer, video i.f., and audio i.f. stages in series with the audio output stage across the 380-volt, low-voltage supply. The circuit is shown in Fig. 5. The circuit is stabilized by bleeder current through the paralleled 10,000-ohm resistors.

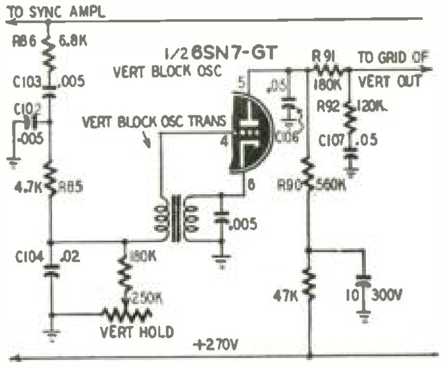


Fig. 4—An interlace stabilizer circuit.

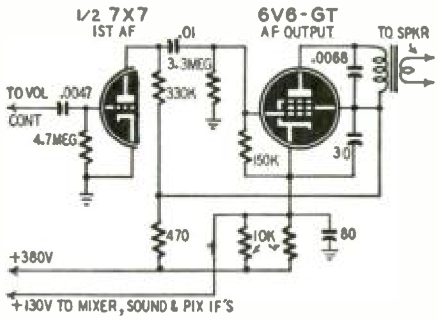
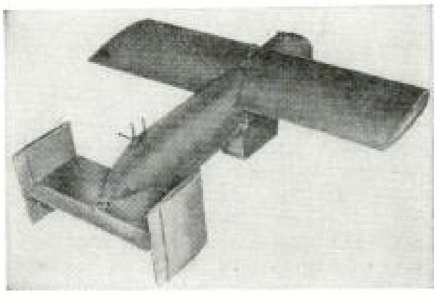


Fig. 5—Circuit eliminates one supply.

TV-GUIDED WAR MISSILE ▶



A TELEVISION device very nearly resembling the human eye was built into a German guided missile, the *Technical Data Digest* (U. S. Air Forces magazine) reported in its issue of May 15, 1949. This television device had an eye that could move, a retina (iconoscope) on which the image was impressed, a system which selected wanted signals and used them, while rejecting unwanted ones, in a manner similar to the human brain, and electric nerves to the steering engine, which played the part of muscles.

Heart of the equipment is an iconoscope, which is scanned in a spiral. The spiral starts at the outside, and when it has reached the "dead area" near the center snaps back to the outside again, being blanked out during the retrace. (Fig. 1) The object at which the missile is aimed is centered in the "dead spot." While it remains there, the missile moves directly toward it. If part of it projects into the sensitive area, it creates a pulse which turns the missile slightly toward that quadrant, thus tending to bring the object back toward the center of the screen. The sensitive area is a narrow ring, which increases in size automatically as the missile gets nearer the target and therefore sees a bigger image of it. This ring-shaped sensitive area is a valuable aid in keeping the missile sighted on its proper objective, rather than other images.

In smaller missiles, the whole missile is moved to keep the image in the center of the screen. In larger ones, it was

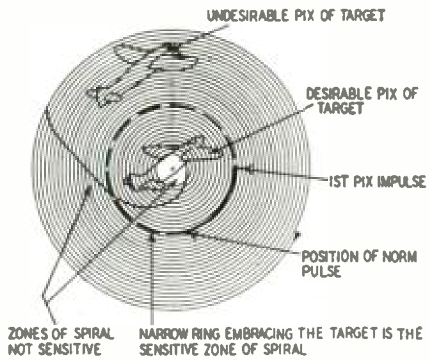


Fig. 1—Iconoscope is scanned spirally.

found better to use a movable mirror (see Fig. 2) on account of its small inertia. Then the mirror follows the target immediately, and the missile is brought around with a slight time lag, much like the action of the eye and body of a baseball player following a fly.

The motors permit steering in four quadrants: up, down, left, and right. If the target moves diagonally, it will first appear in one of the quadrants, then in the adjoining one, and the missile will first move (for example) to the right and up, to bring it back to center.

To sight the projectile, the pilot centers the image of the target on the screen or in the mirror and switches on the automatic steering device. The missile's own computers take over from there and make all the necessary adjustments to keep it moving directly toward the target while the range is decreasing and possibly other disturbing objects are moving across its field of vision.

The photograph shows the smaller of two models which were completed just before the end of the war, but never put into action. About 3 feet long and 7 inches in diameter, it weighed approximately 12 pounds. Expected range was 2-4 miles, depending on the target size. The bombs were chiefly intended for aircraft use, to be launched from a position under the wings of the carrying craft after the pilot had sighted them on the taget and set the automatic steering device.

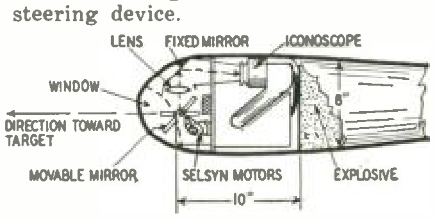


Fig. 2—Arrangement of components.

TV TROUBLE SHOOTING

A practical television man reveals causes and remedies for some of the set ills that may puzzle repairmen

By MURRAY BARLOWE*

TELEVISION manufacturers' service notes usually contain excellent suggestions for trouble-shooting TV receivers. Checking the service notes of a few of the leading manufacturers reveals that most of the troubles listed are due to misadjustment of controls. These cases are obvious to the technician after he has worked on four or five modern receivers, but often there is need for help on troubles whose cures are not so obvious.

Here are the results of many hours of "blood, sweat, and tears" trying to unravel some of the mysterious symptoms which turn up during a day's work in maintaining this new menace to the sanity of the electronic technician.

Black vertical line

Case 1: Service tag reads, "Ragged, black vertical line about an inch from left-hand side of picture on channels 7, 11, and 13. Looks like running water." The condition is illustrated in Fig. 1.

The trouble is caused by high-frequency oscillations in the horizontal deflection amplifier tube (usually a 6BG6) and can occasionally be cured by replacing the tube. The tube amplifies the 15-kc sawtooth voltage which provides the horizontal sweep.

During part of the sweep cycle, the grid approaches zero volts with respect to the cathode. Maximum current flows in the plate circuit, and the plate voltage drops very low. Electrons leaving the cathode are attracted toward the screen, which has a comparatively high positive voltage. Most of the electrons pass through it on their way to the plate, only to be slowed down by the low plate voltage, and attracted back to the screen. Again they pass through the screen, this time headed toward the cathode. There being no attraction for them at the cathode, they are again attracted toward the screen. This motion of the electrons oscillating back and forth within the tube at a very rapid rate is a burst of high-frequency energy. The oscillations, ranging in frequency from approximately 200 to 800 mc, are picked up by the r.f. section of the receiver, detected, amplified, and finally applied to the picture tube. The bursts are caused by the horizontal sweep, which accounts for the black spot's being in the same position on each horizontal line.

If replacing the tube doesn't cure the trouble, tape a small Alnico magnet to the side of the tube, as in Fig. 2-a, determining the best position experimentally. The magnet deflects the oscillating stream of electrons and prevents their following a repetitious path, thereby suppressing the high-frequency oscillations. If the high-voltage compartment has a cover, the magnet can be fastened to the inside of the cover close to the tube, as in Fig. 2-b.

Picture blooms and fades

Case 2: Service tag reads, "Picture intermittently blooms [loses brilliance and increases in size simultaneously]."

This symptom immediately points to trouble in the high-voltage supply. The loss of picture brilliance indicates a decrease in the second-anode voltage, and the increase in picture size confirms it. The increase in size is due to the fact that a low-velocity stream of electrons is more easily deflected than a high-velocity stream; the velocity of the electron stream in the c.r. tube is proportional to the second-anode voltage.

Some of the possible causes of trouble in the high-voltage supply are:

1. Intermittent breakdown of high-voltage button-type or ceramic filter capacitors;
2. Intermittent 1-megohm filter resistor;
3. Bad 8016 (high-voltage rectifier tube);
4. Arcing anywhere along the high-voltage lead from the supply to the second anode;
5. Internal short in the picture tube.

A situation closely allied to the complaint just described occurs when the picture blooms when the brightness control is turned up. Again there is a loss of high voltage, this time only when the brightness control is turned up. Brightness is controlled by varying the bias on the picture-tube grid. Less negative grid voltage results in an increased flow of electrons and consequently more brightness. Loss of high voltage with an increase in electron-beam current indicates poor regulation in the high-voltage supply. This may be caused by a high-voltage filter re-

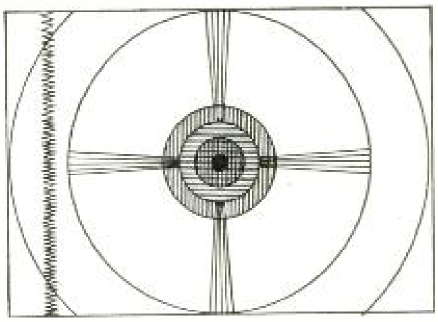


Fig. 1—Vertical black line in pattern.

*Instructor, Radio Electronics School, New York sistor that has increased in resistance, a bad high-voltage rectifier tube, or, in the case of an r.f.-type supply, an incorrect setting of the trimmer capacitor in the oscillator circuit or a bad oscillator tube.

Narrow picture

Case 3: Service tag reads, "Insufficient width." That complaint is one of the most common, especially now with the popularity of the "expanded" picture. There are five or six routine checks suggested by the service manuals, which in many cases solve the problem. But there are always those few stubborn cases which seem to defy all of the logical solutions and turn out to be the most time-consuming jobs in the shop. After replacing tubes and checking voltages in the horizontal deflection circuits has failed to show up the defect, the following remedies will yield that extra quarter inch or so of picture to fill the mask:

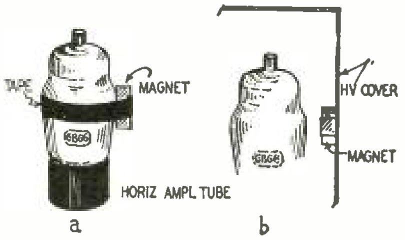


Fig. 2—The magnet damps oscillations.

1. Clip the leads which run from the width-control coil to the horizontal output transformer (A in Fig. 3). This allows maximum sweep. (The action of the width control when it is in the circuit is to *reduce* the sweep width below maximum.)

2. Increase the value of the damping resistor (this is R209 in the RCA 630-TS) in the output of the horizontal amplifier (B in Fig. 3).

3. Add a 10,000-ohm resistor in series with the arm of the horizontal drive control, at point C in Fig. 3.

4. Decrease the size of the 680,000-ohm resistor in the plate circuit of the horizontal discharge tube.

5. Increase the plate voltage to the discharge tube by obtaining it from the "boosted" B-plus available at the linearity control (connection D in Fig. 3) instead of from the 275-volt supply.

6. Increase or decrease the value of the 6BG6-G screen resistor. Increasing the screen voltage occasionally results in a decrease in width due to an increase in secondary emission. Also, the voltage on the screen of the 6BG6-G may be increased by obtaining it, too, from the "boosted" B-plus *via* connection E in Fig. 3.

7. Connect a mica or paper capacitor across those terminals of the horizontal output transformer to which the width control was originally connected (A in Fig. 3). Try various values from .001 μf to about 0.1 μf. The capacitor should be rated at least 600 working volts. It tends to decrease the amount of high voltage produced by the kickback type of power supply. The larger the capacitance, the lower is the output volttage. A decrease in the picture tube's second-anode voltage reduces the speed of the electron stream; a lower-velocity beam can be more easily deflected, resulting in greater sweep width. The disadvantage of this method is that the brilliance is affected. However, the decrease in brilliance is very small for a slight increase in width and is usually justified.

Many of these modifications may result in a change in linearity as well as width. That usually calls for readjusting the linearity controls and possibly changing the values of some resistors. Variable resistors can be used and the effect of different values noted before the final fixed value is decided on.

Herringbone pattern

Case 4: Service tag reads, "Fine herringbone pattern all over picture on all channels." This usually is the result of an interfering signal which has managed to get through the i.f. stages. Often it is the result of image interference produced by an FM broadcast station when the set is tuned to one of the low-frequency television channels.

For example, when a typical set is tuned to channel 2 (54 to 60 mc), the picture carrier is 55.25 mc and the picture i.f. is 25.75 mc. The oscillator operates above the r.f. by an amount equal to the i.f. (55.25 plus 25.75), which is 81 mc. The image frequency is twice the i.f. plus the r.f. (51.5 plus 55.25), or 106.75 mc. An FM station operating at 106.75 mc beats against the local oscillator (81 mc) and produces a difference frequency (106.75—81) of 25.75 mc. This comes right through the i.f. stages and shows up as interference in the picture. It can be eliminated by resonant wavetraps at the antenna input, tuned to the interfering FM frequency.

Image interference is usually present on only one channel. If the pattern is visible on all channels, it probably is due, not to image interference, but rather to a different kind of "beat" interference. Its cause and cure may not be obvious, but such interference can be eliminated.

The sound carrier is always 4.5 mc above the picture carrier. In the receiver, these two carriers beat against a local oscillator and produce sound and picture intermediate frequencies which are still 4.5 mc apart. Both signals may travel through a common i.f. stage and then be separated into their respective i.f. channels. After separation, trap circuits in the picture i.f. stages get rid of any sound signal which may remain, and prevent it from reaching the video detector.

Since all detectors are nonlinear, they mix as well as rectify. If any energy at the sound i.f. frequency gets through to the video detector, it and the sound i.f. heterodyne and a constant 4.5 mc beat signal are present at the output. This 4.5-mc signal is usually within the passband of the video amplifier and therefore is applied to the grid of the picture tube, along with the picture signals.

There are two methods of correcting the condition. The first is to properly align the sound traps.

If they are aligned and the pattern is still present and strong enough to be annoying, the second method usually serves.

Since the interfering signal is at a fixed frequency (4.5 mc) after the video detector, the logical step is to install a 4.5-mc resonant trap somewhere in the video amplifier. The best place is in the plate circuit of the first video amplifier tube. Use a discarded width control coil as a form.

Remove all the wire from the width control. Close-wind 40 turns of No. 32 enameled wire in a single layer. Connect a 50-μμf ceramic capacitor across the winding. Mount the coil close to the plate lead of the first video amplifier and wire it in series with the plate.

To adjust the trap, connect a modulated, 4.5-mc AM signal generator to the grid of the first video amplifier. Set the generator output to maximum, producing horizontal black and white bars on the face of the picture tube. Adjust the trap for minimum intensity of the bars. An alternate method is to tune in a signal and adjust the trap for minimum interference pattern.

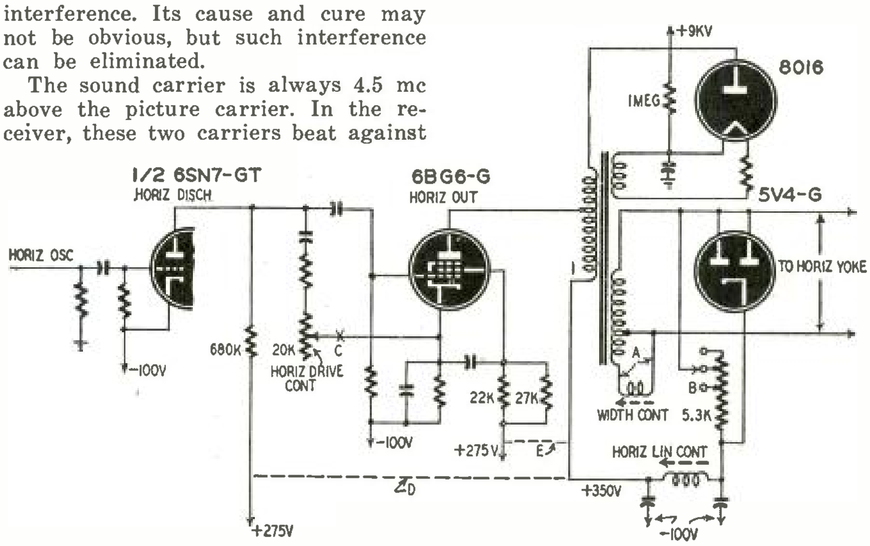


Fig. 3—Schematic of horizontal output circuit indicating the modifications.

Finding and Curing Unusual TV Troubles

By IRVING DLUGATCH

EVERYONE is familiar with "no output," "weak output," or "distorted output" in radio servicing. Television has its "no picture," "no sound," "no sweep," and "distorted picture." In either radio or television work, these ordinary troubles offer no problem to the expert even possessed of the simplest of equipment. Many a radio technician, however, owes his gray hairs to the puzzling intermittents and the "everything's perfect but—." What, then, of the television technician faced with a multiplicity of circuits, each capable of developing individual intermittents and unusual symptoms? Where does he begin using his elaborate service instruments?

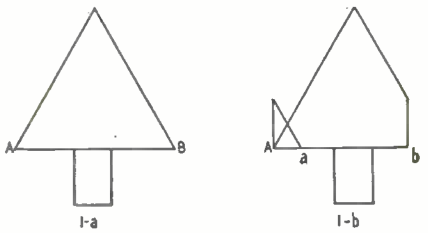


Fig. 1—Misplaced picture distorts tree.

The combination of an intermittent in some obscure circuit plus misalignment or maladjustment is enough to confound the most experienced technician. Too often, by his random twisting of controls and adjustments, he not only indicates his complete befuddlement, but manages to make matters worse. It is often much simpler to analyze the possible causes of the trouble and then proceed methodically with the proper equipment to track down the guilty component. Let's look into a few unusual problems.

The misplaced picture

The picture had a vertical slice cut off the right end and placed very neatly over the left side. In this way, it was possible to watch a ball game in which the pitcher stood behind the batter. He threw a ball off to the left where it disappeared. It reappeared at the right of the picture to fly toward the batter. Note, this is not a case of foldover where the picture is merely distorted at one side; nor is it horizontal slipping. Fig. 1-a shows the signal as transmitted and 1-6 shows the right side transposed to the left. Let's analyze this condition.

The slopes of the sides of the tree being equal and linear, there is no possibility of nonlinearity in the horizontal or vertical sweep circuits because nonlinearity causes sections of the pattern to be abnormally cramped or stretched. Fig. 2-a shows the deflection waveshape for a normal line in Fig. 1-a. The slicing off and transposition to the left of the received picture indicates that the receiver sweep oscillator was cutting off at b and starting a new line while the transmitter sweep continued to B. Thus the part of the picture between a and B appeared at the beginning of the lines instead of the ends where it belonged.

Obviously the receiver's horizontal sweep was somewhat faster than the transmitter's. By signal tracing in the sync circuits, the trouble was located in a sync coupling capacitor which had changed value.

Another type of deflection-circuit trouble is nonlinearity which causes crowding or stretching at the sides and top or bottom of the picture. Figs. 3-a

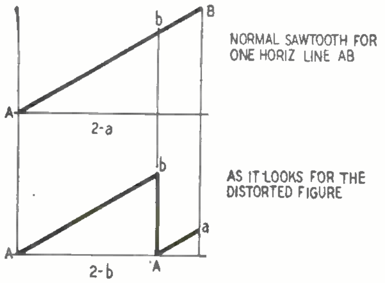


Fig. 2—Horizontal sweep is too fast.

and 4-a show nonlinear vertical and horizontal deflection voltages, while Figs. 3-b and 4-b show the resulting distortion in the picture.

When the vertical deflection wave curves, the downward sweep of the beam is slowed up, permitting more horizontal lines to be scanned in a given period and producing cramping or crowding. The center portion of the sweep is linear, and the lines are evenly spaced.

When the horizontal sweep is distorted, the picture elements are crowded during the curved portions of the sweep and evenly spaced during the linear portion.

If nonlinearity is not correctable with the linearity controls or by standard servicing practices, look for 60- or 120-cycle hum in the deflection circuits. Fig. 5-a and b shows how hum or ripple adds to or subtracts from the amplitude of the horizontal scanning wave and makes corresponding lines longer or shorter. This causes over-all distortion with a sine-wave shape at the left edge of the raster. Ripple or hum in the vertical deflection circuits will cause cramping like that shown in Fig. 3-b.

Another trouble common to deflection circuits is failure of the damper tube. This is characterized by distortion or

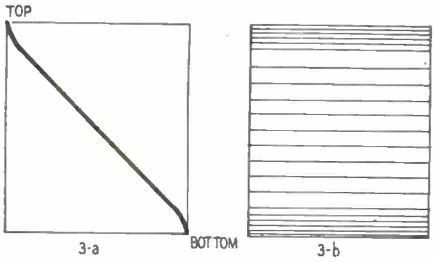


Fig. 3—A nonlinear sweep crowds lines.

foldover at the left side of the picture. This is understandable when we recall that the damper tube stops oscillations caused by the rapid change in deflection-coil current during the retrace period. Occasionally, only a single cycle of spurious oscillation is produced during each scanning cycle. The resultant is a single white bar with no other distortion in the picture.

Leftward tendencies

Sometimes one or more lines are shifted to the left without otherwise distorting the picture. Fig. 6 is exaggerated to show this condition, which is recognizable as a form of tearing—a condition usually caused by loss of sync. Deflection oscillators are usually designed to operate at frequencies somewhat lower than the 60- or 15,750-cycle synchronized rates. Naturally, they slow down to their designed frequency when sync is removed. The usual type of tearing occurs irregularly and over many lines. In this problem, the "slipping" is clean and covers comparatively few lines. Furthermore, the displacement occurs at the same place in the picture. This makes identification positive.

Suppose the receiver in question uses a.f.c. in the horizontal scanning circuit shown in Fig. 7. Capacitor C stores a charge which maintains the bias on the control grid of V1 for one frame, and the oscillator will stay locked in for this period, unless, of course R or C have undergone considerable changes in value. Checking the values of these components is the first step in finding the cause of the intermittent loss of sync.

Regardless of the type of horizontal sweep circuit involved, the trouble is not caused by an intermittent component because the displacement is clean and occurs at regular intervals. Noise pulses can be eliminated because of their irregularity. A more likely cause is an unwanted signal which adds to or subtracts from the video signal so as to destroy the sync

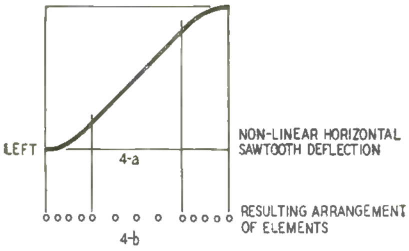


Fig. 4—Horizontal sweep is nonlinear.

for a few lines. Obviously the unwanted signal must occur at a 60-cycle rate to produce this effect. By signal tracing, the trouble can be traced to stray pickup in the r.f. or i.f. circuits. The interference may be caused by parasitic oscillations, high-amplitude deflection voltages, or heterodynes.

The vanishing ghost

A true intermittent ghost or reflected image is not rare. It can occur any time the antenna sways or turns in the wind. The cure is a good antenna installation. We are more concerned with non-reflected streaks and intermittent shadows which appear in the picture. Con-

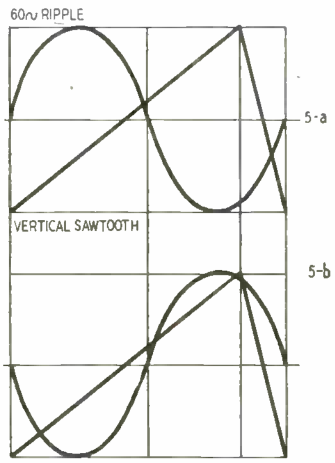


Fig. 5—Hum may cause nonlinearity.

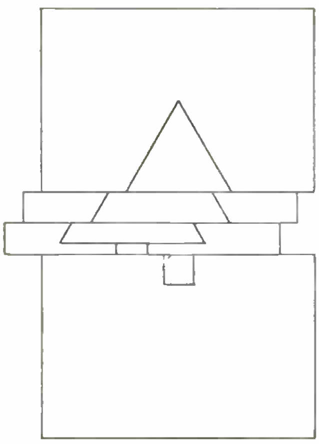
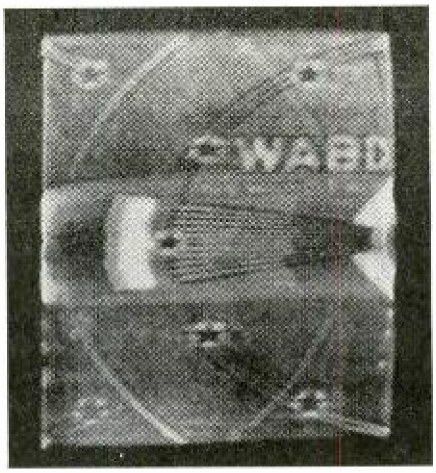


Fig. 6—Some lines shifted to side.



A pattern affected as shown in Fig. 1.

sider what will happen to a picture when an unwanted signal appears in the video amplifiers. Fig. 8-a shows the video signal during one line, 8-b a part of the positive cycle of an unwanted signal, and 8-c shows how the sum of the video and interfering signals places the video signal nearer the white region. When the interference goes negative, the video signal goes closer to the black region. If the inter-

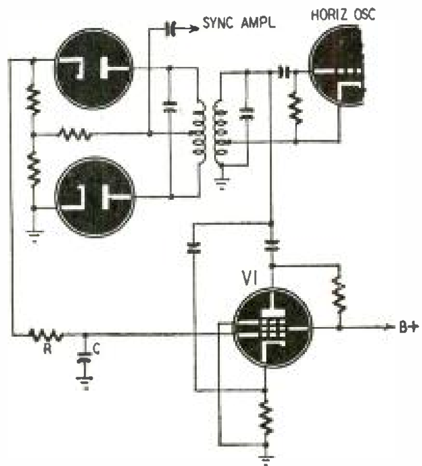


Fig. 7—A horizontal sweep with a.f.c.

ference is a 60-cycle sine wave, half the picture will be brighter and half darker than normal.

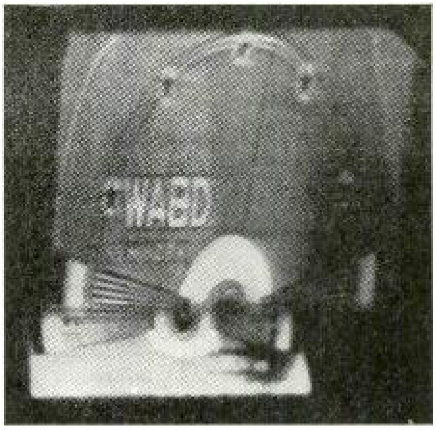
If the interference is at a frequency higher than the line scanning rate, each line will be modulated with white or black dots and vertical lines will appear in the picture.

When sound gets into the picture, we see bars, streaks, or patches, depending on the amplitude, phase, frequency, and duration of the interfering signal.

These three types of interference are easily recognizable and methods for curing them are obvious.

1. Long, dark, horizontal streaks following a thin, horizontal, black object against a white background. This may be caused by misalignment of r.f. or i.f. circuits or by faulty peaking in the video amplifier circuits.

2. White streaks forming at the edges of white objects against a dark background. This is particularly no-



An actual photo of condition in Fig. 6.

ticeable at the hairline on an actor's face. This trouble is also traceable to faulty aligning or peaking.

3. Muddy, washed-out pictures and visible retrace lines can result from turning up the contrast control to compensate for low emission in the picture tube. Advancing the contrast control raises the gain of the i.f. amplifiers, which may alter the over-all response curve and cause smearing like that just described.

Weird sound

Most cases of distorted or missing sound are due to improper operation of the receiver's controls but some may be traced to excessive oscillator drift. A bad tube is usually at fault when poor front-end design is not evident. Misalignment of the r.f. and i.f. stages is an obvious cause of the same trouble. (A common mistake is to realign the picture i.f. rather than the sound stages. The sound i.f. bandpass is not as wide as that of the video i.f.; therefore the former is more critical.)

Mismatch between the antenna system and the tuner can alter the Q of the r.f. input circuits and distort the response curve so that the carriers do not peak simultaneously. Slight mistuning can eliminate one carrier by causing it to fall outside the passband of the r.f. circuit. This condition is

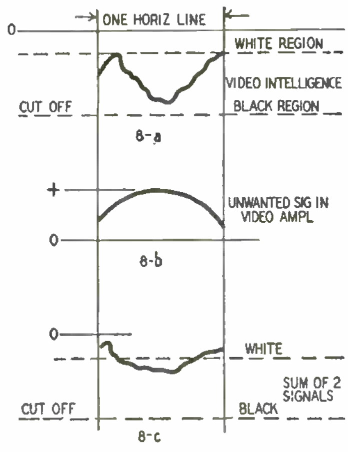


Fig. 8—How interference affects image.

cured by proper matching between the receiver and antenna.

Television Dictionary

Initial installment of a new A-to-Z dictionary of TV terms

By ED BUKSTEIN

A

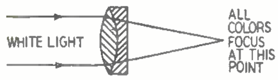
Aberration
A defect of a lens or mirror. For instance, chromatic aberration is the tendency of a lens to separate

white light into its component colors and to focus different colors at different points.

Accelerator
The second anode of a cathode-ray tube. This anode, operated at a high positive potential with respect to the cathode, increases the velocity of the electron stream and is therefore referred to as an *accelerating anode.*

Accommodation
The ability of the eye to focus on objects either near or far.

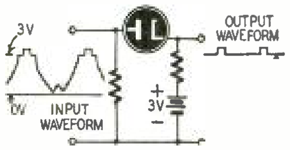
Achromatic lens
A combination of two lenses, the curvature of the second lens being



such that it corrects the chromatic aberration of the first.

Afterglow
A fluorescent material glows when bombarded by electrons and continues to glow for a length of time after the bombardment ceases. This continued glow is referred to as *afterglow, persistence,* or *phosphorescence.*

Amplitude separation
The process of removing a portion of a waveform above or below a given level. In the figure a positive potential of 3 volts is applied to the cathode of the diode. The diode



cannot conduct until the signal voltage on its plate becomes more positive than 3 volts. The output contains only that portion of the input waveform above the 3-volt level. This process is also referred to as *clipping.*

Angle of deflection
In a cathode-ray tube, the angle by which the electron stream deviates from the path it would follow if undeflected.

Angle of divergence
In a cathode-ray tube, every electron in the stream exerts a repelling influence on every other electron. Therefore, the stream tends to spread out or widen. The angle formed by the edge of the stream and a longitudinal line through its center is called the *angle of divergence.*

Angstrom unit
A unit of wavelength measurement. The Angstrom unit is equal to 10^{-10} meter. The wavelength of visible light is between 4,000 and 7,000 Angstrom units.

Aperture
A small opening or window. The term is also used to describe the cross-sectional area of the scanning beam in a television camera tube.

Aperture compensation
Reduction of aperture distortion by emphasizing the high-frequency components of the picture signal.

Aperture distortion
Attenuation of the high-frequency components of the picture signal due to the finite cross-sectional area of the scanning beam. When this area is large enough to cover several mosaic globules in the iconoscope simultaneously, aperture distortion results and the resolution of the image becomes poor.

Aquadag
The graphite coating on the inside of the glass envelope of the cathode-ray tube. The aquadag, which is electrically connected to the second anode, collects the secondary electrons knocked out of the fluorescent screen. It also provides shielding for the tube.

Aspect ratio
The ratio of the width to the height of a television picture. Under present television standards, the picture aspect ratio is 4 to 3.

Astigmatism
When the vertical and horizontal curvatures of a lens are unequal, part of the image is in focus while other parts are not. This defect of the lens is called *astigmatism.*

Automatic brightness control
A circuit which maintains fairly constant the average intensity or brightness of the television picture.

Automatic contrast control
A circuit which varies the bias on one or more variable-mu tubes in such a manner that the intensity and contrast of the television picture are maintained at a constant average level. Automatic contrast control is to the television receiver what automatic volume control is to the sound receiver. The manual contrast control fixes the average level of the picture, and the a.c.c. maintains this average even if video carriers of different peak amplitudes are tuned in.

B

Beam
In cathode-ray tubes, the stream of electrons passing from the cathode to the fluorescent screen.

Beam current
The current in the stream of electrons in the cathode-ray tube. The beam current rarely exceeds 250 μa and is normally less than 100 μa.

Black level
In the television receiver, the video signal is applied to the control grid of the cathode-ray tube. Portions of this signal drive the grid to cutoff and produce the black portions of the picture. Those portions of the video signal which drive the grid beyond cutoff are said to be below the black level.

Black-level control
A control for varying the amplitude of the portion of the video signal which produces the black parts of the picture.

Blacker-than-black region
That portion of the video signal below the black level. The synchronizing and blanking pulses are contained in this portion of the signal.

Blanking
The process of applying negative voltage to the control grid of the cathode-ray tube to cut off the electron beam during the retrace or flyback period.

Blanking pedestal
A voltage pulse used to drive the cathode-ray tube beyond cutoff during the time the spot is returning from right to left or from the bottom to the top of the picture. These blanking pedestals must be synchronized with the sweep circuits so that the beam is cut off at the right time.

Blanking pulse
Same as blanking pedestal.

Blocking oscillator
A vacuum tube so operated that it is continually driven back and forth from cutoff to saturation. If a capacitor is connected in parallel with such a tube, it will charge during the time the tube is cut off and discharge through the tube when it conducts. This process produces a sawtooth voltage waveform which may be used as sweep voltage for the cathode-ray tube.

Brightness
The intensity of the light produced at the screen of a cathode-ray tube.

Brightness control
In the television receiver, the adjustment which varies the average illumination of the picture by varying the bias on the cathode-ray tube grid.

Brilliance
Same as brightness.

Broadband Amplifier
An amplifier having flat response over a wide range of frequencies.

C

Caesium
A photosensitive material used in the mosaic of the iconoscope.

Camera
That component of a television transmission system which houses the iconoscope, orthicon, or image dissector tube. The scene to be televised is focused through a system of lenses upon a photosensitive surface. The camera breaks down the visual image into a large number of small picture elements, translating the light intensity of each element into its electrical equivalent.

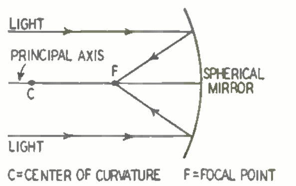
Candlepower
A measure of the light-producing ability of a source. The standard 1-candlepower source produces a light flux of 12.57 lumens.

Catadioptric
The name applied to an optical system employing both lenses and mirrors.

Cathode-ray tube
An electron tube which converts electrical energy into light by projecting a beam of electrons upon a fluorescent screen. The screen glows at the point where the electrons strike it, producing a spot of light. By deflecting the electron stream, the spot may be made to trace a pattern corresponding to the deflection voltage.

Catoptric
The name applied to an optical system employing mirrors but no lenses.

Center of curvature
The point equidistant from all points on the surface of a spherical mirror. If the mirror is considered to be a segment of a complete sphere, the center of curvature



would be located at the center of the sphere. The center of curvature is located on the principal axis.

(*Continued in February issue*)

Adjusting TV Linearity Without a Test Pattern

Audio-modulated signal generator produces parallel bars on screen

By MATTHEW MANDL

THE most common method of adjusting linearity in television receivers is to tune in a station test pattern and adjust the horizontal and vertical linearity controls on the rear apron of the chassis. When the pattern circle is perfectly round, and the width and height controls are adjusted to mask the image properly, we can be reasonably sure that the receiver will not elongate, bend, or otherwise distort the subject material of subsequent television programs.

While this method is highly satisfactory, a test pattern is not always available when needed. The technician should become familiar with the procedures for adjusting linearity without it. The methods are not complex and require no equipment other than a signal generator and a simple audio oscillator. With them, vertical and horizontal linearity can be set, and sweep amplitude can be adjusted by the visible indication appearing on the tube.

Use a signal generator to produce vertical or horizontal lines (or both) on the face of a tube. These lines, which resemble the sound bars so often visible when the receiver traps are not adjusted correctly, are used as a basis for adjusting linearity. If, for instance, a frequency *above* the 15,750-cycle horizontal sweep rate is injected into the video stages, a series of *vertical* bars appears on the picture-tube face. The number of bars depends on how much the frequency of the injected signal exceeds 15,750 cycles. The bars will be perfectly spaced and of equal thickness only if the horizontal linearity is correctly adjusted.

If a frequency *below* 15,750 cycles is used, but above the 60-cycle vertical sweep frequency, a series of *horizontal* bars is visible, and their number depends upon how much higher than 60 cycles the injected frequency is. Again, the spacing and thickness of the bars indicate linearity—vertical in this case.

When an a.c. signal is applied to the grid of the picture tube, it alternately adds and subtracts from the bias already on the tube. If, for instance, we inject a frequency of 60 cycles (the same as the vertical sweep rate), the bias is increased and decreased 60 times per second. Since the vertical sweep rate is only 60 cycles, half of the downward trace is blanked out and half is not. If a 480-cycle signal is injected, it blanks out and releases the beam at a more rapid rate—eight times per field, to be exact, since 480 divided by 60 equals 8. This means that approximately eight white and eight black horizontal bars will appear on the screen. Actually such division will not give the exact number of bars

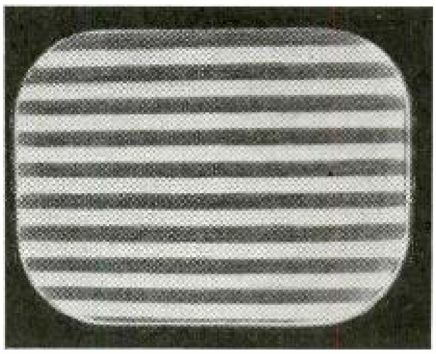


Fig. 1—Horizontal bars afford a check on linearity of vertical sweep source.

which appear on the screen because some are lost during the retrace time. However, more and more bars will appear on the screen as the frequency is raised to 15,750, the horizontal sweep rate. Fig. 1 is a photo of a screen with these bars on it.

When the frequency is above 15,750 cycles, it affects the horizontal lines, since its frequency is now high enough to blank out and release the beam during the horizontal sweep. If the injected frequency is, say, 315 kc (315,000 cycles), the electron beam is cut off 20 times and released 20 times (315,000 divided by 15,750). Almost 20 black and white vertical lines therefore will be visible on the screen. Fig. 2 shows a screen with vertical bars.

Any standard signal generator can be used to produce the vertical bars. It is preferable to use frequencies above 300 kc to get a sufficient number of bars for good linearity adjustment.

Though many r.f. signal generators have a 400-cycle tone available for internal modulation purposes, they are not suitable for producing horizontal bars, since such a frequency would only produce about five lines. The bars would be fairly thick and their linearity rather difficult to determine. It is much more desirable to use a frequency between 800 and 2000 cycles so that from 10 to 30 bars will appear on the screen. If an audio oscillator is available, it can be used. However, audio oscillators having not been employed to any extent by service technicians, one may have to be built up.

Oscillator construction

Fig. 3 is a schematic of an oscillator using a 117L7-GT, which combines a rectifier with a beam-power amplifier. Utilizing the rectifier section for the power supply and the amplifier tube as a grid-blocking oscillator, we can construct a compact audio oscillator without the need for a separate power source. The frequency can be varied with the 500,000-ohm potentiometer, and the ouput is more than sufficient. It can also be used during regular servicing for signal tracing.

The parts can be mounted on a small chassis. A small tin baking pan makes an excellent chassis. Ground all terminals to the chassis, and

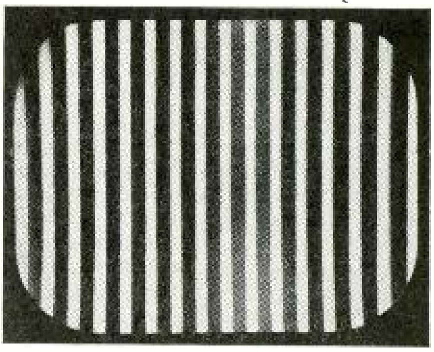


Fig. 2—Even spacing of vertical bars indicates horizontal sweep is linear.

use the isolation transformer indicated in Fig. 3. The isolation transformer is necessary, as otherwise the chassis of the oscillator would be "hot" and there would be danger of shorts and shocks. A small power transformer and tube designed for 250 volts on the plate can be used, of course, as can any oscillator which will produce a good waveform between about 1,000 and 2,000 cycles.

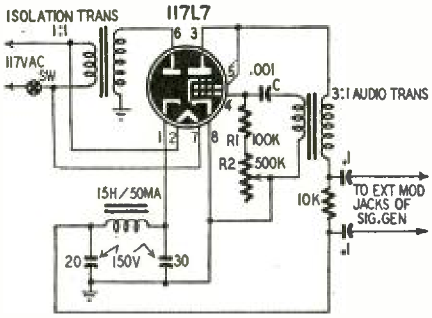


Fig. 3—Circuit of the audio generator.

