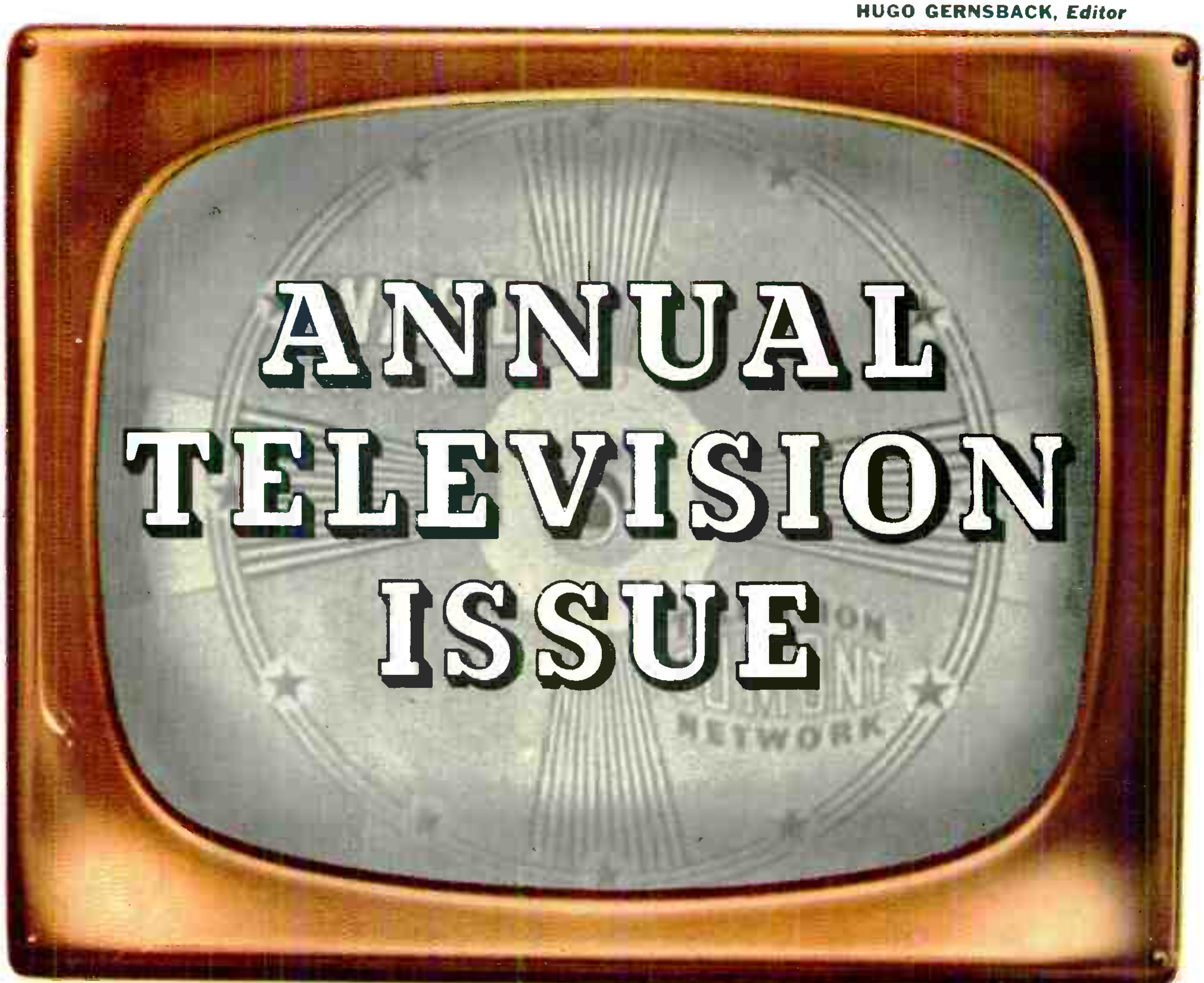
6th ANNUAL TELEVISION NUMBER

JANUARY 1953

RADIO-ELECTRONICS

LATEST IN TELEVISION • SERVICING • AUDIO

HUGO GERNSBACK, *Editor*



In this Issue:

Articles by Guy, Rider, Tilton •
Directories and listings of:
TV Receivers, Boosters, Antennas
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U. H. F. Articles and Circuitry •

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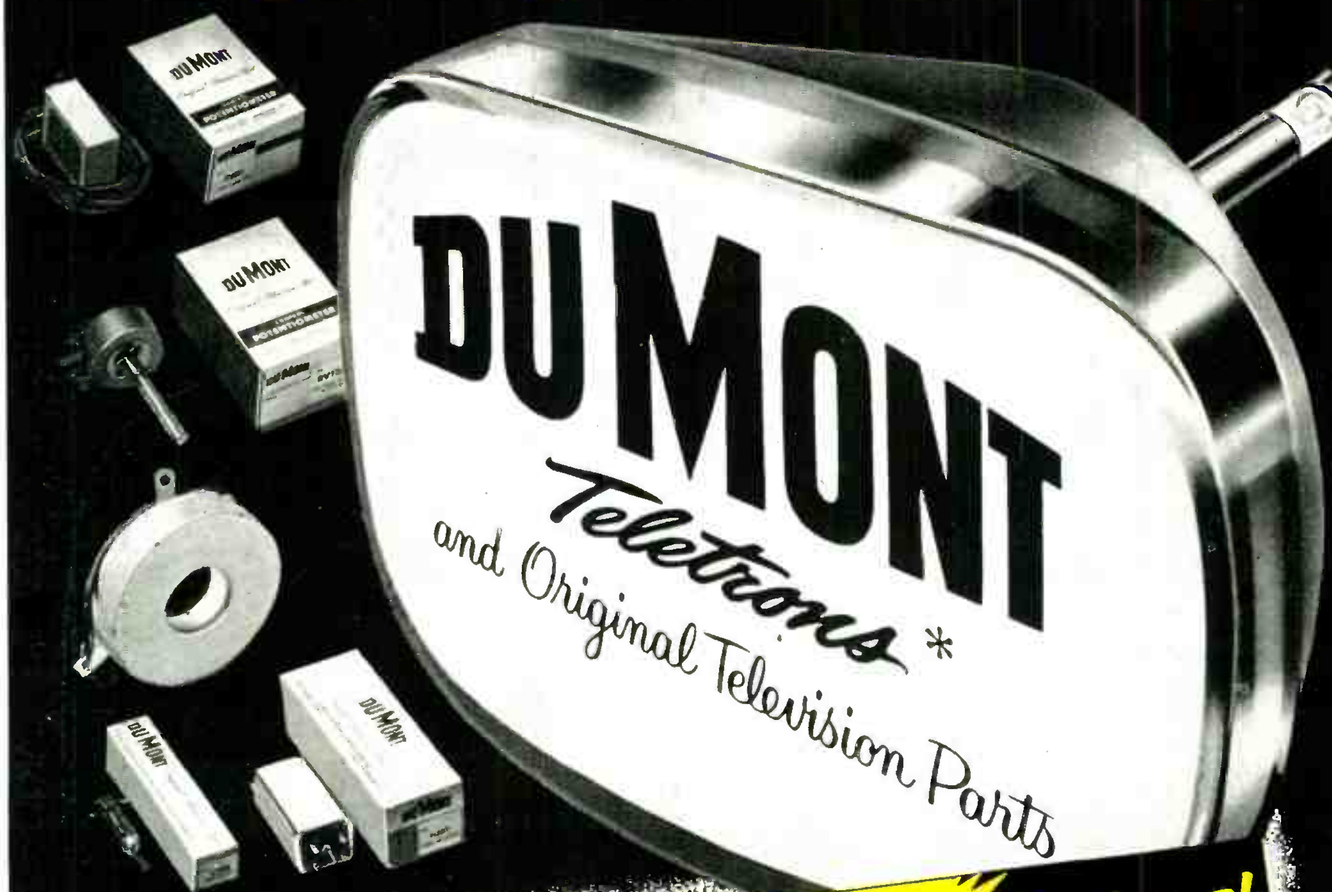

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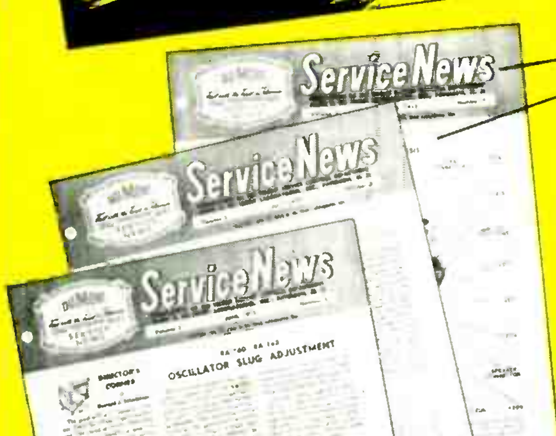

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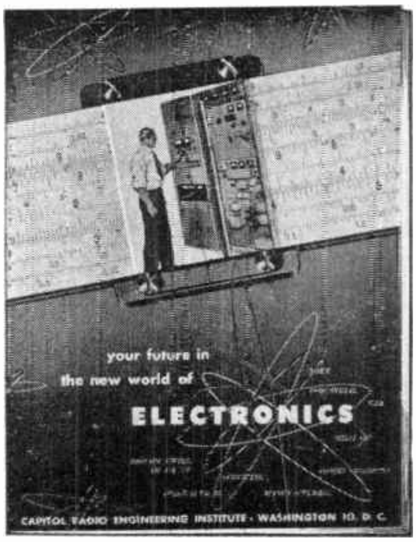

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Think of the thousands of radio-equipped fire and police departments throughout the U.S. Of the many radio-equipped railroads, of the hundreds of cities with 2-way radio service for cars and cabs. Think of the wide-ranging field of aviation communications—radio-controlled aircraft, navigation-and-traffic control, airport stations.

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CONTENTS — JANUARY 1953

6TH ANNUAL TV ISSUE

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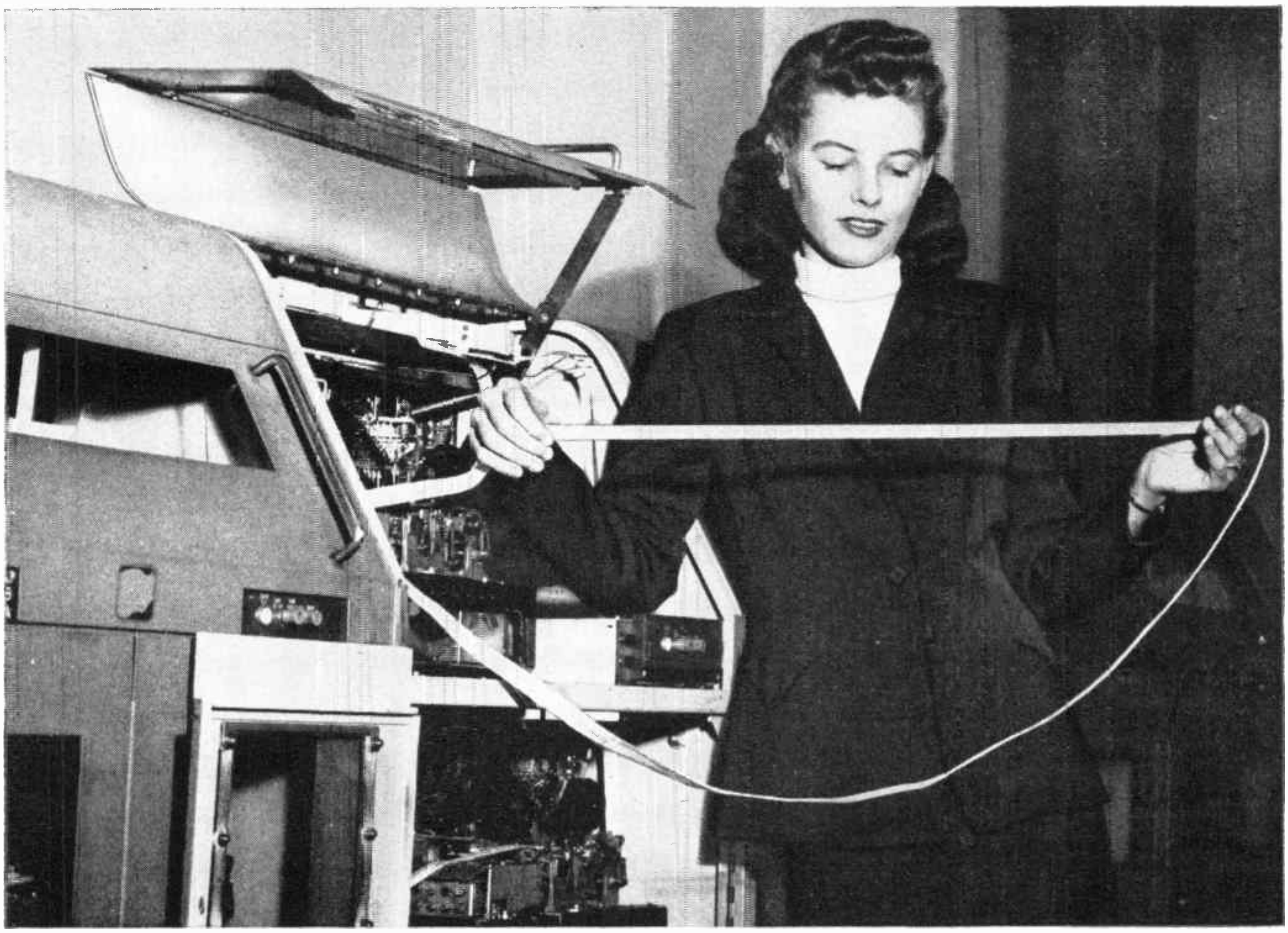
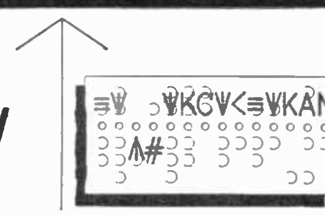