Any audio interstage transformer will work in the tuned circuit. The unit can be tested for oscillation by placing a pair of phones across the output terminals. If there is no oscillation, reverse *either* the primary or secondary connections of the audio transformer, but not both. Make sure the secondary winding (the one having greater d.c. resistance) goes to the grid. If the oscillation frequency is too high or too low, change C, R1, or R2. Exact values for these cannot be given, since frequency range is also dependent on the transformer, the distributed capacitance, circuit wiring, etc. The frequency can, however, be altered by changing any of the values of C, R1, and R2.

Linearity testing

Both vertical and horizontal linearity can be checked and adjusted right in a customer's home. For adjusting vertical linearity the procedure is as follows:

1. Turn on the television receiver and allow it to warm up. Remove the antenna lead-in. Attach the audio oscillator to the EXTERNAL MODULATION jacks of the signal generator, turning off the internal modulation. Attach the output cable of the signal generator to the antenna terminal of the receiver. Set the receiver to the lowest channel.

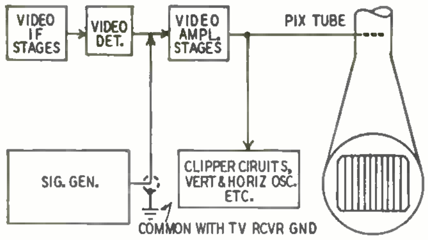


Fig. 4—Tie generator to a video grid.

2. Tune the signal generator to the channel frequency. Vary the signal-generator frequency slightly until bars appear on the screen. Adjust contrast and brilliancy for satisfactory image. (The generator can also be set to the picture i.f. frequency.)

3. Adjust the vertical hold until the horizontal bars stand still. (Fine tuning may also be adjusted.) If more or fewer bars are desired, change the frequency of the audio oscillator. Vary the signal generator modulation control for the desired darkness of the black bars.

4. Adjust the vertical linearity control until there is no crowding of bars either at top or bottom of the screen. Height and vertical positioning controls may need slight retouching for proper centering and amplitude.

If the work is done when the chassis is on the workbench, the r.f. signal generator is not needed. Simply attach the output of the audio oscillator to the grid input of the first video amplifier. Turn the channel selector off a station, and start with step No. 3, above.

For horizontal linearity adjustments, where vertical bars are required, the signal generator output must be injected into the first video amplifier grid, as shown in Fig. 4. This can be done while the chassis is on the workbench, or it can be done in the customer's home by removing the tube and bending a small piece of wire around the grid pin. The output from the signal generator is attached to this piece of wire, with the shield of the cable going to receiver ground. (Do not use a modulated signal.) This is also an alternate method for injecting the audio oscillator directly into the video amplifier without removal of chassis. This does away with the need for a signal generator during vertical adjustments. The procedure for horizontal linearity adjustment is:

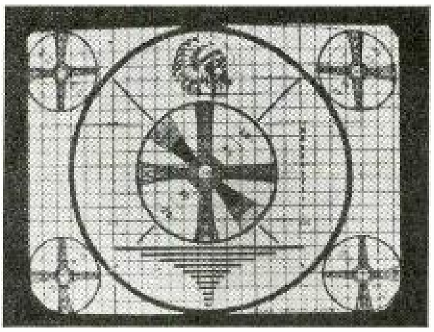


Fig. 5—RCA grating generator pattern.

1. Turn on the receiver and allow it to warm up. Set the channel selector so no station is tuned in, or remove the antenna lead-in. Turn on the signal generator and set the frequency for approximately 300 kc. Vary the output and frequency until 20 or 30 vertical bars appear on the screen, as shown in Fig. 2.

2. Adjust contrast and brilliancy for a satisfactory image. Also vary the horizontal hold until the vertical bars are stationary.

3. Adjust the horizontal linearity until there is no crowding of bars at either side of the screen. Width and horizontal positioning controls may need slight retouching for proper centering and width.

Commercial equipment

Several commercial pieces of equipment are avilable which are so designed that the dark-line trace is thin, and both horizontal and vertical bars appear simultaneously.

The device used by RCA is called a *grating generator* (type WA-3A). The grating pattern appears in Fig. 5. This thin-line trace can be used against a station pattern as shown in the illustration, or it can be used to give the lines against a plain raster background. Improper adjustment of either vertical or horizontal linearity results in crowding or spreading of the bars at top and bottom or at the sides.

The Philco product, which produces the same type of vertical and horizontal bars, is known as a *crosshatch generator* (model 5072). It comes with an adapter harness, as shown in Fig. 6. Plate voltage, heater power, and synchronizing voltages are obtained from the television receiver.

The Philco crosshatch generator is adjusted at the factory to produce 12 horizontal and 16 vertical lines. The number and positions of the vertical lines, however, can be changed by a trimmer which is accessible through a hole in the bottom of the generator. Horizontal line adjustments can also be made.

Two other commercial types are the Hickok linearity-pattern television generator, model 620, and the Supreme composite video generator, model 665. The latter produces a dot modulation pattern. On the tube face a series of slightly elongated dots appears; and if receiver linearity is properly set, vertical and horizontal dot spacing is equal.

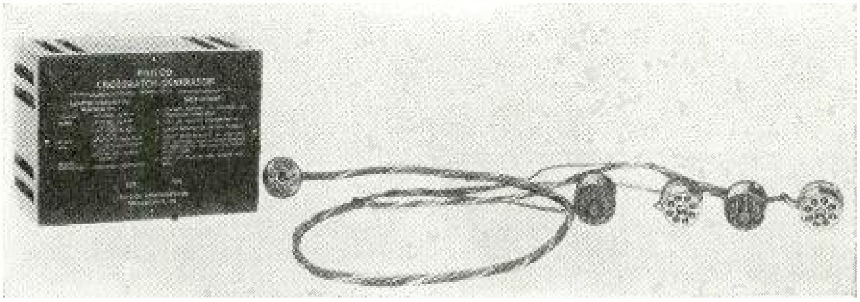
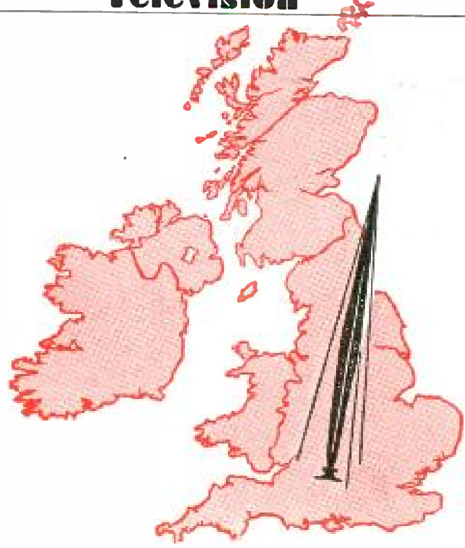


Fig. 6—The Philco crosshatch generator shown with its plug-and-wiring harness.

British TV News



By RALPH W. HALLOWS

BY the time that this article appears in print, Britain's second television station will be on the air in the Birmingham area. We're rather proud of it; for, with its vision output rated at 35 kw and its sound rated at 12, it's the most powerful thing of its kind in the world. Our population is so conveniently arranged from the TV point of view that one pair of stations, London and Birmingham, serves a good half of it. The third station is to be in the north; it will cover the thickly populated districts of Yorkshire and parts of Lancashire and should bring the total of potential televiewers up to nearly three-quarters of the British people.

For all stations except the London transmitter, which is to remain unaltered, the BBC has decided to adopt the asymmetric sideband system illustrated in the drawing. This will allow five individual sound and vision channels to be fitted into the band, the transmitter on each channel radiating a video bandwidth of 2.75 mc with virtual freedom from amplitude or phase distortion.

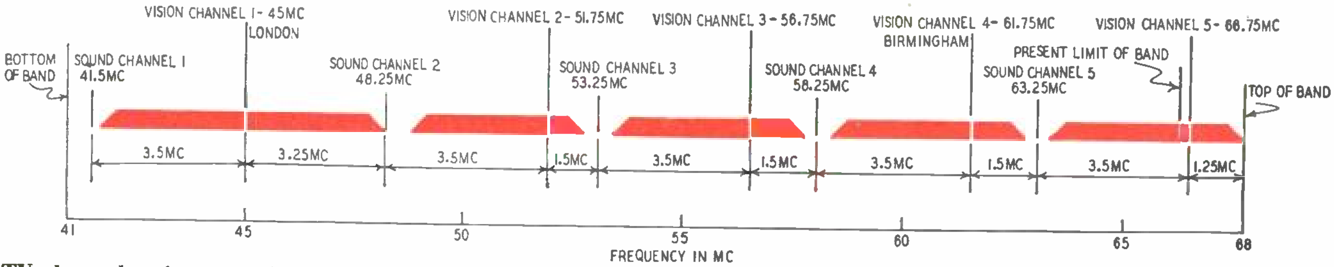
This decision of the BBC's has had considerable effect on the design of televisers produced recently. The separation between the video carrier of any channel (except No. 1) and the sound band of the channel next above it is only 1.5 mc. A considerable degree of selectivity is thus essential, and this rules out the t.r.f. designs, which have been so popular in England because of their freedom from harmonic troubles. All the new televisers are superhets. Next, single-sideband working is called for; rather the receiver should have ideally 100 per cent response to modulation frequencies 2.75 mc below that of the carrier, a similar response to those up to 0.75 mc above it, and then a sharp cutoff. At 1.5 mc above the carrier the attenuation of sensitive receivers must be 50 db or better.

One interesting trend is that toward lower prices. This cannot be done by incorporating a very small picture tube, for the public has shown in no uncertain manner that it will not accept at any price televisers providing an image smaller than about 7½ x 6 inches; and that means that the 9-inch tube is the absolute minimum size. Nor is there any future—or even any present—for the vision-only set without accompanying sound. It's a bit difficult to give you an idea of TV prices in Britain, because ordinarily all are quoted inclusive of purchase tax. Purchase tax is a variable for which the manufacturer has no responsibility. It may at any time go down; equally (and more likely) it may at any time be increased. What I've done, with the aid of such modest mathematical accomplishments as I possess, is to give you from now on the price as it would be were purchase tax not added to it, converted into dollars at the present rate of $2.80 to the pound sterling. If you want the price including tax, add about one-third to the figures given.

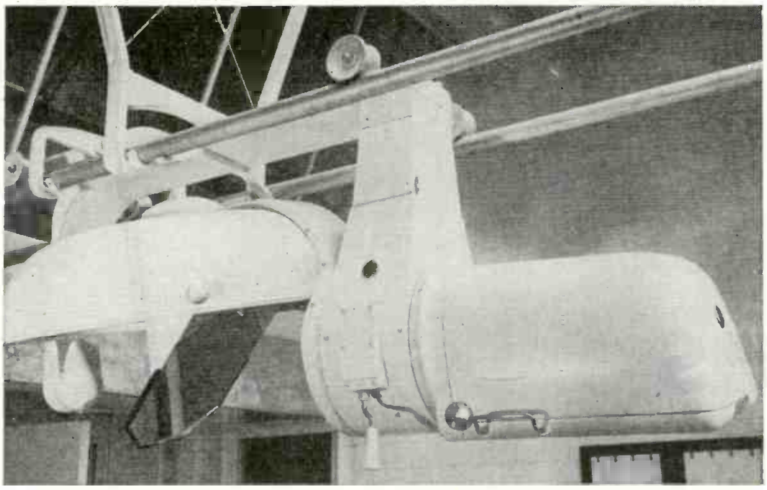
The lowest priced, and in many ways one of our most interesting, small televisers is the Baird *Everyman,* which registered a miniature atom-bomb effect when produced out of the bag on the opening day of Radiolympia. It has a 9-inch tube, has both sound and vision, is a very respectable performer, its appearance is attractive, its overall dimensions are less than a cubic foot, *and its cost is about $78.* Very few beans have been spilt so far about its makeup, but I understand that it contains no more than ten tubes and two metal rectifiers in addition to its C-R tube. I need hardly say that with this small complement of tubes it is a short-range set—the sensitivity, in fact, is a pretty large fraction of a millivolt. But it should appeal strongly to the millions of folk who live in districts where television field strength is high.

Other examples of low-priced televisers are the H.M.V. model 1807 (10-inch tube) at $97, and the Ambassador (10-inch tube) at $88. These are table models. There are also quite a number of table receivers with 12-inch tubes. Ekco has two at about $122 apiece, and there are 12-inch table models by Ambassador, Murphy, and Ultra at comparable prices.

I have mentioned that the small screen is not readily accepted. I'll go further and say that there is a noticeable swing in the direction of images of 80 square inches and upward. Consoles with 12-inch tubes are legion, those for television only being priced, on the average, at about $150, and those with broadcast-band or all-wave



TV channel assignments in Britain. All except No. 1 have asymmetric sidebands. Channels 1 and 4 are those now employed.



Camera in E.M.I. hospital unit travels on rails over operating table.

radio reception as well, running from about $200 upward. I know of two models with 14-inch and a half dozen with 15-inch tubes. Most of these big fellows go in for expensive cabinetwork; prices therefore cover a wide field. There is, however, an Ekco 15-inch tube model with four selected broadcast-band "press-button" stations at $256, and if you want a console housed in a beautiful cabinet and combining all-wave radio with a special high-quality audio end and TV, there's the Haynes at $440.

Projection sets were numerous at Radiolympia; but I don't believe that more than a few of these will become firmly established on the market. Almost all use the Schmidt system. Many manufacturers are chary of offering a set containing a C-R tube requiring 25 kv, which may have a very short life and give a good deal of trouble. This is not unlikely to happen with some of the 2½-inch, high-voltage, superbrilliant projection tubes available; but the Philips-Mullard people seem confident of the ruggedness and the longevity of their newest tube of this kind, for which an average life of 1,000 hours is claimed.

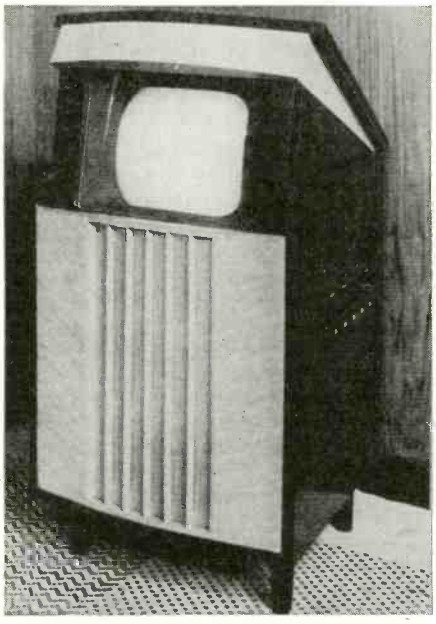
Using this tube and a modified Schmidt assembly, the Philips big-screen televiser has been designed on novel lines. The cabinet contains the projector, but this throws the image on to a beaded-reflector home movie screen outside the instrument itself. The size of the picture varies, according to the length of the throw, from 16 x 12 inches to about 4 x 3 feet. The extraordinarily bright and clear images live up to the maker's claim that they are as good as those of 16-mm home movies. These sets can apparently be made inexpensively, for the price tentatively suggested for the 4 x 3-foot model is about £100, or $280.

Speaking of C-R tubes, there are one or two other points I must mention. The newest aluminized Emiscope tubes give a very bright and contrasting picture. To make the most of them the high voltage must be 8 kv or more. Most sets, whether or not they have aluminized tubes, are now using line-flyback for generating the high-voltage EHT, and it is certainly the most satisfactory system where voltages getting into the neighbourhood of 10 kv are called for.

Two television systems specially designed and developed for the instruction of medical students in hospitals are giving most satisfactory results at the great London hospitals, Guy's and the Middlesex. I want to emphasize that these are not just ordinary TV bits and pieces pressed into occasional service. The apparatus is specially designed for the job, and it is a permanent installation. In the E.M.I. system the transmitter unit incorporates the camera, a specially designed shadowless lamp, and the microphone. The apparatus is suspended from rails above the operating table and the image is delivered to the camera by way of a mirror, which can be tilted at the most suitable angle. The camera has a remotely controlled triple lens system, by means of which the screen can be made to cover a large area on a reduced scale, or to give a natural-sized image, or to give a magnified image of a small area. At the control desk there is a monitor tube and the switches and knobs necessary for making any adjustment that may be required from this remote point. The E.M.I. system is in monochrome, but good definition is obtained by the use of color filters. The Pye Co. has recently developed a system of color television for operating theatres, which gives admirable results.

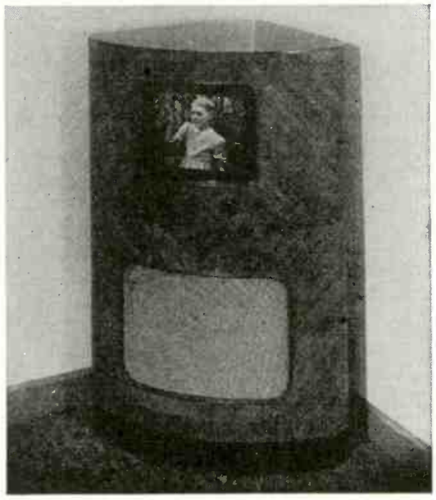
The Cossor Co. has just introduced an interesting extension unit for TV receivers. I won't go into details as extension televisers are dealt with elsewhere in this issue. I'll just mention one or two of Cossor's striking points. It taps off the TV signal at the modulation terminal of the C-R tube; and it doesn't matter whether the tube is grid- or cathode-modulated, for a phase-reversing switch is provided at the extension. The preset variables of the extension have so wide a range that it is readily adjusted for 405-line, 50-frame-per-second, or 525-line, 60-frame-per-second reception. The price is to be from $60 to $70 for the model with 10-inch tube.

From some of the accompanying photographs you'll see what strides have been made in turning the once rather clumsy televiser cabinet into a beautiful piece of furniture. To me the corner model is specially attractive. Not only does it look well and save space, but it allows the TV receiver to be placed where it can do justice to both sound and vision programs.



Ekcovision TSC113 has unusual cabinet.

Ekco device generates a testing pattern.



Receiver by Fitton stands in a corner.

Soap Bubbles and Television

By E. AISBERG*

ALL the color-television systems demonstrated or proposed up to the present are based on the trichromatic principle which has long been used in printing.

To reproduce an image in colors, three cuts are made by photographing through yellow, red, and blue filters. These cuts are then printed successively and in careful registry.

We proceed in the same manner in television, breaking the image up into the elementary colors with appropriate filters and transmitting the partial images either successively or simultaneously. These elementary colors are again combined into a color image at the receiver.

The principle is excellent, but it lacks by far the simplicity that characterizes the real solutions of the hardest problems. I do not believe it will be along this path that the best system of transmission in colors is to be found.

Why not imitate Nature, who resorts to the simplest means to produce her most beautiful hues? What can show more varied colors than a soapbubble? A drop of oil on a damp pavement exhibits more variegated colors than the plumage of the rarest of exotic birds. And speaking of birds, do you think the plumes of the peacock owe their iridescence to colored pigments? Then try to scrape them away with your knife. You will be left with nothing but a uniformly grayish-white substance.

All these instances are examples of the well-known phenomenon of the action of thin transparent layers. Our physics texts tell us that when such an exceedingly thin layer is illuminated, part of the light is reflected by the first (top) surface and that part of it penetrates the layer and is reflected by the second (bottom) surface.

The two reflected rays do not follow the same trajectory. That is, they are not at all times in phase. According to the wavelength of the light and the thickness of the layer, certain of the radiations oppose each other and are weakened or extinguished; others find themselves in phase and therefore are strengthened.

Consequently, if we illuminate our thin layer with white light, composed of all the visible wavelengths, only the radiations of certain colors will be visible after their reflection. (One might note, in passing, how much this phenomenon resembles both the fading of radio waves and the "dead spots" of the u.h.f.'s.)

Thus, a thin transparent layer which itself is colorless (soapbubble, film of oxide on the surface of a metal, varnish, drop of oil or gasoline) reflects a colored light, the color of which depends solely on its thickness.

Without being able—at the present state of technique—to guess at the concrete means necessary to achieve that objective, I dare to affirm that the true solution of the color problem is offered by this phenomenon of thin transparent layers. And this applies in all the fields of image reproduction: photography, printing, phototelegraphy, and television.

Television in color will be realized the day that the cathode-ray tube can modify the thickness of thin transparent optical layers on its screen. Then, illuminated by white light, it will produce a living image in complete color, an image which also can be projected easily onto a large screen.

Here, in my opinion, is the path which those researchers who seek to discover the true solution of color television might profitably explore.

(From *Toute la Radio*, October, 1949)

*Editor, *Toute la Radio*, Paris (France)

Rebalancing TV Set Inputs

REPRESENTATIVE of the many popular television receivers which use a balanced push-pull input system are the RCA 630TS and 8TS30, Admiral 30A1 chassis, Emerson models 571 and 606, Olympic TV-922, Capehart 501P, and many others.

This type of input is really efficient only when the arrangement is well balanced and when the shunt impedance of the input circuit matches the impedance of the transmission line.

A simple test shows unbalance. Tune in a strong station and disconnect the transmission line. Touch one wire of the line to one input terminal; then touch it to the other terminal. If the signal is stronger at one terminal than the other, there is unbalance. Remedying the situation is very simple; and, in view of the improvement you can expect, it is well worth doing even though it necessitates removing the chassis.

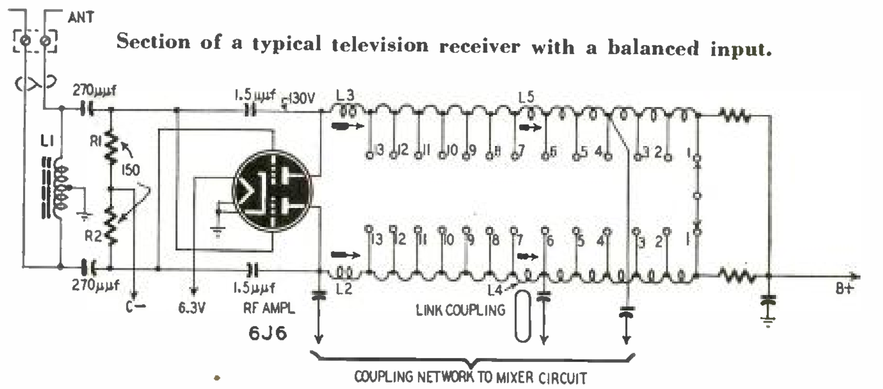
The load on the transmission line is the series value of R1 and R2, 300 ohms. L1 is a choke which acts as a high-pass filter, shorting low-frequency interfering signals but having a high reactance at TV signal frequencies. If either R1 or R2 changes value with age, one will be greater than the other, destroying balance. Even if both change equally, the impedances will not match. Check R1 and R2 on a good ohmmeter and replace with 150-ohm units if necessary.

The schematic shows that separate inductors are used to tune each plate circuit. If opposite numbers here are not matched, there will be unbalance. If the unbalance is not very bad, you can eliminate it without test equipment.

Tune in the highest-channel, high-band (channel 7-13) station in the area. Adjust the high-band tuning slugs L2 and L3 until the balance test (using the single transmission-line lead as before) shows good balance. Ordinarily both tuning-slug screws should project about equally from the tuning assembly.

Next, tune in the highest-channel station in the low band (channels 2-6) and adjust L4 and L5 for the best possible balance.—*Matt Mandl*

Section of a typical television receiver with a balanced input.



Television Antennas

Directory of manufacturers and their antenna products

Aero Tower & Rotator Div.,
Knepper Aircraft Service
116 Linden St., Allentown, Pa.
Antenna masts of tubular steel, built in triangular form, 10 to 198 feet high.

Alliance Mfg. Co.,
Alliance, Ohio
Antenna rotators, with or without direction indicators.

Alprodco, Inc.,
Box 56F, Mineral Wells, Tex.
Aluminum antenna towers, assembled or knocked down in 6-foot sections. Bases for mounting on vertical, horizontal, or sloping surfaces.

American Phenolic Corp.,
1830 South 54th Ave.,
Chicago, Ill.
High-gain, multielement, folded dipoles; one indoor unit. Four antenna models. Masts, standoffs, brackets, transmission lines.

Astatic Corp.,
Conneaut, Ohio
Four-tube, all-channel booster.

Baker Mfg. Co.,
133 Enterprise St.,
Evansville, Wis.
Antenna towers, self-supporting and guyed, up to 100 feet.

Best Vue Products
247 Centre St., New York, N. Y.
Conical-type antenna, adaptable for high or low bands; single or stacked arrays.

Brach Mfg. Co.,
200 Central Ave., Newark, N. J.
Wide- and narrow-lobe, high-gain arrays, fans and conical types; indoor V's. Twelve antenna models. Lightning arresters. Twelve-receiver distribution system.

Brooklyn Television Co.,
1630 St. Johns Place,
Brooklyn, N. Y.
Straight and folded dipoles; conicals. Wall and chimney mounts; standoffs.

C & G Tool Manufacturers, Inc.,
39 Main Street, East Orange, N. J.
Antenna rotor; mast extenders; chimney and wall mounts; copper-plated ground rods.

Camburn, Inc.,
32-40 57th St., Woodside, N. Y.
Dipoles, folded dipoles, and conicles, multielement, single- and double-bay, high- and low-frequency; indoor V's; window dipoles. Brackets and mounts, guy wire, mast extensions, lightning arresters, ribbon transmission line.

Channel Chief Co.,
37 Mali Drive,
North Plainfield, N. J.
Square, corner-reflector broad-band, high-frequency antennas.

Channel Master Corp.,
Napanoch Road, Ellenville, N. Y.
Dipoles and folded dipoles with reflectors; biconical and fan arrays; in-line-types, three-element beams; V's; lazy-H's; masts. Thirty models.

Circle-X Antenna Corp.,
500 Market St., Perth Amboy, N. J.
Circular, high-gain, wideband antennas, indoor and outdoor. Two models.

Commercial Plastics Co.,
1198 Merchandise Mart, Chicago 54
Ethyl cellulose plastic clamp to support 300-ohm ribbon line.

Communication Measurements Corp.,
120 Greenwich St., New York, N. Y.
Unequal-length folded dipoles driven by phasing section, for high, low, and both bands; narrow-band, three-element arrays; pole-mounting antenna selector switch.

Cornell-Dubilier Electric Corp.,
South Plainfield, N. J.
Single- and double-bay conicals and folded dipoles with reflectors. Rotators with direction indicators.

Crown Controls Co.,
124 S. Washington St.,
New Bremen, Ohio
Antenna rotators with direction indicators.

Delson Mfg. Co.,
126 11th Ave., New York, N. Y.
Dipole, folded-dipole, and conical window antennas; indoor V's. Six models.

Dielectric Products Co., Inc.,
125 Virginia Ave.,
Jersey City 5, N. J.
All-channel, unidirectional V's for 72- or 300-ohm line; all-channel dipoles, bidirectional on low band, unidirectional on high band. Twelve models.

Easy-Up Tower Co.,
3800 Kinzie Ave., Racine, Wis.
Prefabricated towers, 30 to 100 feet high.

Electro-Steel Products, Inc.,
112 N. 7th St., Philadelphia 6, Pa.
Indoor triple-loop antenna.

Garrett-Buckley Co.,
624 South Michigan Ave.,
Chicago, Ill.
No information furnished.

General Cement Mfg. Co.,
919 Taylor Ave., Rockford, Ill.
Towers 28 to 100 feet high; indoor V antennas. Mounts, brackets, clamps, insulators, and all accessories. 300-ohm twin line.

Gonset Co.,
Burbank, Calif.
No information furnished.

Hy-Lite Antennae, Inc.,
528 Tiffany Street, Bronx 59, N. Y.
Multielement conicals, Yagi arrays, folded dipoles.

Industrial Television, Inc.,
359 Lexington Ave., Clifton, N. J.
Master antenna systems to feed six receivers without, and more with, amplification equipment.

Insuline Corp. of America,
36-02 35th Ave.,
Long Island City, N. Y.
Wideband biconicals, indoor and window dipoles. Eleven models.

Jerrold Electronics Corp.,
121 N. Broad St., Philadelphia 7, Pa.
Master antenna system amplifiers, lead-ins, matching networks.

JFD Mfg. Co., Inc.,
6101 16th Ave., Brooklyn 4, N. Y.
Multielement and multibay dipoles, folded dipoles, and conicals, with special modifications, and Yagi beams; window and indoor antennas. Eighty-eight antenna models. Masts, extensions, brackets, arresters, and other accessories.

La Pointe-Plascomold Corp.,
Unionville, Conn.
High-gain antennas, masts, towers, and mounts, with accessories; transmission lines and arresters.

Lyte Parts Co.,
15 Washington Ave., Plainfield, N. J.
Ten high- and low-band antenna models, multielement, multibay folded dipoles and conicals. Rotators and masts.

McKinney Steel & Sales Co.,
8 Madison St., Waukegan, Ill.
Swivel bases for antenna masts.

Metalace Corp.,
2101 Grand Concourse, Bronx 53, N. Y.
Twenty-four types of mounts for antenna masts.

Nicholas Equipment Co.,
Bellevue, Ohio
Antenna rotator.

Oak Ridge Antenna,
239 East 127th St., New York, N. Y.
Multielement, multibay dipoles, folded dipoles, and Yagi arrays; indoor and window antennas. Transmission line. Mounting accessories.

Walter E. Peck, Inc.,
2842 West 30th St.,
Indianapolis 22, Ind.
Six-element, folded-dipole Yagi beams for low band; single- and double-stacked, collinear, phased dipoles and reflectors for high band. Five models.

Peerless Products Industries,
812 North Pulaski Road,
Chicago 51, Ill.
Indoor telescoping V.

Penn Boiler & Burner Mfg. Corp.,
Lancaster, Pa.
Tripod-type towers in sections, usable to 120 feet; tower bases, turning caps, pole mounts, roof mounts.

A. A. Peters,
231 North 7th St., Allentown, Pa.
No information furnished.

Philson Mfg. Co., Inc.,
60 Sackett St., Brooklyn 31, N. Y.
Wide- and narrow-band arrays; indoor dipoles; masts.

Phoenix Electronics, Inc.,
Lawrence, Mass.
No information furnished.

Precision Plastic Products, Inc.,
628 West Lake St., Chicago 7, Ill.
Adjustable folded dipoles.

Premax Products Division,
Chisholm-Ryder Co., Inc.,
Niagara Falls, N. Y.
Adjustable V-shaped dipoles (outdoor).

Price Tenna-Trailer Co.,
660 East Walnut St., Watseka, Ill.
Trailer carrying telescoping mast for TV demonstration; telescoping masts for permanent installation.

Progress Mfg. Co.
2165 Morris Ave., Union, N. J.
Chimney mounts.

Rad-El-Co Mfg. Co.,
7580 Garfield Blvd.,
Cleveland 25, Ohio
Broadband X-type, in-line, and folded-dipole-and-reflector arrays. Five models.

Radiart Corp.,
3571 West 62nd St.,
Cleveland 2, Ohio
Single and multielement, single- and multi-stack, folded-dipole arrays for high and low bands; single and stacked conicals; indoor V's. Fifty-six models. Mounts, masts, and brackets. Antenna rotators.

The Radio Craftsmen, Inc.,
1617 South Michigan Ave.,
Chicago 16, Ill.
Adjustable indoor "slide-rule" antenna.

Radio Merchandise Sales
550 Westchester Ave., New York 55
Single- and multibay dipoles, folded dipoles, conicals, and special V types; indoor and window antennas. Mounts and hardware. Twenty-five antenna models.

Radion Mfg. Co., Inc.,
1137 Milwaukee Ave.,
Chicago, Ill.
No information furnished.

Raytron Mg. Co.,
441 Summit, Toledo, Ohio
Single- and double-stacked fans and conicals. Aluminum rods, Plexiglas insulators, and hardware for antenna builders.

RCA Tube Department,
415 South 5th St., Harrison, N. J.
Wide- and narrowband arrays, reversible beams, indoor dipoles, V attachments for increasing forward gain of wideband dipoles. Thirteen antenna models. Transmission line, mast mountings, couplings, guy rings.

Norman N. Sewell, Inc.,
Susquehanna Ave. at Dearstine,
Lansdale, Pa.
No information furnished.

Snyder Mfg. Co.,
22nd & Ontario Sts.,
Philadelphia, Pa.
Dipole, folded-dipole, and conical arrays; indoor antennas. Brackets, masts.

South River Metal Products Co., Inc.,
South River, N. J.
Chimney and wall mounts; standoffs.

Spirling Products Co., Inc.,
62 Grand Street, New York, N. Y.
Indoor V antennas.

Square Root Mfg. Co.,
901 Nepperhan Ave.,
Yonkers, N. Y.
No information furnished.

Standard Coil Products Co., Inc.,
2329 North Pulaski Road,
Chicago 39, Ill.
High-gain booster.

Technical Appliance Corp.,
Sherburne, N. Y.
Stacked and single-bay Yagis, conicals, lazy H's, and folded dipoles; indoor antennas. Forty-one models.

Tel-A-Ray Enterprises, Inc.,
P. O. Box 332, Henderson, Ky.
High-gain multielement dipole antennas.

Telrex, Inc.,
26 Neptune Highway,
Asbury Park, N. J.
Single-bay and multistack conicals.

Telvision Laboratories, Inc.,
542 N. Parkside Ave.,
Chicago 44, Ill.
"Printed" antennas (conducting paint in the shape of a folded dipole on heavy paper).

Tricraft Products Co.,
1535 North Ashland Ave.,
Chicago 22, Ill.
End-loaded dipoles, indoor and outdoor; single and stacked conicals.

U.H.F. Resonator Co.,
224 7th St., Racine, Wis.
High-gain, highly directional, stacked, colinear arrays.

Unimac Division,
Marvin Radio-Television,
Buckeye at 89th St., Cleveland, Ohio
Universal, standard, and chimney mounts.

Universal Products,
4100 Taylor Ave., Racine, Wis.
Steel towers, conical antennas, masts. Eleven models.

Veri-Best Television Products, Inc.,
233 Spring St., New York, N. Y.
Dipoles and folded dipoles with reflectors; indoor V's; mounting brackets.

Walco Products, Inc.,
East Orange, N. J.
Aluminum towers.

Ward Products Corp.,
1523 East 45th St., Cleveland, Ohio
Single- and multistack, broadband folded dipoles. Fifteen models.

Warren Mfg. Co., Inc.,
250 East St., New Haven, Conn.
Dipoles, folded dipoles, conicals, fans, and V's.

J. M. Weaver Co.,
267 Kings Road, Madison, N. J.
All-channel folded dipoles and hardware.

Western Coil & Electrical Co.,
215 State St., Racine, Wis.
Towers, telescoping masts, and accompanying mounts, guy rings, insulators, etc.

Wincharger Corp.,
East 7th & Division Sts.,
Sioux City 6, Iowa
Thirteen models of towers.

Wind Turbine Co.,
East Market St. & Penna. R.R.,
West Chester, Pa.
Ten models of towers.

Workshop Associates, Inc.,
66 Needham St.,
Newton Highlands, Mass.
Narrowband arrays with three and twelve elements. Thirty-six antenna models. Masts, mounts, matching transformers, silver-plated connectors.

Overhead Planes Cause TV Flutter

DURING the war, it was a good thing that airplanes reflect high-frequency radio waves so well, radar being one of our most effective weapons. Now this reflecting property is a great annoyance. Many TV owners are bothered by picture flutter caused by passing planes. The TV signal, like a radar beam, is reflected to the receiving antenna by the moving aircraft. Here it adds or subtracts from the direct signal, giving alternately a brighter and darker picture.

The same effect, incidentally, is noticed on FM receivers, due to the high frequency on which they operate. It manifests itself as a rapid fading, and is not as troublesome as on television, partly because of the automatic volume control action and partly because the ear is not as critical as the eye.

It is difficult to experiment with this type of interference because it lasts only a few seconds each time. However, A. H. Cooper describes in *Wireless World* (London, England) his theoretical investigations supplemented with actual observations (he lives near two airports).

The phase difference of an echo depends upon how much longer it has traveled than has the direct signal. This added time (or distance) is fixed only if the plane travels in an ellipse with receiving and transmitting antennas at the foci. There would be no flutter if a plane were to follow such a course. The picture would be strengthened or weakened by the echo, but it would remain steady.

Since a plane never does fly such an ideal course, flutter does result from an aircraft flying in the neighborhood. While the plane is still distant, the flutter frequency is high, probably more than 20 cycles per second. As the craft approaches, the frequency is reduced. In some cases the image may become completely blacked out for about a second, followed by an intensely brilliant screen for the next second. Then the frequency increases again until the plane disappears.

Flutter may be reduced by automatic gain control (a.g.c). Unfortunately, this is not the whole solution. The echoes may be progressively swept across the screen, going positive and negative alternately. To make matters worse, these echoes may arrive in time to interfere with the sync pulses. Also echoes of the pulses may interfere with the picture. There are no known cures for these conditions.

Mr. Cooper offers partial solutions. A good directional antenna limits the directions from which echoes can be picked up. (Stacking increases the horizontal pickup at the expense of the vertical, greatly reducing such interference.—*Editor.*) Increased antenna height may also help by increasing the direct signal without greatly changing the reflection. He also finds that a.c. coupling between video amplifier and kinescope is preferable to direct coupling. With a.c. coupling the *average* brightness does not vary during a fade.
—*Nathaniel Rhita*

Directory of TV Receiver Characteristics

1 Manufacturer	2 Model	3 Chassis number	4 Cabinet type	5 FM-AM-SW	6 C-R tube type	7 C-R tube anode kilovolts	8 Number of tubes (less rectifiers)	9 Number of rectifiers	10 Intercarrier sound	11 Tuner type	12 A.g.c. (RF or IF)	13 A.f.c. (RF or sweep)	14 AC, DC, Both	15 FM wave traps	16 Audio output (watts)	17 Speaker size (inches)
Admiral Corp.	4H126A[1], 4H137A[1]	21A1	CO	AM-FM	16AP4	13	27	4	No	T	Both	Sweep	AC	No		12
3800 Cortland St.	17T11, 17T12	17T1	TA	No	7JP4	5.5	16	2	Yes	T	Both	No	AC	No		5
Chicago 47, Ill.	20X11, 20X12	20X1	TA	No	10BP4	9	17	2	Yes	T	Both	Sweep	AC	No		5
	20X122	20X1	CO	No	10BP4	9	17	2	Yes	T	Both	Sweep	AC	No		6
	24A125	20A1	CO	No	10BP4	9	21	3	No	T	Both	Sweep	AC	No		6
	24C15, -16, -17	20B1	CO	No	12LP4	9	21	3	No	T	Both	Sweep	AC	No		6
	25A15, -16, -17	21A1	CO	No	16AP4	13	21	4	No	T	Both	Sweep	AC	No		10
	30F15, -16, -17[1]	20B1	CO	AM-FM	12LP4	9	27	3	No	T	Both	Sweep	AC	No		10
Air King Products	1001A	499-3	CO	No	10BP4	10	19	1	Yes	T,S	Both	Sweep	AC	No	2.5	10
Co., Inc.	A1000	496	TA	No	10BP4	10	28	2	No	T,S	No	Sweep	AC	Yes	2.5	5
170 53 St.	A1001	496	CO	No	10BP4	10	28	2	No	T,S	No	Sweep	AC	Yes	2.5	10
Brooklyn, N. Y.	A1016	496-1	CO	No	16AP4	13.5	28	2	No	T,S	No	Sweep	AC	Yes	2.5	10
	A2000, A2010	499	TA	No	10BP4	10	18	2	Yes	T,S	Both	Sweep	AC	No	2.5	5
	A2001	499-1	TA	No	12LP4	10	18	2	Yes	T,S	Both	Sweep	AC	No	2.5	5
	A2002	499-2	CO	No	12LP4	10	18	2	Yes	T,S	Both	Sweep	AC	No	2.5	10
	A2012	499-1	CO	No	12LP4	10	19	1	Yes	T,S	Both	Sweep	AC	No	2.5	5
Altec Lansing Corp.	ALC-202	400	WC	No	12LP4	9	19	2	No	S	No	Sweep	AC	Yes	3.5	
1161 North Vine St.	ALC-203	400	TA	No	12LP4	9	19	2	No	S	No	Sweep	AC	Yes	3.5	8
Hollywood 38, Calif.	ALC-204	500	CO	No	12LP4	9.5	21	2	No	T	Both	Sweep	AC	No	3.5	8
	ALC-205	516	WC	No	16DP4	13.5	21	3	No	T	Both	Sweep	AC	No	3.5	
	ALC-206	516	CO	No	16DP4	13.5	21	3	No	T	Both	Sweep	AC	No	3.5	8
Andrea Radio Corp.	Carenia COVK16[1]	VK15-16	CO	AM-FM	16-in.	13.5	27	3	No	C	No	Sweep	AC	No	6.0	12
27-01 Bridge Plaza North	Gramercy CVK126[8]	VK12	CO	AM-FM	12½-in.	10.5	26	3	No	C	No	Sweep	AC	No	4.5	10
Long Island City 1	Ridgeway CVK125[1]	VK12	CO	AM-FM	12½-in.	10.5	26	3	No	C	No	Sweep	AC	No	4.5	10
New York	Saratoga TVK12															
	Sharron TVK127[8]	VK12	TA	AM-FM	12½-in.	10.5	26	3	No	C	No	Sweep	AC	No	4.5	8
	Winfield CVK151[8]	VK151	CO	AM-FM	15½-in.	12.5	27	3	No	C	No	Sweep	AC	No	6.0	12
Ansley Radio and	706[1]	703	CO	AM-FM	16-in.	13	26	4	No	T,S	No	Sweep	AC	Yes	8	12[11]
Television, Inc.	717	P101		No	3NP4[10]	26	30	6	No	T,S	No	Sweep	AC	Yes	3	8
41 St. Joes Ave.	718	P101	CO	No	3NP4[12]	26	30	6	No	T,S	No	Sweep	AC	Yes	3	12
Trenton 9, N.J.	719[1]	703	CO	AM-FM	16-in.	13	26	4	No	T,S	No	Sweep	AC	Yes	8	12
	720[1]	702	CO	AM-FM	12½-in.	9	26	3	No	T,S	No	Sweep	AC	Yes	8	12
	721, 724	703	CO	No	16-in.	13	26	4	No	T,S	No	Sweep	AC	Yes	3	12
	723	703	TA	No	16-in.	13	26	4	No	T,S	No	Sweep	AC	Yes	3	6
Arvin Radio and Television	3100TM	272-1	TA	No	10BP4		20	3	No	T	Both	Sweep	AC	No	2	5x7
Noblitt-Sparks Industries, Inc.	3120CM	272-2	CO	No	12LP4		20	3	No	T	Both	Sweep	AC	No	2	10
Columbus, Ind.	3160CM	276	CO	No	16AP4		20	5	No	T	Both	Sweep	AC	No	2.5	10
	3101CM	272-1	CO	No	10BP4		20	3	No	T	Both	Sweep	AC	No	2	5x7
Bace Television Corporation	160C	160C	CO	No	16-in.	13.5	25	4	No	S	Both	Sweep	AC	Yes	4	8
Green and Leuning St.	160TM	160TM	TA	No	16-in.	13.5	25	4	No	S	Both	Sweep	AC	Yes	4	8
South Hackensack, N. J.	190C	190C	CO	No	19-in.	13.5	25	4	No	S	Both	Sweep	AC	Yes	4	8
Bell Television, Inc.	1500 (16-in. Club)		TA	No	16-in.	12.5	31	2	No	S	Both	Sweep	AC	Yes	4	8
552 West 53 St.	1501 (16 in. Remote)		RE	No	16-in.	12.5	31	4	No	S	Both	Sweep	AC	Yes	4	8
New York 19, N. Y.	2000 (20-in. Club)		TA	No	20-in.	12.5	32	4	No	S	Both	Sweep	AC	Yes	4	8
	2001 (20-in. Remote)		RE	No	20-in.	12.5	32	4	No	S	Both	Sweep	AC	Yes	4	8
Belmont Radio Co.	No information supplied															
Division Raytheon Mfg. Co.																
59 1 West Dickens Ave.																
Chicago 49, Ill.																