These signals find the way



SENDING

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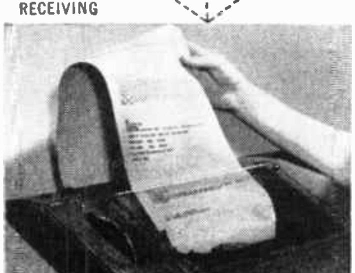

When you dial a telephone number, high-speed switching mechanisms select your party and connect you. Through a new development of Bell Telephone Laboratories, similar mechanisms are doing the same kind of job in private wire teletypewriter systems which America's great businesses lease from the telephone company.

Company X, for example, operates an air transportation business with scores of offices all over the country. At one of these offices, a teletypewriter operator wishes to send a message, let us say, to Kansas City. Ahead of the message, she types the code letters "KC". The letters become electric signals which guide the message to its destination.

Any or all stations in a network, or any combination of stations, can be selected. Switching centers may handle 50 or more messages a minute . . . some users send 30,000 messages a day. Delivery time is a few minutes.

Defense manufacturers, automobile makers, airlines and many other American businesses are benefiting by the speed and accuracy of the new equipment — another example of how techniques developed by the Laboratories for telephone use contribute to other Bell System services as well.

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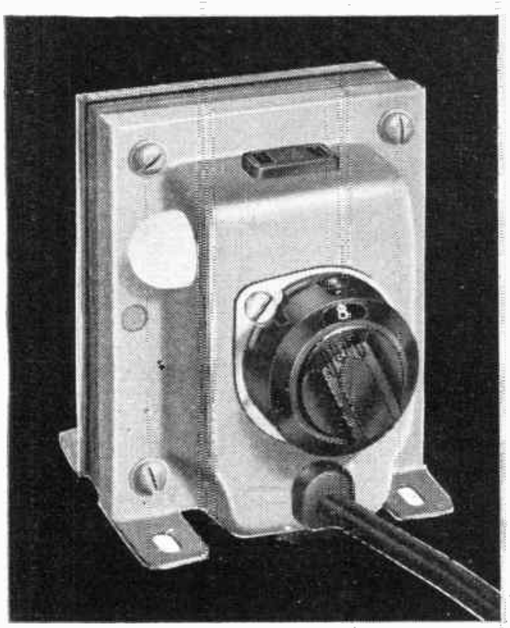

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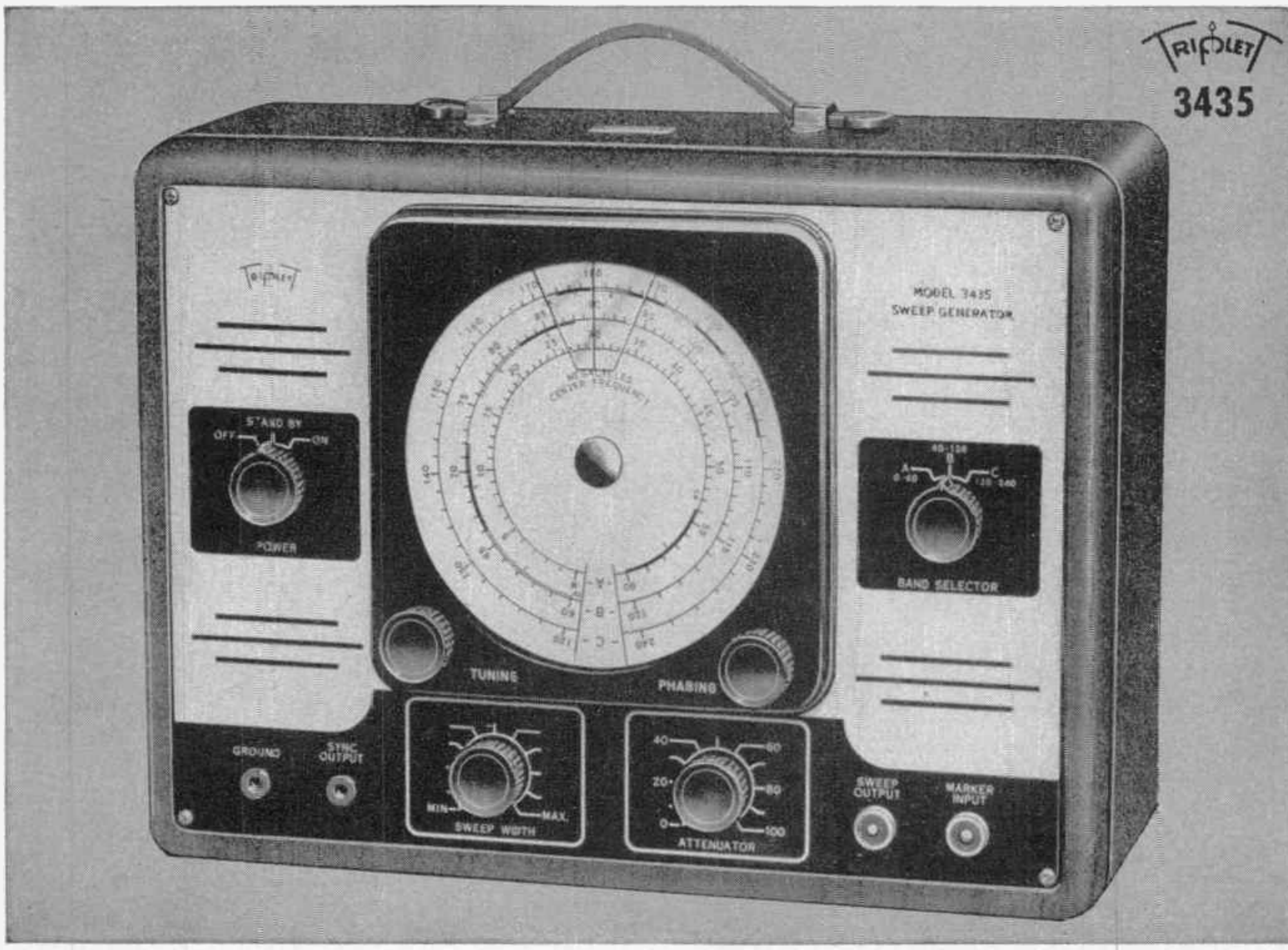

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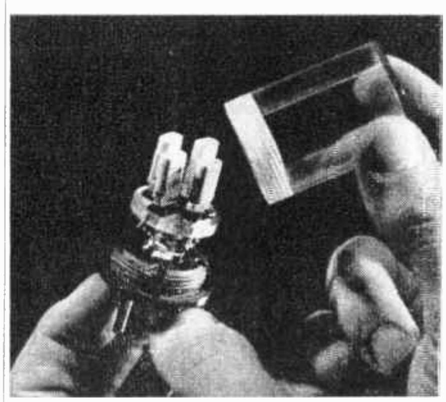
RCA SHOWS TRANSISTOR progress in a wide range of radio, television, and industry applications. The demonstration was held November 17, at the David Sarnoff Research Center in Princeton, N. J.

Transistors were shown operating a portable television receiver, radio sets,



The transistor push-pull output stage.

loudspeaker systems, miniature transmitters, parts of electronic computers, and other experimental devices.

The portable TV set was a single-channel battery-operated receiver with a five-inch screen, no larger than a portable typewriter (12 x 13 x 7 inches). With only a built-in loop antenna the 27-pound receiver produced satisfactory pictures on channel 4 five miles from the Empire State Building. A small "rabbit-ear" antenna boosted its range to fifteen miles.

The experimental receiver has 37 transistors. Its total power consumption is *only 14 watts*, less than 1/10th that of a standard table-model set.

An experimental push-button-tuning automobile radio with 11 transistors provided comparable audio output to standard present-day types.

An important feature of this all-transistor set is the elimination of the B supply (vibrator, transformer, and rectifier). The transistors operate directly off the six-volt automobile battery. Total battery drain with the experimental receiver is *only one amp* (including two pilot lights).

An entirely new kind of audio power amplifier was also shown. This consists of nothing but the four experimental junction transistors shown in the photograph.

These are pairs of *p-n-p* and *n-p-n* transistors in a bridge arrangement, acting as a push-pull amplifier and driving a speaker voice coil directly. Such a device can do the job that now requires two or more tubes, a phase inverter, an output transformer, and other components.

MICROWAVES MAKE MEALS to order in seconds in new *Lunch-O-Mat* slot-machine restaurant. Radar cooking, developed some years ago by Raytheon Manufacturing Company, is being used successfully for large-scale food preparation on the new *S.S. United States* and in many hotels and institutions. Refrigerated meats, soups, and beverages are cooked thoroughly in less than 15 seconds, without destroying vital nutritional elements. This appears to be the first successful attempt to use it in a vending machine.

Heart of the *Lunch-O-Mat's* hot-food section is the hand-size magnetron oscillator shown in the photograph.

COMMUNITY ANTENNAS have reached the stage of big business. A plan under consideration for Vancouver, Canada, would call for an expenditure of $10 million. It is being considered as a serious business proposition by Famous Players Canadian Corp., and would bring programs from Seattle and Bellingham, Washington, to residents of Vancouver. Coaxial cable distribution and a coin-meter service is included in the plan. The antenna would be 300 feet high, mounted on high ground near the city.

In Corsicana, Texas, the city commission is considering an ordinance which would grant a 10-year franchise to a local company for a city-wide TV master antenna system. Tentative charges as proposed would be $125 for connection to the system and from $3.50 to $4.50 a month as rental fee. A central tower high enough to assure the subscribers excellent television reception would be erected.

Latest arrival in the vending machine field is this coin-in-the-slot Radarange.

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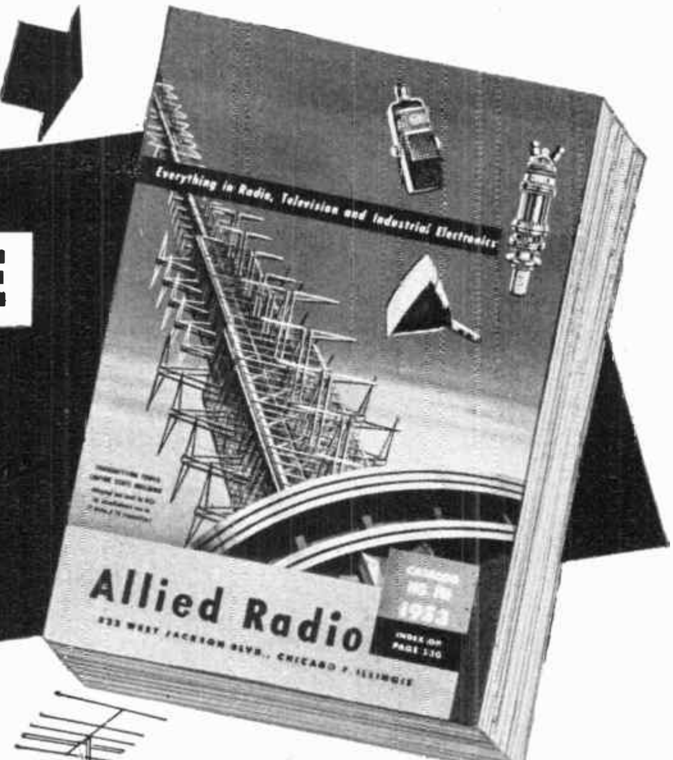

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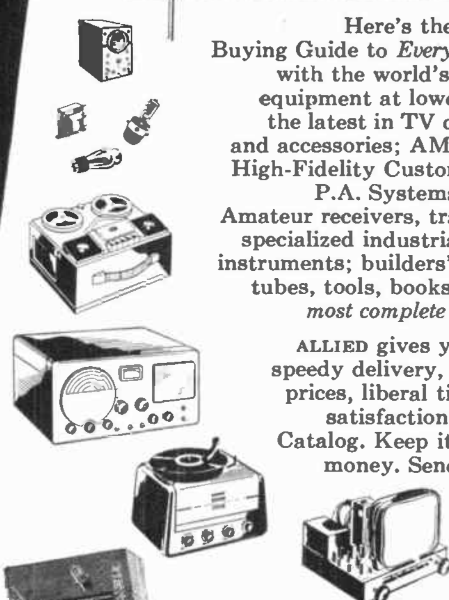