Bendix Radio-Television and Broadcast Receiver Division Bendix Aviation Corp. Baltimore 4, Md.	235B1, 235M1, 325M8[3]	T1, T2	TA	No	10BP4	10	20	3	No	C,S	Both	No	AC	Yes	3	4x6
		C1-5, C11-1	CO	AM-FM	10BP4	10	20	3	No	C,S	Both	No	AC	Yes	3	12
	2001	T4-1	TA	No	10BP4	7	14	2	Yes	T	Both	No	AC	No	1.5	4x6
	2020	T4-2	TA	No	12KP4	7.5	14	2	Yes	T	Both	No	AC	No	1.5	4x6
	3001, 3002	T4-1	CO	No	10BP4	7	14	2	Yes	T	Both	No	AC	No	1.5	4x6
Bowers Battery & Spark Plug Co. Reading, Pa.	TC-12		CO	No	12AP4	9	22	2	Yes	S	No	No	AC		5	12
	TC-16		CO	No	16AP4	12.6	22	2	Yes	S	No	No	AC		5	12
	TTM-10		TA	No	10BP4	7.5	22	2	Yes	S	No	No	AC		5	6
	TTM-16		TA	No	16AP4	12.6	22	2	Yes	S	No	No	AC		5	8
Brunswick Division Radio and Television, Inc. 244 Madison Ave. New York 16, N. Y.	812		TA	No	12LP4	9.2	18	2	Yes	S	Both	Sweep	AC	No	3	5
	816		TA	No	16-in.	11	18	2	Yes	S	Both	Sweep	AC	No	3	8
	8125		CO	No	12LP4	9.2	18	2	Yes	S	Both	Sweep	AC	No	3	10
	8165		CO	No	16-in.	11	18	2	Yes	S	Both	Sweep	AC	No	3	10
Capehart-Farnsworth Corp. Fort Wayne 1, Ind.	462P12	C-276	CO	No	12½-in.	12	32	2	No	S	Both	Sweep	AC	Yes	5	12
	661P10		CO	No	10-in.	12	27	2	No	S		Sweep	AC	Yes	5	12
	B504P16[4]		CO	AM-FM	16-in.	12	40	3	No	S	Both	Sweep	AC	Yes	12	12
	3001[6]	CX30		No	12½-in.		19	3			Both		AC		5	6
	3001-B, -M[5]	C-272	TA	No	12½-in.	12	19	3	Yes	C	Both	Sweep	AC	No	5	6
	3002[6]	CX30		No	12½-in.	12	19	3			Both		AC		5	8
	3002-B, -M[5]	C-272	CO	No	12½-in.	12	19	3	Yes	C	Both	Sweep	AC	No	5	8
	3004[6]	CX31		AM-FM	12½-in.		30	2			Both		AC		12	12
	3004-M[5], 4001-M[4]	C-268	CO	AM-FM	12½-in.	12	30	2	No	T	Both	Sweep	AC	No	12	12
	3006[7]	CX31		AM-FM	16-in.		30	2			Both		AC		12	12
	3006-M[5]	C-274	CO	AM-FM	16-in.	12	30	2	No	T	Both	Sweep	AC	No	12	12
	4001[3]	CX31		AM-FM	12½-in.		30	2							12	12
	504P16[4]	U12		AM-FM	16-in.		40	3			Both		AC		12	12
Cascade Television Co. 179-181 South St. Newark 5, N. J.	Cascade	F30	CO	No	16-in.	13	26	4	No	T	Both	No	AC	Yes	5	12
	Cascade Junior	125D	TA	No	15-in.	13	27	4	No	S	Both	No	AC	Yes	5	5x7
	Cascade Custom[2]	F38-4X3	RE	No	5-in.[13]	25	32	6	No	T	Both	No	AC	Yes	5	12
Certified Radio Laboratories 5507 13 Ave. Brooklyn 19, N. Y.	Certified	48-10	K	No	7JP4	3	16	2	No	S	No	No	AC	No	2	4x6
	Sovereign	4920	K	No	10BP4[14]	10	18	2	Yes	T	Both	Sweep	AC	No	2.5	4x6
Conrac, Inc. 649 West Foothill Blvd. Glendora, Calif.	520	520	CO	No	12LP4	9.5	20	2	Yes	S	IF	Sweep	AC	Yes	3.5	12
	536	536	CO	No	16DP4	13.5	20	3	Yes	S	IF	Sweep	AC	Yes	3.5	12
Convertible Television, Inc. 630 5th Ave. New York 20, N. Y.	The Essex	10T149	TA[15]	FM[16]	10-in.[16]		19	3	Yes	RT	Both	No	AC	No		5
	The Hampshire	16T170	TA[15]	FM[16]	16-in.[16]		19	3		RT	Both	No	AC	No		5
	The Sussex	12C160	TA[15]	FM[16]	12½-in.[16]		19	3		RT	Both	No	AC	No		5
Crosley Division Avco Corp. 1329 Arlington St. Cincinnati, Ohio	9-403MA	227	TA	FM	10BP4	8.5	18	3	No	I	No	Sweep	AC	No	3.5	7x5
	9-404M[3], 9-414B[3]	228, 229	CO	AM-FM	10BP4	8.5	21	3	No	I	No	Sweep	AC	No	4	10
	9-409M Family Theater[3]	226, 276	CO	AM-FM	12QP4	8.5	28	5	No	I	No	Sweep	AC	No	4	10
	9-419M Popularity[8]	277	TA	FM	12LP4	8.5	23	4	No	I	No	Sweep	AC	No	3.5	7x5
	9-422M Master Showman[8]	232	CO	FM	16AP4	11.5	24	5	No	I	No	Sweep	AC	No	4	10
	9-424B	270	CO	FM	10BP4	8.5	18	3	No	I	No	Sweep	AC	No	4	10
	9-425		PO	No	7JP4	5.3	19	5	Yes	S	Both	No	AC	No	1.8	5
Delco, United Motors Service Division of General Motors Corp. General Motors Building Detroit 2, Mich.	TV-102[9]		TA	No	10BP4	8.5	21	2	Yes	S	Both	No	AC	No	2	6½
	TV-121		CO	No	12LP4	11.5	21	2	Yes	S	Both	No	AC	No	3	6½
	TV-122		CO	No	12LP4	11.5	21	2	Yes	S	Both	No	AC	No	3	6½
	TV-160		CO	No	16AP4	10.5	21	2	Yes	S	Both	No	AC	No	3	8
DeWald Radio Mfg. Company United Scientific Laboratories 35-15 37 Avenue Long Island City 1, New York	BT-100		TA	No	10BP4	9.2	26	4	No	S	Both	Sweep	AC	Yes	4	6½
	CT-101		CO	No	16AP4	10	26	4	No	S	Both	Sweep	AC	Yes	4	6½
	CT-102, CT-103		TA	No	10BP4	9.2	19	3	No	S,T	Both	Sweep	AC	Yes	3	6½
	CT-104, CT-120		TA	No	12LP4	10	19	3	Yes	S		Sweep	AC	Yes	3	6½
	CT-160		TA	No	16AP4	12	19	3	No	S		Sweep	AC	Yes	3	6½
	CT-2000		CO	No	3NP4[13]	25	29	8	No	S		Sweep	AC	Yes	4	12
	DTX-160, DTX-161		TA	No	16AP4	12	19	3	Yes	S		Sweep	AC	Yes	3	6½
Allen B. Du Mont Laboratories 35 Market St. East Patterson, New Jersey	Bradford[3]	RA-108	CO	FM	19AP4	14	30	6	No	I	IF	Sweep	AC	No	2.5	12
	Club 20[8]	RA-106	CO	FM	20BP4	16	29	6	No	I	Both	Sweep	AC	No	2.5	10
	Colony[3]	RA-105	CO	AM-FM	15AP4	10	34	7	No	I	Both	Sweep	AC	No	8	12
	Hastings[8]	RA-104A	TA	FM	15DP4	8.5	25	5	No	I	No	Sweep	AC	No	2.5	6

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Allen B. Du Mont Labs. (cont'd)	Manchu[8]	RA-106	CO	AM-FM	20BP4	16	35	7	No	I	IF	Sweep	AC	No	8	12
	Ramson [8]	RA-103D	TA	FM	12QP4	8	25	5	No	I	No	Sweep	AC	No	2.5	6
	Savoy[3]	RA-103	CO	AM-FM	12JP4	8.5	30	4	No	I	No	Sweep	AC	No	2.5	10
	Sheffield[8]	RA-103D	CO	FM	12QP4	8	25	5	No	I	No	Sweep	AC	No	2.5	10
	Sussex[8]	RA-105B	CO	FM	15DP4	12	29	6	No	I	IF	Sweep	AC	No	2.5	12
	Westwood[8]	RA-110A	CO	FM	19AP4	8.5	25	5	No	I	No	Sweep	AC	No	2.5	12
Electromatic Manufacturing Corp. 88 University Place New York 3, New York	100	500100	TA	No	10BP4	9	17	4	Yes	S	Both	Sweep	AC[17]	No	4	6
	101	500100	TA	No	10BP4	9	17	4	Yes	S	Both	Sweep	AC[17]	No	4	6
	120	500100A	TA	No	12CP4	9	17	4	Yes	S	Both	Sweep	AC[17]	No	4	6
	150	500100B	TA	No	15CP4	11	17	4	Yes	S	Both	Sweep	AC[17]	No	4	6
Electro-Technical Industries 1432 North Broad Street Philadelphia 21, Pa.	Telekit 7B	7B	K	No	7JP4	6	16	3	No	S	IF	No	AC	No	5	5
	Telekit 10B	10B	K	No	10BP4	9	16	2	No	S	IF	Sweep	AC	No	5	6x8
	Telekit 16B	10B	K	No	16AP4	14	16	2	No	S	IF	Sweep	AC	No	5	6x8
Emerson Radio & Phonograph Corp. 111 Eighth Avenue New York 11, New York	600	120103B	PO	No	7JP4	6	19	2	Yes	T	Both	Sweep	Both[17]	No	2	4
	608	120089B	CO	No	16AP4	13	22	7	Yes	T	Both	Sweep	AC[17]	No	3	12
	609	120084B	CO	No	3NP4[13]	25	25	9	Yes	T	Both	Sweep	AC[17]	No	5	12
	614 637	120110B	TA	No	10BP4	8	20	3	Yes	T	Both	Sweep	AC	No	3	6
	621, 628	120098B	TA	AM-FM	10BP4	8.5	25	3	Yes	T	Both	Sweep	AC	No	3	6
	622[3]	120098P	CO	AM-FM	10BP4	8.5	25	3	Yes	T	Both	Sweep	AC[17]	No	3	12
	626	120104B	CO	No	16AP4	13	22	7	Yes	T	Both	Sweep	AC[17]	No	3	12
	627	120107B	TA	No	12LP4	8	20	6	Yes	T	Both	Sweep	AC[17]	No	3	6
	630[3]	120099B	CO	AM-FM	12LP4	8.5	25	3	Yes	T	Both	Sweep	AC	No	3	12
	631	120109B	TA	No	16AP4	13	22	4	Yes	T	Both	Sweep	AC[17]	No	3	6
	632[3]	120096B	CO	AM-FM	16AP4	13	25	4	Yes	T	Both	Sweep	AC	No	3	12
	638	120087B	CO	No	10BP4	8	20	6	Yes	T	Both	Sweep	AC[17]	No	3	6
	639	120103B	TA	No	7JP4	6	19	2	Yes	T	Both	Sweep	Both[17]	No	2	4
	644	120113B	TA	No	12LP4	8	20	3	Yes	T	Both	Sweep	AC	No	3	6
Espey Manufacturing Company 528 East 72 Street New York 21, New York	TV3K	TV3K	K	No	3-in.	0.93	16	2	No	S	No	Sweep	AC	No	2	3
Fada Radio and Electric Co., Inc. 525 Main Street Belleville, N. J.	TV30		TA	No	10-in.	8.5	26	4	No	S	No	Sweep	AC	Yes		5x7
	880		CO	No	3NP4[12]	25	30	6	No	S	No	Sweep	AC	Yes		10
	895[3]		CO	AM-FM	12½-in.	9.5	27	3	No	S	No	Sweep	AC	Yes		10
	925		TA	No	16-in.	12.5	27	4	No	S	No	Sweep	AC	Yes		6[18]
	930		TA	No	12½-in.	9.5	27	3	No	S	No	Sweep	AC	Yes		5x7[1]
	940		CO	No	12½-in.	9.5	27	3	No	S	No	Sweep	AC	Yes		10
	965		CO	No	16-in.	12.5	27	4	No	S	No	Sweep	AC	Yes		10
Federal Television Corp. 139 Duane Street New York 3, New York	Commodore[3]	1600C	CO	AM-FM	16DP4	12.5	27	4	No	I	Both	Sweep	AC	No	4	12
	Dover[19]	1200D	CO	FM	12LP4	9	24	2	No	I	Both	Sweep	AC	No	4	12
	Essex[19]	1600E	CO	FM	16DP4	12.5	24	4	No	I	Both	Sweep	AC	No	4	12
	Manhattan[19]	1600M	TA	FM	16DP4	12.5	24	4	No	I	Both	Sweep	AC	No	4	5x7
	Mohawk	1600M	TA	No	16DP4	12.5	23	4	No	T	Both	Sweep	AC	No	4	5x7
	New Yorker[19]	1200N	TA	FM	12LP4	9	24	2	No	I	Both	Sweep	AC	No	4	5x7
	Pacemaker	1600P	CO	No	16DP4	12.5	23	4	No	T	Both	Sweep	AC	No	4	12
Fisher Radio Corp. 41 East 47th Street New York, N. Y.	No information supplied															
Freed Radio Corp. 200 Hudson St. New York, N. Y.	No information supplied															
Garod Electronics Corporation 70 Washington Street Brooklyn 1, New York	10TZ20, 10TZ22 (Tele-Zoom)[21]	93	TA[20]	AM-FM	10BP4	9	22	4	No	C	Both	Sweep	AC	Yes	2	6[66]
	1042 (Headliner)[21]	94	TA	No	10BP4	8.5	16	3	Yes	C	Both	Sweep	AC	No	2	5
	12TZ20, 12TZ22 (Tele-Zoom)[21]	93	TA[20]	AM-FM	12LP4	9	22	4	No	C	Both	Sweep	AC	Yes	2	6[66]

	1244 (Madison)	94	TA	No	12LP4	8.5	16	3	Yes	C	Both	Sweep	AC	No	2	5
	15TZ24 (Tele-Zoom)[21]	93	CO	AM-FM	15LP4	10	22	5	No	C	Both	Sweep	AC	Yes	3	10
	1546 (Newport)	94	TA	No	16LP4	10	16	3	Yes	C	Both	Sweep	AC	No	2	6
	1548 (Raleigh)	94	CO	No	16LP4	10	16	3	Yes	C	Both	Sweep	AC	No	2	10
General Electric Company Receiver Division Electronics Park Syracuse, New York	10C101		CO	No	10-in.	10.5	18	3	Yes	S	Both	Sweep	AC[17]	Yes	2	10
	10T1, 10T4, 10T5		TA	No	10-in.	10.5	18	3	Yes	S	Both	Sweep	AC[17]	Yes	2	4
	12C101, 12C102, 12C105		CO	No	12½-in.	10.5	18	3	Yes	S	Both	Sweep	AC[17]	Yes	2	12
	12K1[1]		CO	AM-FM	12½-in.	10.5	24	4	Yes	S	Both	Sweep	AC[17]	Yes	5	12
	12T1		TA	No	12½-in.	10.5	18	3	Yes	S	Both	Sweep	AC[17]	Yes	2	4
	800		TA	No	10-in.	10.5	18	3	Yes	S	Both	Sweep	AC[17]	Yes	2	4
Hallicrafters 4401 West Fifth Avenue Chicago, Ill.	600[6]		TA	No	10-in.	9	18	2	Yes	S	Both	Sweep	AC	No	1.5	4x6
	601, 602[6]		TA[20]	No	12½-in.	12	18	2	Yes	S	Both	Sweep	AC	No	1.5	8
	603, 604[6]		TA[20]	No	16-in.	13	18	2	Yes	S	Both	Sweep	AC	No	1.5	8
Hoffman Radio Corporation 3761 South Hill Street Los Angeles, Calif.	C610	140	TA	No	10BP4	9	22	2	No	T	Both	Sweep	AC	No	3	6
	C612	142	TA	No	12LP4	9	22	2	No	T	Both	Sweep	AC	No	3	6
	C912, C913[22]	147	CO	AM-FM	16AP4	12.5	36	5	No	T	Both	Sweep	AC	No	15	12
	600	154	TA	No	10BP4	9	22	2	No	T	Both	Sweep	AC	No	3	5
	601	155	TA	No	12LP4	9	22	2	No	T	Both	Sweep	AC	No	3	5
	613	149	TA	AM-FM	12LP4	9	25	2	No	T	Both	Sweep	AC	No	3	5
	820, 821, 822	146	CO	No	12LP4	9	22	2	No	T	Both	Sweep	AC	No	3	12
	826, 827, 828	143	CO	No	16AP4	12.5	22	4	No	T	Both	Sweep	AC	No	3	12
	830, 831	151	CO	No	16AP4	12.5	23	4	No	T	Both	Sweep	AC	No	3	12
	836, 837, 840	153	CO	No	19AP4	12.5	24	4	No	T	Both	Sweep	AC	No	3	12
	914, 915[3]	150	CO	AM-FM	12LP4	9	25	2	No	T	Both	Sweep	AC	No	3	8
	917, 918, 920[3]	152	CO	AM-FM	16AP4	12.5	26	4	No	T	Both	Sweep	AC	No	3	12
Industrial Television, Inc. 359 Lexington Avenue Clifton, New Jersey	Century 326[2]	IT-26R	CO	No	16FP4	14	30	5	No	T	No	Sweep	AC	Yes	5	12
	Century 821D	IT-21R	TA	No	12LP4	11	17	3	Yes	T	Both	Sweep	AC	Yes	3	5
	Century 921D	IT-21R	CO	No	12LP4	11	17	3	Yes	T	Both	Sweep	AC	Yes	3	12
International Television Corp. 238 William Street New York 7, New York	D-12	630TS	TA	No	12½-in.	9	27	4	No	S	No	Sweep	AC	No	4½	12
	D-16	630TS	CO	No	16-in.	14	27	4	No	S	No	Sweep	AC	No	4½	12
	D-19	630TS	CO	No	19-in.	14	27	4	No	S	No	Sweep	AC	No	4½	12
Lytle & Co. 4721 N. Kedzie Avenue Chicago, Ill.	No information supplied															
Magnavox Company, The Fort Wayne, Ind.	American Modern[3]	CT224,-235	CO	AM-FM	12KP4[23]	12	22	3	No	S	Both	Sweep	AC	Yes[26]	18	15[27]
	American Traditional[3]	CT220	CO	AM-FM	12KP4[23]	9	22	3	No	S	Both	Sweep	AC	No	4[28]	12
	Brittany	CT232,-236	CO	No	16AP4	14	22	4	No	S	Both	Sweep	AC	Yes[26]	4	12
	Constellation	CT232,-236	TA	No	16AP4	14	22	4	No	S	Both	Sweep	AC	Yes[26]	4	8
	Contemporary, Normandy	CT232,-236	CO	No	16AP4	14	22	4	No	S	Both	Sweep	AC	Yes[26]	4	12
	Embassy[3]	CT224	CO	All	12KP4[23]	12	22	3	No	S	Both	Sweep	AC	No	20	15[30]
	Embassy 150[3]	CT246	CO	All	16AP4[24]	14	23	4	No	S	Both	Sweep	AC	No	20	15[30]
	French Provincial[3]	CT237	CO	AM-FM	12KP4[23]	9	22	2	No	S	Both	Sweep	AC	No	4[29]	15[27]
	Hepplewhite[3]	CT220	CO	AM-FM	12KP4[23]	9	22	2	No	S	Both	Sweep	AC	No	4[28]	12
	Modern Symphony	CT238	CO	No	12KP4[23]	9	22	2	No	S	Both	Sweep	AC	Yes	4	12
	Modular	CT237	TA	No	12KP4[23]	9	22	2	No	S	Both	Sweep	AC	No	4	8
	Windsor Bookcase[25]	CT235	25	No[25]	12KP4[23]	12	22	3	No	S	Both	Sweep	AC	Yes	45	15[27]
Mars Television, Inc. 29-05 40th Road Long Island City, New York	Academy	631	CO	No	16HP4	13.5	27	4	No	T	Both	Sweep	AC	Yes	4	10
	Baldwin	630	TA	No	12RP4	10	27	3	No	T	No	Sweep	AC	Yes	4	5x7
	LaSalle[31]	631	CO	No	16HP4	13.5	28	4	No	T	Both	Sweep	AC	Yes	4	10
	Princeton[31]	631	TA	No	16HP4	13.5	28	4	No	T	Both	Sweep	AC	Yes	4	5x7
Mattison Television and Radio Corp. 220 Fifth Ave. New York 1, N. Y.	No information supplied															
John Meck Industries, Inc. Plymouth, Ind.	XD-704		TA	No	7JP4	4	19	4	Yes	S	Both	No	AC[17]	No	2	5
	XE-705		PO	No	7JP4	4	19	4	Yes	S	Both	No	AC[17]	No	2	5

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
John Meck Industries, Inc. (Cont'd)	XM-751		TA	No	10BP4	9	17	3	Yes	S	Both	Sweep	AC	No	2	5
	XQ-776		TA	No	12LP4	9	17	3	Yes	S	Both	Sweep	AC	No	2	5
	XR-778		CO	No	12LP4	9	17	3	Yes	S	Both	Sweep	AC	No	2	10
	XS-786		CO	No	16DP4	11	17	3	Yes	S	Both	Sweep	AC	No	2	10
	XT-785		TA	No	16DP4	11	17	3	Yes	S	Both	Sweep	AC	No	2	5
Meissner Manufacturing Division, Maguire Industries, Inc., Mt. Carmel, Ill.	TV1[32]		TA	No	12KP4	9	22	3	No	S	No	Sweep	AC	No	2	5
	24TV[32]		WC	No	12KP4	9	22	3	No	S	No	Sweep	AC	No	2	5
Motorola, Inc., 4545 Augusta Blvd., Chicago, Ill.	7VT2, 7VT5, 9VT1	TS-18	TA[33]	No	7JP4[34]	6	15	3	Yes	S	IF	Sweep	AC[17]	No	1.5	5[39]
	10VT10,-24; 10VK12,-22	TS-14	TA[35]	No	10BP4	10	18	3	Yes	S	Both	Sweep	AC[67]	No	1.5	5[40]
	12VT13, 12VK11	TS-23	TA[35]	No	12LP4	10	18	3	Yes	S	Both	Sweep	AC[67]	No	1.5	6[40]
	12VF4[3]	HS-190[36]	CO	AM-FM	12LP4	10	24	5[43]	Yes	S	Both	Sweep	AC	No	1.5[41]	10[42]
	12VK15	TS-30	CO	No	12KP4	13	24	5[44]	Yes	S	Both	Sweep	AC	No	2.6	10
	16VK7	TS-16	CO	No	16AP4	13	24	5[44]	Yes	S	Both	Sweep	AC	No	2.6	10[42]
	16VF8[3]	TS-16[37]	CO	AM-FM	16AP4	13	32	6[38]	Yes	S	Both	Sweep	AC	No	2.6[45]	12[42]
Multiple Television Mfg. Co., 987 Hegeman Ave., Brooklyn 8, N. Y.	No information supplied															
Muntz T. V., Inc., 1735 Belmont Avenue, Chicago, Ill.	M-20	M-158	TA	No	10BP4	8.8	14	2	Yes	T	Both	Sweep	AC	No	1.5	5
	M-21	M-160	TA	No	12LP4	10.5	14	2	Yes	T	Both	Sweep	AC	No	1.5	5
	M-22	M-169	CO	No	12LP4	10.5	14	2	Yes	T	Both	Sweep	AC	No	1.5	8
	M-26	M-159	CO	No	16-in.	11.5	14	2	Yes	T	Both	Sweep	AC	No	1.5	10
National Company, Inc., 61 Sherman Street, Malden 48, Mass.	NC-TV-7W, NC-TV-7M		TA	No	7JP4	5	18	3	Yes	S	Both	No	AC	No	2	6[18]
	NC-TV-10W		TA	No	10BP4	10	20	2	Yes	S	Both	Sweep	AC	No	3	6[18]
	NC-TV-12T, NC-TV-12C		TA	No	12LP4	12	20	2	Yes	S	Both	Sweep	AC	No	3	6[18]
	NC-TV-1225		CO	No	12LP4	12	20	2	Yes	S	Both	Sweep	AC	No	3	10
Nielsen Television Corporation, Newton Ave. at Crawford Road, Norwalk, Conn.	1018B	1018	CO	No	10-in.	8.5	27	3	No	S		Sweep	AC	Yes	4	12
	1018D	1018	TA	No	10-in.	8.5	27	3	No	S		Sweep	AC	Yes		6
	1218D	1218	TA	No	12½-in.	9	27	3	No	S		Sweep	AC	Yes		6
	1618B	1618	CO	No	16-in.	11	27	4	No	S		Sweep	AC	Yes		12
Pathe Television Co., 5302-98 Second Avenue, Brooklyn 32, New York	12-1		TA	No	12LP4	10	18	2	Yes	S,T	Both	Sweep	AC	No	2.5	5
	12-10		CO	No	12LP4	10	18	2	Yes	S,T	Both	Sweep	AC	No	2.5	10
Philco Corporation, C and Tioga Sts., Philadelphia 34, Pa.	702		TA	No	7JP4	5	17	3	No	S	Both	Sweep	AC	No	1.5	5
	1104[6]		TA	No	10BP4	8	20	2	No	S	Both	Sweep	AC	Yes	1.5	4x6
	1105[6]		TA	No	10BP4	7.5	20	3	No	S	Both	Sweep	AC	No	1.5	4x6
	1400, 1401, 1402[6]		TA	No	12LP4	9	20	2	No	S	Both	Sweep	AC	Yes	1.5	4x6
	1430[8]		CO	No	12LP4	9	20	2	No	S	Both	Sweep	AC	Yes	1.5	4x6
	1443[8]		CO	No	12LP4	10	22	4	No	T	Both	Sweep	AC	No	2.5	5
	1477, 1478, 1479, 1481[46], 1482		CO	AM-FM	12LP4	9	25	3	No	T	Both	Sweep	AC	No	5	10
	1483[46]		CO	AM-FM	12LP4	10	26	4	No	T	Both	Sweep	AC	No	5	10
	1630[46]		CO		16LP4	12	22	5	No	T	Both	Sweep	AC	No	5	10
Philharmonic Radio Corporation, 119 West 57 St., New York 19, New York	1200		TA	No	12LP4	9.5	19	1	Yes	S	Both	Sweep	AC	No	3.5	5
	1600		TA	No	16DP4	11.5	19	1	Yes	S	Both	Sweep	AC	No	3.5	8
	1700		CO	No	16DP4	11.5	19	1	Yes	S	Both	Sweep	AC	No	3.5	10
Pilot Radio Corporation, 37-06 36 St., Long Island City, New York	TV-37	TV-37	PO	No	3KP4	2.5	17	3	Yes	C	No	No	AC[17]	No	0.3	4
	TV-42	TV-42	CO	No	3NP4[12]	25	30	4	No	S	Both	No	AC	Yes	8	12
	TV-47, TV-48	TV-47,-48	CO	No	16AP4	13	30	4	No	C	Both	No	AC	No	3.5	12
	TV-121[8]	TV-121	TA	FM	12LP4	10	22	3	Yes	C	Both	No	AC	No	3.5	6½
	TV-952[3]	TV-952	CO	AM-FM	3NP4[12]	25		4	No	S	Both	No	AC	Yes	8[48]	12[18]
Radio Corp. of America, Front and Cooper Sts., Camden, New Jersey	9-PC-41[2]		CO	No	5TP4[47]	28	34	7	No	S	IF	Sweep	AC	Yes	12	12
	9-T-246[8]	KCS 38	TA	No	10-in.	9.5	22	2	No	S	Both	Sweep	AC	Yes	2.5	5x7
	9-T-270[8]		TA	No	16-in.	12.5	23	4	No	S	Both	Sweep	AC	Yes	2.5	8
	9-TC-240[8]	KCS 28	CO	No	10-in.	9.5	22	2	No	S	Both	Sweep	AC	Yes	2.5	12
	9-TC-245[8]	KCS 34	CO	No	12-in.	10.3	22	2	No	S	Both	Sweep	AC	Yes	2.5	12
	9-TC-247, 9-TC-249[8]	KCS 34	CO	No	12-in.	10.3	22	2	No	S	Both	Sweep	AC	Yes	2.5	12
	9-TC-272, 9-TC-275[8]		CO	No	16-in.	12.5	23	4	No	S	Both	Sweep	AC	Yes	2.5	12
	9-TW-390[8]		CO	All	16-in.	12.5			No	S	Both	Sweep	AC	Yes	12	12

Radio Craftsmen, Inc., The 1617 South Michigan Ave. Chicago 16, Ill.	RC 100	RC 100	WC	[illegible]	16-in.	13	25	4	No	T	Both	Sweep[33]	AC	No	10[49]	No
Regal Electronics Corp. 603 West 130 St. New York 27, N. Y.	1007	1007	TA	No	10BP4	9.5	18	2	Yes	T	Both	Sweep	AC	No	3	4x6
	1031	1031	TA	No	10BP4	9.5	27	3	No	S	No	Sweep	AC	Yes	4	5x4
	1207	1207	TA	No	12LP4	11	18	2	Yes	T	Both	Sweep	AC	No	3	4x6
	1208	1208	CO	No	12LP4	11	18	2	Yes	T	Both	Sweep	AC	No	3	12
	1230	1230	TA	No	12LP4	11	27	3	No	S	No	Sweep	AC	Yes	4	5x7
	1607	1607	TA	No	16DP4	12.5	18	2	Yes	T	Both	Sweep	AC	No	3	4x6
	16T31	16T31	TA	No	16DP4	12.5	27	4	No	S	No	Sweep	AC	Yes	4	5x7
	16T36[8]	16T36	TA	AM-FM	16DP4	12.5	37	4	No	S	No	Sweep	AC	Yes	4	5x7
Remington Radio Corp. 80 Main St. White Plains, New York	Georgian, 80, 1606, 1950		CO[50]	FM	12-in.	11	23	2	No	I	Both	Sweep	AC	No	5	8
	130, 721, 1606-15		CO[50]	FM	15-in.	11	23	2	No	I	Both	Sweep	AC	No	5	10
	Night Watch		CO	FM	19-in.	11	24	2	No	I	Both	Sweep	AC	No	5	10
Scott Radio Laboratories 4541 North Ravenswood Chicago 40, Ill.	400B	6T11	TA	No	3NP4[13]	25	27	6	No	S	Both	Sweep	AC	No	2.5	6
	800BT[3]	6T11	CO	All	3NP4[13]	25	48	9	No	S	Both	Sweep	AC	No	20	15[11]
	9T47[3]	9T40	CO	No	16-in.	11.5	50	10	No	S	Both	Sweep	AC	No	20	15[11]
	9T48[3]	9T40	CO	All	16-in.	11.5	46	10	No	S	Both	Sweep	AC	No	20	15[11]
Shevers, Inc., Harold 33 West 46 St. New York 19, N. Y.	12T	931	TA, WC	No	12LP4	9	28	3	No	T	IF	Sweep	AC	Yes	2.5	6
	16Q, 16CL, 16C, 16R, 16ET	032	CO[65]	No	16FP4	12.5	28	4	No	T	IF	Sweep	AC	Yes	2.5	12
Sightmaster Corp. 385 North Ave. New Rochelle, N. Y.	12½-S-4[57]	S-4	TA	No	12½-in.	11	21	2	Yes	C	No	Sweep	AC	Yes	4	8
	12½-D-4[57]	D-4	TA	FM	12½-in.	11	22	2	No	I	No	Sweep	AC	No	4	8
	16-C-8[57]	C-8	CO	No	16-in.	13.5	21	2	Yes	C	No	Sweep	AC	Yes	4	8
	16-D-8[57]	D-8	CO	FM	16-in.	13.5	22	2	No	I	No	Sweep	AC	No	4	8
	16-S-8[57]	S-8	TA	No	16-in.	13.5	21	2	Yes	C	No	Sweep	AC	Yes	4	8
	19CD9[57]	CD9	CO	FM	19-in.	14	27	4	No	I	Both	Sweep	AC	No	4	8
Snaider Television Corp. 540 Bushwick Ave. Brooklyn 6, N. Y.	Auditorium[13]	2620R	CO	FM	5TP4	30	34	4	No	I	No	No	AC	Yes	11	12
	Champion	1230	TA	FM	12LP4	10	28	2	No	I	No	No	AC	Yes	4.5	5x7
	Crusader	1912	CO	No	12LP4	10	17	2	Yes	I	No	No	AC	No	4.5	8
Sparton Radio Television 2400 East Ganson St. Jackson, Mich.	4916, 4917, 4918	24TL10	CO	AM-FM	10BP4	10	25	2	No	S	Both	Sweep	AC	No	2.5	10
	4920, 4921, 4922[3]	24TM10	CO	AM-FM	12LP4	10	25	2	No	S	Both	Sweep	AC	No	2.5	10
	4935, 4942	23TC10A	CO	No	12LP4	10	21	2	No	S	Both	Sweep	AC	No	2.5	10
	4944[3]	24TB10	CO	No	16AP4	12	25	2	No	S	Both	Sweep	AC	No	2.5	10
	4950, 4951, 4952	24TA10	TA	No	10BP4	10	25	2	No	S	Both	Sweep	AC	No	2.5	4x6
	4954	23TC10	TA	No	10BP4	10	21	2	No	S	Both	Sweep	AC	No	2.5	4x6
	4960, 4961	23TC10A	TA	No	12LP4	10	21	2	No	S	Both	Sweep	AC	No	2.5	4x6
	4900TV, 4901TV[3]	24TV9C	CO	AM-FM	12LP4	10	25	2	No	S	Both	Sweep	AC	No	2.5	10
	4939TV, 4940TV[3]	24TV9	CO	No	10BP4	10	25	2	No	S	Both	Sweep	AC	No	2.5	10
Starrett Television Corp. 601 West 26 St. New York 1, N. Y.	Adams[1]		CO	AM-FM	12½-in.	9	32	3	No	S	Both	Sweep	AC	Yes	3.5	12
	Ambassador		TA	No	16-in.	13	26	4	No	S	Both	Sweep	AC	Yes	3.5	5x7[18]
	Cleveland[1], John Hancock[1]		CO	AM-FM	16-in.	13	32	4	No	S	Both	Sweep	AC	Yes	3.5	12
	Cosmopolite[1], Washington[1]		CO	AM-FM	16-in.	13	38	5	No	S	Both	Sweep	AC	Yes	15	12
	Gotham[1], Lincoln[1]		CO	AM-FM	16-in.	13	38	5	No	S	Both	Sweep	AC	Yes	15	12
	Henry Hudson, Henry Parks		TA[20]	No	16-in.	11	19	2	No	T	Both	Sweep	AC	No	3.5	16[68]
	Jefferson		CO	No	12½-in.	9	17	2	Yes	S	Both	Sweep	AC	No	3	4x6
	King Arthur		TA	AM-FM	20-in.	13	32	4	No	S	Both	Sweep	AC	Yes	3.5	12
	Nathan Hale		TA	No	12½-in.	9	17	2	Yes	S	Both	Sweep	AC	No	3	4x6
	Robert Fulton		CO	AM-FM	12½-in.	9	23	3	Yes	S	Both	Sweep	AC	No	3	10
Stewart-Warner Electric Div. 5, Stewart Warner Corp. 1826 Diversey Parkway Chicago 14, Ill.	9100J	9100J	TA	No	10BP4	9.5	21	3	Yes	T	Both	Sweep	AC	No		6
	9103B[6]	9103B	TA	No	12LP4	8	22	3	Yes	T	Both	Sweep	AC	No		6
	9103C[6]	9103C	CO	No	12LP4	8	22	3	Yes	T	Both	Sweep	AC	No		6x9
	9104A[7]	9104A	TA	AM-FM	12LP4	8	27	3	Yes	T	Both	Sweep	AC	No		6
	9104B[1,6]	9104B	CO	AM-FM	12LP4	8	27	3	Yes	T	Both	Sweep	AC	No		6x9
	9105A[1,6]	9105A	CO	AM-FM	3NP4[13]	20	30	6	Yes	T	Both	Sweep	AC	No		12