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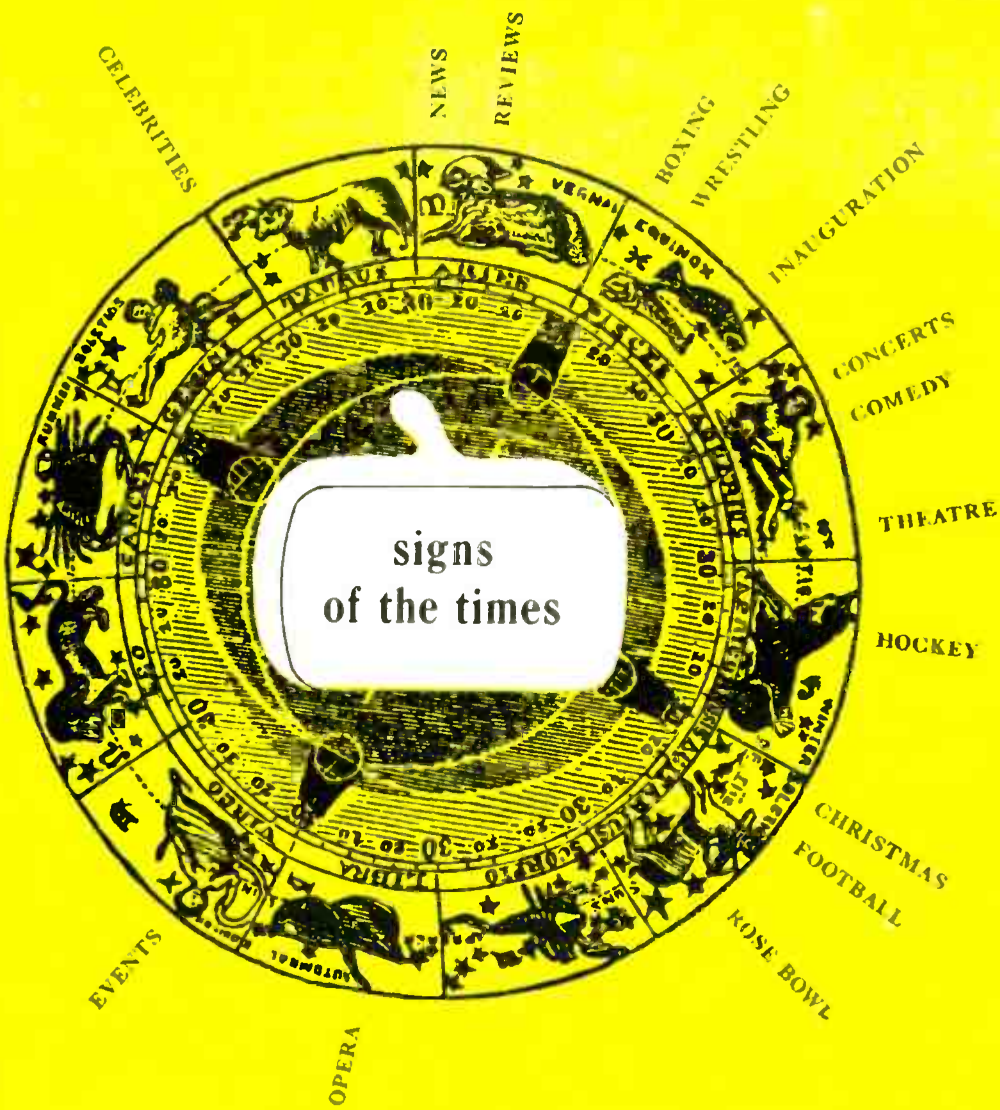

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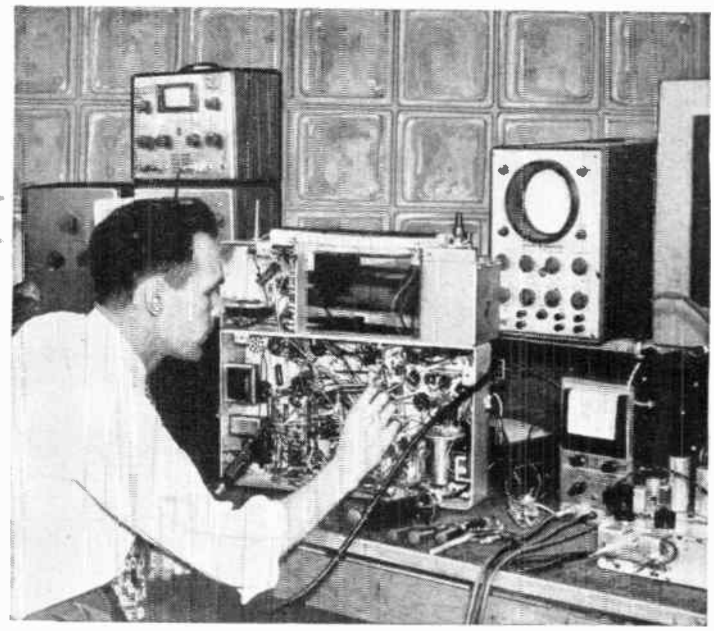

to prepare for a good job or a business of your own in TV SERVICING

There are today more good jobs open in TV Servicing than there are trained and experienced men to fill them. Yes, thousands of opportunities exist now for good-pay jobs offering employment security for years and years to come. Thousands of TV Servicing jobs are going begging. Do you want one of them?

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The Big New Industry with a Great Future

Television is just in the beginning stages of its big industrial boom. Look at these amazing facts:

- Lifting the freeze on new TV stations will open many new TV areas and will improve the coverage of existing areas. The result will be an enormous demand for TV receivers.
- Within a few years over 1000 TV stations will be telecasting compared with 108 TV stations now on the air.
- Nearly one-half of all families living within the present TV areas do not yet own TV receivers.
- The new trans-continental video network plus better and more interesting programs plus larger viewing screens and color TV will increase the installation of new receivers, will induce present owners of 12-inch and smaller size viewing screens to buy newer model receivers.
- The power increases of many existing stations and improved reception range of current receivers will result in receivers being installed and serviced in the fringe areas of present stations.
- Under the FCC proposal, over 70 per cent of all communities will be served by UHF channels exclusively. This means TV servicemen must know UHF receivers before the new UHF stations in their area are opened.
- No one yet knows how great the industrial TV market will be.

RCA Institutes Home Study Course prepares you for a Career in TV Servicing

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QRM ON CHANNELS 4 AND 5 is being caused by fixed-relay stations in the 72–76-mc band, according to a complaint filed with the FCC by the NARTB and station WCCO-TV, Minneapolis. In asking the Commission to reconsider assignments in the 4-mc non-TV gap between the channels, John M. Sherman, technical director of WCCO-TV, cited severe interference over large areas in Wisconsin and Minnesota from police relay stations operating on 73.22 and 74.5 mc.

A SERIES OF SCIENCE FILMS will be shown this fall on national TV network programs sponsored by the American Telephone & Telegraph Company. The 13 one-hour features will be made for AT&T by Hollywood producer Frank Capra. First two films to be presented are titled "The Sun" and "The Moon", with cost of production estimated at $200,000 each.

U.H.F.-TV SIGNALS give practically the same degree of coverage as v.h.f. signals with the same transmitter power, reports the RCA Victor Division of RCA. Surveys made on KPTV, Portland, Oregon—the nation's first commercial u.h.f. station—show Class A coverage over a 20-mile radius, assuring good reception to 95% of the city's residents. Outlying districts within 30 to 40 miles of the transmitter get Class B coverage over favorable terrain. These signals reach 88% of the surrounding population, only 6% less than the estimated coverage for v.h.f. transmission. (*See also page 62.*)

END OF RADIO LICENSE FEES and opening of television field to private broadcasters were demanded by Canada's Liberal Party Council. The 253-member Council, in session at Ottawa, voted the demands over the objections of Revenue Minister McCann, who defended the Government's policy of vesting exclusive television rights in the Canadian Broadcasting Corporation.

WEST GERMANY'S TV NETWORK now stretches from Hamburg to Cologne, carries two hours of regular programs daily. The NWDR (Northwest German Radio) plans to extend the chain of u.h.f. relay links to southern Germany, and share programs with Dutch and Belgian TV networks, which also use the continental 625-line standard.

THE "TELEPROMPTER," a device which unrolls a prepared script that can be seen only by the speaker, will be available to public speakers, nationally on a rental basis from the RCA Service Company, Inc. First brought to the public's attention at the national political conventions last July, the device feeds the manuscript, in letters an inch high, at a speed suited to the speaker's rate of delivery, and has been used for several years in TV studios. Synchronized multiple installations allow the speaker to move freely around the set or platform without losing sight of the written material.

PRIVATE RADIO-MESSAGE service, already established in New York, Cincinnati, and other U. S. cities, was inaugurated in Cleveland December 15. Subscribers hear personal code signals on vest-pocket receivers pre-tuned to 43.58 mc, then call service office for message. The system is similar to the *Air-Call*, operated in New York City by Telanserphone, and described in this magazine in October, 1951.

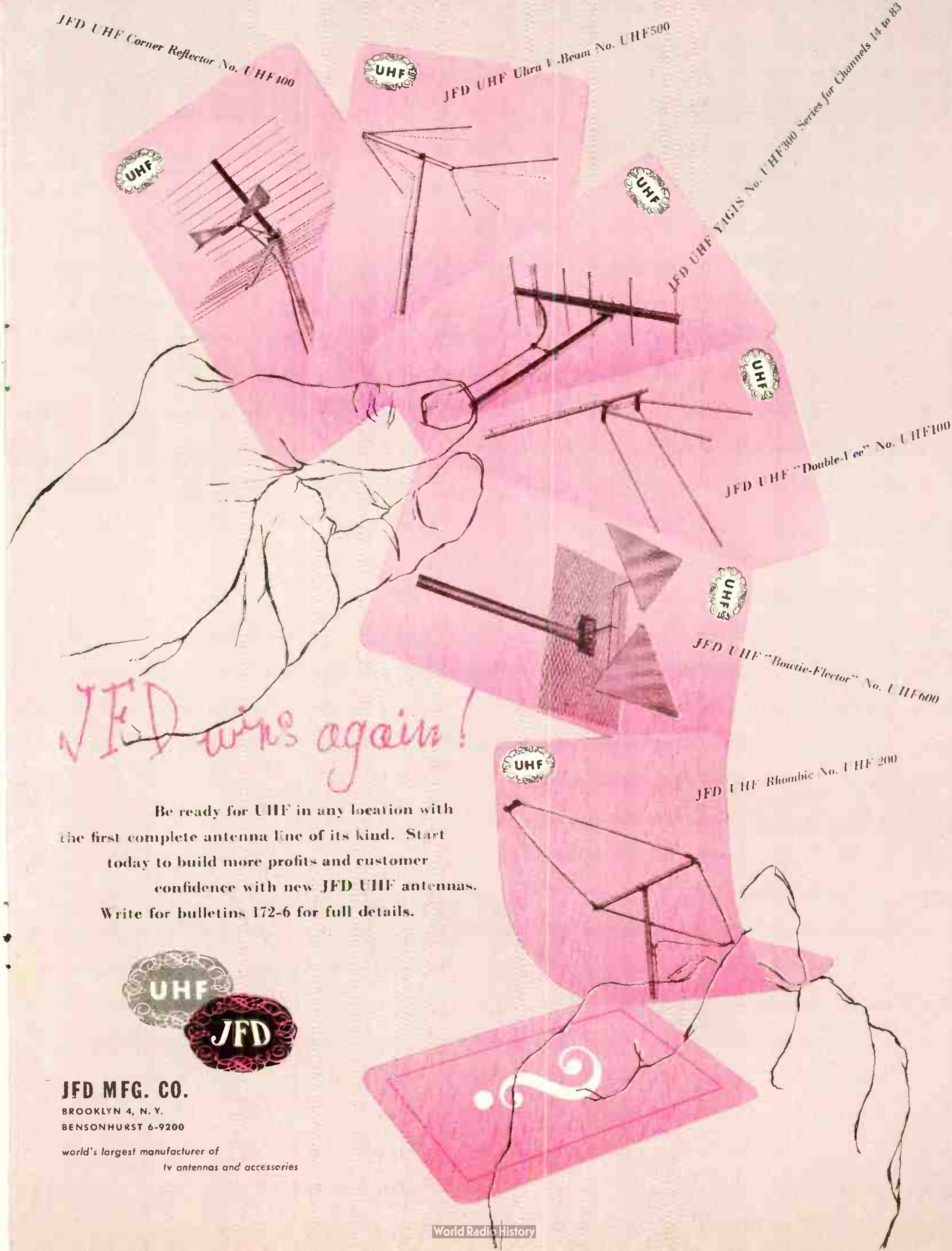
BLASTS AT TV PROGRAMS are no novelty, but Frank P. Walsh of West Hempstead, N. Y., hit the headlines (and the family TV receiver) on October 20, when he made his with a 38-caliber revolver. Walsh, who works nights as a plant security guard, tried vainly to sleep while his wife, mother-in-law, and five children watched a coast-to-coast comedy broadcast. Finally, because "it was playing too loud," he put an end to the program with one well-aimed shot through the picture tube. His wife called police, but Walsh was not held.

BETTER DRY BATTERIES are now being made by micropulverizing the chemical ingredients with ultrasonic vibrations. The method was invented by George Hunrath of Asbury Park, N. J., and is covered by U. S. Patent No. 2,-613,877. Reducing the particles to the smallest possible size by supersonic agitation increases their chemical activity by exposing more surface to chemical activity.

CANADIAN WIRED-RADIO-TV service is being sued for copyright infringement. In a test case, Canadian Admiral Corporation has asked the Exchequer Court to hold Rediffusion, Inc. liable for damages in retransmitting Admiral-sponsored football telecasts without authorization. Rediffusion, Inc. rents radio and TV receivers, and supplies programs over leased wires to subscribers in Montreal.