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Stromberg Carlson Co.	Century TC-125-HM, Brentwood TC-125-LM[3]	TC-125	TA[20]	No	12QP4		22		Yes	C	Both	Sweep	AC	No	3	8
100 Carlson Rd.	Chinese Classic TS-125-M5M[3]	TS-125	CO	AM-FM	12LP4[60]	9	43	2	No	C	Both	Sweep	AC	No	10	12
Rochester, N. Y.	Dorset TS-125-HM	TS-125	TA	AM-FM	12LP4[60]	9	43	2	No	C	Both	Sweep	AC	No	3	8
	Emperor TC-19-LM[3]	TC-19	CO	No	19AP4	18	29	1	Yes	C	Keyed	Sweep	AC	No	3	12
	Manhattan TG-10-H	TC-10	TA	No	10BP4	9	22	1	Yes	C	Both	Sweep	AC	No	3	5
	Monmouth TS-16-M1M[3]	TS-16	CO	AM-FM	16AP4	13	43	2	No	C	Both	Sweep	AC	No	10	12
	Somerset TS-16-PM[3]	TS-16-PM	CO	AM-FM	16AP4	13	43	2	No	C	Both	Sweep	AC	No	10	12
	Weymouth TS-125-LM	TS-125	CO	AM-FM	12LP4[60]	9	43	2	No	C	Both	Sweep	AC	No	10	12
	Yarmouth TS-16-L1M	TS-16	CO	AM-FM	16AP4	13	43	2	No	C	Both	Sweep	AC	No	10	8
Sylvania Television	075		TA		10-in.		24	3								5¼
1280 Main St.	076		CO		10-in.		28	3								10
Buffalo, N. Y.	090		CO		16-in.		24	5								10
	113		CO		10-in.		24	3								8
	114		CO		12½-in.		24	3								8
	125		TA		12½-in.		24	3								5¼
	128		CO		12½-in.		28	3								12
	210		TA		12½-in.		24	3								5¼
Tech Master Products Co.	930		All[51]	No	10BP4	9	28	2	No	S	No	Sweep	AC	Yes	2.5	4
443 Broadway	1230		All[51]	No	12LP4	9	28	2	No	S	No	Sweep	AC	Yes	2.5	4x6
New York, New York	1530, 1530C		All[51]	No	15-in.	13	29	2	No	T.S	No	Sweep	AC	Yes	2.5	6[54]
	1631		All[51]	No	16-in.	13	29	2	No	T.S	No	Sweep	AC	Yes	2.5	6[54]
	1632		All[51]	No	16-in.	13	30	2	No	T.S	Both	Sweep	AC	Yes	2.5	6[54]
	2031		All[51]	No	19-in.	13	29	2	No	T.S	No	Sweep	AC	Yes	2.5	6[54]
	BC1223 (Blue Ribbon)		All[51]	No	12LP4	9	22	1	No	T	Both	Sweep	AC	No	2.5	4x6
Tele King Corp.	510	510	TA	No	10BP4	8.5	16	3	Yes	S	Both	Sweep	AC	Yes	3	4x6
601 West 26 St.	616	616	CO	No	16CP4	13	16	4	Yes	S	Both	Sweep	AC	Yes	3	8
New York 1, New York	712	712	TA[20]	No	12LP4	8.5	16	3	Yes	S	Both	Sweep	AC	Yes	3	4x6
	816	816	TA	No	16CP4	13	16	4	Yes	S	Both	Sweep	AC	Yes	3	10
Telequip Radio Company	12	CS12	TA	No	12LP4	8	17	1	Yes	S	Both	No	AC	No	2	4x6
1901 South Washtenaw	112	C12	TA	No	12LP4	9	17	1	Yes	T	Both	Sweep	AC	No	2	4x6
Chicago 8, Ill.	116	C16	TA	No	16GP4[55]	9	17	1	Yes	T	Both	Sweep	AC	No	2	4x6
	212	C12	CO	No	12LP4	9	17	1	Yes	T	Both	Sweep	AC	No	2	6x9
	216	C16	CO	No	16GP4[55]	9	17	1	Yes	T	Both	Sweep	AC	No	2	6x9
Tele Tone Radio Corp	TV 220[6]	TK	PO	No	7JP4	[illegible]	21	2	Yes	S	IF	No	AC[17]	No	2	4x6
540 West 58 St.	TV 254, TV 255[6,69]	TT	TA	No	10BP4	[illegible]	19	2	Yes	S	IF	Sweep	AC	No	3.5	4x6
New York 19, New York	TV 284, TV 287, TV 288	TH, TJ	TA[56]	No	12TP4[23]	[illegible]	20	2	Yes	S	IF	Sweep	AC	No	4	4x6
	TV 286		CO	No	16AP4	13	21	3	Yes	S	IF	Sweep	AC	No	4.5	10
Televista Corp. of America 12-01 44 Ave. Long Island City, New York	Electra, Imperial, President, Trafton	104	WC[58]	No	16DP4	11.5	20	2	No	T	No	Sweep	AC	Yes	4	12
Trad Television Corporation	13-E, 14, 15-E[2]		CO	FM	5TP4[13]	27	33	7	No	S	No	Sweep	AC	Yes	5.6	12
1001 First Avenue Asbury Park, New Jersey	D-250		CO	No	16AP4	11	27	4	No	S	No	Sweep	AC	Yes	3.4	12
Transvision Inc.	1	WRS	CO	No	10BP4	10	17	2	Yes	C	No	No	AC	No	4.5	4x6
460 North Ave.	2	WRS	CO	No	12LP4	10	17	2	Yes	C	No	No	AC	No	4.5	6x9
New Rochelle, New York	3	WRS	CO	No	16DP4	11	17	2	Yes	C	No	No	AC	No	4.5	6x9
	4	WR	TA	No	10BP4	10	17	2	Yes	C	No	No	AC	No	4.5	4x6
	5	WR	TA	No	12LP4	10	17	2	Yes	C	No	No	AC	No	4.5	6x9
	6	WR	TA	No	16DP4	11	17	2	Yes	C	No	No	AC	No	4.5	6x9
	10	A	TA	FM	10BP4	10	21	2	No	S	No	Sweep	AC	No	4.5	4x6
	13	A	TA	No	12LP4	10	21	2	No	C	No	Sweep	AC	No	4.5	6x9

	27	WRS	CO	No	16DP4	11	17	2	Yes	C	No	No	AC	No	4.5	6x9
	33	A	CO	FM	16DP4	11	21	2	No	I	No	Sweep	AC	No	4.5	6x9
	63[3]	A	CO	FM	16DP4	11	21	2	No	I	No	Sweep	AC	No	4.5	6x9
	16AD[59]	A	K	FM	16DP4	11	21	2	No	I	No	Sweep	AC	No	4.5	6x9
	16AS[59]	A	K	FM	16DP4	11	21	2	No	S	No	Sweep	AC	No	4.5	6x9
	W12RS[59]	WRS	K	No	12LP4	10	17	2	Yes	C	No	No	AC	No	4.5	6x9
	W16RS[59]	WRS	K	No	16DP4	11	17	2	Yes	C	No	No	AC	No	4.5	6x9
Trav-ler Radio Corp. 571 West Jackson Blvd. Chicago, Ill.	12 TM	12 T	CO	No	12LP4	10	21	2	Yes	T	Both	Sweep	AC	No	1.5	6x9
	16 TM	16 T	CO	No	16AP4	12.5	22	2	Yes	T	Both	Sweep	AC	No	1.5	6x9
United States Television Mfg. Corp. 3 West 61 Street New York 23, New York	C-12924[8]		CO	No	12-in.	8	22	2	No	T	No	Sweep	AC		6	12
	CFM-12824, CFM-15925, CFM-19930, KFM-19930[8]		CO	FM	15-in.[61]	8.5[71]	23	2	No	T,C	No	Sweep	AC		6	12
	KRV-15993[3]		CO	AM-FM	15-in.	8.5	27	6	No	T	No	Sweep	AC		8	12
	T-10824[8]		TA	No	10-in.	8	22	2	No	T	No	Sweep	AC		6	5
	T-12924[8]		TA	No	12-in.	8	22	2	No	T	No	Sweep	AC		6	5
	T-15925[8]		TA	No	15-in.	8.5	23	2	No	T	No	Sweep	AC		6	5
	T-19930[8]		TA	No	15-in.[61]	14.5	22	4	No	T,C	Yes	Sweep	AC		10	12
Vidcraft Television Corporation 780 East 137 Street New York 54, New York	1200[8]	1200	TA	FM	12½-in.	7.5	21	3	No	T	Both	Sweep	AC	Yes	4	6
	1600[8]	1600	TA	FM	16-in.	12	24	3	No	T	Both	Sweep	AC	Yes	4	8
	1601[8]	1601	CO	FM	16-in.	12	24	3	No	T	Both	Sweep	AC	Yes	4	12
	1602[1]	1602	CO	AM-FM	16-in.	12	32	4	No	T	Both	Sweep	AC	Yes	4	12
Video Corporation of America 229 West 28 Street New York 1, New York	VS-160, VS-161		TA	No	16-in.	12	16	2	Yes	T	Both	Sweep	AC	Yes	4	8
	VS-166, VS-167, VS-168		CO	No	16-in.	12	16	2	Yes	T	Both	Sweep	AC	Yes	4	8
Westinghouse Electric Corporation Home Receiver Division 1354 Susquehanna Avenue Sunbury, Pa.	H-600T16[6]	V-2150-61	TA	No	16JP4	12	25	3	Yes	S	Both	Sweep	AC	No	4.5	6
	H-601K12, H-602K12[6]	V-2150-41	CO	No	12LP4	11	25	3	Yes	S	Both	Sweep	AC	No	4.5	10
	H-603C12, H-608C12[63]	V-1252-01[70]	CO	AM-FM	12KP4A	11	28	4	Yes	S	Both	Sweep	AC	No	11	10
	H-604T10[6]	V-2150-94	TA	No	10BP4	9	23	2	Yes	S	Both	Sweep	AC	No	1.5	4
	H-650T12[64]	V-2150-101	TA	No	12RP4	11	25	3	Yes	S	Both	Sweep	AC	No	4.5	5
Wilcox-Gay Corporation Charlotte, Mich.	9-302		WC[62]		12BP4	8	19	3	Yes	T	Both	Sweep	AC		3	12
	9-400		WC[20]		10BP4	8	19	3	Yes	T	Both	Sweep	AC		3	12
	9-422		WC[20]		12BP4	8	19	3	Yes	T	Both	Sweep	AC		3	12
	9-462		WC[20]		12BP4	8	19	3	Yes	T	Both	Sweep	AC		3	12
Zenith Radio Corporation 6001 Dickens Ave. Chicago 39, Ill.	G2346R, G2340R[9], G2353R, G2441R, G2442E,	23G22	CO	No	12UP4A	10	20	3	Yes	T	Both	Sweep	AC	No	3.5	7
	G2442R, G2448R[9]	24G22	CO	No	16EP4	12	21	3	Yes	T	Both	Sweep	AC	No	3.5	7
	G2957R, G2958R[3,9]	23G23	CO	AM-FM	12UP4A	10	20	3	Yes	T	Both	Sweep	AC	No	3.5	12
	G3059R, G3062[3,9]	24G23	CO	FM-AM	16EP4	12	21	3	Yes	T	Both	Sweep	AC	No	3.5	12

Codes for TV receiver tabulation

C Continuous
CO Console or consolette
I Inputuner
K Kit
PO Portable
RE Remote viewer with tuner and picture tube in separate cabinets.
S Switch
T Turret
TA Table model
WC Wired chassis

1 With 3-speed phono
2 Has remote control
3 With phono, type not specified
4 Has built-in antenna, 3-speed phono, Polatron picture tube
5 Has built-in antenna, Polatron picture tube
6 Has built-in antenna
7 Has built-in antenna, phono switch and jack
8 Phono connections
9 Has electronic picture magnifier
10 36 x 48-inch picture (projection)
11 Co-axial speaker
12 12 x 16-inch picture (projection)
13 Projection receiver
14 Also uses 12TP4 and 16CP4
15 Table models convertible to consoles by addition of bottom speaker section. Units fit together.
16 Optional FM and larger picture tube by changing tuner and picture-tube chassis
17 Transformerless supply
18 Dual speakers of same type
19 Has connections for slave units and phonograph
20 Also available in console cabinets
21 Has electronic picture enlarger and phonograph input
22 Phonograph with disc recorder optional
23 Also uses 12LP4
24 Also uses 16EP4
25 Bookcase-type cabinet to match Windsor Imperial AM-FM-SW receiver
26 No wave traps on CT-232 or CT-224
27 Tweeter included
28 10 watt output from radio
29 18 watts output from radio
30 Dual tweeters
31 With tuning eye
32 Has extension speaker jack
33 Model 7VT5 is portable
34 Model 9VT1 has 8BP4 C-R tube
35 10VK12, 10VK22, 12VK11 are consoles
36 Also chassis TS-23
37 Also chassis HS-211
38 Two of the rectifiers are selenium
39 Model 7TV5 has 6½-inch speaker
40 8-inch speaker on Models 10VK12 and 12VK11, 6-inch on 10VK22
41 1-watt output on AM-FM radio
42 Also has a 5-inch speaker
43 Three of the rectifiers are selenium
44 One rectifier is selenium
45 3.8 watts output from AM-FM radio
46 With tunable built-in antenna and 3-speed phono except on Model 1477 which has a 2-speed phono
47 15 x 20-inch projection picture
48 8 watts output from AM-FM radio
49 Three volts into 500-ohm input of RC2 10-watt amplifier
50 1950 and 721 are table models
51 Except portable. Model 2031 except portable and table
52 Also 20-inch pictures
53 Vertical and horizontal sweep
54 Other speakers up to 10-inch available
55 Also uses 16LP4
56 Model 284 is console
57 Remote control optional
58 Also available as table models and in console cabinets
59 Remote control and phono optional
60 Also 12KP4 or 12QP4
61 Also available with 16-inch tube
62 Also table model
63 With built-in antenna, 3-speed phono, and electronic magnifier
64 With built-in antenna, electronic magnifier
65 Also wired chassis and table model with 4 x 6-inch speaker
66 10-inch speakers on consoles
67 Transformerless low-voltage supply with filament transformer
68 Some sets have 5 x 7-inch speakers
69 No built-in antenna on TV-254
70 H-608C12 also uses chassis V-2149-3
71 14.5 kv on CFM-19930 and KFM-19930

Making Large Electrets

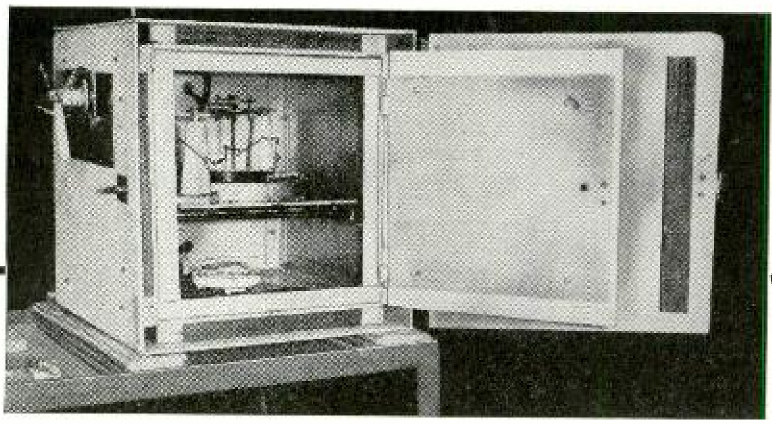


Fig. 1—Aluminum-walled angle-iron oven has Transite insulation.

New 7-inch electrets supply enough output Voltage to energize a 2-watt neon lamp

By VICTOR H. LAUGHTER

SIMPLY stated, the electret is made by pouring melted wax between two metal plates to which a high direct voltage is applied. The voltage remains on until the mixture solidifies. When it cools, the wax disc has become electrostatically charged, with a positive and a negative surface. This charge remains.

Many materials will take on a temporary charge but M. Eguchi of Tokyo published the first reports on electrets of the so-called permanent kind. This type is made of equal parts carnauba wax and resin with 10% beeswax. When removed from the charging plates, it usually shows a minus charge where the plus plate touched it and a plus charge opposite the minus plate. Later the electret reverses polarity and the new charges are permanent.

Early work with electrets indicated that some method for rapid, though not necessarily highly accurate, means should be provided for making comparative measurements of electrostatic field strength. The device must also indicate polarity. The vacuum-tube voltmeter was naturally the answer. The first instrument used had an input impedance of 5,000 megohms and proved very satisfactory until summer weather arrived with high humidity. Erratic readings were traced directly to leakage paths. The obvious solution was to use a comparatively low-impedance meter, which meant increasing the output of the electret.

Past experience indicated that the output depends on the surface area, which should be increased until the electrostatic field would cause an indication on a standard 10-megohm-input vacuum-tube voltmeter (this instrument was free from humidity effects). A final diameter of 7 inches was selected as a good balance between output and manufacturing limitations.

The cooling oven

Fig. 1 is a photograph of the oven. A 14-inch-square framework of ¾-inch angle iron was built up. Two pieces of angle were mounted inside, about 5 inches from the bottom, as a shelf support. Five sides are covered with 1/16-inch aluminum sheet, and a door of aluminum provided. A 4 x 5-inch cutout on the left side about 3 inches from the top is covered with a sheet of Bakelite in which holes were drilled for the high-voltage leads. The metal box is covered with Transite, held about 1 inch from the metal surface by wood spacers.

A sheet of Bakelite measuring about 5 x 10 inches and ⅛ inch thick was mounted over a cutout in the left side of the Transite. Next, two standoff insulators were mounted on a second 3 x 6-inch piece of which is attached to the first Bakelite, with 1-inch screws and nuts. Flexible leads run from the underside of the 1-inch screws, through holes in the Bakelite which covers the aluminum, to the inside of the oven. Short flexible leads with alligator clips at each end connect the outside ends of the 1-inch screws with the tops of the screws which mount the insulators.

A 600-watt heating element is at the bottom and another is at the top. Asbestos-covered line cords are used, as the interior heat reaches about 400 degrees F. A thermometer projecting from the top left is a laboratory unit about 12 inches long. The thermometer bulb rests near the wax solution, but there is, of course, some difference between the indicated temperature and the exact heat of the solution. The heat of the wax is 5 to 10 degrees above that shown by the thermometer.

A metal grill of ¼-inch iron rod is placed on the shelf angles to support the wax container.

The wax pan

Fig. 2 is a photo of the wax-holding assembly. One part is an aluminum plate 11 inches square and ¼-inch thick, with two 4½-inch-high standoff insulators. The aluminum crossbar has a slot in each end to allow adjustment.

In the center of the crossbar is a brass ball that has been drilled and threaded. The ball is held in place by an aluminum top plate held to the crossbar with screws and compression springs. The brass ball is a swivel joint. A threaded brass rod is fastened to the ball at one end and to a 5½-inch-diameter disc at the other. The disc is the upper high-voltage plate, and the

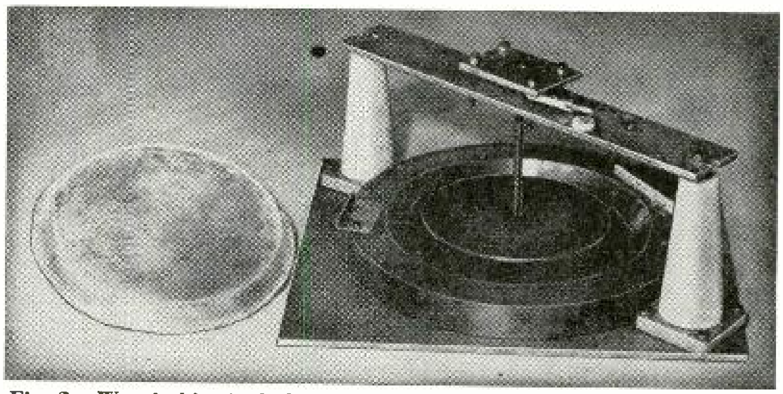


Fig. 2—Wax holder includes a pan and a crossbar for upper electrode.

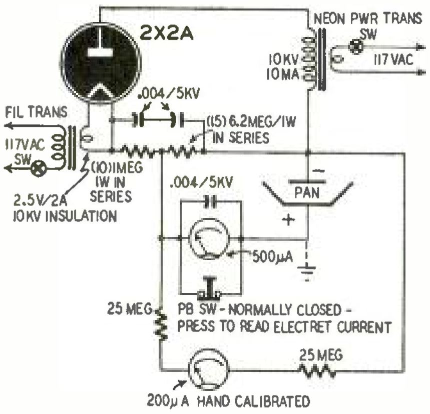


Fig. 3—High-voltage capacitors in this power supply are ordinary TV-set types.

brass-ball swivel makes it adjustable.

The pan that holds the wax solution was turned from a solid piece of 1-inch iron plate. A common pie pan will answer just as well and has about the same dimensions as the cut-out metal section. If a pie pan is used, it should be clamped to the base. To the left of assembly is shown a plaster of Paris form. To make it, wipe the pan with an oiled rag and fill it with a mixture of plaster of Paris and water. Two 1-inch-long screws, heads down, are inserted in the solution before setting to serve as a handle for lifting.

The complete schematic of the high-voltage power supply appears in Fig. 3.

Suitable waxes

Any wax or plastic for making electrets must have the peculiar inherent polar arrangement that permits the action to occur that makes an electret when influenced by a high d.c. field. Carnauba wax, used in making the first electrets, has the required quality to a high degree. The base wax is usually mixed with some other wax, in which case the addition is an inert filler used for economy and prevents the electret from cracking.

Small-size electrets do not usually crack when made of equal parts of carnauba wax and resin, with 10% beeswax. When making large electrets, cracking becomes a problem, and the usual mix will not answer. A carnauba-wax electret that measures 7 inches in diameter when melted in the pan, will shrink to about 6¾ inches when cool. This shrinkage develops an enormous pressure toward the center. It appears that the better electrets have the greatest shrinkage, so it is best to use a filler that will allow the shrinkage to take place and at the same time bind the particles so the electret does not break. The filler must not, of course, harm the inherent electret features of the wax. A compromise is necessary between the diameter used and the filler.

It would appear that some one of the plastics would make a good electret. Many samples have been tried out but results so far have been poor. Naturally, some untested or new plastic may make an excellent electret.

To avoid confusion, we should define the electret of Eguchi more exactly. As explained, the electret, when first removed from the charging plates, indicates a positive surface opposite the negative plate and a negative charge opposite the plus plate. This charge later reverses and we have an electret as made by Eguchi.

Gemant suggests the word *hetero* to describe the charge on one side of an electret when the charge is unlike that on the plate which was adjacent to this surface during manufacture. Thus, if one side has a negative charge and was next to the positive plate, the charge is a hetero. When the charge is the same as that of the plate, the term suggested is *homo*. A hetero charge, such as the one given as an example, may change to a homo. In this case, the side of the electret which faced the positive power electrode and originally turned out with a negative (hetero) charge, may in time become positive and would then be said to have a positive homo charge. The plastics mentioned above generally indicated a temporary hetero charge.

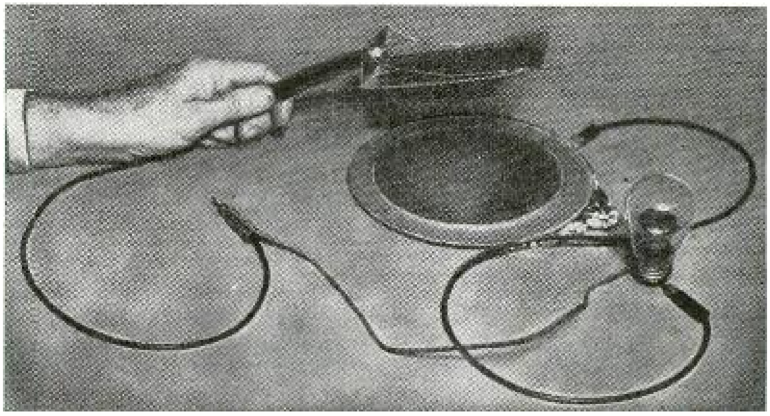


Fig. 4—Electret provides output enough to flash 2-watt neon lamp.

The first step in making an electret is to line the pan and cover the upper plate with aluminum foil. (You can use the Reynolds Wrap from any grocery store.) Cover the bottom of the plaster of Paris form with foil, allowing a margin, and force the form down into the pan, wrapping the margin of the foil around the end of the pan. Then remove the form by lifting on the imbedded screws. Smooth the foil with a soft rag. For the upper plate, lay a piece of foil on a smooth surface and push down on it with the plate so as to leave a line indicating the circumference. Lift the plate and write on the foil all pertinent data—date, mixture, and so on—using a blunt pencil. Place the plate back on its mount and wrap the excess foil around its edges. The data will print out on the finished electret. The average amount of wax for this size electret is about 6 ounces.

Carnauba wax. Carnauba wax is obtained from the leaves of tropical palms. The grade used for electrets is No. 1 yellow. Carnauba wax is hard and lustrous, and breaks clean. Its melting point is about 190 degrees F. Filter it for electret use. A 10-cent-store strainer covered with a piece of a silk or nylon stocking may be used.

A satisfactory electret cannot be made of carnauba alone. Excellent cooling curves of carnauba are given in the article, "Electret Behavior," by Padgett, in the May, 1949, issue of RADIO-ELECTRONICS.

Candelilla wax. Candelilla wax is obtained from a coating on a weed found in northern Mexico and southern Texas. It is brown in color, hard, lustrous, and brittle. Melting point is about 150 degrees F. It comes in assorted sizes and lumps. When melting, it has an aromatic odor.

Table I was made up using lumps of wax as received in shipment, not filtered or otherwise treated. This wax exhibits a very peculiar and interesting property, as Tables I and II indicate. In Table I the current through the wax increases as the temperature decreases until 130 ma is reached. It stays at this point until the wax solidifies. Some type of cumulative effect occurs here in molecular orientation; there would be a complete short circuit were it not for the limiting resistor in the power supply. Table II shows cooling of the same wax after remelting. The suprising thing here is that the wax now acts in a perfectly normal manner. The one treatment has changed the structure so that the readings of Table I cannot be duplicated unless we start again with virgin lump wax. This test has been made many times and is easily duplicated.

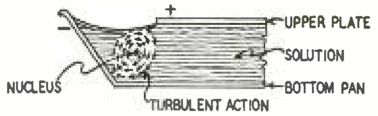


Fig. 5—Turbulent particles in wax solution move in arrow-indicated paths.

Electrets made as in Table I usually have a weak hetero charge, with temporary life. Electrets were also made using 9,000 volts and virgin wax, in which case the maximum reading reached 450 ma. Voltage was removed just before the current reading started to drop. These showed no electret signs.

Electrets made from candelilla wax once treated, as in Table II, usually show strong hetero charges on both sides.

Montan wax. Montan wax is extracted from lignite. Hard, brittle, lustrous, it has a melting point of about 170 degrees F. Its color is brown.

Ouricury wax. This is obtained from leaves of the ouricury palm. Melting point is about 185 degrees F. It has a brown color.

Ethyl Cellulose. Viscosity 100, type N. A white granular powder. Melting point depends on the wax with which it is mixed.

TABLE I

Volts	Ma	Temp. (F)	Minutes
6,300	45	195	0
5,600	60	186	10
3,125	90	172	20
1,250	120	169	22
800	130	168	25
300	130	128	100
1,000	125	126	110
1,250	120	120	118
3,200	90	106	130
5,800	50	88	148
8,000	20	82	175
8,600	10	70	210

Electret mixtures

The basic mixture of equal parts carnauba and resin, with 10% beeswax, makes an excellent electret, when the diameter does not exceed 4 inches. A suitable mix for the 7-inch diameter is 3 oz. of carnauba, 1 oz. yellow beeswax, 1 oz. white refined beeswax, and 1.5 oz. of resin. Run the mix through a filter to remove foreign matter.

Table III gives the data for a typical run of the latter mixture. The temperature was 198 degrees F at the start and 100 degrees F when the last reading was taken.

The electret made from this mixture reverses immediately after removal from oven. It shows an excellent homo charge on both surfaces.

The addition of ethyl cellulose produces a hard, high-gloss electret that will not crack under normal conditions, and raises the melting point according to the proportion of eythl cellulose used. However, the cellulose tends to decrease the crystalline structure of the waxes which is proven in the finished electrets.

TABLE II

Volts	Ma	Temp. (F)	Minutes
6,800	35	175	0
6,950	32	150	33
7,500	28	142	68
8,000	20	126	83
8,700	10	116	123

Candelilla wax makes an electret that gives a strong hetero charge which gradually reduces to a minus hetero surface of indefinite life. Five ounces of reworked candelilla and 1 oz. of Montan wax make an electret that will end up with a strong homo charge on the minus side and hold this final charge over a long period. The addition of the montan lifts the conductivity of the mixture to a maximum of about 300 ma from the usual 35-50 ma of candelilla alone. It is possible that the addition of a small amount of montan wax would improve the charge of other electrets, as the greater conductivity may allow more perfect fibering. Candelilla and carnauba wax will not make a satisfactory electret. Electrets made from this wax act about the same as candelilla though they do not show the rising current of Table I.

TABLE III

Volts	Ma	Minutes
1,800	115	0
3,750	90	37
4,900	70	54
5,900	50	71
7,500	30	103
8,600	10	116
8,700	08	143

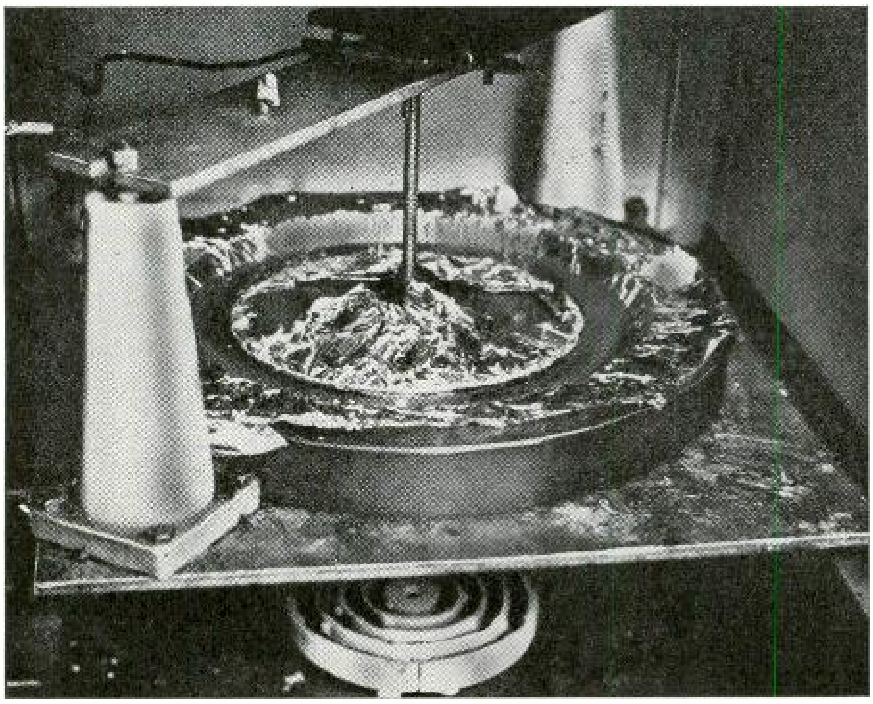


Fig. 6—Light-colored circle in liquid wax indicates turbulence noted in text.

Testing electrets

A vacuum-tube voltmeter may be used for testing electrets. A zero-center meter is best. A piece of 4 x 5-inch brass or phosphor bronze .01 inch thick, with a ½ inch portion at the long end bent up at right angles and punched, is attached to the voltmeter probe. The instrument is set on the 3-volt scale. The electret is laid on a piece of metal and the ground test lead connected to this piece. Swing the probe to the electret and the meter will indicate a positive or minus surface. Turn the electret over and it should read in the opposite direction. Generally the negative meter swing will be greater.

The readings are not indicative of the actual voltage values. The estimated potential near the surface of an electret is 20,000 volts. The electret has only a minute power output; therefore, when the probe begins to approach it, the power begins to dissipate through the load impedance of the meter; and only a small portion of the output is indicated. If the probe plate can be laid on the electret and then removed rapidly, a reading will be obtained opposite to that when approaching. H. Gernsback suggested the small neon glow lamp (Fig. 4) as an indicator of electret output. The neon lamp has all the necessary requirements as it offers infinite impedance until ionization begins. Immediately ionization begins, though, a short circuit is put across the electret and the ionization ceases.

The original small-size electrets gave a dim flash in complete darkness. The present 7-inch size flashes a G-E 2-watt NE34 neon in normal room light.

Turbulent action

A turbulence can be observed in the wax mixture, between the edge of the upper plate and the pan. Fig. 5 is a cross-section drawing of a portion of the plate and pan. The upper plate is positive and the pan negative. For viewing this effect a special wax mixture is used, 3¾ oz. of candelilla and 2¼ oz. of No. 1014 Halo wax.

In the perfect fluid state no action can be observed; but when the mixture begins to cool down, small particles of the Halo begin to move. Some particle takes on, say, a minus charge and starts in the direction of the upper, plus-charged plate. When near this plate, it becomes positively charged and is repelled, and is attracted by the minus lower charge. This action is repeated by the bottom plate, resulting in rotation. A nucleus 1/16 to ⅛ inch in diameter gathers at the center, and bands are formed around the circumference of the upper plate in broken sections. The nucleus rotates, windmill fashion, collecting and losing particles due to centrifugal action, as indicated in Fig. 5. The photograph of Fig. 6 shows the solution, the upper plate, and the lower pan. The white band around the solution is the nucleus. The details are not sharp enough to illustrate the rotating particles.

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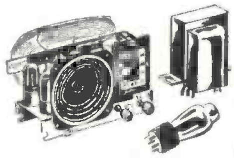

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Fundamentals of Radio Servicing

Part XI—The Pentode vacuum tube

By JOHN T. FRYE

MORE than 20,000 miles a second! That's the speed at which an electron hits the plate of the tetrode described last month. No wonder that the terrific impact of the speeding electron knocks other electrons loose from the plate. It's like throwing an apple at an apple tree; if you throw it hard enough, a whole shower of fruit falls to the ground.

Up to now the only emission we had run into was that from the cathode, caused by heat, but now we have electrons emitted from the plate—and without any heat at all! This kind of knock-'em-loose emission is called *secondary emission* because it can't take place until a "primary" electron from the cathode comes along to do the knocking.

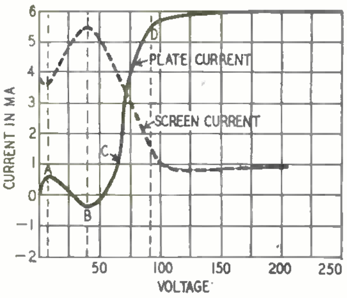

Fig. 1-a—Curves show tetrode behavior.

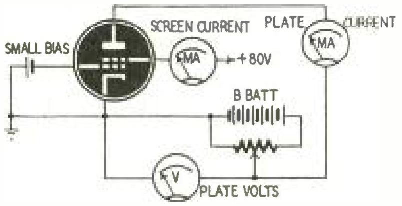

Fig. 1-b—Circuit for obtaining curves.

Secondary emission in a triode bothers no one. The plate is usually the only positive electrode in the tube and its irresistible fascination for the negative secondary electrons pulls them right back where they came from. The negative grid helps to shoo them on their way.

But the tetrode is a different story, for the screen is also positive, and some of the secondary electrons are attracted to it. The plate actually loses electrons to the screen. This wrong-way traffic is just about as upsetting inside our tube as it would be on a one-way street. Collisions occur between the "in reverse" electrons and those emitted from the cathode; furthermore, electrons arriving from the cathode are repelled by the cloud of secondary electrons surrounding the plate.

The graph of Fig. 1-a shows these upsetting effects. The curves show how plate and screen currents vary when the plate voltage is changed. During the experiment, the screen is held at 80 volts. The test circuit appears in Fig. 1-b. Beginning with zero plate voltage (potentiometer arm at grounded end), plate current is zero. There is screen current, because the screen is 80 volts positive and acts like a plate.

Now we run up a little plate voltage, say about 10 volts. There is a little rise in plate current and a little drop in screen current because some of the electrons from the cathode are reaching the positive plate instead of going to the screen. The attraction of the plate is not great enough to make them travel really fast, so they dislodge no secondary electrons from the plate.

As the plate voltage rises above the 10-volt level, however, the electrons speed up and a few secondary electrons are knocked off the plate. Remember that the total plate current is made up of the electrons that reach it from the cathode *minus the secondary electrons grabbed by the screen.* As the plate voltage rises, the speed gets higher and higher, knocking off more and more secondary electrons for the screen to steal. As the graph plainly shows, the net plate current between voltages A and B actually gets *less* as the plate voltage rises, and the screen current increases! After a while, in fact, the impact of primary electrons is so great that each one of them knocks loose *several* secondary electrons from the plate. This is clearly a losing proposition—the plate is giving up more electrons that it is getting. So, as the solid curve shows, not only does the net plate current go down to zero, but it actually flows in the wrong direction. We indicate this topsy-turvy state of affairs by showing "negative" (wrong-direction) plate current.

As the voltage is increased beyond point B, the growing attraction of the plate begins to enable it to hold its own against the siren call of the screen. A higher percentage of the secondary electrons commence to fall back onto the plate instead of going to the screen grid, and the plate current starts to increase again. At point D the plate has become positive enough to put an end to the screen's theft of its electrons, and it reclaims *all* of its emitted particles. From this point on, the plate current is little affected by the plate voltage. The screen and control grid voltages, determine the plate current, as we learned in Chapter X.

If the plate voltage always stayed in the region beyond point D; secondary emission would cause no trouble; but when a tube is working in a circuit, the plate current is constantly changing. By the same token, so is the plate voltage, because of the varying drop across the plate load resistance. (See last installment.) In fact, when the grid is driven strongly positive, the plate voltage may dip *below* the screen voltage.

When this happens, we have lost a good bit of our ability to control the plate current solely with the signal grid. For, as we have just seen, a change in the plate voltage in this lower-voltage region has a very decided effect on the plate current on its own hook. If we are to avoid the bad effects of this double control, we must either keep signal voltages very small so that the plate voltage will not swing down near the screen voltage, and thus sacrifice a large portion of the tube's ability to amplify; or we must use a very high plate voltage to insure the same thing even with increased amplification. What is really needed is some device that will put a stop to this dominance secondary emission gives to plate voltage over plate current.

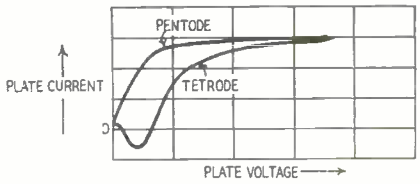

Fig. 2—Adding suppressor alters curve.

Just such a device is the *suppressor grid*, which looks much like the control and screen grids, although the spacing between turns is usually greater. It is found between the plate and screen and is connected—often inside the tube—to the cathode. This is the fifth element added to our tube, so the family name of *pentode* (*pente* is Greek for five) is

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This suppressor grid being negative with respect to the plate, it sends secondary electrons right back to the plate instead of letting them pass through its turns to the screen. Control of the plate current is restored to the control grid, even under conditions where the instantaneous plate voltage dips below the screen voltage. In power output tubes, such as the 3V4 and the 6K6, this means higher power output with lower grid-driving voltage; in tubes used to amplify radio frequencies, such as the 6SJ7 and the 12SK7, signal voltages can be amplified tremendously without employing high plate voltages. Fig. 2 shows how adding a suppressor grid takes the dip out of the plate-voltage-vs.-plate-current curve of the tetrode. Remember that the effect of the suppressor grid on secondary emission is the same as that of a good kiss-proof lipstick: the act isn't prevented from taking place, but it is kept from causing any trouble!

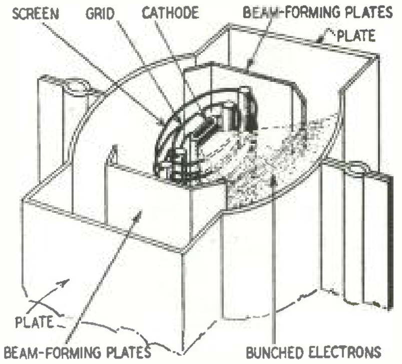


Fig. 3—Beam tube needs no suppressor.

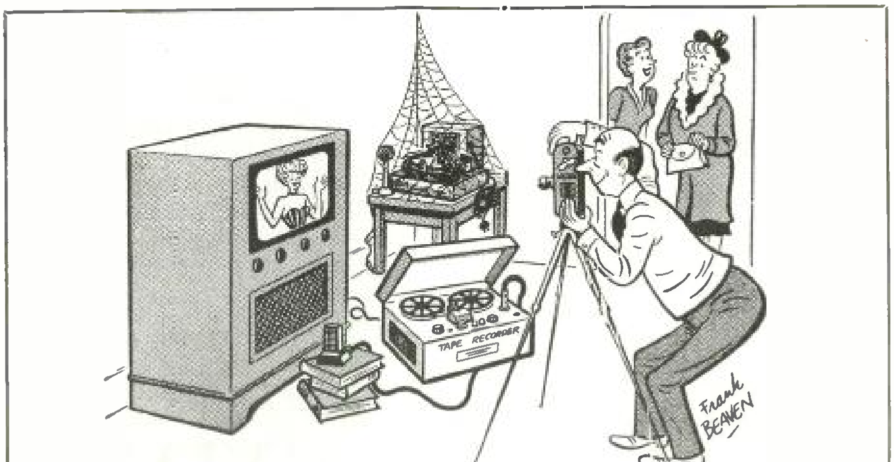
One special kind of tube contains no suppressor but arrives at the same result as the pentode. Fig. 3 is a cutaway drawing of a *beam* tube, the 6L6. The beam-forming plates are connected to the cathode. The negative beam plates repel electrons so that they are all concentrated in a stream directed at the curved parts of the plate. The plates also prevent any secondary electrons from sneaking over to the screen by the side doors—outside the beam.

As the electron stream goes through the grid, the grid wires slice it up so that the beam is a stack of flat sheets. The sheets pass between the wires of the screen, which are aligned with the grid wires. Since the electrons do not hit the screen wires directly, the screen takes very few of them and almost all go to the plate where they can do the most good.

The steady voltage on the screen may often be higher than the instantaneous plate voltage, while it is varying rapidly to amplify a signal; therefore, the screen is more attractive to the electrons than is the plate. After the electrons have passed through the screen, this greater attraction slows them up—they are not as anxious to get to the plate as they thought they were! Because of the "braking" action, the slowed-up electrons bunch up between screen and plate, as the heavier dashed lines in Fig. 3 show. The concentration of electrons results in a negative space charge, a "wall" between plate and grid, which prevents secondary electrons knocked out of the plate from getting to the screen just as effectively as a suppressor would.

We have by no means pumped the well dry on the subject of different types of electron tubes. There are literally hundreds of varieties on the shelves of any well stocked radio store. Many of the differences, though, are produced by mechanical variations in the filament structure, the basing arrangement, or the housing of a single basic type. For example, there are beam tubes with filaments that operate at 1.4, 6.3, 12, 25, 35, 50, 70, and 117 volts. Beam tubes come in small, medium, and large envelopes, and the envelope may be made of either metal or glass. If we look at the bases, we will find beam tubes with 7-prong miniature bases, with octal bases, and with loktal bases.

Another flock of types is produced by a kind of electronic grafting, in which two or more basic types of tubes are housed in the same envelope and are built around a common cathode. This method produces some fearsome sounding names, such as "duo-diode-hi-mu-triode;" but that name really describes nothing more awful than a hybrid tube in which two diodes and a high-amplification triode are all clustered around the same cathode inside one envelope.



Suggested by: Hugh Lineback, Stillwater, Okla.

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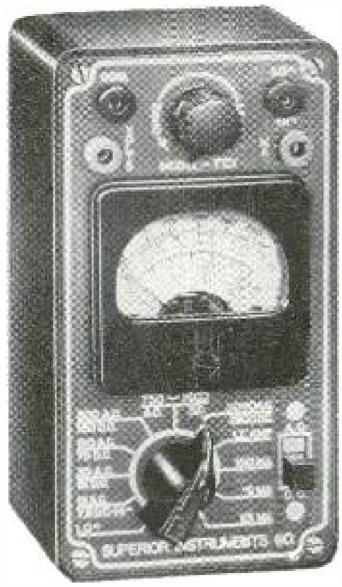

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D.C. CURRENT: 0 to 1.5/15/150 Ma. 0 to 1.5 Amperes
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- 5 D. C. CURRENT RANGES
  0-50 Microamperes
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- 4 RESISTANCE RANGES:
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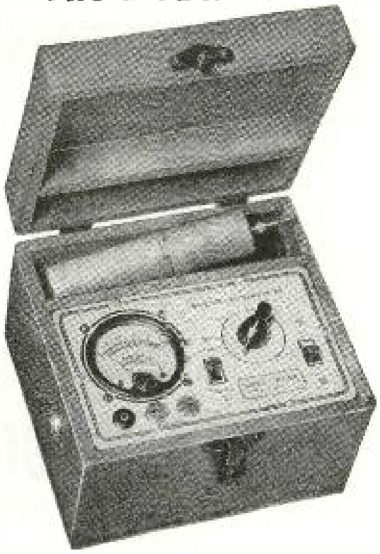

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FEATURES

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4

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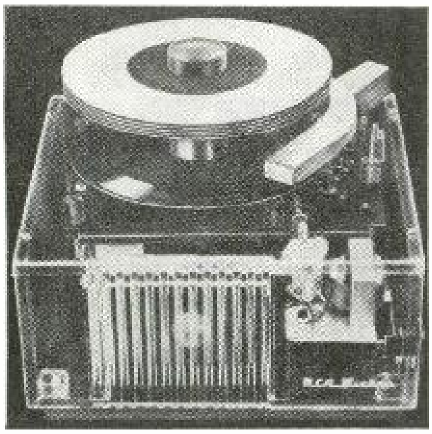
5

Radio Set and Service Review

RCA Victor's 45-r.p.m. changer is unusually small and uncomplicated

By RICHARD H. DORF



Changer in special transparent mount.

THE repair technician is going to see a lot of the new RCA Victor 45-r.p.m. record changers now that their price is so low. And for the same reason, he is going to have to service them at top speed to keep repair charges in reasonable proportion to original cost. If he knows how they *should* work, he is in a good position to find out quickly why a particular specimen *doesn't* work. Fortunately, the mechanism is simple enough to be described fully in these pages. The 9-JY record-player attachment was the particular model examined, but the same mechanism is used in all the RCA 45-r.p.m. players.

The turntable is a brass casting $5\frac{1}{4}$ inches in diameter. An underside view appears in Fig. 1. The shaft is a hollow metal tube (A in Fig. 1) which goes through hole B in the metal pillar attached to the metal panel that supports the changer mechanism (Fig. 2). Inside the hollow tube is the drive shaft C (Fig. 1) which is free to rotate independently. At the lower end of C is a star wheel (explained later and not shown in Fig. 1). At the upper end is a small drive gear, which appears in the cut-away drawing of Fig. 3. The assembly shown in the drawing is within the upper part of the $1\frac{1}{2}$-inch-diameter spindle of the turntable.

Two small gears at the top of very short, hollow shafts fit over short rods set in holes in the spindle. Atop each gear is a small support shelf. Fig. 3 shows how the assembly is put together; note that the pins atop the right and left gears are mounted off center. The spring pushes the shelves apart so they normally extend outside the spindle.

When the drive shaft rotates in the direction of the arrow, the gears also rotate as shown. During the first half-revolution, the offset-mounted pins on the outside gears pull the support shelves inside the housing; during the second half, the spring pushes them out.

The separator blades are also mounted on the offset pins. During the first half-turn of the drive shaft, they project from the housing; during the second, they recede.

The events must have the sequence illustrated by Fig. 4, a cross section of a small part of the spindle. At first the shelves are out, supporting all records which are on the spindle (condition 1). As the change cycle begins, the separators emerge while the shelves are still out (condition 2). Then the shelves recede, allowing the lower record to fall (condition 3). The shelves emerge again (condition 4), and finally the blades recede (condition 5).

The action described takes place as the result of one revolution of the drive shaft. In the changer the drive shaft is actually made to stand still while the turntable goes through one revolution—which produces the same effect. Normally, the entire group rotates as a unit. The star wheel shown in Fig. 3 is attached to the drive shaft. When the change cycle begins, a lever in the main mechanism moves in and stops the star wheel while the turntable keeps running. After a single revolution the lever moves away and the star wheel is released. Since the entire action takes place in the course of a single revolution, the change cycle requires only $\frac{1}{45}$ minute, or $1\frac{1}{3}$ seconds.

(*Continued on page* 94)

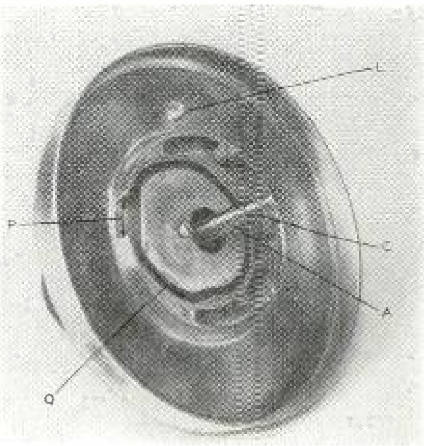


Fig. 1—The underside of the turntable.

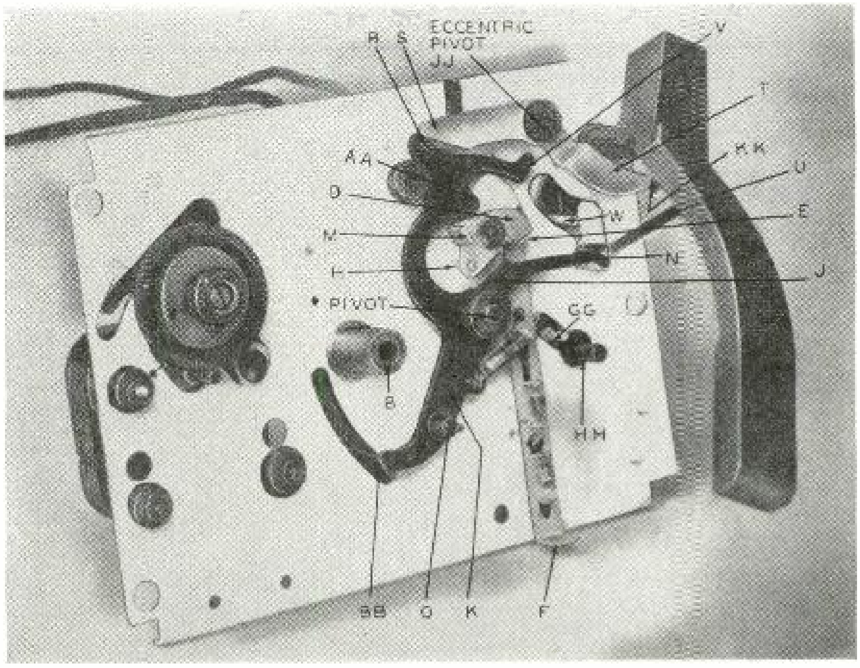
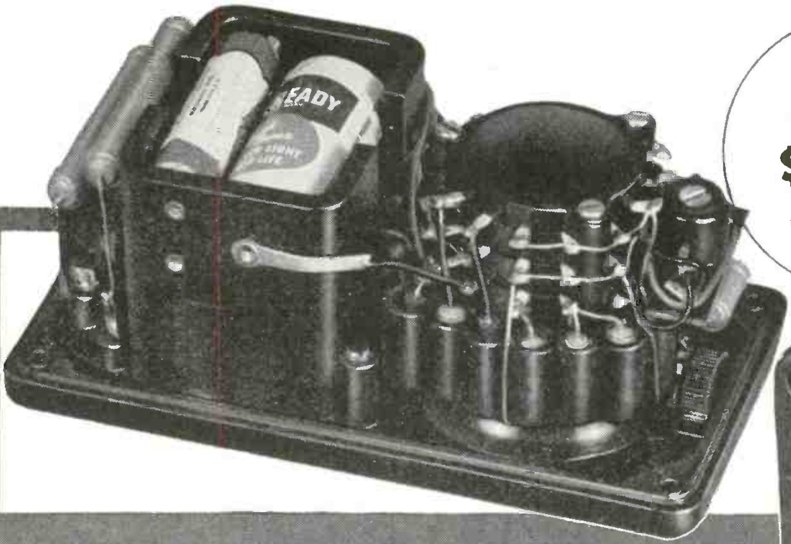


Fig. 2—Top of changer mechanism. Lettered parts are referred to in the text.



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RADIO SET & SERVICE REVIEW

(*Continued from page 92*)

The change cycle

Fig. 2 is a photo of the metal chassis removed from its Bakelite housing and with the turntable removed. Fig. 5 shows the underside of the chassis. All parts appear in their normal positions while playing a record, except that in Fig. 2 the tone arm has been moved out and held up to reveal parts it would otherwise obscure.

The key component is the trip pawl D (Fig. 2). Its vertical, down-projecting tab E is pushed rearward, either by the reject lever F or by the inward travel of the pickup arm, through lever G under the chassis (Fig. 5). The short down-projecting pin H under trip pawl D now lies against point J on main lever K.

As the turntable rotates, a small projection L on the underside of the turntable (Fig. 1) hits the upward-projecting tab M on trip pawl D (Fig. 2), making M strike point J on main lever K. This pushes arm N of main lever K toward the front of the changer and upward-projecting pin O slightly toward the center of the turntable.

At this instant, opening P (Fig. 1) under the turntable is opposite pin O (Fig. 2), and pin O passes through the opening. As the turntable continues to rotate, pin O is caught in the cam groove Q under the turntable. The groove is so shaped that, during one revolution, pin O is pushed close to the turntable center, then outward again, finally escaping through opening P.

As pin O moves in, pin R (Fig. 2) travels to the right, pushing arm S of the lift lever rearward because of the shape of the inner edge of arm S. Arm T then moves forward. Pin U, attached to the pickup arm, normally is close to arm T in the position shown. When arm T moves forward, it pushes against pin U, raising the pickup off the disc. At the end of the cycle, when pin O on the main lever has come back to its normal position as shown in the photo, the

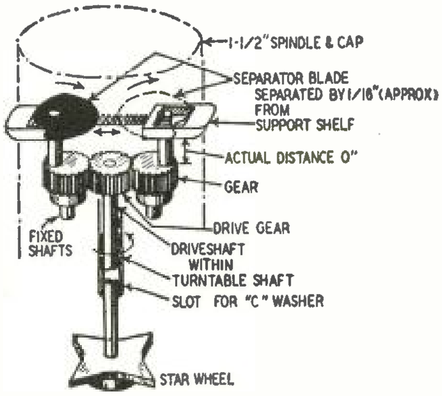

Fig. 3—The record-drop mechanism.

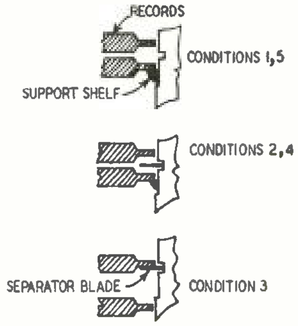

Fig. 4—Sequence of record-drop cycle.

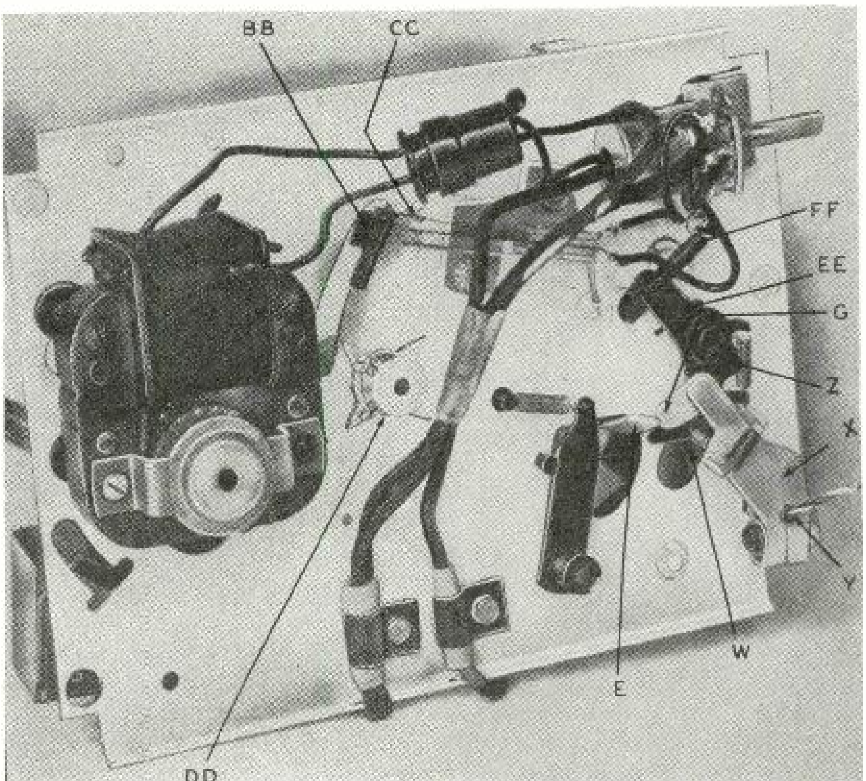

Fig. 5—Under changer chassis. Tab BB stops star wheel DD to start record drop.

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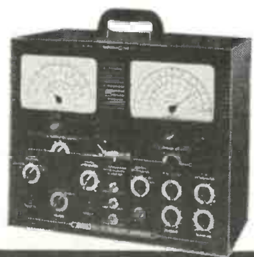

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reverse takes place and the pickup is lowered.

As pin O moves in, and after the pickup has risen somewhat, point V on the main lever strikes upward-projecting pin W. Pin W is part of lever X (Fig. 5), which is rigidly attached to the rear pickup-arm bearing Y, which projects down through the chassis and on which the arm swings. As point V (Fig. 2) pushes pin W rightward, the pickup arm is swung outward. The outward swing is limited by pin W's hitting a portion of lever Z (invisible in the photo but quickly understood when the actual unit is examined). In the second half of the cycle, when point V recedes leftward, the pickup remains at the outside limit which has been provided by a coil-spring arrangement on lever Z.

The trip pawl is reset by point AA on main lever K (Fig. 2). This hits the rear surface of tab E on the pawl, so that the pawl is rotated clockwise back to its initial position. It is then ready for the next cycle.

The record-change is caused by BB, the downward-projecting tab on main lever K. When this travels inward, it gets between the points of the star wheel DD (Fig. 5) and prevents it from turning, so that a new record is dropped as explained earlier. At the end of the cycle, the cam groove under the turntable pushes pin O (Fig. 2) outward and tab BB goes along with it, allowing the star wheel to turn with the table again.

In the playing position, BB rests against the leaf of the muting switch CC (Fig. 5) holding it open. When the cycle starts and BB begins to move in, the leaf is released, shorting the pickup leads, which are connected across the contacts, and muting the device to prevent audible clicks and thumps.

Adjustments

The set-down point for the pickup depends on the normal position to which arm EE (Fig. 5) of the limiting lever is pulled by spring FF. Pin GG (Fig. 2) projects upward from arm EE and hits an eccentric collar on screw HH. The travel limit of pin GG, and therefore the resting and set-down points of the pickup, can be altered by turning screw HH. This can be done without any disassembly. Adjust the screw so that the needle sets down about halfway between the first record groove and the record's outer edge. It will then move into the first groove smoothly.

The height to which the arm rises is controlled by the position of the pivot JJ of the lift lever. Turning the pivot screw moves the entire lever backward and forward through an eccentric mounting. Adjust this so that the arm does not hit the bottom-most of the records on the spindle during the change cycle. Bend lug KK (Fig. 2) so that the needle rests just high enough to clear the empty turntable when the mechanism is in the playing condition (not in the change cycle).

The record-drop mechanism in the turntable spindle must operate at the

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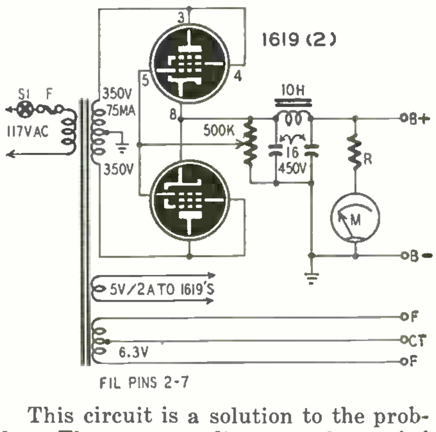
The changer should trip immediately after the needle leaves the last close-spaced groove and enters the spiral. To make the trip occur sooner, bend tab E on the trip pawl (Fig. 5) to decrease the angle between the tab and the pawl body; to delay the trip, bend it the other way. *Do not bend it much in either direction or it will not trip at all.*

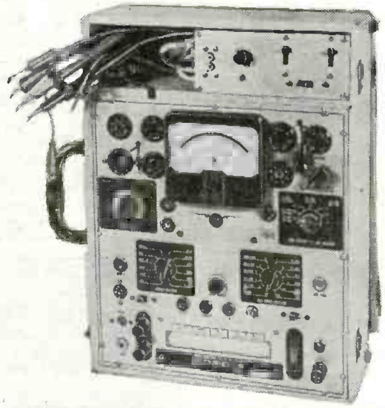
There is no way to adjust the speed at which the pickup falls on the record. The fall, when there are only one or two discs on the turntable, is hard enough to make the pickup bounce. This is a fault of the design. Recent models, however, are equipped with a pneumatic dashpot which stops the bounce.

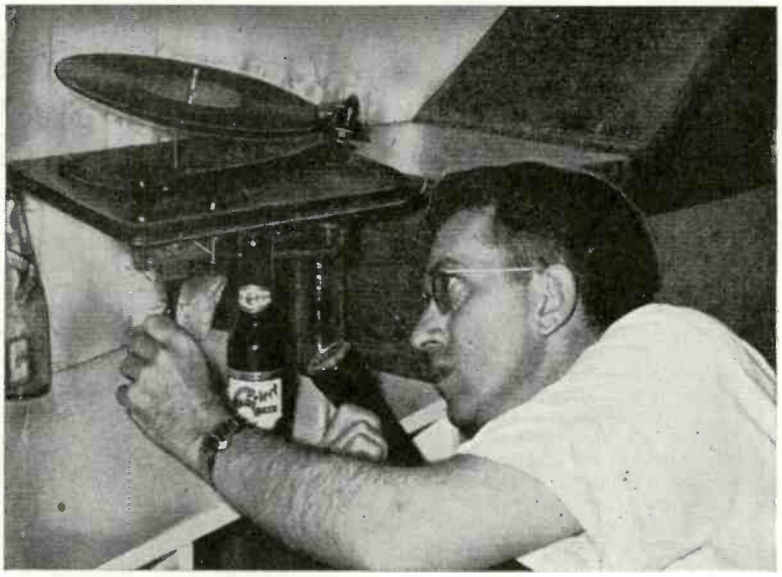
REGULATED POWER SUPPLY

Experimenters frequently use tapped bleeders across power supplies. A system of this type will work as long as the current from all the taps remains at the level at which the taps were adjusted. Any change in current drain from one tap will change the voltage at all taps.



This circuit is a solution to the problem. The output voltage can be varied from approximately 50 to 225 volts under ordinary loads. The voltage and current ranges can be increased—within limits—by using a huskier transformer and choke. A pair of 1619's can be obtained from surplus stocks for about $1.00. The control potentiometer should be one of the molded-element type to carry the current. If this type is not available, you may use a standard 1-megohm carbon potentiometer. Resistor R is the meter multiplier. Its resistance depends on the meter and voltage to be measured.—*Charles J. Applegate*





"... got underneath ... and began getting a crick in my neck."

Record Changers--Bah!

By JAMES R. LANGHAM

WE'VE all heard fantastic tales about record changers. And Lord knows they *can* be fantastic. George Price drew a very fine cartoon of one hurling a disc through the air and its owner saying, a trifle smugly, to a visitor: "Our record changer says if it isn't Bach, to hell with it." Fantastic, yes—but close enough to the truth to be funny.

Back in the days when I was doing general service work we didn't get many record changers. In the first place there weren't as many of them. In the second place those we had were a little better in quality and workmanship (though poorer in design) and so tended to go wrong less often.

I remember one brute I was called in on. All the thing needed was a new length of phosphor-bronze cable run through its complicated system of wheels and pulleys. It wore me down to trace it out and then string up a new one, so I charged the owner $15 for the repair job. Looking back now, I wonder how I had the nerve to charge so much and why he accepted the charge without complaint. It certainly wasn't much of a job to thread it up once I discovered how it was supposed to go. It wasn't nearly as bad as the dial arrangement on some of the new all-band or communications receivers you run into.

I got into audio work just a little while after that, specializing more in design and construction than servicing. I didn't get to see many record changers because both the XYL and I scorned them heartily. Hard on the records.

We had a neighbor once who kept a small hammer alongside his record changer. Every once in a while it would stop playing records and begin saying "wood chuck." It would just say it over and over: "Wood chuck wood chuck wood chuck." The owner would reach over and hit it with the hammer, and it would stop saying "wood chuck" and go back to playing records. He'd hit it right on the center of the turntable spindle. I haven't the faintest idea why. Sometimes he would have to hit it only a couple times an evening, and sometimes he'd cosh it about every fifteen minutes. Depended on the cosmic rays, maybe. He didn't mind it particularly—he was rather proud of it! It sort of set him off from other people. The XYL was all for my digging into it and removing its appendix or something but I shushed her. I didn't want any part of that fearsome affair.

Anyhow, a little over a year ago the XYL suggested that we buy a changer. She was almost apologetic about it. "It would be nice for the youngsters and for dancing, and we could put some Strauss waltzes on at mealtime and. . . ."

I let her talk me into it, agreeing that it might be pleasant. Sucker! After all, loads of people have them. They probably have been exercised of evil spirits by now. Just about foolproof.

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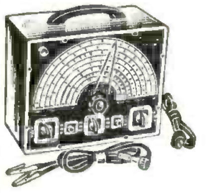

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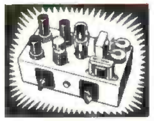

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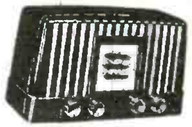

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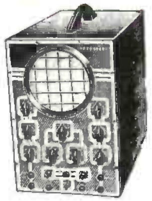

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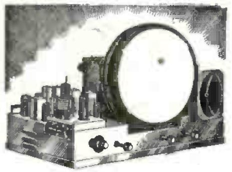

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wholesale house and asked to be shown. I'm a pretty good customer, and so they bent over backward and lined up a whole row for our inspection. We both hefted the tone arms and looked underneath with a technical air that probably fooled the clerk.

The first question was whether to choose a center-post changer or one with the two bladelike dinguses that hold the discs by the edges. We were inclining toward the two-blade affair when the XYL happened to wonder about some records being thicker than others.

The salesman assured us that it just wasn't so. All the records were the same size, he insisted.

The more we thought about it, the more we stalled, finally calling a moratorium on the purchase, and went to a record shop. It was our regular shop and the girl knew us, but this time we were in a hurry and didn't want to go through a whole bunch of explanations. We demanded a thick record.

"Uh—thick?" The girl wasn't sure.

We nodded. "Preferably laminated. Columbia. A thick one."

The girl was very unhappy over the whole thing. It was a silly way to choose a record and our reputations took an awful drop. We finally went back to the wholesale house with a thick, laminated disc of Lanny Ross singing some tepid number. We slapped it on the changer.

The XYL's fears were true. Those knife-edges tried to go in between Lanny Ross. It stuck and kind of growled and grunted and then the record gave up. Lanny lost his first eight bars.

The salesman was humiliated and a bit resentful. We should have taken his word for it. "Any record shop will exchange a bad record like that."

The XYL smiled sweetly. "There may be quite a few like that in our library. We've had them for some years. Do you really think we could exchange them now? Let's look at the center-post changers."

The salesman shrugged in a resigned, hopeless manner. "What's the use? They'll wear out the center holes. You can't make an omelet without breaking eggs."

"We don't want an omelet, thank you. Also we don't want to have to sweep out the record chips every night."

Anyhow we finally got down to a choice between a most-popular American model and another, slightly higher, imported from Great Britain. We decided on the American model because of ease in getting replacement parts. I commented on Whitworth and S.A.E. threads. Also because the American model looked as though it had more bronze and less pot metal underneath it. Also it was cheaper. I was still a newborn babe. I found out afterward the bronze was paint, and there were only two or three screws in the whole thing.

Anyhow we took home a brand new changer all sealed in its carton. We

felt smugly confident that we had done the RIGHT thing. Scientific method.

Then for a couple of days I wrestled with plywood to make a box for the thing. Inside dimensions, 14 x 14 inches. Nice fit. A flame finish went pleasantly with the playroom decor, and so I squirted the blow torch at it while the XYL stood by with trepidation and a fire extinguisher.

When I put the changer in, I noticed the flame finish on the outside had made the wood squeeze in a bit on each side. Not much. Just made it a nice push fit.

I had already equalized the crystal with it on *manual* with the changer standing on three beer bottles and had got it about right, so I now called the XYL and loaded up the changer with a nice stack of Sibelius. Then I pushed the button.

Man, it was funny! The changer walked right through that stack of records and never played a note. Just changed them all, one right after the other, as fast as it could. Fast cycle too!

"My," admired the XYL. "That was a quick symphony wasn't it? What did you say it was?"

Glaring at her, I set them up in the other alley. Same result. It wouldn't play a single bar of music. As fast as the tone arm set down on a record, the mechanism would go into another spasm. All ten records just like the little Indians. My loving helpmate giggled.

"Well, after all," I remarked. "*You* wanted a changer. It changes them. It just doesn't play them. We have a regular turntable to play them on. Speed is the catchword of modern progress."

She frowned. "I wonder where we could get a service technician?"

That was too much! I chased her out of the room, pried that fool changer out of it's corsetlike box, and set it up on the three beer bottles again. Then I loaded it up, got underneath with a flashlight, and began getting a crick in my neck.

Like most items in a competitive economy this affair was made as cheaply as possible. The motor board is a stamped piece of sheet steel covered with bronzelike stain. The mechanism works with a series of little springs in different directions. The who-dad bumps on the dingbat and that releases the gimmick (if the tensions are right on the springs) that triggers the bull-sprocket, and so on.

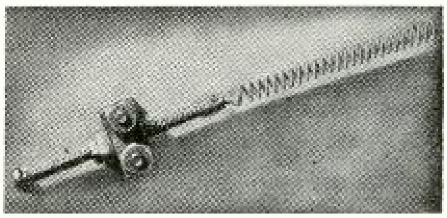
That nice tight-fitting box was warping the light motor board so that the vector tensions of the springs were thrown slightly cattywampus. The box being my pride and joy and my blood and sweat, too, the answer was not to knock the box apart and rebuild it. The answer to me—then—was simply to adjust those little springs.

Those little springs were held by small tongues that were punched out of the sheet metal of the motor board. The little tongues were pushed up and the springs just looped over them. The only adjustment possible, of course, was to bend those little tongues this way and that. My natural tendency seemed to be to bend them the wrong way at first and about seven times too far.

Progress was slow on it, too, because the only way of testing it each time was to push the thing down into the box again and, then, when it didn't work, pull it and pry it out and set it up on the bottles again.

Looking back on it now, I honestly think a regular record-changer repairman could have adjusted that thing within an hour or so. I even think I could do it now. But not then. It was bend and put it in the box and try it; pry it out and bend again; ad nauseum. Humiliating! Also slow.

After some hours the XYL called out something, and I just snarled at her. Still later she brought me a cheese sandwich and a glass of beer. Then she



". . . flattened the screws out and hooked the springs through the small holes . . ."

came down in her slippers and robe to say it was nearly three thirty and didn't I think I'd better stop for now?

I didn't and bent a tongue again. This time the little tongue broke off in my pliers, and the spring went "ANG-UH-Ang-uh-ang-uh." Something whizzed through the air and hit the speaker baffle.

At that point, I confess, I put my head down in my arms and wept. The XYL picked up the washer, turned out the lights, and led me off to bed.

The next morning I broke off the other two little tongues and failed to solder the first one on so that it would hold. The XYL came in and got the axe away from me just in time. I went for a long walk by the beach then and tried to commune with myself.

When I got back, I made up three little brass blocks and drilled them to clear 6-32 screws. These were bolted to the motor board. Then I made a longer 6-32 screw into a little hook and anchored the springs with the hooks. This longer screw was adjustable with a lock nut. The bullcog had bumps that fouled these hooks, so I flattened each screw out and put the springs through a small hole drilled through it. Still adjustable tension.

Then I got to work. I changed the tensions a little at a time and (of course) got it in less than an hour. I locked down the nuts and there it was. Adjustable and lockable. Then I put it back and, trembling, called the XYL.

This time it worked fine. It changed not only standard Victor, Columbia, and Decca discs but even some Telefunken records which are slightly smaller over-all and have no eccentric grooves at the end of the cut. It even worked fine with acetate recordings although I don't recommend that practice—too rough on the acetate discs.

Since then I have become a sort of minor authority on the adjustment of record changers among a small circle of high-fidelity fans. I have had to make several machines work after various wives had seen ours working and made their husbands buy them. In each case I have installed at least one brass block for adjusting the spring tension. The most critical (and one is always more critical than the others) is generally the one toward the corner where the switch is.

Aside from this there's not an awful lot to go wrong with a record changer. The whole thing is mechanical and you can generally diagnose the trouble by inspection while it's going through its routine. Instead of beer bottles, I now have three threaded brass rods to stand the thing on.

Wear often seems to occur at the underside of the dog-leg arm that pushes the stack of records. The manual says to bend this arm so it won't go so far, but it is better to shim it with a piece of cardboard.

Impatient folk will try to stop a changer in its cycles sometimes, and then you do have a rebending job on the spindle or, on some changers, on the little sheet-metal finger that trips the trigger. Most of the changers have poor bearings, and, when they wear out, you either have to make new ones or buy them.

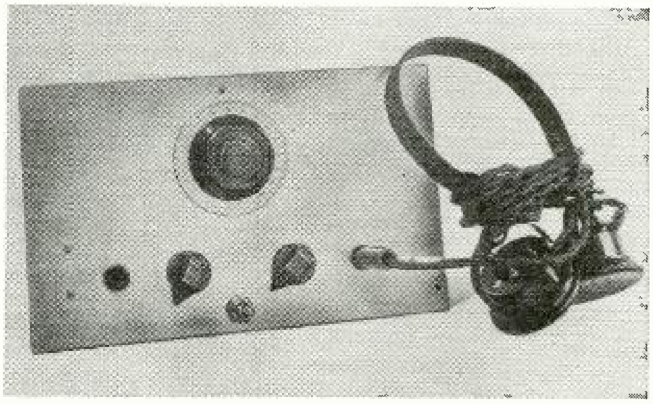
Those bull-gears with the knobs that look as though they are made of pot metal *are* made of pot metal, so watch your step and don't bump them! Sometimes they crumble if you breathe hard on them. I've had that trouble with three or four popular British changers, and I don't particularly like them for that reason.

As to fidelity, they aren't so hot if you want the finest. You don't get the results with them that you have a right to expect from a really nice pickup. In spite of the fad for reluctance heads right now, I personally prefer crystal units on changers. The reluctance heads require a lot of bass boosting and have low output anyhow, making it too easy to have your hum level up there so high the quiet passages can't be heard.

The crystals (as well as the reluctance cartridges) require equalization; I've never had a pickup yet that didn't need it. You can swap cartridges for another type, but don't try to switch arms. One chap converted an old Capeheart changer to swing a Brush PL-50 arm and head. He finally got it working, but took up absinthe shortly afterward and was never much good for anything again. Got to seeing everything green.

Changers do gouge the records more than a straight player but not an awful lot. You don't really expect records to last forever anyhow. They don't do as much damage in a dozen playings as some careless jerk who wipes the dust off the grooves with sweaty hands.

D. F. Receiver For Yachts



The little direction-finder receiver is simple and neat.

By T. W. DRESSER

IN THE average small sea-going yacht with a waterline length of 30 to 50 feet, space is at a premium. There simply is not room for elaborate direction-finding gear, even if the owner could afford it. A standard battery receiver with built-in loop may be used, but it does not give the sharp null required for accurate bearings.

The receiver described here does not have the great accuracy of elaborate commercial jobs, but it will furnish bearings with much less error than those usually obtained by amateur yachtsmen. The dimensions are so small that the gear can be stowed in a locker or fastened to a bulkhead without being obtrusive. The cost is very reasonable and maintenance requirements low. Although the equipment is primarily a navigational aid, it operates on the broadcast band as well as on the beacon band and can be used for entertainment.

To insure a clear null and good stability, the receiver, antenna, and connections must be effectively shielded. It is not possible to obtain an absolutely silent null point by shielding alone, as the capacitance to ground within the shield is not symmetrical. However, with a little practice, it is a simple matter to estimate the bearing by taking the mean of two equal-signal-strength points either side of minimum. (An output meter would be very useful for this purpose in view of the notorious inaccuracy of the ear in judging the strength of any but the very lowest-level sounds.—*Editor*)

The receiver circuit, diagrammed in Fig. 1, is orthodox, with an r.f. amplifier followed by a regenerative detector and an audio output stage. To reduce the amount of iron in the vicinity of the loop assembly and compass, crystal headphones are used, with the output tube arranged as a voltage amplifier. There is, thus, no need for an output transformer or the field magnet of a speaker. Battery requirements are very modest—1.5 volts for the filaments and 45 volts for the plates. The chassis and case are both made of aluminum. Specifications for the tuning coil appear in Fig. 2.

In arriving at the size of the loop frame, the ratio of diameter to coil length (in this case width) is the determining factor. A high ratio contributes greatly to better geometrical accuracy in relation to the wavefront and also to alignment of the compass, which should be mounted on the antenna itself.

The old big-ship method wherein a

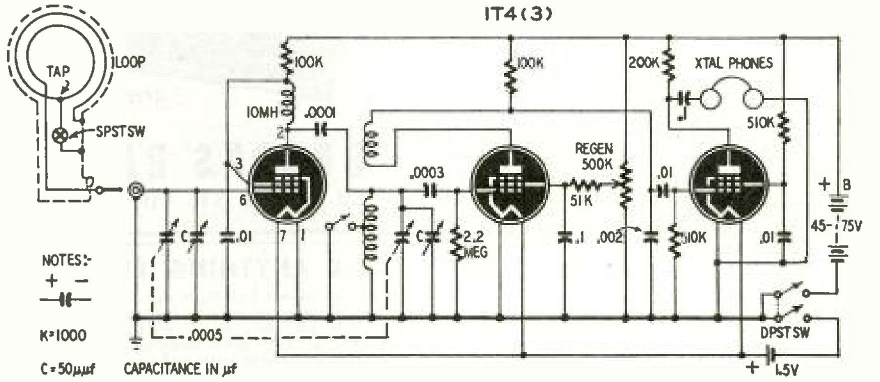


Fig. 1—Receiver is an ordinary regenerative battery unit with three tubes.

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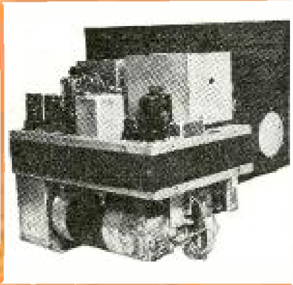

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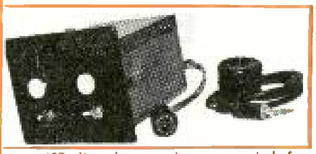

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UNITED SURPLUS MATERIALS

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fixed scale indicates the bearing of the loop in relation to the fore-and-aft line of the ship (to make a correction, the course must be rated at the moment the bearing is taken) is cumbersome and liable to error in even the biggest of ships. In a small yacht with its quick motion and often an inexperienced crew, it is impossible; the advantages of having the compass right on the antenna are obvious.

Fig. 3 shows how the loop antenna is constructed. Two strips of plywood veneer are formed into circles (with the help of some steam). Hardwood blocks join the concentric circles and

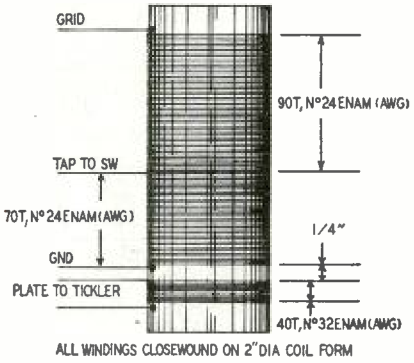


Fig. 2—Specifications for tuning coil.

wire is wound in slots sawed in the blocks. The switch shorts out some of the turns to make the coil tune the broadcast band. Copper foil is used to cover the loop frame for shielding purposes, but a gap is left at the bottom of the loop so the foil will not form a closed turn and absorb power.

The big-ship practice of mounting the loop rigidly on a deckhouse top is not recommended for small craft. Whereas a big vessel, even in the worst weather, is on an even keel at one point of her motion, which is sufficient to get a bearing, the smaller ship is frequently laid over for long periods in a stiff breeze and any bearings taken are hopelessly inaccurate. A better method is to support the antenna from the deck head by some flexible means so that it finds its own vertical, whatever the ship's motion may be. An old set of compass gimbals serves admirably as the flexible mount.

The choice of a compass can be left to the yachtsman, who will know that it should be dead-beat.

Operation

Bearings can be obtained on ordinary ship-to-shore stations, on beacon stations in the 900–1,000-meter range, or on seaboard broadcast stations. On ship-to-shore stations and beacon transmitters it may be advisable to advance the regeneration control until the receiver oscillates, and adjust the pitch of the note so that it stands out against the background of other stations on the same band. That makes it easier to concentrate on the one signal.

A swing of about 8 or 10 degrees will be enough to indicate points of equal signal strength each side of minimum. As there is only a single loop and no sensing antenna, there are two points of minimum signal 180 degrees apart. In coastwise and inshore sailing it is usually obvious which is correct.