AUDIO ENGINEERING SOCIETY elected the following new officers at its recent convention in New York City: president, F. Sumner Hall, F. Sumner Hall, Inc.; executive vice-president, Jerry B. Minter, Measurements Corp.; central vice-president, Walter S. Pritchard, Ohio Bell Telephone Co.; western vice-president, Richard L. Burgess, Allied Recording Mfg. Co.; secretary, C. J. LeBel, Audio Instruments Co., Inc.; treasurer, Ralph A. Schlegel, WOR Recording Studios; governors, Price E. Fish, Columbia Broadcasting System; Jay H. Quinn, Fairchild Recording Products Corp.; Carleton H. Sawyer, Bell Telephone Laboratories.

BLACKMAILING TV-CHANNEL applicants is a new racket reported from Washington. The blackmailer threatens to file a competitive application for an unopposed channel assignment unless paid off in cash or with an interest in the station. This new variation on the old shake-down theme is blamed on the shortage of FCC examiners to handle contested applications without delay. END



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JFD wins again!
Be ready for UHF in any location with the first complete antenna line of its kind. Start today to build more profits and customer confidence with new JFD UHF antennas. Write for bulletins 172-6 for full details.
UHF
JFD
JFD MFG. CO.
BROOKLYN 4, N. Y.
BENSONHURST 6-9200
world's largest manufacturer of tv antennas and accessories

BAROMETER of the PARTS INDUSTRY

During November, 50 of the leading 400 manufacturers of Radio-Television-Electronic parts and equipment made changes in their lines. Actually there was a decrease in "change activity" as compared to October.

In price revisions by the number of manufacturers and products affected, the following summary illustrates the comparative trend for the months of October and November.

	No. of Manufacturers	
	October	November
Increased prices	13	16
Decreased prices	11	7

	No. of Products	
	October	November
Increased prices	68	204
Decreased prices	49	136

For a summary of the most active product categories, see the following table:

Product Group	Increased Prices		Decreased Prices		New Products		Discontinued Products	
	No. of Mfrs.	No. of Products	No. of Mfrs.	No. of Products	No. of Mfrs.	No. of Products	No. of Mfrs.	No. of Products
Antennas & Acces.	2	12**	3	128*	7	124**	6	102*
Capacitors	0	0	0	0	2	48**	0	0
Controls & Resistors	0	0	0	0	1	1**	1	4*
Sound & Audio Prod.	2	10*	2	2*	6	61**	7	113*
Test Equipment	4	6*	0	0	2	5*	1	2**
Transformers	1	36*	0	0	5	57*	1	13*
Tubes	5	49*	1	5**	11	44**	4	14*
Wire & Cable	2	91*	1	1*	2	11**	0	0

* Increase over October
** Decrease from October

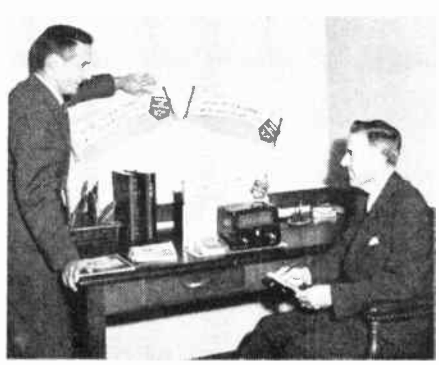
* Increase over October
** Decrease from October

Comment: There is an apparent trend toward increased prices by the leading TV Tube Manufacturers. While "change activity" continues to center around the introduction of new items, it is noticeable at this time that there is a decrease in the number of manufacturers involved.

This data is prepared by the staff of United Catalog Publishers, Inc., 110 Lafayette Street, New York, publishers of RADIO'S MASTER, the Official Buying Guide of the Parts Industry.

Merchandising and Promotion

P. R. Mallory & Co., Inc., Indianapolis, is backing up its u.h.f. converter sales with an aggressive promotion campaign. The merchandising plan includes a consumer product display, colorful banners, and envelope stuffers. Newspaper mats are also available in addition to suggested news releases for local newspapers. The entire campaign has been tied together by advertising in consumer and trade publications.



Alliance Manufacturing Co., Alliance, Ohio, has prepared a series of one-minute TV spot film commercials in co-operation with its advertising agency, Foster & Davies, Inc., Cleveland. The commercials demonstrate the new Alliance *Cascamatic* booster which mounts out of sight on the back of the TV set, is pretuned to all v.h.f. stations and requires no manual controls.

Jensen Industries, Inc., Chicago, has prepared a new replacement phonograph needle wall chart designed to simplify the work of the service technician and record dealer. The unique guide also aids in inventory control and shows authorized needle substitutions. The chart is available either directly from Jensen Industries or from its distributors.

The Sylvania Television Picture Tube Division, Seneca Falls, N. Y., is shipping its TV tubes for renewal sales in a new factory-sealed carton which provides easy and safe handling. The new carton also adds an attractive note when displayed in service technicians' shops.

Allen B. Du Mont Laboratories, cathode-ray tube division, Clifton, N. J.,

reported its recent *Tele-Mirror* promotion as one of the most successful yet undertaken by the Division, according to Edwin B. Hinck, sales manager for the Replacement Sales Department of the division. Based on the success of this campaign, similar promotions directed to the service technician will be forthcoming.

Cornell-Dubilier Electric Corp., South Plainfield, N. J., is giving away a useful clear plastic compartment case with the purchase of each of six new C-D Twist Prong Capacitor Kits. The see-through compartments are ideal for storing screws, tubes and small parts of all kinds.

Allied Radio Corp., Chicago, in cooperation with the American Radio Relay League, distributed a free booklet, "You Can Be There," to radio clubs, classes, and other groups of radio or electronics students or hobbyists. The booklet tells the story of the romance which amateur radio operation offers young men.

RMS (Radio Merchandise Sales), New York City, conducted another in its series of forums for TV service technicians in Portland, Ore. The forum, which was co-sponsored by Pacific Stationery and Central Distributors, TV parts distributors, and arranged by the Burt Porter Co., RMS representative in the Pacific Northwest, emphasized u.h.f. antenna problems.

Production and Sales

The RTMA reported that 3,670,591 TV sets and 6,689,535 radios were produced during the first nine months of 1952. The association pointed out that September, 1952, production of 755,665 TV sets was 124% over industry output for September, 1951.

Shipments of receiving tubes by members of the RTMA totaled 34,196,286, valued at $24,432,747, a substantial increase over shipments for the previous month and for September, 1951. During the first nine months of 1952, 245,689,629 tubes were shipped, compared to 280,795,338 during the 1951 period.

General Electric Tube Department's manager of marketing, E. P. Peterson, Schenectady, predicted production of 6,200,000 TV sets during 1953, the highest since the record year of 1950. He said that 435,000,000 receiving tubes would be produced during 1953, as compared with an estimated total of 375,000,000 for 1952.

Westinghouse Television-Radio Division plant at Sunbury, Pa., reported an unprecedented high in employment and production figures. Employment figures were running 28% over the similar period of 1951; production topped last year's figures by 35%.