Bearings taken beyond a distance of 100 miles should not be accepted as accurate if standard charts on Mercator's projection are used, since bearings on such a chart are Rhumb lines, while radio follows a great-circle route.

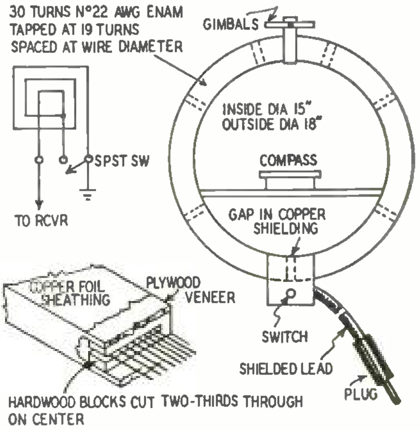
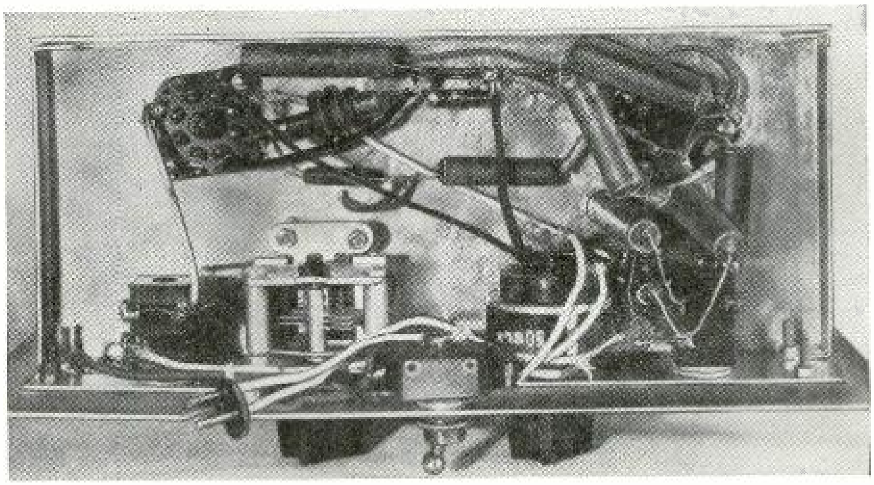


Fig. 3—The loop may be built as shown here or a surplus unit purchased.

Bearings taken over 50 miles at night are subject to skywave-path inaccuracies. Don't trust them.



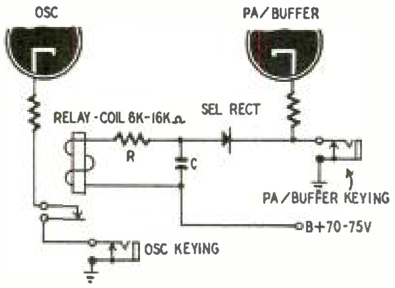
Any amateur radioman can easily build this receiver. It has few components.

TIME-DELAY CIRCUIT KEYS AMATEUR RIGS

By OTTO L. WOOLEY, WØSGG

KEYING an amateur c.w. transmitter for best results on all bands involves a number of considerations. Oscillator keying allows complete break-in or semi-break-in on or near the operating frequency. However, above 7 mc this type of keying may easily produce a chirpy signal, so the final amplifier or a buffer stage is often selected for keying on the 14- and 28-mc bands. The disadvantage of this setup is obvious—the continuously running oscillator is a nuisance, prohibiting operation on the same frequency. Of course a manually operated switch may be employed to kill the oscillator during reception periods, but this adds a control and multiplies the chances of operational error.

The problem is to obtain a method which will turn the oscillator on instantly when a following stage is keyed, and keep it on at normal keying speeds. The system should then kill the oscillator after a predetermined time interval when keying ceases.



Relay stays closed between characters.

The circuit diagrammed fulfills these requirements and uses only a relay, small resistor, capacitor, and rectifier.

The schematic shows how the circuit operates. When the key is plugged into the oscillator keying jack, the oscillator is keyed in the usual manner, the relay being held shut by the current from B+ to ground through the closed-circuit amplifier keying jack.

If the key is plugged into the amplifier keying jack, the oscillator is inoperative because the relay contacts are open. However, the instant the key is depressed, current flow closes the relay, turning on the oscillator and charging capacitor C. As long as the amplifier is being keyed, the charge on C will keep the relay closed; but when keying ceases, the relay will open after the time interval required for C to discharge through the resistance of R and the relay coil in series.

This interval may be determined from the formula $t = RC$. When C is in microfarads and R is in megohms, t will be the number of seconds necessary for C to discharge to approximately one-third of the charging voltage.

For example, let us suppose a certain relay will open at 25 volts. We know from the formula that the charging voltage must be 75 volts, which may be obtained from a tap on the power-supply bleeder. Assume the relay coil resistance to be .008 megohm and R to be .047 megohm, with a capacitor of 2 μf. Therefore, $(.008 + .047) \times 2 = 0.11$ second. This interval is about right for fairly fast keying.

The interval may be increased by using a larger capacitor, resistor, or charging voltage. In any case the constants will have to be adjusted to suit the operator's keying speed.

The relay contacts should be spaced very close to prevent clipping part of the first character as the amplifier is keyed.

Capacitor C must be of good quality. A leaky capacitor will prevent satisfactory operation. Do not use an electrolytic. The relay is a sensitive unit with a coil resistance of 6,000-16,000 ohms.

The selenium rectifier prevents interaction between the relay and tube circuits when the key is up. Do not key any stage where the rectifier's inverse voltage rating will be exceeded.

Cathode keying of the oscillator is shown; however the circuit may be used with most forms of oscillator keying. As a matter of fact the system may be used to turn on and off an oscillator that is not satisfactory for keying.

How to Become a Ham

Part IV—How to put together an excellent 1-tube converter

By GEORGE W. SHUART, W4AMN

Utility box encloses converter neatly.

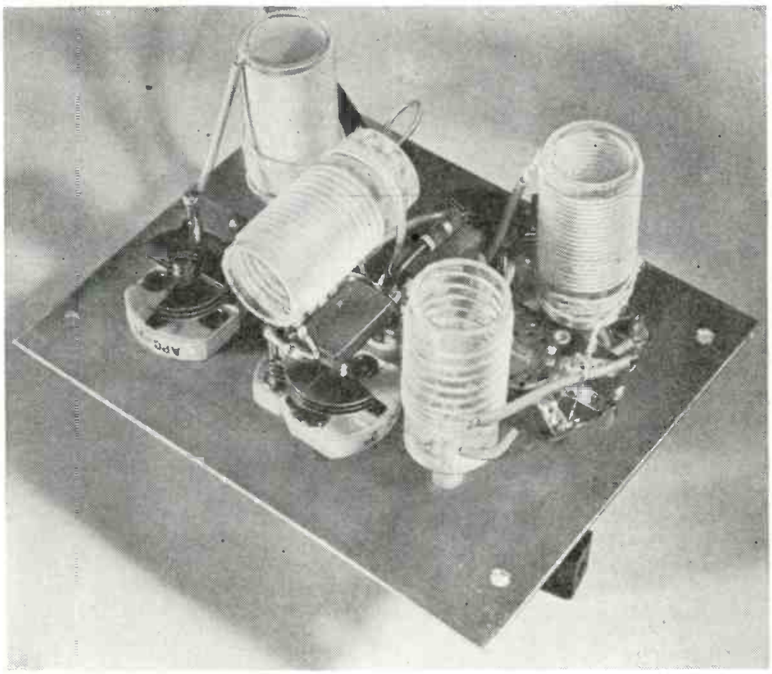
ANYONE with a little technical knowledge can, in a matter of hours, put together a transmitter that will produce remarkable results. The receiver problem is different! It's a big problem no matter how you look at it, and the majority of amateurs have spent a lifetime trying to find the ideal receiver. It's our opinion that unless the reader is loaded with cash and buys the best on the market he'll never know what it is to be satisfied. It's a safe bet, too, that he'll be satisfied only a few months at the most no matter what he buys.

Let's assume that the reader isn't loaded with cash, and that he is aware that the old-fashioned 2-tuber just won't compete in the present-day crowded ham bands. A fairly good receiver will cost something less than two hundred dollars, and a good one will cost much more.

Since there seems to be no great disgrace in owning a "used automobile," there's no reason why the newcomer in ham radio can't economize by buying a good used receiver. Reliable dealers recondition their trade-ins, and thereby offer the opportunity to obtain top performance at a very reasonable cost. The surplus market has offered top value for little cash outlay, but of late the better buys are not so often seen, and prices are higher. There are still a number of receivers that cover one or more of the ham bands available at a low price. These usually operate on 28 volts but units to convert them to 120-volt a.c. operation are becoming available.

There are several very low-cost receivers which appeal to the beginners with little cash to spend, but they have several shortcomings which limit their effectiveness; for example, lack of a crystal filter and sufficient pre-selection.

(*Continued on page* 113)



Converter parts are on metal panel. The coils are wound on polystyrene forms.

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0A3/VR75	.98	1N5GT	.80	6AD7G	1.28	6J6	1.16	6SV7	.88	7Z4	.72	14C5	.88	45	.66
0A4G	1.06	1P5GT	1.06	6AF6G	1.25	6J7	.80	6T7G	1.24	10	.69	14C7	.88	45Z3	.60
0B2	2.05	1Q5GT	1.06	6AG5	1.06	6J7GT	.80	6V5/6G5	.72	12A	.60	14E6	.72	45Z5GT	.72
0B3/VR90	.75	1R4	1.06	6AG7	1.28	6J8G	1.28	6U6GT	.72	12A6	.39	14E7	.88	46	1.03
0C3/VR105	.98	1R5	.80	6AH6	1.56	6K5GT	.96	6U7G	.72	12A6GT	.29	14F7	.88	47	.96
0D3/VR150	.75	1S4	.96	6AJ5	.99	6K6GT	.60	6V6/6V6G	1.28	12A7	1.28	14F8	1.06	49	.88
0Y4	.88	1S5	.72	6AK5	1.56	6K7	.66	6V6GT	.80	12A8GT	.80	14H7	.88	50	1.56
0Z4	.88	1T4	.80	6AK6	.96	6K7GT	.66	6W7G	.88	12AH7GT	.88	14J7	1.06	50A5	.88
0Z4G	.88	1T5GT	1.06	6AL5	.80	6K8	.96	6X4	.60	12AL5	.80	14N7	1.06	50B5	.66
01A	.50	1U4	.80	6AL7GT	1.06	6K8GT	.96	6X5GT	.60	12AT6	.60	14Q7	.88	50C5	.66
1A3	.72	1U5	.72	6AQ5	.80	6L5G	1.06	6Y6G	.96	12AT7	1.16	14R7	.88	50L6GT	.66
1A4	1.28	1V	.88	6AQ6	.72	6L6	1.42	6Y7G	.88	12AU6	.80	14S7	1.06	50Y6GT	.72
1A4P	1.56	2A3	1.28	6AQ7GT	.88	6L6G	1.16	6Z7G	1.28	12AU7	.96	14W7	1.06	53	1.06
1A5GT	.72	2A5	.88	6AR5	.66	6L6GA	1.16	6ZY5G	.88	12BA6	.72	14X7	1.06	56	.72
1A6	1.28	2A6	1.06	6AS7G	4.95	6L7	.96	7A4/XXL	.72	12BE6	.72	19	1.28	57	.80
1A7GT	.80	2A7	1.06	6AT6	.60	6L7G	1.16	7A5	.72	12C8	.69	19T8	1.56	58	.80
1B3GT	1.49	2B7	.88	6AU6	.80	6N6G	1.56	7A6	.72	12F5GT	.72	22	1.28	59	1.06
1B4	1.56	2V3G	1.98	6AV6	.60	6N7	.96	7A7	.72	12H6	.39	24A	.88	70L7GT	1.56
1B5/25S	1.28	2X2A	1.25	6B4G	1.28	6N7GT	.96	7A8	.72	12J5GT	.39	25A6	1.06	71A	.80
1B7GT	1.06	3A4	.39	6B5	1.56	6P5GT	.96	7AD7	1.06	12J7G	.80	25A6G	1.06	75	.66
1C5GT	.88	3A5	1.49	6B6G	.88	6Q6G/6T7G	1.06	7AF7	.72	12J7GT	.80	25AC5GT	1.16	76	.66
1C6	1.28	3A8GT	1.98	6B7	1.28	6Q7	.80	7AG7	.88	12K7GT	.66	25L6GT	.66	77	.66
1C7G	1.28	3B7	.36	6B8	1.28	6Q7GT	.72	7AH7	.88	12K8	.88	25Y5	1.16	78	.66
1D5GP	1.55	3D6	.36	6B8G	1.28	6R7	1.06	7B4	.72	12K8GT	.96	25Z5	.60	79	.88
1D7G	1.28	3LF4	1.28	6BA6	.80	6R7GT	1.06	7B5	.72	12Q7GT	.72	25Z6GT	.60	80	.46
1D8GT	1.56	3Q4	.88	6BE6	.72	6S7	1.28	7B6	.72	12SA7	.66	26	.72	81	1.56
1E5GT	1.38	3Q5GT	.96	6BF6	.66	6S7G	1.28	7B7	.72	12SA7GT	.66	27	.60	82	1.06
1E7G	1.56	3S4	.80	6BG6G	1.92	6S8GT	1.06	7B8	.72	12SG7	.72	28D7	.39	83	1.06
1F4	1.06	3V4	.80	6BH6	.80	6SA7	.66	7C4/1203A	.39	12SW5	.80	30	.39	83V	1.28
1F5G	1.06	5A74	.60	6BJ6	.80	6SA7GT	.66	7C5	.72	12SF5GT	.80	31	.39	84/6Z4	.72
1F6	1.56	5R4GY	1.15	6C4	.39	6SB7Y	.88	7C6	.72	12SF7	.80	32	1.28	85	.88
1F7G	1.56	5T4	1.28	6C5	.66	6SC7	.72	7C7	.72	12SF7GT	.80	32L7GT	1.26	89	.72
1G4GT	1.06	5U4G	.60	6C5GT	.66	6SD7GT	.49	7E5/1201	1.66	12SG7	.72	33	.39	89Y	.39
1G6GT	1.06	5V4G	.96	6C6	.80	6SF5	.66	7E6	.72	12SH7	.39	34	.38	117L7GT	1.56
1H4G	.88	5W4	1.06	6C7	1.28	6SF5GT	.72	7E7	.88	12SJ7	.66	35/51	.80	117M7GT	1.56
1H5GT	.66	5W4GT	.66	6C8G	1.28	6SF7	.80	7F7	.88	12SJ7GT	.66	35A5	.72	117N7GT	1.56
1H6G	1.28	5X4G	.72	6D6	.66	6SG7	.80	7F8	1.06	12SK7	.66	35B5	.80	117P7GT	1.56
1H6GT	1.28	5Y3GT	.42	6D8G	1.28	6SH7	.39	7G7/1232	1.06	12SK7GT	.66	35L6GT	.66	117Z3	.60
116GT	1.28	5Y4G	.60	6E5	.85	6SJ7	.66	7H7	.80	12SL7GT	.88	35W4	.46	117Z4GT	1.16
114	.80	5Z3	.72	6F5	.66	6SJ7GT	.66	7J7	1.06	12SN7GT	.80	35Y4	.72	117Z6GT	.96
1LA4	1.06	5Z4	1.06	6F5GT	.66	6SK7	.66	7K7	1.06	12SQ7	.60	35Z3	.72	FM-1000	1.28
1LA6	1.06	6A3	1.28	6F6	.80	6SK7GT	.66	7L7	.88	12SQ7GT	.60	35Z4GT	.60	UX120	1.38
1LB4	1.06	6A6	1.06	6F6GT	.66	6SL7GT	.96	7N7	.88	12SR7	.39	35Z5GT	.50	UX200	1.28
1LC5	1.06	6A7	.80	6F7	1.06	6SN7GT	.88	7Q7	.72	12SR7GT	.39	36	.39	9001	.89
1LC6	1.06	6A8	.80	6F8G	1.28	6SQ7	.60	7R7	.88	12Z3	.88	37	.39	9002	.39
1LD5	1.06	6A8GT	.80	6G6G	1.06	6SQ7GT	.60	7S7	1.06	12X3	.98	38	.39	9003	.69
1LE3	1.06	6AB5/6N5	.88	6H6	.60	6SR7	.72	7V7	1.06	14A7/12B7	.88	39/44	.39	9004	.49
1LG5	1.06	6AB7/1853	1.06	6H6GT	.60	6SR7GT	.72	7W7	1.06	14AF7/XXD	.88	41	.66	9005	.98
1LH4	1.06	6AC5GT	1.16	6J5	.54	6SS7	.66	7X7/XXFM	1.06	14B6	.88	42	.66	9006	.49

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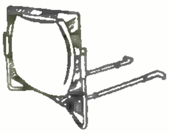

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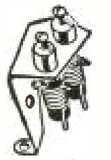

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complete plans, working drawings and instructions in the January issue of RADIO & TELEVISION MAINTENANCE

DESCRIPTION OF EDITORIAL CONTENTS AND BALANCE FOR 1950

Four general types of editorial material will appear in Radio & Television Maintenance Magazine. The description of the editorial coverage and emphasis has therefore been broken into four sections.

A. Technical articles. The articles in this group will fall into three categories as listed below.

1. *Educational:* The purpose of these articles is to keep the reader informed of new technical developments from the standpoint of operating theory. *Examples:* New circuits appearing in current TV VM and AM receivers, new tools, test equipment.
2. *Techniques:* These articles will deal with the practice of radio servicing. *They will cover*—troubleshooting, alignment repair, measurement, installation, etc.
3. *Shop Planning, Construction and Supplies:* These articles will deal with the problems encountered in the operation of service organizations as a productive unit. *Subjects, such as* shop equipment, shop layout, keeping inventory, stock requirements, etc. will be covered under this grouping.

B. NEWS

The subject will be covered by a series of monthly columns as follows:

1. *Current Happenings:* The Radio Industry Newsletter will cover current news. *It will consist* of two pages of short, concise news items with as few words and comments as possible. It will keep the reader informed with a minimum expenditure of his time.
2. *Trends:* Electronically Speaking will analyze current news insofar as it affects the reader. *It will cover,* in greater detail news subjects which are beyond the scope of the Newsletter.
3. *Products:* The Industry Presents will describe new products. *Included* in this department will be parts, tubes, test equipment, receivers, shop equipment, antennas, etc.
4. *Literature:* Review of Trade Literature. *This* short monthly column will describe new manufacturer's literature and review new books.

C. SALES AND ADVERTISING

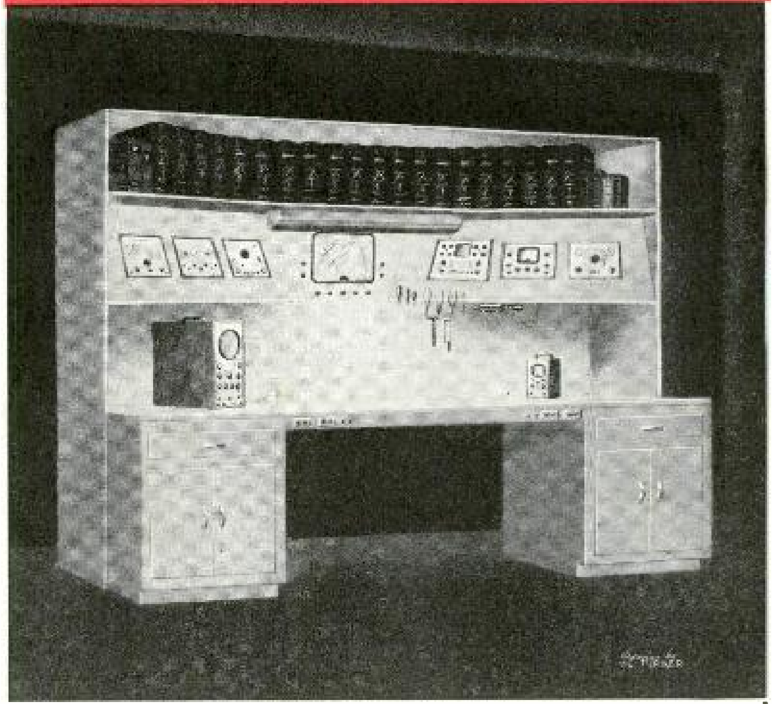
Articles in this group will fall into two categories:

1. *Advertising programs:* These articles will cover the advertising of Service Replacement Parts, Receivers, Specialty Products and Accessories. A monthly department will be *devoted* to describing various types of display and advertising material such as manufacturer's packaged point of sales displays—how they can be used and what can be expected of them.
2. *Sales Techniques:* These articles will cover handling the customer, in the home, in the store, closing, sales opportunities, etc.

D. BUSINESS METHODS

Typical subjects to be covered will be management, pricing, costing, taxes, systems, goals, banking, credit, bookkeeping, etc.

RADIO & TELEVISION MAINTENANCE



PLUS: 12 big new construction articles as follows:

How to build the 1950 TV service bench. (January, see cover proof enclosed herewith.)
Building power supplies for the service bench.
How to make receiving dollies for incoming radios.
Planning and constructing inventory racks (and how to stock economically).
How to plan and build efficient set-storage racks for AM, FM and TV.
How to construct a truck interior for efficient field work.
Building an auxiliary bench for tube testing, minor repairs, operating observation, etc.
Construction of cathode-ray tube holder for servicing chassis when tube is separately mounted.
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They are also less sensitive than the more costly models, and liable to be plagued with images.

Selectivity is becoming more important every day. Manufacturers are constantly improving the design of the i.f. amplifiers in their receivers, and informed hams will carefully scrutinize the actual shape of the selectivity curve of the receiver they intend purchasing. The steepness of the sides of the curve, and the width of the skirt are important. An ideal situation would be one where the sides were vertical. See Fig.

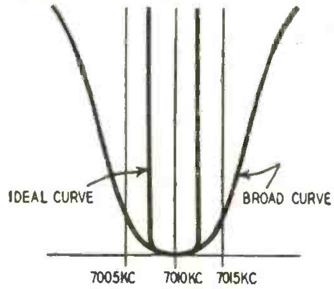


Fig. 1—I.f. selectivity is important.

1. Note that in an ideal receiver tuned to 7010 kc, stations on 7005 and 7015 would not be received at all, but in a cheap receiver might be received with almost as much volume as the desired signal.

Poor sensitivity and low image rejection can be simply overcome in a low cost receiver by the addition of a high-frequency converter to be operated ahead of the receiver's r.f. section. Such an arrangement will make a "double super" out of the simplest receiver. With the receiver proper tuned to something between 3 and 6 mc, the first stages act as an intermediate-frequency amplifier wherein images could be removed by some 6 to 12 mc—enough to just about eliminate "images" (signals as far below the oscillator frequency as the desired signal is above it) even though the new converter uses the simplest circuit.

Somewhere, at the beginning of this article, we said that the 2-tuber wouldn't compete in the crowded bands. However, many newcomers won't be satisfied unless they have a try at using one. For their benefit a circuit diagram and other data are supplied (Fig. 2).

The coils can be wound on polystyrene forms approximately an inch in diameter. Coil L1 should consist of about 15 turns of No. 24 d.c.c. wire, spaced to occupy one inch, and L2 of 6 turns of No. 24 or smaller wire, closewound about 1/8 inch from the ground end of L1. This will cover the 20-meter band. About 30 turns for L1 and 10 turns for L2 will cover the 40-meter band. Experiment with the tickler coil (L2) especially, adding or taking off turns till regeneration is smooth.

Very loose antenna coupling produces best results. Two pieces of metal about half an inch square separated about a quarter of an inch should prove entirely satisfactory. The amount of coupling may be varied by bending the plates closer together or farther apart. Loose coupling reduces interference from strong stations on adjacent channels. Close coupling results in dead spots in the tuning range due to absorption by the antenna system.

At this point it is understood that the reader has built, borrowed, bought, or stolen a receiver that is suitable for

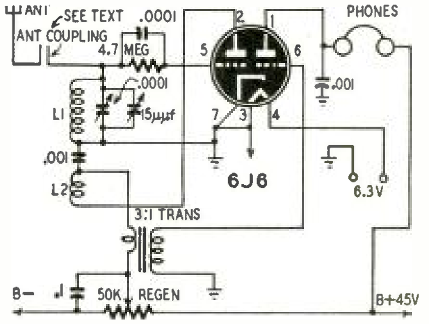


Fig. 2—Simple receiver you can build.

use in the ham bands. The converter illustrated in the photos and in Fig. 3 will produce amazing results. Its simplicity should be no measure of its effectiveness. One word of warning—*do not* connect this converter to an a.c.-d.c. receiver!

A 6J6 twin triode forms the basis for this converter. The circuit is by no means a new one. It has been used by many oldtimers. One section of the tube is employed as a grid-leak detector (especially well suited to weak-signal reception), and the other section is used as a plate-feedback oscillator. The circuit employs fewer components than any other we have ever used. The particular converter shown in the photo was an experimental model. Others which preceded it incorporated slight variations which in some cases may be desirable. For example, one had a direct tuning control, while the one shown here is fix-tuned.

Since the frequency band to be covered is quite limited the detector input circuit is broad enough to permit all tuning to be done by the receiver tuning control. This latter arrangement has

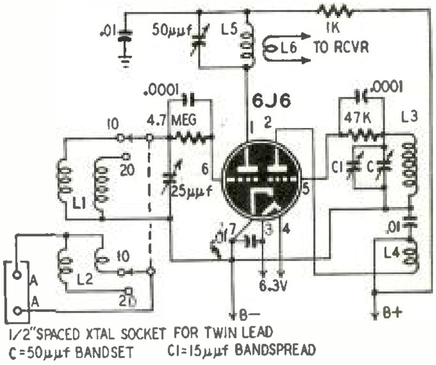


Fig. 3—A converter improves reception.

the advantage that all operating is done right at the receiver control panel. However, the one disadvantage lies in the likelihood of interference due to direct pickup by the receiver on this new so-called "high intermediate frequency." Where there is a separate tuning control on the converter, the receiver can be adjusted to a clear channel very close to the desired i.f. and all tuning then done at the converter panel. All other units which were built covered a single ham band.

Because a signal may be received with the oscillator tuned to either the high or the low side of the detector, it was possible to cover two bands with a single oscillator coil, simply by using the high side for the low frequency band and the low side for the higher band. A slight readjustment of the oscillator is necessary, but that offers no problem. The unit shown in the photos is the fixed-tuned model for the 14-mc and the 28-mc bands. It is illustrated because it had the best layout of components. The same arrangement may be used to cover any other band. In fact, this unit will work very efficiently at the very high frequencies. The only change would be in the selection of a different i.f.; 10 mc should be satisfactory. Table I provides the various tuning ranges of the detector and oscillator circuits at the recommended i.f.'s. Normally a much higher i.f. would be used for the upper two ranges. Low-cost receivers with which this converter is to be used suffer from loss of gain above 10 mc. The 10-mc i.f. is a compromise.

The intermediate frequencies listed are not critical. Should the receiver perform better at a slightly different setting, then, by all means use the frequency that allows the lowest noise.

Noise, by the way, is the basic reason for adding a converter to a low-cost receiver. All receivers generate noise in the r.f. and converter stages. When a signal is weak due to losses in the receiver itself or to outside conditions, then noise (hiss) tends to override the signal. By operating a receiver at a relatively efficient point in its tuning range (where sensitivity is great and noise, therefore, not bothersome) and adding a high-sensitivity, low-noise

TABLE I

Band (mc)	Det. range (mc)	Osc. range (mc)	I.f (mc)
3.5	3.5–4	6.5–7	3
7	7–7.3	11–11.3	4
14	14–14.4	9–9.3	5
28	28–29.7	22–23.7	6
50	50–54	40–44	10
144	144–148	134–138	10
220	220–225	210–215	10

converter, signals can be made to override the noise by a substantial factor. The result is an extremely quiet receiver where the signals pop right out of an almost silent background. Of course, as we previously pointed out, the image problem is greatly reduced at the same time due to the higher i.f.

The converter illustrated in the photo is built in a 3 x 4 x 5-inch utility box. One cover of the box was discarded and an aluminum one was substituted for ease of working. The entire unit is mounted on the aluminum cover. Coils are wound on miniature 7/8-inch-diameter polystyrene forms in accordance with information given in Table II.

It is recommended that the reader follow the exact arrangement of the untuned converter but add the extra tuning control to the opposite cover. Mount the dial (a small vernier) and the bandspread capacitor on the cover.

TABLE II

Band (meters)	Turns L1	L2	L3	L4
10	8	3	8	2
20	20	4	8	2
40	30	5	19	4
80	40	10	32	5

Power for the converter may be taken directly from the receiver with which it is operated. The heater of the 6J6 should be connected in parallel with those in the receiver. Best results were obtained with about 60 volts on the plates of the 6J6. The current requirement at that voltage was between 12 and 13 ma. Plate voltage should be taken from a high-voltage point which feeds the i.f. stages in the receiver. *Do not* use the point that feeds the audio amplifier because that may not be sufficiently filtered. Employ Ohm's law to calculate the value of resistance needed to drop the receiver's voltage to 60 volts for the converter.

Antennas are important! We found that a folded doublet made of 300 ohm ribbon lead works very well. Cut it to resonate within the band in which you are working. The antenna coupling coil will vary with antennas. In general, close coupling works best with this converter. Where spacing permits, the antenna coil should be interwound with the B-minus end of the detector grid coil. In other cases wind it directly over the grid coil, at the same point, as follows:

Band	Ant.	Osc. plate.
3.5	10	5
7	5	4
14	4	3
28	3	2

All coils are wound in the same direction. The output coupling coil will depend on the receiver with which it is used. Some experimenting may be necessary but in all probability 10 or 12 turns will work satisfactorily. All wire No. 24 d.c.c. except that L1 uses No. 26 on 80 meters. All coils 1 inch long except L3 on 80 meters, which is closewound. L5 is 50 turns No. 28 d.c.c. for 4-5mc; L6 is 10-12 turns.

Tuning is simple. Adjust the receiver to the desired i.f.; then adjust the oscillator bandsetting capacitor until a signal is heard at the low-frequency end of the band. The vernier bandspread capacitor should be set as maximum. After a signal is received adjust the detector for maximum signal strength, then adjust the output transformer. If the receiver has fairly accurate frequency calibration set it at the frequency to which the converter's oscillator should be tuned and adjust until the oscillator is heard in the receiver. Then make adjustments as previously outlined.

French Radio Developments

By E. AISBERG*

THE recent Paris Fair demonstrated that the French radio industry is back on its feet after the hardships and technical stagnation of the occupation years.

The appearance of receivers has changed drastically. Before the war cabinets were usually rectangular boxes with more or less fancy-work. Today, right angles and points are being replaced with curves in many designs.

One of the more novel receivers is the Super-Boom, shown in Photos 1 and 2. The chassis is a circle of sheet iron. As the photos indicate, the parts layout is quite different from that of an ordinary receiver.

PHOTO 1

Nonradio electrical devices in France have long gone unrepaired and unimproved with the result that man-made interference is a serious threat to good broadcast reception. To reduce noise pickup in receivers, the old loop antenna is being revived. Widely used between 1925 and 1930, the loop had been practically discarded before the war.

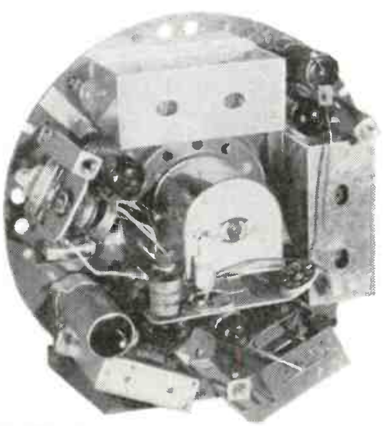


PHOTO 2

Loop antennas are available today both as separate units or, as shown in Photo 3, built into receivers. The loop itself is within the cylinder and is tuned by the receiver's variable capacitor. The wire wound around the cylinder is grounded at one end and acts as a shield.

Some of the loops available as single units have an amplifier tube in the base to improve signal-to-noise ratio still more.

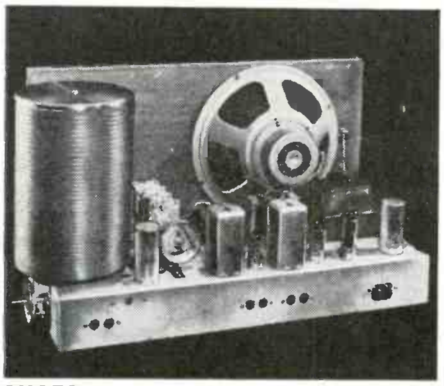


PHOTO 3

The American invention of the amplifying crystal, the transistor, made quite a stir in French technical circles. Engineers have been working on them enthusiastically and have come up with several interesting applications as well as an improved version of the transistor itself, known as the *transistron.*

The action of the germanium crystal, whether it is used in the ordinary role of rectifier or with extra electrodes added as a transistor (or transistron), is governed largely by a small amount of impurities in the germanium. French engineers have developed a method of holding the amount of impurities to a closer tolerance than heretofore, with the result that the amplifying action is more stable and predictable.

PHOTO 4

Photo 4 shows a radio receiver which uses six transistrons and no tubes at all. Transformers are required between each two cascaded stages to take care of impedance matching.

The transistron, no longer a laboratory curiosity, may soon be put into large-scale commercial production. Very soon repeaters using transistrons will be installed in the telephone circuit between Limoges and Paris. Photo 5 shows one of these.

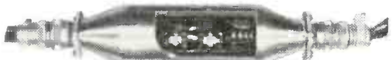


PHOTO 5

* Editor, *Toute la Radio*, Paris

NEW RESISTORS

International Resistance Co.
Philadelphia, Penna.

Two recently announced miniature units are the IRC BTR and BTB. Type BTR at 1/3 watt meets JAN-RC10 specifications. Type BTB at 2 watts is equivalent to JAN type RC40.

BTR has a body length of only 13/32 inch and a diameter of 3/32 inch, while BTB has a body length of 1¼ inches and a diameter of ¼ inch. Their construction features provide a resistor of extremely low operating temperature and excellent power dissipation in a compact, lightweight, fully insulated unit. Minimum resistance of each is 470 ohms, and maximum resistance 22 meg ohms. Available in ± 5% and ± 10% tolerances in RMA ranges.

Like all advanced-type BT's, the new resistors are protected against moisture by a phenolic resin housing molded at high pressure. Copper leads are securely anchored inside insulation —heavily tinned for easy soldering.

TELE GENERATOR

Superior Instruments Co.
New York, N. Y.

Model TV-30, a television signal generator, permits alignment of television i.f. and front ends without the use of an oscilloscope.

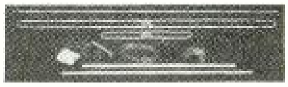
The model TV-30 permits alignment operation in the manner normally employed to align broadcast and shortwave receivers. Four frequency ranges are 18-32 mc; 35-65 mc; 54-98 mc, and 150-250 mc, without switching. Audio-modulating frequency is 400 cycles (sine wave).

Cabinet measures 6x7x9 inches. Shielded co-axial lead is supplied.

TV-FM ANTENNA KIT

J. M. Weaver Co.
Madison, N. J.

This TV-FM installation kit contains all the necessary essentials required for installing a TV or FM receiver, including a broadband all-channel folded dipole antenna, mounting bracket. 75 feet of lead, lightning

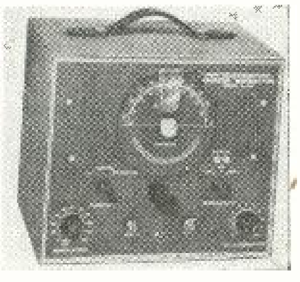


arrestor, standoff insulators, hardware, and assembly instructions. The antenna is prefabricated, and it requires but a moment's time to complete the assembly. The dipoles are made from single lenghs of tubing. This eliminates the usual connections between sections which are potential sources of trouble. The mounting bracket is of unique design and requires the use of only one hand for rotating the antenna for proper adjustment.

MARKER GENERATOR

Approved Electronic Instruments
New York, N. Y.

Marker generator model A-450 is a precision-built, tuneable oscillator pro-



viding a marker modulated or unmodulated, for indicating frequencies on a displayed frequency response of a television or any wideband i.f. amplifier, when used with a sweep generator and an oscilloscope.

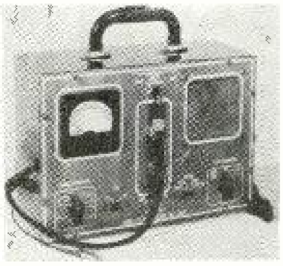
The frequency range is 19.5 to 40 mc, accurate to 0.5% or better. Accurate sound or video frequency spotting can be obtained using an externol crystal of proper frequency.

The unit operates on 115 volts, 60 cycles.

SIGNAL TRACER

Radio City Products Co.
New York, N. Y.

Model 777A Dynatracer provides such exceptionally high amplifications that actual gain measurements may be made for receivers or other apparatus.



An accurate meter gives callibrated indications, which are not possible with magic-eye indicators.

Input capacitance is only 3 micromicrofarads. Attenuation is 10,000 to 1 by means of a ladder attenuator with vernier control. Sensitivity is 10,000 microvolts for full-scale deflection of meter or 200 microvolts per division.

Frequency range covers approximately 160 megacycles.

A jack is provided for testing microphones and pickups. An automatic control switch permits either speaker or meter to be used alone or together or standby.

Its tube complement is 6AU6, 6AT6, 6AQ5, and 6X4; its crystal rectifier, a 1N34. The speaker employs an Alnico 5 magnet.

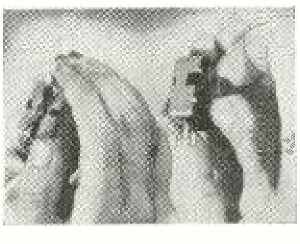
TWIN-STYLUS CARTRIDGE

General Electric Co.
Syracuse, N. Y.

The new twin-stylus, variable-reluctance phonograph cartridge, model RPX-050, is capable of playing conventional and Microgroove records.

The twin-stylus assembly is replaceable as a unit with sapphire tips having 1- and 3-mil tip radii. Stylus pressure with either stylus is 8 grams.

The new cartridge is the same in size as present models having the replaceable stylus, and features increased



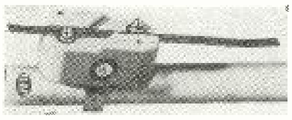
compliance and a very high signal-to-noise ratio. It shows a smooth, wide-range, frequency-response curve over a useful range of 40 to 10,000 cycles.

LIGHTNING ARRESTER

JFD Manufacturing Co.
Brooklyn, N. Y.

The safe TV guard is an Underwriters Laboratory approved lightning arrester for both outdoor and indoor use. It can be installed on the mast, on a grounded pipe, a wall, window sill, or other flat surface.

Charges are dissipated by contacts sealed in rare-gas tubes. The arrester does not affect the impedance of the 300-ohm line, which is passed through the groove on top of the arrester. Toothed washers, tightened by nuts, bite through the insulation to make the contact. No cutting, stripping, or spreading of the line is needed.



SIGNAL GENERATOR

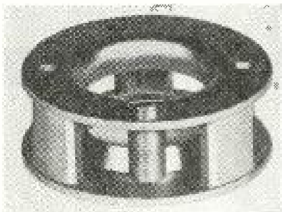
Electronic Measurements Corp.,
New York, N. Y.

The model 500K r.f. signal generator is now available in kit form. The generator covers 150 kc to over 30 mc on fundamentals, and harmonics are usable past 100 mc. Internal 400-cycle modulation is provided. All coils not in use are shorted.

TELEVISION UNITS

Quam-Nichols Co.
Chicago, Ill.

Two new television components—an ion trap and a focalizer unit—are in production.



Simplified design of the Quam focalizer unit utilizes Alnico permanent magnets to replace the old-style, wire-wound focus coil and permits permanent precision focusing of the picture not affected by temperature or line-voltage changes.

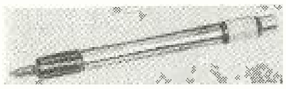
The Quam ion trap also features an ingenious use of permanent magnets (see illustration).

GEIGER TUBE

Amperex Electronic Corporation
Brooklyn, N. Y.

The type 52N is a new, thin-metal-wall, radiation counter tube for beta and gamma detection.

This self-quenching tube features extremely rugged mechanical construction, unlimited life, unchanging characteristics with use, low operating voltage, and a long plateau.



The tube may be operated over a wide temperature range without affecting tube life or electrical characteristics. Accidental overvoltage will not harm it.

TELEVISION MIRROR

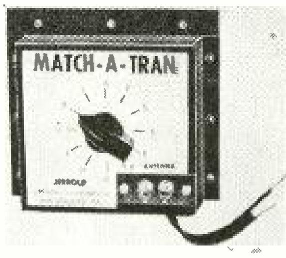
General Cement Mfg. Corp.,
Rockford, Ill.

The Service Mirror is designed for use by the television technician in adjusting receivers. While he sets the rear-panel controls, he can see the screen's reflection. The mirror is 10 x 12 inches in size and clamps easily to a chair, table, or other piece of furniture. It is made entirely of metal.

TV IMPEDANCE MATCHER

Jerrold Electronics Corp.,
Philadelphia, Pa.

The Match-A-Tran is a step-type variable-impedance transformer designed to match the antenna transmission line to the input of any television receiver. Connected between line and set, it



tunes out the reactance present and makes the line termination almost completely resistive, eliminating standing waves. This peaks the signal and reduces negative ghosts.

DIRECTIVE ANTENNA

Technical Appliance Corp.,
Sherburne, N. Y.

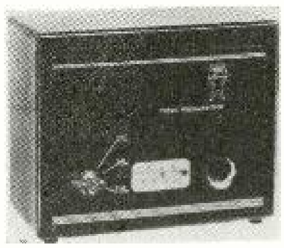
Type 900 Taco television antenna has four driven elements, two vertical and two horizontal instead of parasitic ones, giving better control of the field pattern and permitting lobe switching. It is possible with a diplexer network to eliminate entirely the co-channel interference present in many locations where two stations are on the same channel or adjacent channels, located about 180 degrees apart at the installation. It also makes possible reception from either direction without turning the antenna itself. Front-to-back ratio ranges up to 20 to 1.

The antenna is supplied with a diplexer, located at the receiver. The diplexer serves as a matching transformer between transmission line and receiver, eliminating any standing waves due to a mismatch. It also serves as a reversing switch for switching directivity lobes.

TV PREAMPLIFIER

Radio Merchandise Sales, Inc.
New York, N. Y.

Preamplifier model SP-4 is said to provide an average gain of four to six times over the entire TV range. It features individually shielded input, output, and power sections, with further



shielding around the whole unit. Input and output are iron-core tuned. Coils are wound with flat ribbon.

An isolation transformer eliminates shock hazard.

TV DISTRIBUTION SYSTEM

Electro Engineering & Mfg. Co.,
Detroit, Mich.

As many as eight television receivers may be operated from a single antenna without interaction with the aid of the TVD-8 Television Distribution System. Eight 6J6's are used as isolation stages. There is no amplification, but attenuation of the signal is lower than with resistive isolation systems. The unit covers all channels.

Input and output circuits are balanced, with 300-ohm impedances in both. The system is built on a chassis 18½ x 6¼ x 6½ inches.

European Report

By MAJOR RALPH W. HALLOWS

THE outdoor antenna is disliked heartily by both broadcast listeners and televiewers in Britain. They don't like the expense of putting up an outdoor antenna, they don't like the look of it, and not a few have (without any foundation) misgivings about it during thunderstorms. It is mainly for these reasons that the broadcast receiver with built-in antenna and that using the supply mains as antenna have become so popular. Those who have sets requiring an external antenna largely use indoor types, such as a length of wire stapled to the picture molding or slung from end to end of the attic. We have TV models using the supply mains as antenna, but the distance at which they can be used from the transmitter is usually quite short—and mains-borne interference is apt to be a nuisance.

The big demand for the indoor TV antenna is being met in a variety of ways. One type which gives good results is made of flexible wire molded into a plastic ribbon. It consists of two "arms" of equal length, the feed being taken from the mid-point between the arms (like some antennas described in American magazines). This antenna is designed for door-frame mounting: either tack one arm vertically up the side of the frame and the other along the skirting board to form an L, or run the horizontal arm along the top of the frame so that the L is inverted. Then there's the inverted V, made in rigid form and intended for installation in the attic, where it fits in very conveniently. These and some other types are all quite successful, so long as the field strength is high. I expect that there will be a big enough demand for indoor antennas to stimulate fresh developments when the 35-kw Birmingham station gets into its stride. At close quarters, in fact, the field strength of its transmissions is likely to provide some pretty problems in the design of attenuators.

For years past the H-shaped combination of dipole and reflector (remember our vertical polarization) has been almost the standard outdoor TV antenna in Britain. One sees a few reflectorless dipoles (can they be called I-shaped?), but they're not very common. One reason for the popularity of the H-type is that it has a front-to-back attenuation, with proper spacing of its two elements, of about 7 db. In areas where field strength is high, it can thus be oriented so as to use the reflector as a shield screen against interference coming mainly from one direction. Very promising results have been obtained from a new X-shaped antenna, with which the front-to-back attenuation is nearly three times as great. The forward gain, too, may show an improvement of 2 db over that of the H-array.

In districts where low field strength makes reception chancy with the H antenna, better results have been obtained with an X arrangement. Still more promising are the Yagi arrays which are now becoming popular in fringe areas. One type coming increasingly into use has a dipole, a reflector, and two directors. I shall not be surprised to see more complex arrays coming along—say, dipole, reflector, and from four to six directors or more—for the Yagi has proved itself to be, not only sensitive, but also highly directional. It can, therefore, be a powerful defense against interference. Further, it is adaptable to either polarization. What about a light TV Yagi array, designed for attic installation? It could make an effective indoor antenna where other types don't deliver the goods.

We're getting on

Although up to now we have had only one television station in service for the whole of the country, the monthly jumps in the number of receiving licenses have been spectacular. I reported that at the end of March

1947, the license total was 18,000. At the end of August, 1949, just 30 months later, that figure had risen to 162,150. A nine-fold increase in that time is remarkable enough—and you have to remember that the total would have grown far more rapidly could manufacturers have kept pace with the demand. I'm willing to bet that within 12 months, the opening of the Birmingham station plus increased production of receivers will bring the number to at least 400,000. Growth would be even more rapid were it not that so much of our available manpower and electrical materials must still be devoted to making good the wartime damage to our power stations and distribution systems (it is little realized how great this was), and to catching up with the expansions and improvements in them which should have been made during the approximately six years that we were at war.

Room for both

One noteworthy fact is that the widespread interest in television is not killing the market for radio receivers. The definite slump in radio set sales during the earlier part of this year now appears to have been due largely to the fact that people were holding back for Radiolympia. There was no exhibition last year, and the average family felt that it would make do with the old set until the next show, when there were bound to be worth-while improvements shown. When Olympia opened, there were many who lamented that its organizers had allowed the TV side to eclipse radio. It looked rather like that, for the emphasis appeared to be largely on television and televisers. They were staged, rightly or wrongly, as the chief attraction, and visitors regarded them as such. But it was generally realized that the most important and most complete source of home entertainment for some years to come must be the radio receiver. The result (hardly hoped for, but very gratifying) was, first, that television didn't steal the show, and, second, that the business done in orders for radio receivers proved that there is a boom rather than a slump in this department. The underlying reason, I believe, is that our folks have not been oversold on television and that they are not holding back from radio through any falsely encouraged belief that TV at crystal and headphone radio set prices, or even at five-tube radio set prices, is just around the corner for everyone.

Definition chaos

You don't need to be much of a prophet to foretell with certainty that if the television of, say, 10 years hence depends on scanning, it won't be limited to 405, 525, or indeed any three-figure number of lines. In the meantime we're limited to definition of those orders since, with any system we now know, the bandwidth of modulation frequencies depends approximately on the *square* of the number of lines. Even if there were room for the enormously wide channels required by 1,000-line or 1,500-line systems, the cost of televisers capable of dealing with passbands of these widths would be prohibitive. Intensive work toward higher definition is going on, and one day it will come. Till that day dawns, we can't go much beyond the present American and British standards, which have proved amply that they provide pictures of real entertainment value.

For that reason it's a pity that there's not more of the get-together spirit. France is changing over to the British system, which means that we can exchange programs. And between our two countries there's more to it than that. France is committed to the adoption of 819 lines within five years, and we have agreed to explore the possibilities of developing our forthcoming high-definition system on the same standard. Quite a few European countries either have started in a small way (or are likely to start in the near future) transmissions of the 400–600-line order. If only some common standard could be agreed upon, long-range international relays and exchanges could take place over the great network of co-axial cables already in existence or nearing completion. These cables can carry television relays with a modulation-frequency range corresponding to 400–500 lines, but no more. Unhappily, each country seems to prefer to work on a standard of its own, thereby cutting itself off from the others. Holland, for instance, is developing 449 lines; the "iron curtain" countries, 625 lines; Italy, 441; and Denmark 657. It almost seems as if some of them were just being pernicketty by working out systems which effectively prevent them from transmitting to or receiving from other countries! And that is just about the last thing that should be done in television or in any other variety of broadcasting.

The Birmingham station

Here's the very latest information about Britain's Birmingham station which is to go on the air with a full service on December 17, 1949. Its vision is on 61.75 mc; output power, 35 kw; sound, 58.25 mc; output power, 12 kw. Its antenna system is eight equally spaced vertical dipoles mounted on a mast 800 feet high and connected to the transmitters by devices which eliminate the possibility of interference between sound and vision signals. The antennas have each a de-icer and an arrangement preventing the accumulation of moisture from rain or snow. Should any adjustments or repairs be required, technicians can quickly reach the dipoles by means of an elevator inside the lattice mast. The Birmingham station is connected to the London studios by both co-axial cable and a chain of radio links. There are four of the latter, and it is not unlikely that in the future some of them may operate as unattended transmitters, thus greatly increasing the service areas of both Birmingham and London.

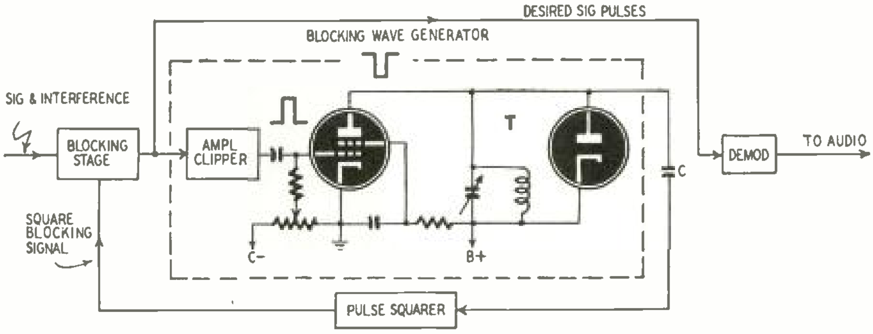
MULTICHANNEL BLOCKING SYSTEM

Patent No. 2,468,058
Donald D. Grieg, Forest Hills, N. Y.
(Assigned to Federal Tel. and Radio Corp.)

A method of accepting certain pulses and blocking others, such as patented here, is needed in multiplex signaling with pulse modulation.

The pulses pass through a blocking stage after which they are squared and amplified. Then they appear as negative pulses across a high-Q resonant circuit T. As is known, such a circuit goes into oscillation at its resonant frequency when it is shock-excited by a pulse. The first half (negative) of the oscillation wave passes through C, but the following positive voltage is virtually shorted out by the diode. The energy is dissipated and there are no further oscillations until the next negative pulse arrives from the blocking stage.

The negative waves coming through C are squared and used to bias the blocking stage to cutoff. The duration of cutoff depends upon the width of the biasing square wave, which is governed in turn by the resonant frequency of T. The duration should be equal to or less than the interval between wanted pulses arriving at the receiver. This keeps the receiver blocked for all but the desired channel. Only the wanted pulses are transmitted to the demodulator which follows.



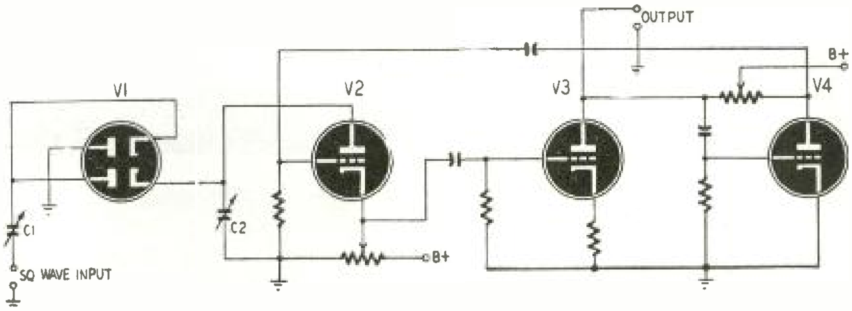
ELECTRONIC SCALER

Patent No. 2,469,031
Arthur E. Canfora, Brooklyn, N. Y.
(Assigned to Radio Corp. of America)

This circuit counts positive pulses. The input square-wave signal is transmitted through C1 to the duo-diode V1. Negative pulses are bypassed to ground through the upper diode, positive pulses being rectified by the lower diode to charge C2. Tube V2 is normally cut off by cathode bias from the voltage divider across the B-supply. V4 normally conducts.

As the charge in C2 increases, the voltage across it reaches a critical value which permits V2 to conduct. The rise in cathode current results in a positive pulse at the grid of V3, which is amplified. The pulse is reversed in phase at the plate of V3, therefore a negative pulse appears at the grid of V4, blocking it.

The plate voltage on V4 rises abruptly to the value of the B-supply because there is no drop across the tube. This positive surge is transmitted through a capacitor back to the grid of V2.



V2 becomes saturated, the charge on C2 is virtually short-circuited through it and C2 is ready for the next charge.

C1 and C2 are adjustable, thus making it possible to control the number of pulses which can accumulate on C2 before the critical potential is reached. For example, if this number is 10, the actual count is 10 times greater than the pulses across the output terminals.

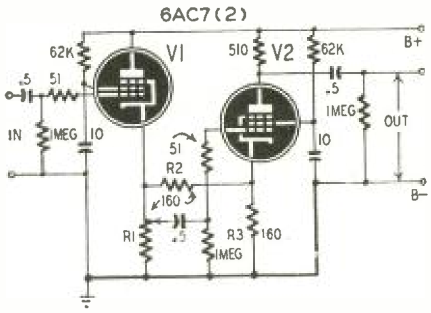
GAIN AND POLARITY CONTROL

Patent No. 2,464,594
John J. Mahoney, Jr., Lynbrook, N. Y.
(Assigned to Bell Telephone Labs)

In this amplifier circuit a single potentiometer controls both volume and polarity of the output wave.

The two tubes V1 and V2 are cathode-biased by 160-ohm resistors R1 and R3. The two cathodes are connected by another 160-ohm resistor, R2. R2 and R3, in series across R1, constitute a voltage divider which places the cathode of V2 above ground by exactly half the voltage across R1. This is true for signal voltages only, since biases are controlled, not only by the resistor network, but by the plate currents through V1 and V2. V1 is a cathode-follower whose output appears across R1, the arm of which is coupled to the grid of V2.

Assume an input to the amplifier which produces a +1-volt pulse across R1. Due to the voltage divider R2-R3, +0.5 volt appears across R3. If the arm of R1 is at the top as in the figure, +1 volt is coupled to the grid of V2. With the V2 cathode at +0.5 volt and the grid at +1, the



net grid voltage is +0.5 and a corresponding amplified negative pulse appears at the output terminals.

If the arm of R1 is at the bottom (grounded), grid voltage is zero. Since the signal appearing at the cathode of V2 is still +0.5 volt, the net grid voltage is —0.5 volt, equal in amplitude but opposite in polarity to that described before.

If the potentiometer arm is at exact center, grid voltage is +0.5 volt. With cathode also at +0.5 volt, net grid potential is zero and no output appears.

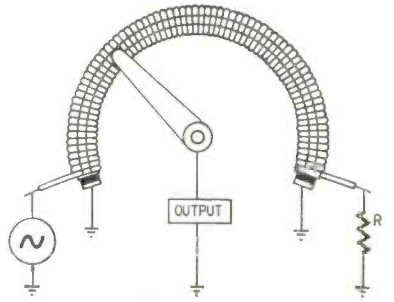
Varying the potentiometer arm between either end and center varies the output amplitude.

ADJUSTABLE TIME DELAY

Patent No. 2,467,857
John H. Rubel, Albany, and
Roy E. Troell, Schenectady, N. Y.
(Assigned to General Electric Co.)

A time delay is often needed when dealing with r.f. pulses. For example, it may be necessary to delay pulses applied to the plates of an oscilloscope until the sweep has started.

A transmission line made of insulated copper wire is wound around a semicircular core. Each turn of the line is insulated from all others, but a portion of each turn is exposed to the contact



of a rotary arm. The core is made of Litz wires soldered together at each end and grounded.

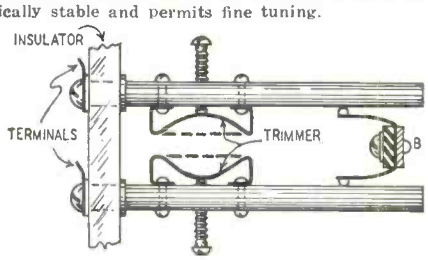
This line has large capacitance and inductance and is the equivalent of a much longer conventional line. Therefore there is appreciable delay in transmitting a signal through it. In a typical case the core was 3/16 inch in diameter. The coil had 130 turns of wire, 28 to the inch. Inductance was 76.2 microhenries per inch and capacitance 78.7 μμf per inch. The impedance was 1,200 ohms. The result was a time delay of about .07 microsecond per inch of coil.

Resistor R which terminates the transmission line should be equal to its characteristic impedance.

LECHER SYSTEM

Patent No. 2,475,198
Charles G. Reischmidt, Hempstead, N. Y.
(Assigned to Bell Tel. Labs., Inc.)

The resonant frequency of a Lecher system is ordinarily controlled by changing its physical length, which is neither very convenient nor efficient if only slight frequency changes are required. The new trimmer arrangement is mechanically stable and permits fine tuning.



The two parallel conductors are insulated at one end, and terminals are provided for connecting them to the remainder of the circuit. At the other end a shorting bridge B is supported on an arm and arranged to slide along the conductors. The metal contacts short the conductors at desired points for coarse tuning.

The trimmers are made of spring-metal strips riveted to each piece of tubing. A screw passes through a tapped hole in each conductor and presses against the strips. As the metal pieces are forced closer together, the added capacitance between them partially shorts the parallel lines.

Dotted lines show the trimmers in position for maximum frequency.

ALL-WAVE T.R.F. RECEIVER

Most regenerative shortwave receivers use 140-μμf or smaller tuning capacitors and seven coils or more in each stage for continuous coverage of the spectrum between 550 kc and 30 mc. A four-tube receiver described in *Radio and Hobbies* (Australia) uses 365-μμf tuning capacitors and five coils per stage to cover this range.

The circuit of the receiver is shown in the diagram. A 6SK7 or similar remote-cutoff pentode is the r.f. amplifier, and a 6SJ7 is the regenerative detector. The detector circuit is unusual in that oscillations take place between the grid and screen grid of the 6SJ7. The plate, being coupled to the detector through the electron stream, acts an a.f. amplifier to drive the 6V6 power amplifier. The suppressor is tied to the screen grid to insure reliable oscillation up to 30 mc. Regeneration is controlled by the 250,000-ohm potentiometer in the screen circuit of the 6SJ7 and the r.f. gain by the 25,000-ohm control in the cathode return of the 6SK7 r.f. tube.

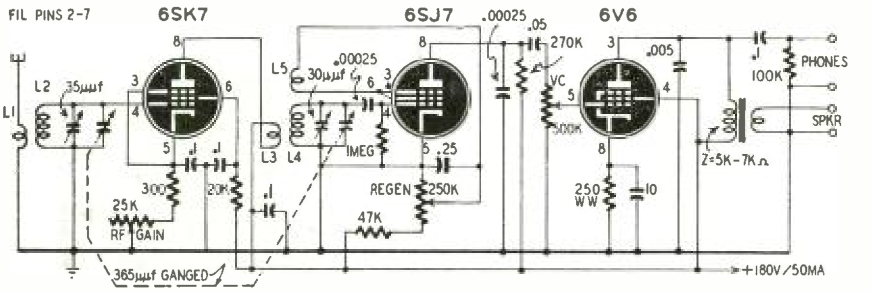
The antenna coils are wound on four-prong, 1¼-inch, low-loss, plug-in forms, and the detector coils are wound on six-prong forms of the same type. All coils are wound with No. 32 enameled wire except where noted. All windings are in same direction. Coils are wound as in the table below.

L1 and L3 are spaced approximately ⅛ inch below the ground end of L2 and L4 on all except the 13–33-mc coil.

Band (mc)	L1 (turns)	L2 & L4 (turns)	L3 (turns)	L5 (turns)
0.55-1.6	15	110	25	62
1.5-4	11	35*	15	26
3-8	6	12½*	12	15
6-16	3	7*	6	8
13-33	1	3†	2	3*

*—No. 24 enameled wire. †—No. 19 enameled wire.

One turn of L3 is interwound with the bottom turn of L4 on this coil. L5 is spaced approximately ⅛ inch above the grid end of L4 on all coils. It may be necessary to vary the spacing between L4 and L5 for best results on each band. Be sure that the connections to L3 are reversed as per the diagram.



The 35-μμf capacitor across L2 is mounted on the panel to permit the r.f. stage to be peaked. The midget air or mica trimmer across L4 is normally set at approximately half capacitance. To make sure that the r.f. and detector stages track, tune in a signal and peak it with the r.f. trimmer. If the signal is loudest with the trimmer all the way in, add a fraction of a turn or more to L2. Remove a turn or fraction thereof if the stage peaks with the trimmer full open.

SHORTWAVE CONVERSION

I modified my automobile radio for 75-meter reception by adding a 75-meter coil and capacitor connected as shown. The coil and capacitor, any combination tuning the desired band, are switched in and out of the circuit with a d.p.d.t. switch. The second harmonic of the receiver oscillator is made to beat with the incoming 75-meter signal to produce the intermediate frequency. The receiver tuning control is used for shortwave tuning and logging, and capacitor C for peaking the signal. Tune in shortwave signals by setting the receiver tuning control to the frequency found from the equation

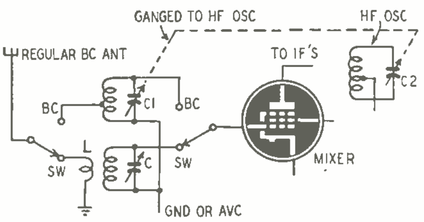
$$\frac{F_1 - F_2}{2} - F_2,$$

when F_1 is the frequency of the shortwave station and F_2 is the intermediate frequency of the receiver.

Assume, for example, that it is desired to tune in a 4000-kc signal on a receiver with a 460-kc i.f. and its oscillator above the signal frequency. The receiver would have to be tuned to 1300 kc as shown by

$$\frac{4000 - 460}{2} - 460 = 1310 \text{ kc.}$$

The same system can be used to provide 10-meter reception on receivers tuning to 18000 kc. Other bands can be covered by using the proper coil-capacitor combinations in the antenna circuit and using the harmonic of the receiver



oscillator. The harmonic may be below or above the signal frequency. The third harmonic may be used to increase further the tuning range of a receiver. However, the added L-C combination must be sharp tuning (high Q) and the oscillator well shielded.—*S. Beverage, WIMGP*

GROUNDED-GRID OSCILLATOR

A novel grounded-grid triode oscillator designed for displacement measurement and control was described in *The Review of Scientific Instruments.* The circuit is shown in Fig. 1. Since the grid is grounded through C1, the plate and cathode are isolated and the positive feedback necessary for sustained oscillations must come from outside the tube. L2-C2 is the tuned frequency-determining circuit and L1 is the cathode feedback coil. If a thin metal vane

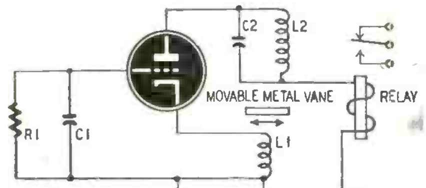


Fig. 1

is inserted between L1 and L2, it reduces the coupling to the point where feedback is insufficient to sustain oscillations. Therefore, the plate current is high and the relay closes. As the vane is withdrawn, the feedback increases and the tube breaks into oscillations and produces a sharp drop in plate current which opens the relay.

It is claimed that when L2-C2 is tuned to 30 mc, a vane displacement of .002 inch is enough to open or close the relay. Circuits of this type can be used to level elevators so the bottom of the car is even with the floor. The oscillator coils can be mounted on the wall of the shaft and the metal vane on the car. The circuit can be connected to stop the car when the vane passes between the coils.

A variation of this oscillator, Fig. 2, can be used as an 80-meter v.f.o. V1-a

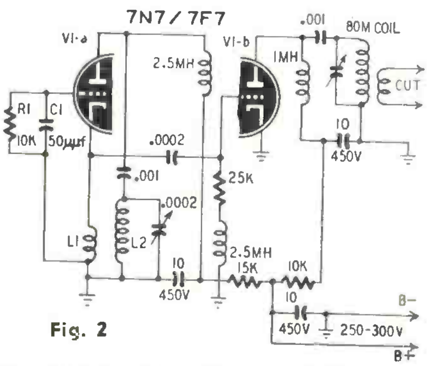


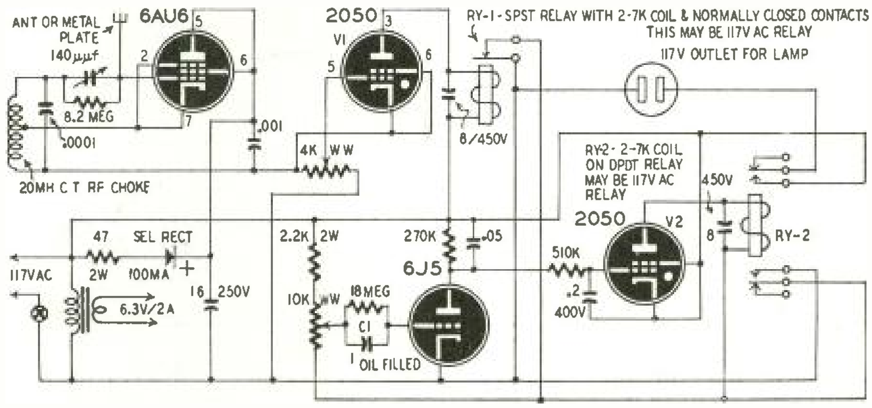
Fig. 2

is a 160-meter oscillator and V1-b is a doubler. The frequency stability depends on the values of R1 and C1. With the values shown, a 30-volt change in line voltage will change the output frequency but a few cycles. In this circuit, L1 is 11 turns of No. 22 enameled wire closewound ⅛ to ¼ inch from L2, which has 25 turns of No. 20 enameled wire closewound on a 2½-inch-diameter form.

CAPACITANCE-TIME CONTROL

I would like a circuit for a device which will light a lamp or ring a bell for 5 to 15 seconds whenever someone approaches or steps on a metal plate sunk into the floor. If you can help me, please print the circuit and explain briefly how it works.—G.L., Montreal, P. Q.

A. This circuit is a combination of a capacitance relay and a time-delay relay. The 6AU6 and the 2050 (V1) form the capacitance relay and the 6J5 and V2 the timing circuit.



To adjust the circuit, connect your metal plate or "feeler" to the grid of the 6AU6 with the shortest possible leads. Confine the lead to 30 feet or less if you can. If not, it may be necessary to shunt the 140-μμf variable capacitor with a 100-μμf mica or larger. Adjust the variable capacitor and 4,000-ohm variable resistor so relay RY-1 closes its contacts when you pass your hand near the wire to the feeler or the grid of the 6AU6. Vary these controls for maximum sensitivity. When you approach the feeler, RY-1 closes the timer circuit, lighting the lamp for a period determined by the setting of the 10,000-ohm control in the grid circuit of the 6J5.

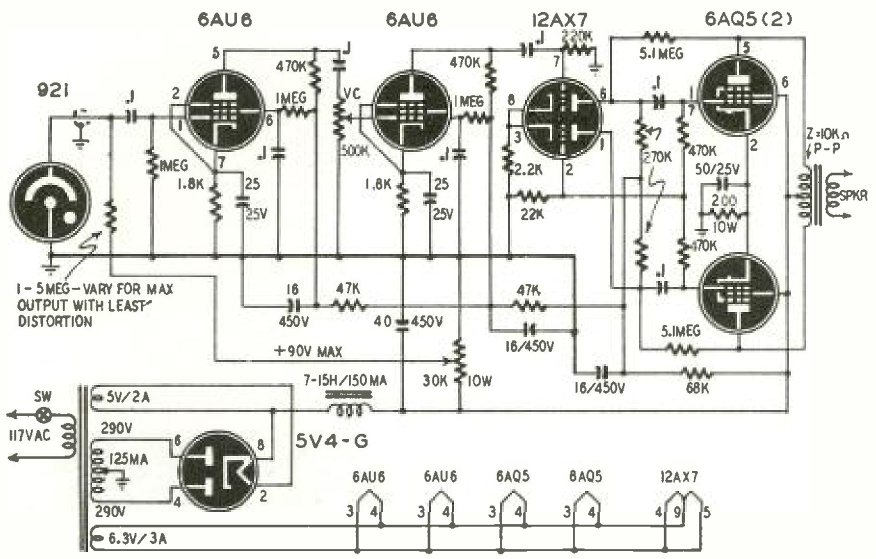
When the device is ready to operate, the 6AU6 is oscillating and its cathode current—flowing through the 4,000-ohm control—is low. V1 conducts and keeps the two contacts of relay RY-1 open.

The timing capacitor C1 charges through the grid-cathode circuit of the 6J5 which is conducting. There is no plate voltage on V2. Furthermore, its grid is biased negative by the drop across the 270,000-ohm resistor in the 6J5 plate circuit.

When you approach the feeler, the 6AU6 cathode current rises and produces a drop across the 4,000-ohm control. This voltage drop biases V1 to cutoff and closes the contacts on RY-1 so the lower end of the 10,000-ohm control is connected to the cathode of the 6J5 and the charge on C1 biases this tube to cutoff. This removes the bias from V2, causing it to draw plate current through RY-2 and close the contacts in series with the lamp or alarm. The lamp remains lighted until enough charge has leaked off C1 to permit the 6J5 to conduct and cut off V2.

AMPLIFIER FOR SOUND MOVIE

? Please print a diagram of a 10-watt amplifier that I can use with my movie projector. I would like to use miniature tubes, where feasible so the



unit can be constructed as compactly as possible. The projector uses a 921 phototube.—W.W., New York, N. Y.

A. Your needs should be met by this amplifier. The 6AU6's should provide sufficient amplification to drive the 6AQ5 output tubes to full output with normal signal input. The 5.1-megohm resistors between the plates of the 12AX7 and 6AQ5's may be omitted.

FOREIGN TUBES

? *I have a European receiver using tubes made by Philips. Are replacements available in this country?—G.J.M., Keokuk, Iowa*

A. Most of the tubes made by Philips are available from Philips Export Corp., 145 Palisade Street, Dobbs Ferry, N. Y. Write to them requesting information on the tubes you desire. All tubes are not stocked, so it may take about six weeks to fill your order.

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 February, 1950, issue, must reach us not later than December 24, 1949.
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PHONOGRAPH RECORDS 15¢. Catalogue. Paramount TG-313 East Market, Wilkes-Barre, Penna.

BRITAIN CALLING AMERICA! Britain's leading radio-television monthly, PRACTICAL WIRELESS AND PRACTICAL TELEVISION, contains exclusive articles by foremost British experts; latest British-European radio-television developments; newest transmitters and receivers fully analyzed. Send only $1.50 made payable to our authorized agent Jeremy North—Bookseller (PW.46), "Friendship House," Jamestown, Rhode Island, for 12 consecutive issues sent direct to your address from London. Two Years $2.75.

TELEVISION—Bright and clear. Adjust present aerial. Build low-cost precision antennae. Instructions, charts, diagrams, dimensions, plans. Free—Television stations, kilowatts, tower heights. Propson Company, Lumberton, N. J.

FIVE ELEMENT TV YAGI BEAMS. HIGH BAND $6.75, Low Band $8.50. Aluminum Tubing, etc. Willard Radcliff, Fostoria, Ohio.

101 RADIO REPAIRING TIPS (BOOKLET). SEND 50 cents U.S. Radio, 135 E. 28 St., New York 16, N. Y.

All steel TV tower—Shipped direct from the factory at $8.50 per 10' section. Easy to climb. Can be erected to 70' or more. The Youngstown Steel Towers, 1316 Wilson Avenue, Youngstown 8, Ohio.

ADMIRAL 30 SERIES CHASSIS

The a.f. output from the 30A, -B, -C, and -D series TV chassis can be increased by making the following changes:

1. Remove R620, the 150,000-ohm resistor, in the 4H1 (FM tuner) chassis.

2. Replace the 15,000-ohm ratio-detector load resistors R219 and R220 with 27,000-ohm units.

3. Remove the 6AG5 r.f. amplifier grid return from the arm of the contrast control and connect it to the junction of R305 and R307. This fixes the bias at approximately 1.25 volts and increases the sensitivity. If the receiver is located in an area where both strong and weak signals are received, the contrast control may not operate correctly on strong signals. If this happens, disconnect the video i.f. grid return from the junction of R304 and R305 and connect it to the arm of the contrast control. The r.f. grid return should then be moved to the junction of R304 and R305.

4. Realign the ratio detector transformer.

5. Check the 6AU6's in the audio i.f. amplifier to make sure they are good.

6. Replace the 6K6-GT power amplifiers with 6V6-GT's.

These changes will increase the a.f. sensitivity and output and are recommended where the complaint is low volume in fringe areas. However, it has been found that some TV stations do not deviate more than 7 or 10 of the permissible 25 kc; therefore their a.f. output will be low. If the station is the cause of low TV volume, these changes, while improving the output, may not produce more than room volume.—*Admiral Radio Service Bulletin*

INTERMITTENT PICTURE

If the picture on a TV receiver varies in intensity or disappears intermittently, look for arcing at the base of the high-voltage rectifier socket. This condition can best be checked in a dim light. If arcing is noted, lengthen the insulation path by bending the socket prongs and coating them with service cement or coil dope. Replace the socket if continuous arcing has charred it.—*John L. Johnson*

(This condition may exist at the socket of the C-R tube, particularly in sets using electrostatic deflection systems. The same remedy applies.—*Editor*)

STROMBERG-CARLSON TV-12

If the complaint is "no raster" with the sound operating OK, check the 680,000-ohm, 1-watt resistor between the 1B3 high-voltage rectifier and the anode of the C-R tube. If this resistor is open, replace it with a high-quality unit. Check the 500-μμf high-voltage filter capacitor, because the voltage is high when the load is removed by the open resistor.—*Wilbur J. Hantz*

TV SIGNAL SUBSTITUTION

The problem of isolating a defective stage in a TV receiver can be simplified by using another receiver as a signal source if both receivers have the same intermediate frequency. A length of 300-ohm transmission line and two .01-μf capacitors are required.

Check power plug polarity to ground on both chassis if sets are transformerless.

Use one conductor of the transmission line to connect the two chassis; connect one capacitor to each end of the other conductor. Tune the operating receiver to a station, and connect one capacitor to the *output* of the video amplifier. Use the other capacitor as a probe and feed this signal into the *input* of the video amplifier in the defective set. If the video amplifier is good, you will get the same picture on both sets, assuming that the sweeps are in good order. Proceed in a like manner to the front end of the set or until the defective stage is isolated.

The good receiver can be used as a signal tracer by reversing the process. —*Ralph E. Hahn*

SHORTED C-R TUBE

A 5BP4 cathode-ray tube, used in an experimental TV receiver, developed a large brilliant spot on one side of the screen. Since this spot would not focus or take modulation, we suspected the tube. On checking it for interelement continuity, we found a low-resistance shunt between cathode and control grid.

Normally, this condition would have meant discarding the tube; however, as an experiment, we connected a 110-volt d.c. supply across the shorted elements. The foreign matter—whatever it was—was quickly burned out, restoring the tube to normal operating conditions—*David Gnessin*

RCA 630TS AND SIMILAR SETS

If the picture cannot be locked in with the horizontal hold control, check the adjustment of the frequency control on the rear of the chassis. Set this control so the picture is stable at both extremes of the hold control after the signal is momentarily removed and restored.—*Harry Ashby*

TELEVISION RECEIVERS

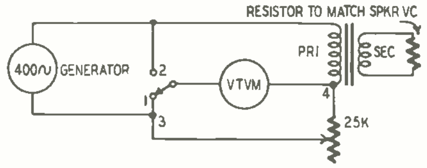
A number of the smaller TV receivers use 6SN7's or 12SN7's in the sweep and deflection circuits. In the event of oscillator failure, try switching the tubes between the sweep and deflection circuits. A tube which will not work as an oscillator may work as an amplifier. This is an emergency measure, so the defective tube should be replaced as soon as possible.—*G. J. Macheak*

HOWL IN TV RECEIVERS

If a set howls when a station is tuned in, the trouble may be traced to a microphonic high-frequency oscillator tube which is affected by vibrations from the speaker. Replace this tube with one which is not microphonic, taking care to select one having similar characteristics so the alignment will not be disturbed.—*William J. Wegge*

OUTPUT TRANSFORMER CHECKS

To check the primary impedance of an output transformer, connect a 400-cycle signal generator, v.t.v.m., and 25,000-ohm variable resistor to the transformer primary as shown in the diagram. Load the secondary with a resistor equal to the voice-coil impedance



of the speaker you plan to use. Switch the v.t.v.m. between points 1 and 2, and adjust the variable resistor until both readings are equal; then measure the resistance between points 3 and 4. The result is the primary impedance of the transformer at 400 cycles.—*G. F. Beard*

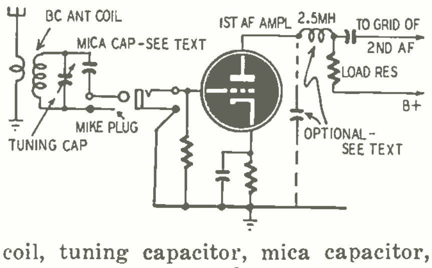
NOTE TO CONSTRUCTORS

After completing a successful radio or electronic project, make a note of all operating voltages and currents. Should the unit become defective, a comparison of operating voltages will help localize the defect. The same method can be applied to commercial equipment where these measurements are not given in a manual. The information may be kept in a notebook or attached to the chassis.

If you record operating characteristics, repairs can be made with simpler equipment than would be required if voltage and current measurements were unavailable.—*Gerald Samkofsky, W2YSF*

TUNER FOR PA AMPLIFIER

Many PA amplifiers can be used to receive signals from strong local stations with the addition of a broadcast



coil, tuning capacitor, mica capacitor, and a microphone plug, connected as shown. In this system, the first stage of the amplifier becomes a grid-leak detector. The mica capacitor should have a high a.f. and low r.f. reactance compared to the resistance of the grid resistor in the first a.f. stage of the amplifier. Experiment with values between 50 and 250 μμf for best results.—*Charles Erwin Cohn.*

(The tuner may be improved by connecting a 2.5-mh r.f. choke and plate bypass capacitor as shown. The capacitor should be between .001 and .002 μf for triode amplifiers and 250 to 500 μμf where the first stage is a pentode.—*Editor.*)

SWITCHES AND CIRCUIT BREAKERS

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

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DPDT 110V. slide switch---------- .19
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Potter & Brumfield OVERLOAD relay relay No. 1 is 5000 ohms, coil current 10 ma., relay No. 2 is 110V-60 cy. Ac coil. SPDT----------$1.95

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Plate sensitive relay—5000 ohm coil contact DPST ---------- 1.49

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

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32 MFD-2500VDC PK. No. 777, 100W. Sec.-PHOTOFLASH ----------14.95
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TN 300-1000 MC oscillator (uses 368AS doorknob tube) ---------- 3.95
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IF XFMR-5 MC with air trimmer-impedence coupled, mounted in Alum. shield can ---------- .95
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AN-3106-28-2P	AN-3102-14S-1P
AN-3057-16	PL-147
AN-3057-8	AN-3106-32-101S
UG-21/U	AN-3102-18-20S
PL-Q171-10H/414	U-16/
AN-3108-14S-2S	PL-112
AN-3102-14S-2S	PL-118
AN-3108-40-1S	AN-3102-20-27P
PL-182-10H/258-S	MC-136
AN-3108-22-17P	ARC-9589
AN-3108-24-19P	AN-3102-22-14P
AN-3106-22-1S	AN-3102-14S-75
AN-3102-18-5S	AN-3106-18-12S
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EMPIRE STATE FEDERATION MEETS

The Empire State Federation of Radio Technicians (ESFETA) held their regular meeting at Rochester, N. Y. November 13, 1949. Representatives from eight of the ten affiliated organizations were present.

Final amendments and corrections on the Federation's constitution and by-laws were approved and the secretary, Wayne Shaw, authorized to approve any further minor corrections.

Max Liebowitz reported on the progress of the New York City check-up campaign. Distributors, he reported, generally felt that a less busy month should be selected. The meeting concurred, and suggested February or August.

Other routine business included a report on the trends among organized radio technicians in Pennsylvania and discussion of local organization activities. The meeting adjourned till the annual meeting which will be held early in April.

NEW YORK HAS STATE-WIDE LECTURE COURSE

Empire State Federation of Electronic Technicians Associations reports an excellent reaction to the first of their series of 16 television lectures for New York State technicians, which began Sept. 7 (RADIO-ELECTRONICS, November, page 84). Four locations were chosen for the lectures, New York City, Poughkeepsie, Binghamton-Endicott, and Rochester, at each of which points all 16 lectures are being heard. The tables below list the subjects covered by lectures still to be delivered, the sponsoring company in each of the locations, and the date of presentation at each of the four lecture points.

Lecture No.	Subject
7	Picture tubes.
8	Sync and sweep circuits; a.f.c.
9	High-voltage circuits.
10	Oscilloscopes.
11	Projection systems.
12	Sweep generators.
13	Alignment.
14	Installation.
15	Servicing.
16	Examination.

LECTURE SCHEDULE

Lecture No.	New York City	Poughkeepsie	Binghampton-Endicott	Rochester
7	December 7 Allen B. DuMont Labs., Inc.	December 14 Allen B. DuMont Labs., Inc.	January 3 Allen B. DuMont Labs., Inc.	January 9 Allen B. DuMont Labs., Inc.
8	January 4 Precision Inst.	January 11 Precision Inst.	January 17 Motorola, Inc.	January 23 Motorola, Inc.
9	January 18 Beta Electronics Company	January 25 Beta Electronics Company	January 31 Precision Apparatus Co., Inc.	February 13 Precision Apparatus Co., Inc.
10	February 1 Hickok Elec. Inst. Co.	February 8 Hickok Elec. Inst. Co.	February 14 Hickok Elec. Inst. Co.	February 27 Hickok Elec. Inst. Co.
11	February 15 Allen B. DuMont Labs., Inc.	February 22 Allen B. DuMont Labs., Inc.	February 28 Allen B. DuMont Labs., Inc.	March 13 Allen B. DuMont Labs., Inc.
12	March 1 Coastwise Electronics Co.	March 8 Coastwise Electronics Co.	March 14 General Electric Co.	March 27 General Electric Co.
13	March 15 Kay Electric Co.	March 22 Kay Electric Co.	April 4 Kay Electric Co.	April 10 Kay Electric Co.
14	April 5 *Service* Magazine	April 12 *Service* Magazine	April 18 *Service* Magazine	April 24 *Service* Magazine
15	April 19 Allen B. DuMont Labs., Inc.	April 26 Allen B. DuMont Labs., Inc.	May 2 Allen B. DuMont Labs., Inc.	May 8 Allen B. DuMont Labs., Inc.
16	May 3 Examination	May 10 Examination	May 16 Examination	May 22 Examination

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PLAQUE TO JOHN RIDER FROM N.Y. TECHNICIANS

A plaque was presented to John F. Rider by the Empire State Federation of Electronic Service Technicians Associations, at a banquet in Rochester, N. Y., November 12. The banquet was held under the joint auspices of the Rochester Radio Technicians Guild and the ESFETA, and was attended by a large number of technicians from the Rochester area, as well as by ESFETA delegates to the November 13 meeting.

The award was given in recognition of Mr. Rider's work in breaking ground for the Federation's winter lecture course, and for his patience and good humor in the face of finding himself the unintended "trouble-shooter" of all the preliminary roughnesses and organizational difficulties of the lecture series. The presentation was made by Dave Liebowitz, 10-year-old son of ESFETA's president.

TELEVISION SCHOOL

The Radio Servicemen's Association of Luzerne County, Wilkes-Barre, Pa., is running a television school every Friday evening under the direction of Ed Lukas, one of its members. Average attendance at last reports was about 40. There is as yet no television in Wilkes-Barre, but members of RSALC intend to be ready for it when it comes.

OFFICERS ELECTED

The following officers were elected at the annual meeting of the Whaling City Chapter of the Radio Technicians' Guild of New England in Bedford, Mass.: John Tavares, president; Al Gagnon, vice-president; J. L. Shepley, secretary; J. Sumner, treasurer; Louis Senra, sergeant-at-arms; and Frank Cambra, librarian. A board of directors for the next year was also elected at the meeting.

VANCOUVER CONVENTION

Vancouver chapter of the Associated Radio Technicians of British Columbia held a convention on October 12 at the Stanley Park Pavilion. Lecturers were Miles Green of B. C. Laboratories Co., Ltd. (on telephone, FM, and microwave techniques), Don Hinges of Electronic Laboratories of Canada (on TV receiver design and TV conditions in Vancouver), Wilf Munton (on running a service business), and Nick Foster of the Edison Vocational Schools in Seattle (on TV installation and service). Mr. Foster received an honorary membership in the association for his work in its behalf. K. P. Caples, regional director of CBC, spoke to the convention about CBC programs. Jobbers' displays and demonstrations were part of the meeting, as was a party with entertainment.

ELECTRONIC LITERATURE

Any or all of these catalogs, bulletins, and periodicals are available to you if you write to us on your letterhead (do not use postcards) and request them by number. It is necessary to send only the number of item you want. We will forward the request to the manufacturers, who in turn will send the literature directly to you. This offer void after six months.

JV-1—RELAY CATALOG

The Ward Leonard Catalog D-20A describes their line of industrial and general-purpose relays, with some general information. Thermal and motor-driven time-delay relays are included. 12 pages. —*Gratis*

JV-2—NEWARK CATALOG

The Newark Electric Co. of New York and Chicago announce their 1950 catalog. Besides covering their usual complete line of radio and television equipment, a special section features high-fidelity FM and AM radio and phono instruments for custom installation.—*Gratis*

JV-3—CRYSTAL ADJUSTMENT

A new publication of the National Bureau of Standards, *Fundamental Techniques in Frequency Adjustment of Quartz Crystals*, is now available from the Superintendent of Documents, Government Printing Office, Washington 25, D.C. This 9-page booklet points out that there are other methods of changing the frequency of a crystal-controlled device than using a new crystal. The detailed instructions given should enable even a novice to make the necessary adjustments.—*10¢*

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Modern Electrics	1908
Electrical Experimenter	1913
Radio News	1919
Science & Invention	1920
Television	1927
Radio-Craft	1929
Short-Wave Craft	1930
Television News	1931
Wireless Association of America	1908

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

IN THE JANUARY 1916 ISSUE OF ELECTRICAL EXPERIMENTER

The Radio League of America, by H. Gernsback
Photo Transmission, by Samuel Cohen
Wireless on the Firing Line
Two New Wireless Detectors
A Direct Reading Wave Meter for Radio Measurements
Measuring Pressure on Detector Crystals
Ultra-Sensitive Wireless Phones
Cabinet Style Radio Receptor
Regenerating Audion Circuits for Wireless Receiving, by Frank J. Collins
Switch Points and Tikkers, by Frederick J. Schlink
An Audion Transformer
Novel Detector Stand, by K. Roberts
A Safety-Pin Detector, by Louis H. Buehl
Hearing Through Your Teeth, by H. Gernsback

Frank B. Powers, formerly assistant vice president in charge of production of the AMERICAN CAR AND FOUNDRY CO. and an executive with more than 20 years of outstanding service in the engineering and manufacturing field, has been appointed director of manufacturing operations of FEDERAL TELEPHONE AND RADIO CORP., Newark, N. J.

The appointment was announced by William H. Harrison, chairman of the board.

Mr. Powers will be responsible for telephone, radio, selenium rectifier, and vacuum tube operations of the company.

Al Friedman has been appointed chief engineer and national field service representative of RADIO MERCHANDISE SALES, INC., New York, according to Sid Pariser, president of the company.

Friedman is well known in the electronics field through his past associations as independent consulting engineer and his connection in similar capacity with Federal Telephone and Radio Co. and, more recently, with the JFD Manufacturing Co. as chief engineer, consultant, and field sales engineer.

Dr. Harry F. Olson, director of the acoustical research laboratory of RCA LABORATORIES, PRINCETON, N. J., received the first John H. Potts Memorial Award from the Audio Engineering Society at the Society's banquet which took place at the Hotel New Yorker.

Dr. Olson, a leading authority on acoustics, was given the award for "outstanding accomplishments in the field of audio engineering." The medal, named for the late editor of *Audio Engineering Magazine*, was given by his widow, Mrs. Dorothy Slavin Potts, to W. Lindsay Black, Chairman of the Awards Committee, who presented it to Dr. Olson.

The RCA scientist pioneered in the research and development of directional microphones, including the velocity type. Directional microphones are now almost universally employed in radio broadcasting, sound motion pictures, and television.

General David Sarnoff, chairman of the board of RCA has received the Peter Cooper Medal for the Advancement of Science from New York's Cooper Union.

Albert E. Keleher, Jr., has been appointed as manager of mobile radiophone sales, RAYTHEON MFG. Co.

During the past two and one-half years, Mr. Keleher was engaged in the sale of Raytheon broadcast equipment in New England. His previous experience includes application engineering with Raymond M. Wilmotte, Inc., and manufacturing engineering with Western Electric and Bell Telephone Laboratories.

Percy L. Spencer, manager of the power tube division of RAYTHEON MFG. Co., received the Distinguished Public Service Award in ceremonies recently held at the Waltham, Mass., plant.

Rear Admiral Hewlett Thebaud, Commandant of the First Naval District, acting for the Secretary of the Navy, made the presentation.

The award, highest civilian honor bestowable by the Secretary of the Navy, was given for Mr. Spencer's development of the vacuum tube used in proximity fuses and his simplified method of magnetron tube production.

John K. McDonough, was appointed director of sales, C. K. (Larry) Bagg sales manager, and Bernard O. Holsinger, advertising and sales promotion manager for SYLVANIA's new line of TV receivers.

Mr. McDonough was associated with the Ford Motor Co. and Commercial Investment Trust before joining the company in 1943.

Mr. Bagg comes to Sylvania from Newell-Emmet Co., where he was an account executive. He previously held sales executive positions with 1900 Washer and RCA.

MONEY-SAVING PLAN

Dear Editor:

I bought a television set about a year and a half ago and enjoyed it tremendously—for about two weeks. After that the neighbors discovered my antenna, and, not being a very tall fellow I saw few programs over their heads.

I think you will acknowledge that my solution was ingenious. A slight modification in the receiver's sweep circuits converted the image to spiral scan. Anyone can do the same. Simply feed quadrature sine voltage to the horizontal and vertical deflection coils and modulate the sine source with a sawtooth of a frequency low enough to give the correct separation between lines.

You can imagine what this does to the picture! But if you think I cut off my nose to spite my face, think again. While the spiral scan does not present the picture with its elements oriented as in the original, there is nothing random about it—the image is there all right. A famous opthalmologist (who prefers to remain anonymous) has designed a pair of glasses *which restores the picture elements to their proper places.* The neighbors are told that the set just won't work—they can see that for themselves. But my wife and I each have a pair of the special double-circular-reverse-anastigmatic lenses, and we enjoy the programs—alone!

SULEIMAN H. CRIPPS
New York, N. Y.

TV TUBE CORRECTIONS

Dear Editor:

Milton Kiver's article on "Replacing Picture Tubes in Television Receivers" in the October issue was very good, but I would like to point out a few errors.

Typical operating conditions are merely selected operating figures, with no significance as maximum and minimum ratings. In the discussion comparing the 10BP4 and 10EP4, for example, there is no difference between the two except for the anode contact.

The 12QP4 is not physically the same as the 12JP4. The 12QP4 has a 12 7/16-inch diameter bulb, while that of the 12JP4 is 12 inches. The 12RP4 is the replacement for the 12JP4 and has the bent-gun type of ion trap using a single-magnet beam bender. This type was created so the tube could be operated at lower anode voltage without formation of ion spots. The 12LP4 is comparable to the 12QP4 except that it is longer and has a female cavity anode contact.

All the 12-inch tubes have the same deflection angle; the 12JP4 was the first tube in this size and subsequent types have maintained the same angle.

A. Y. BENTLEY, *Head of Tube Engineering Dept., Allen B. Du Mont Labs, Inc., Passaic, N. J.*

WAS READY FOR TV

Dear Editor:

Some readers of *our* RADIO-ELECTRONICS should have been in my shoes just a couple of months ago. Most technicians in this little town thought TV was a long way off and did no TV studying. I stayed with your magazine, and with it and the help of Philco's home study course and the school that A. K. Sutton of Charlotte, N. C., put on for Philco members, I was ready for TV. I don't claim to be a hot shot but so far I have serviced a number of TV sets and found it profitable.

But some service technicians did just what Mr. Johnson suggested in an earlier letter: found themselves a hole and crawled into it. They know now that television has arrived—and to stay!

S. P. HALLEY, JR.
Monroe, N. C.

IN MARKET FOR MULE

Dear Editor:

I think there are too many articles on TV. You claim that TV reaches between 50 and 60 percent of the U.S. population. I think a more accurate estimate would be perhaps 20 percent.

In my opinion TV will never replace AM radio. The only ones who think so are the television manufacturers. TV may become popular in five or ten years when transmitters and receivers are perfected to the point where one can receive high-quality, sharp, clear pictures.

After the summer's heat had died away and radio writers could think clearly again, I had hoped to see some good articles like those we've had in the past from James Langham and J. C. Hoadley, but no, the October issue sings of the Geiger counter, a Snooperscope and a neon blinker. (That damned Geiger counter has appeared so much that I'm thinking of buying a mule and heading for uranium territory!)

It is hard for a magazine to please all the readers all the time, but please, can't you please some of us some of the time?

ROBERT O. BARG,
Rochester, N. Y.

(Our statement was that 50 to 60 percent of the U.S. population are in reach of existing television stations—quite a different thing from saying that such a percentage are now enjoying television. As to the other comments—well, what do you readers want? Shall we abandon experimental articles?—*Editor*)

FIRST-HAND EXPERIENCE

Dear Editor:

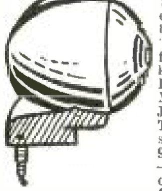
I built my own TV receiver (a 630TS) and so far I have serviced it three times. That is the best kind of TV experience for any technician. We hope to have a station here soon.

Continue the good work. I wouldn't miss your articles!

LEW COOK, WFWW,
Lincoln, Nebr.

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

MICROPHONES



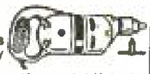
Super Special-High-est quality all chrome bullet shaped CRYSTAL MIKE of top-flight nationally known brand—$5.95. Bullet DYNAMIC MIKE—$7.95. MIKE Jr.—60c. PUSH-TO-TALK MIKE with switch on handle—98c. LAPEL MIKES—(Specify whether carbon or magnetic) 93c.

CO-AXIAL CONNECTORS

Army No. PL 259 or Amphenol 83-15P
Army No. SO-239 or 83-1R
Army No. PL 258 or 83-1J
Army No. M 359 or 83-1AP
49c each — in lots of 10 assorted 39c each

PORTABLE ELECTRIC DRILL

TERRIFIC VALUE

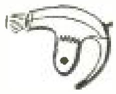


Equipped with ¼" Jacobs Geared Chuck and Key

$19.95 (Sold at less than established factory price so we cannot mention brand name)

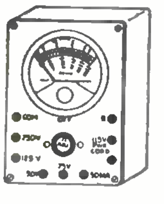
Not an intermittent duty drill, but a full size rugged tool. Most convenient type switch. Natural grip handle. Balance like a six shooter. Precision cut gears. Turbine type cooling blower. Extra long brushes. No stalling under heaviest pressure because of powerful 110 Volt AC or DC motor and multiple ball thrust bearing. Other bearings self-aligning lifetime-lubricated Oilite type. Made for toughest year-in and year-out service in plant or on construction jobs. Amazing perpetual factory guarantee assures you of a lifetime of trouble-free use. Satisfaction guaranteed or money refunded if returned prepaid within 5 days.

HEAT GUN



Streamlined pistol grip heat gun. Vivid red housing. 20 cubic feet per minute blast of hot air at 160° Fahrenheit. Ordinary blowers have small fan motors, but this has a lifetime-lubricated AC-DC motor of the rugged vacuum cleaner type, that produces a hurricane of either hot or cold air. Blow out dirt or dust from radio chassis. Dry out ignition systems. Heat carburetors. Quick-dry paint. Thaw out radiators or water pipes, etc. Warning:—Keep this away from your wife. She will use it to dry her hair because it will do it in half the time of her ordinary hair dryer, to say nothing of her using it to dry stockings or clothing, or defrost the refrigerator instantly. Only $12.95. Satisfaction guaranteed or money refunded if returned prepaid within 5 days.

This analyzer featuring a sensitive repulsion type meter housed in a bakelite case; represents the culmination of 15 years achievement in the instrument field by a large company specializing in electronic test equipment. Specifications of the AC-DC Model Volt-Ohmmilliameter: AC Volts—0-25, 50, 125, 250. DC Volts—0-25, 50, 125, 250. Milliamperes AC—0 to 50. DC Milliamperes—0 to 50. Ohms Full Scale—100,000. Ohms Center Scale—2400. Capacity—.05 to 15 Mfd. Total Price, prepaid anywhere in the USA $7.00



Brand New General Electric BC-375 or BC-191 transmitters, export packed, absolutely complete and including additional complete set of spare tubes as well as 10 and 20 meter conversion instructions $100.00. BC-312, BC-348 or BC-224 receivers sold with the above transmitters. (unit for unit) **$125.00**

SCR610 portable 6, 12, and 24 Volt crystal controlled transmitter receiver with built-in loudspeaker on receiver. Complete **$59.95** SCR-522 Transmitter-receiver in guaranteed condition complete with remote controls, antenna and mike. No conversion necessary to license for taxicab use. A natural for any 2 meter use. **$100.**

Brand new APN1 Altimeters. Both 24 volt and 12 volt models available. Not just chassis, but complete with everything. Original factory packing. Descriptive literature on request. **$45.00 and $75.00.**

POWER RHEOSTAT

Exceptionally Rugged. Trouble-free design. Withstands severe overloading to many times the nominal 25 watt rating without burning or smoking. Perfect for motor speed control or line voltage adjustment. 3 sizes available: 50, 60 and 200 ohms. Regular price $5.20. Special—**$1.00.**

"SO" RADAR SET

"SO" RADAR SET complete with 9 tubes including picture tube. This Plan—Position—Indicator Oscilloscope has a selfcontained pack designed to run from the 110 V. power supply on LST or PT boats. It provides a 5" diameter picture adjustable at will to an 80, 40, 4 or 2 mile circle with the boat at the center, showing location of land, other ships, or any obstruction, so that navigation can be carried out in pitch darkness or densest fog with as much safety as in brightest sunlight. Your cost $39.95.

CERAMIC INSULATED VARIABLE AIR CONDENSERS

10, 15 or 23 mmf— $.35, 10 for $2.90, 100 for $23
35 mmf— $.40, 10 for $3.40, 100 for $28
50 mmf— $.45, 10 for $3.70, 100 for $30
75 mmf— $.50, 10 for $4.40, 100 for $38
100 mmf— $.55, 10 for $4.50, 100 for $39
140 mmf— $.80, 10 for $7.40, 100 for $64
160 mmf—$1.00, 10 for $8.50, 100 for $75

Butterfly condensers, rotor has double ball bearings and ¾" shaft.
15 mmf. per section $.50, 10 for $4.50, 100 for $40
30 mmf per section $.60, 10 for $5.50, 100 for $50
50 mmf per section $.70, 10 for $6.50, 100 for $60

SUPER SPECIAL!
2 gang midget superhet tuning condensers with ¼" shaft and trimmers.. **9 for $2.50**
2 gang 140 mmf—$1.60, 10 for $12.50, 100 for $100
350 mmfd 5 gang—$1.95
3 gang—$1.29

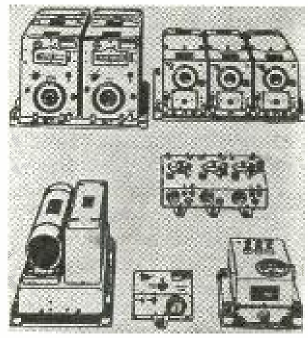
Manufacturers and Distributors: Write for prices on larger quantities. WE HAVE OVER 250,000 VARIABLE CONDENSERS IN STOCK.

AUTO RADIO DEALERS! ATTENTION!

Car radio specially made by famous American manufacturer of communications sets for export to South America. (Recently imposed currency restrictions make export impossible.) 6 tubes, 3 gang condenser, and unbelievable sensitivity and selectivity. Fungous proofed and tropicalized. Out of this world, compared to any radio built for the domestic market. A sensational value at **$28.00** net, or **$25.00** in lots of 3.

SCR 274N Command Set (Made by Western Electric)

THE GREATEST RADIO EQUIPMENT VALUE IN HISTORY



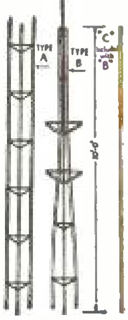
A mountain of valuable equipment that includes 3 separate Communications Receivers, covering up to 9.1 MC, 2 separate 40 watt Transmitters including crystals. 4—28v Dynamotors (easily converted to 110v AC operation). Pre-Amplifier and Modulator. 2 Tuning Control Boxes, and 1 Antenna Coupling Box complete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

Phonograph Scratch Eliminator

Consists of 2 condensers and powdered iron core choke connected in a filter network. Same as used in most jukeboxes to improve low note response and eliminate scratch. Connects instantly between pickup and amplifier. A super bargain at.................................. **$2.00**

THE BUFRAD SECTIONAL TOWER

This latest addition to the famous line of BUFRAD antenna products makes up to a hundred foot tower from any desired number of ten foot sections of extremely strong welded construction. The sections are shipped assembled so erection is a matter of minutes rather than hours. Finished in gray "TELECOTE," a new time and climate proof finish that will outlast the pyramids. Assembly is a one man job and is accomplished by climbing up the completed portion of the tower with the next 25 lb. section to be installed. Hand and footholds are provided to make the work safe and easy. Cap at top of tower provides bearing surface for rotating, and prevents water from entering tubes. Useful for police, or amateur transmitters, and in addition the tower will provide satisfactory TV reception where otherwise it would be impossible. Ideal for supporting permanent or temporary power lines, wind generators, stadium public address speakers, or spot lights for gas stations or parking lots. "B" and "C" sections together cost a total of $15.75 and total 20 feet. "A" Sections, which make up the entire tower except for the top, are each ten feet long and cost but $12.75 apiece. Those who wish a mast base will be able to obtain one (not shown) for only $6.00. The base is especially useful when erecting the tower on a sloping roof.



COMPRESSED AIR

INSTANTLY ANYWHERE

Portable Air Compressor and Storage tank. Ruggedly built. Best Materials. Lifetime lubricated ball-bearing on connecting rod and oil-impregnated main bearing on shaft. Unusual design forever eliminates valve trouble, the most common fault in air compressors.

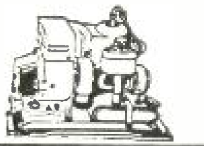
PATENTED unique air intake system increases efficiency tremendously so that air output is much greater than that from larger compressors powered by heavier motors. Delivers approximately 3500 cu. inches of air per minute at maintained pressure of 30 lbs., or will inflate a 90 lb. truck tire in less than one minute. Complete with 100 lb. gauge. Finger-tip adjustment allows setting of output pressure at any value, which will automatically be maintained. Works from any ¼ H.P. motor. Useful for spraying paint, lacquer, disinfectant, insecticide, annealing or brazing with natural gas, inflating tires, etc. Price **$14.50** postage prepaid anywhere in the U. S. Efficient, completely adjustable syphon type spray gun complete with 12 ft. of 100 lb. tested hose, only **$7.75** with pint container, also prepaid.

"DRILLMASTER" ELECTRIC DRILL

Low-priced electric drill, ideal for hobbyists. Complete with sander, buffers, grinding wheels, etc. This is bankrupt stock and only a few are available. A sensational bargain at $9.95. Satisfaction guaranteed or money refunded if returned prepaid within 5 days.

Our PE-109 Power Plant Direct Current

A gasoline engine coupled to a 2000 watt 32 volt DC generator. Can be adjusted to give 12 to 40 V. output. Ideal for use in locations not serviced by commercial power or to run any of the surplus items that require 24-32v DC for operation. The price of this power plant tested and in good condition is only **$79.95.** We can also supply a converter that will supply 110v AC from the above unit or from any 32v DC source for **$12.95.**



We also have a limited supply of brand new PE-109s in original factory packing for **$125.00** each, F.O.B. Buffalo.

6.95 TAKES ALL THREE BIG BARGAINS "E"

1. **AUDIO AMPLIFIER** — Brand new push-pull output triode amplifiers having 2 of the valuable and scarce ouncer type audio transformers that sell for over $10.00 apiece. Neat aluminum case, fully enclosed (largest dimension 6 inches). Perfect for intercom systems, phone amplifiers, mike amplifier, or signal tracer amplifier for testing radio sets. A sensational bargain at only ....**$3.40 each**
2. **BANDSWITCHING TUNING TURRET** made by Western Electric. Covers 4 bands above 100 MC. All coils wound with #14 silver-plated wire. Complete with tuning condensers and powerful electric driving motor. ONE OF OUR MOST TERRIFIC VALUES—ONLY **$2.95**
3. **CARBON MIKE** with Push-To-Talk Switch and Gold Plated Carbon Lapel Mike. Combination offer on both mikes **$1.75**

DELUXE SUPERHET A.C.-D.C. RADIO KIT

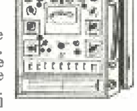
Extra high quality standard production line radio in kit form with complete instructions. Features 2 iron core I.F. transformers, a 2 gang condensor, and polyethylene insulated edgewise wound antenna loop. 12AT6, 12BA6, 12BE6, 50B5 & 35W4 tubes supplied. Receives broadcast band from 550 to 1700 KC. Kit form **$8.75** or 2 for..**$17.00** Assembled, Wired & Tested **$12.95** or 2 for....**$25.00**

SIGNAL GENERATOR

Genuine Laboratory-type precision signal generator. Manufactured and sold for $68.00 each in large quantities during the war by Northeastern Engineering Corp., one of the top manufacturers of electronic equipment for the U.S. Govt. Five fundamental bands starting at 150 KC. Strong harmonics up to 120 MC. Five step ladder type attenuator as well as potentiometer output control. Regular 1000 cycle audio oscillator using vacuum tube, not a cheap neon sawtooth audio oscillator. Audio output separately available externally. Weight without packing material 16 lbs. which should show what a world of difference exists between this signal generator and the ordinary cheap oscillator used by the average serviceman. Complete with fused plug and coaxial output lead. Super Special **$38.75.**

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

1950 MODEL MUTUAL CONDUCTANCE TUBE TESTER $56.95

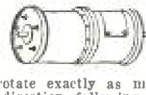


Attractive panel and case ... Large 4½" meter ... Calibrated micromho scale as well as Bad-Good scale ... Front panel fuse ... Individual sockets for all tube base types. Proper filament voltage supplied to test any tube ever made. Unequalled switching flexibility allows all present and future tubes to be tested regardless of location of elements on tube base. Indicates gas content. Detects shorts or opens on any element of any tube. Tests cold cathode, magic eye and voltage regulator tubes as well as all ballast, amplifier and rectifier types.

Model "C"—Sloping front counter case $56.95
Model "P"—Handsome hand-rubbed portable case 59.95

Built-in roll chart with either of above $5.00 extra.

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



LS-7 "PM SPEAKERS"

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

$7.05 TAKES BARGAIN "C"

(All three items below)

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

SIGNAL CORP INTER-CONNECTOR RELAY BOX 730A

This valuable unit, made by Bell, and more familiarly known by the U. S. Army designation BC616, is encased in a highly polished aluminum case 6½x5¼x2½, and contains 150 mfd. of condenser capacity, sensitive relays, resistors, and terminal strips. Order several at the giveaway price of only **$1.95**

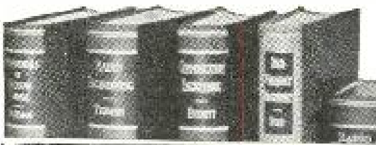
REMOTE CONTROL UNIT—Aluminum case 4 x 3 x 2 containing 2 potentiometers, triple pole switch, 4 knobs, phone jack, gear mechanism and revolution counter. Including 8 prong JAN connector to fit box..........**$1.39**

Meter Rectifiers—Can be used for replacement, or in construction of all types of test equipment—Full Wave—**$1.25.** Half Wave—**$.75.**

BUFFALO RADIO SUPPLY, 219-221 Genesee St., Dept. RT-1 BUFFALO 3, N. Y.

ADVERTISING INDEX

RADIO SCHOOL DIRECTORY



THEORY OF HEARING, by Ernest Glen Wever. Published by John Wiley & Sons, Inc., New York. 5½ x 8½ inches, 484 pages. Price $6.

Too many electronics men concerned with audio tend to forget that the final purpose of all their efforts is to stimulate the human ear. The result is that many unwarranted assumptions based on pure mathematics are made. It satisfies a certain sense of neatness to achieve a flat frequency response in an amplifier or to arrange a sound installation so that tones of all frequencies have the same loudness as measured on a sound-level meter. The ear, however, refuses to accept the dicta of the decibel meters and responds differently to identical frequencies at different intensities.

Dr. Wever has made intensive study of the effect of sound on the ear since 1930. His book, while indicating that much remains to be done, contains a wealth of enlightening information for the serious audio man. The physiological basis for ear behavior is discussed throughout but—what is of greater interest to the electronician—many theories and experimental results throwing light on the ear's behavior are given. Whys and wherefores of response to simple and complex waveforms, to various loudness levels, to different frequencies, and to shifts in phase are discussed in detail.

TELEVISION SERVICING FOR RADIOMEN, by H. P. Manly. Published by Frederick J. Drake Co. 5½ x 8 inches, 418 pages. Price $4.00.

A book for the practical radio technician rather than the student of television theory, this work goes right into the front end of the receiver after a single preliminary chapter on the television signal. It continues in following chapters through the i.f.'s, video detector and amplifier, and the sound section.

The question of alignment is considered a major one by the author, and a number of chapters are devoted wholly or partly to it. Instructions are practical, and often given step-by-step.

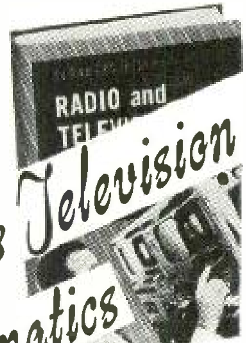
After covering thoroughly those parts of the receiver which handle the video and audio signal, separate chapters are given to sync, sweep oscillators, sweep amplifiers, magnetic deflection amplifiers, power supplies and trouble shooting with test patterns.

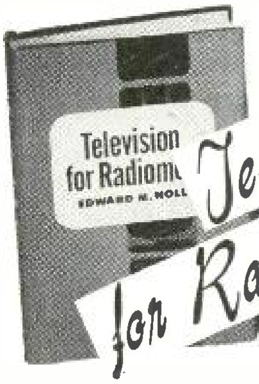
TELEVISION WORKS LIKE THIS, by Jeanne and Robert Bendick. Published by Whittlesey House, New York. 6¾ x 10 inches, 64 pages. Price $1.75.

In this thoroughly nontechnical explanation, only a very few pages are devoted to technical processes and the rest to program production. Probably 50% of the space is taken up with illustrative drawings — almost cartoons in character—with text on the adult level but designed for quick reading.

BASIC ELECTRONICS, by Royce G. Kloeffler and Maurice W. Horrell. Published by John Wiley & Sons, Inc., New York. 6 x 9½ inches, 435 pages. Price $5.

A basic text book for those with a knowledge of physics but not of electronics. The treatment is not mathematical but calculations are introduced wherever necessary to avoid superficiality.—*R.H.D.*





TUBES

- TRANSMITTING
- RECEIVING
- INDUSTRIAL
- SPECIAL PURPOSE

Guaranteed by WELLS

Check this list for exceptional values in magnetrons, cathode ray tubes, voltage regulators, transmitting tubes—also neon, pilot and flashlight bulbs. These are brand new, standard make tubes. Order enough for future needs directly from this ad or through your local parts jobber.

TYPE	PRICE EACH
OA4G	$0.95
O1A	.45
1A5GT	.65
1B22	4.35
1B23	7.50
1E42	5.25
1C5GT	.65
1D8GT	.95
1E7GT	1.95
1E7G	1.95
1G6	.65
1L4	.75
1LC6	.75
1N5GT	.75
1N21 (Crystal	.65
1N21A Diode)	.95
1N21B " "	.95
1N22 " "	.80
1N23 " "	.80
1N23A " "	.85
N27 " "	.85
1N29 " "	.85
1Q5GT	.85
1R4/1294	.65
1S5	.70
1T4	.75
2A3	1.05
2A7	.85
2B7	.75
2B22/GL559	3.75
2C22/7193	.35
2C26	.35
2C26A	.45
2C34	.55
2J21A	11.45
2J22	9.85
2J26	8.45
2J27	12.95
2J31	9.95
2J32	14.85
2J33	18.95
2J34	17.50
2J37	13.85
2J38	6.95
2J48	12.95
2J61	27.50
2Y3G	1.20
2X2/879	.65
3A4	.35
3B22	2.65
3B24	1.75
3BP1	3.75
3C24/24G	.50
3D6/1299	.65
3E29	4.95
3FP7	2.95
3FP7A	4.95
3GP1	4.50
3HP7	2.95
3Q5	.90
3S4	.75
REL-5	14.95
5AP1	3.95
5BP1	2.75
5BP4	3.95
5CP1	3.75
5D21	24.75
5FP7	3.25
5GP1	4.95
5HP4	4.75
5J23	13.45
5J29	13.45
5R4GY	.95
6-4	.35
6-7	.35
6A3	.95
6A6	.75
6AB7	.95
6AC7	.90
6AK5	.80
6AK6	.80
6B4G	.95
6B7	.80
6B8	.95
6BE6	.65
6C4	.40
6C6	.70
6C21	19.25
6D6	.60
6E5	.70
6F6	.60
6G6G	.80
6H6	.45
6J5	.45
6J5GT	.45
6J6	.90
6J7GT	.70
6J8G	.95

TYPE	PRICE EACH
6K6GT	.55
6L7	.75
6N7	.75
6R7G	.75
6SA7	.65
6SC7GT	.70
6SF5	.65
6SG7	.65
6SH7	.40
6SJ6GT	.60
6SK7GT	.60
6SL7GT	.60
6SN7GT	.80
6SQ7GT	.60
6SR7	.60
6SS7	.60
6U7G	.85
6V6GT	.75
6Y6G	.75
7-7-11 Ballast	.35
7A4	.60
7A7	.60
7B4	.60
7C4/1203A	.40
7E6	.60
7F7	.70
7H7	.70
7K7	.70
7L7	.70
7N7	.70
7Q7	.60
10	.45
10T1 Ballast	.50
10Y	.45
12A6	.25
12A6GT	.25
12AH7GT	1.10
1208	.50
12F5GT	.65
12H6	.40
12J5GT	.40
12J7GT	.70
12K8	.65
12SF7	.70
12SG7	.65
12SH7	.40
12SK7	.60
12SL7GT	.60
12SQ7GT	.60
12SR7	.60
12X825 2 amp. Tungar	2.10
13-4 Ballast	.35
14B6	.75
15R	1.20
REL-21	2.75
23D4 Ballast	.45
RK24	1.75
24A	.75
25Z6GT	.55
26	.65
27	.50
28D7	.40
30	.75
30 (VT-67) Walkie	.75
33 (VT-33) Talkie	.75
34	.35
RK-34	.45
35Y4	.65
36	.40
37	.40
38	.40
39/44	.35

TYPE	PRICE EACH
45 Spec.	.50
46	.75
EF50/VT250	.45
56	.65
70L7	1.05
72	1.75
RKR-73	1.25
76	.55
77	.55
VR-78	.65
80	.45
FG-81A	3.95
83V	.90
89Y	.40
VR-90	.65
VR-92	.65
100R	2.75
FG-105	9.75
VR-105	.85
VU-111-S	.55
1148	1.20
117Z3	.55
VT-127 British	.35
VT-127-A (Triode)	2.95
VR-150	.50
VT-158	14.95
FG-172	19.75
205B	1.45
211 (VT4C)	.60
215A	1.75
221A	2.10
231D	1.20
268A	2.95

TYPE	PRICE EACH
304TH	5.75
304TL	1.75
307A	4.25
316A	.75
350B	2.55
354C	14.95
371A	.95
371B	.85
388A	3.95
393A	4.6'
395A	4.95
MX408U	.40
417A	14.50
434A	3.40
446A	1.55
450TH	17.95
471A	2.55
527	9.95
530	9.95
531	12.95
532A.1B32	3.55
GL-559	3.75
KU-610	7.45
HY-615	1.05
700B	7.95
700C	7.95
700D	7.95
702A	2.95
703A	3.95
704A	1.75
705A	2.65
707A	17.50
707B	19.50
708A	4.95

TYPE	PRICE EACH
710A	2.45
713A	1.55
714AY	3.90
715B	9.75
717A	.85
721A	3.75
723AB	14.95
724A	4.25
724B	4.25
725A	9.95
726A	17.45
730A	10.95
801	.50
801A	.70
803	5.25
804	9.95
805	5.95
807	1.25
808	1.65
811	2.35
813	7.85
814	3.75
815	2.85
826	.75
829B	4.95
830B	3.95
834	5.75
837	1.65
838	3.25
841	.50
843	.50
851	39.00
860	2.40
861	29.25

TYPE	PRICE EACH
864	.45
865	2.55
866A	1.30
869	19.95
869B	27.25
872A	2.45
874	1.95
878	1.95
930 Photo Tube	1.00
954	.45
955	.55
956	.50
957	.45
959	.55
991 (NE-16)	.30
1005	.35
1148	.35
1201	.75
1203A/7C4	1.05
1616	1.25
1619	.45
1624	1.25
1625	.45
1626	.45
1629	.40
1630	3.95
1638	.90
1641/RK-60	.75
2051	.75
7193	.30
8011	2.25
8012	3.25
8020	3.25
8025	6.75
9001	.65
9002	.45
9003	.60
9004	.40
9006	.40
38111A	.45

NEON BULBS

NE-11	.24
NE-16	.24
NE-20	.06
NE-21	.24
NE-48	.24

PILOT AND FLASHLIGHT BULBS

STOCK NO	MFR. NO.	VOLTS	WATTS	BULB	BASE	PRICE EACH
342-5	1256	6	21CP	S-8	DC Spec.	$0.05
350-41	943	6-8	100CP	G-16½	Auto Soc.	.10
354-76	1491	2.4	.8A	G-7	DC Bay.	.09
LB-200	S6	115	6	S-6	Cand. Screw	.16
350-43	11A/T4C	18	.11A	T-4	Cand. Screw	.14
342-6	1245	6	3CP	G-6	SC Spec.	.08
LB-201	319	3	(Aircraft, metal housing, Amber Lens)			.22
LB-202	328	24	"	T-1¾	Pressure Flange	.40
350-40	64	6-8	3CP	G-6	DC Bay.	.07
350-42	Spec.	12	6A.	S-6	Cand. Screw	.13
350-20	1446	12	.2 amp.	G-3½	Min. Screw	.07
350-14	49	2	.06	T-3¼	Min. Bay	.06
348-22	PR-10	6	.5 amp.	B-3½	Min. Flange	.05
350-19	Proj. Bulb	120	500 W.	T-20	Med. Pf.	1.45
LB-17C	248	24	.035 a.	T-2	Tel. Base	.18
LB-58A	Nite Lite	110	7W	C-7	Cand. Scr.	.17
LB-57A	53	12-16	1CP		Min. Bay	.07
354-78	Airplane Headlite	24	239W	A-19	Med. Pf.	.38
350-55	323	3	(Aircraft)	T-1½	953	.22
342-3	LM-60	115	250W	T-20	Med. Pf.	.40
LB-102	1195	12-16	50CP	RP-11	DC Bay	.14
342-2	CC-13	110	100W	T-8	DC Pf.	.33
354-76	1491	2.4	.8A		DC Bay.	.14
354-77	302	28	(Airplane Type)		DC Bay.	.14
LB-104	313	28	.17A	T-3½	Min. Bay	.11
350-24	12A	12	.09-.11A	T-2	Tel. Base	.18
LB-107	24-A2 WE	24	.75-.105A	T-2	Tel. Base	.18
350-63	AR-1 Argon	105	2½W	S-14	Med. Screw	.22
LB-109	5122	Telephone Type Neon		T-2	Tel. Base	.17
350-18	1477	24	17	T-3	Min. Screw	.16

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