New Plants and Expansions

CBS-Hytron, Danvers, Mass., is constructing an addition to its TV picture tube plant and large warehouse for TV picture tubes at Newburyport, Mass. The additions will enable the company to handle the production of 24- and 27-inch picture tubes in volume. The company expects that the construction of the new buildings will be completed by the middle of 1953.

Clarostat Manufacturing Co., Inc., Dover, N. H., opened an additional plant in the Chicago area. The new plant, now in operation, was purchased so that the company would be in a better position to serve its Midwest and Western customers.

Raytheon Manufacturing Co., Waltham, Mass., is constructing a new $2,000,000 electronics laboratory in Bedford, Mass., designed to be one of the most modern and efficient of its kind. The new building is being constructed by Raytheon for the Navy and will be used by the company as a research and development center.

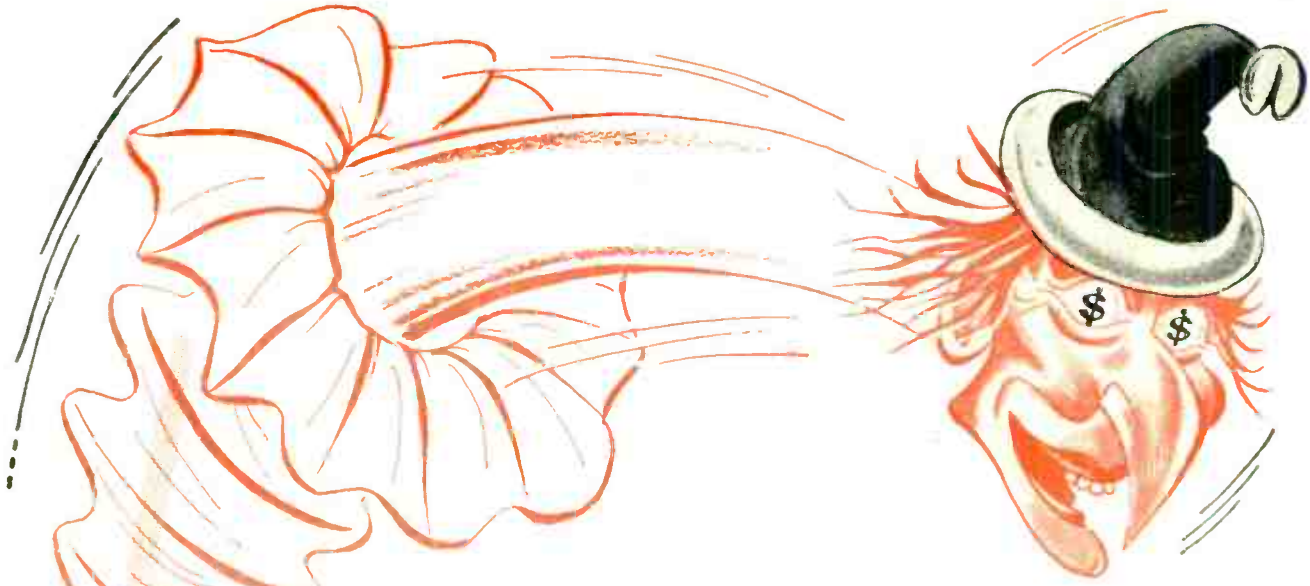
General Electric is now producing u.h.f tuners for its TV sets at its Receiver Department plant, Auburn, N. Y. One hundred and fifty employees were added to the payroll to handle this new production.

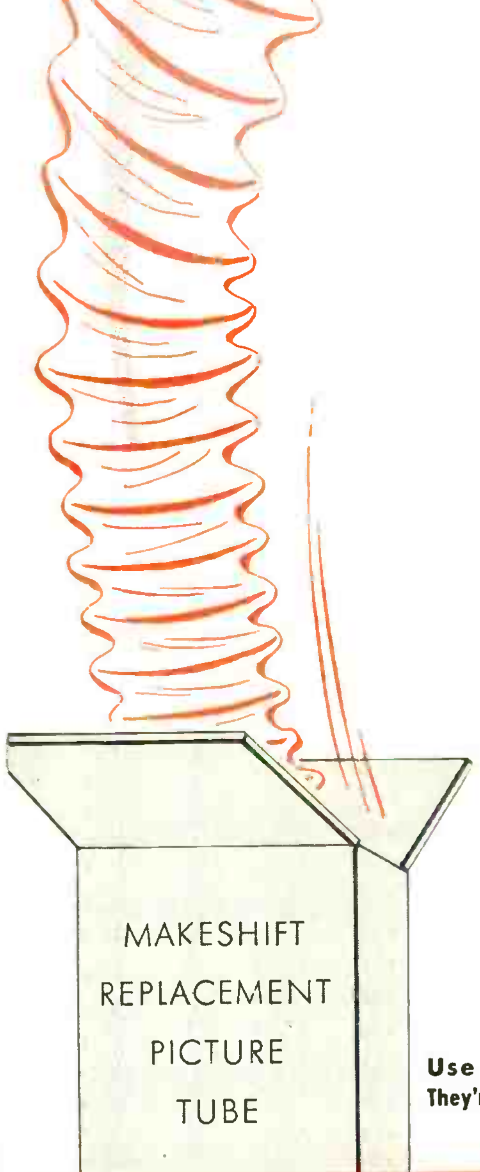
General Cement Manufacturing Co., Rockford, Ill., opened new warehouse facilities in Los Angeles to provide West Coast parts distributors and service technicians with better service and faster deliveries.

Synthane Corp., manufacturer and fabricator of laminated plastics for industry, added a two-story brick wing to its plant at Oaks, Pa. The new wing marks the eleventh plant expansion since the company's original factory was built.

Hammarlund Manufacturing Co., New York City, leased an additional 12,000 square feet of space at 541 W. 34th Street.

Radio City Products Co., New York City, moved all its test equipment production facilities to its Easton, Pa., plant. The Engineering, Sales, and Purchasing Departments and the general offices will remain in New York City. Walter Jonas, production manager, will direct operations at both plants. Burt Levy was appointed sales manager of the Jobber and Industrial Division. END





Are you sticking your neck out on Picture Tubes?

You are if you're using makeshift replacements instead of brand new tubes. You may think you'll save a little money but you could lose your good reputation. Play it safe. Use the tubes that are given *101 rigid quality tests and checks* to insure their electrical and mechanical perfection . . .

RAYTHEON

TELEVISION PICTURE TUBES

These *brand new tubes,* the precision products of a multi-million dollar corporation, are creating satisfied customers with their superb performance wherever they are installed. And this quality performance is enhancing the reputation of the Service Technicians who install them. Protect your future with RAYTHEON TV PICTURE TUBES.

Use RAYTHEON TELEVISION PICTURE TUBES
They're Right for *Sight* . . . and Right for *You* . . . and *Always New!*

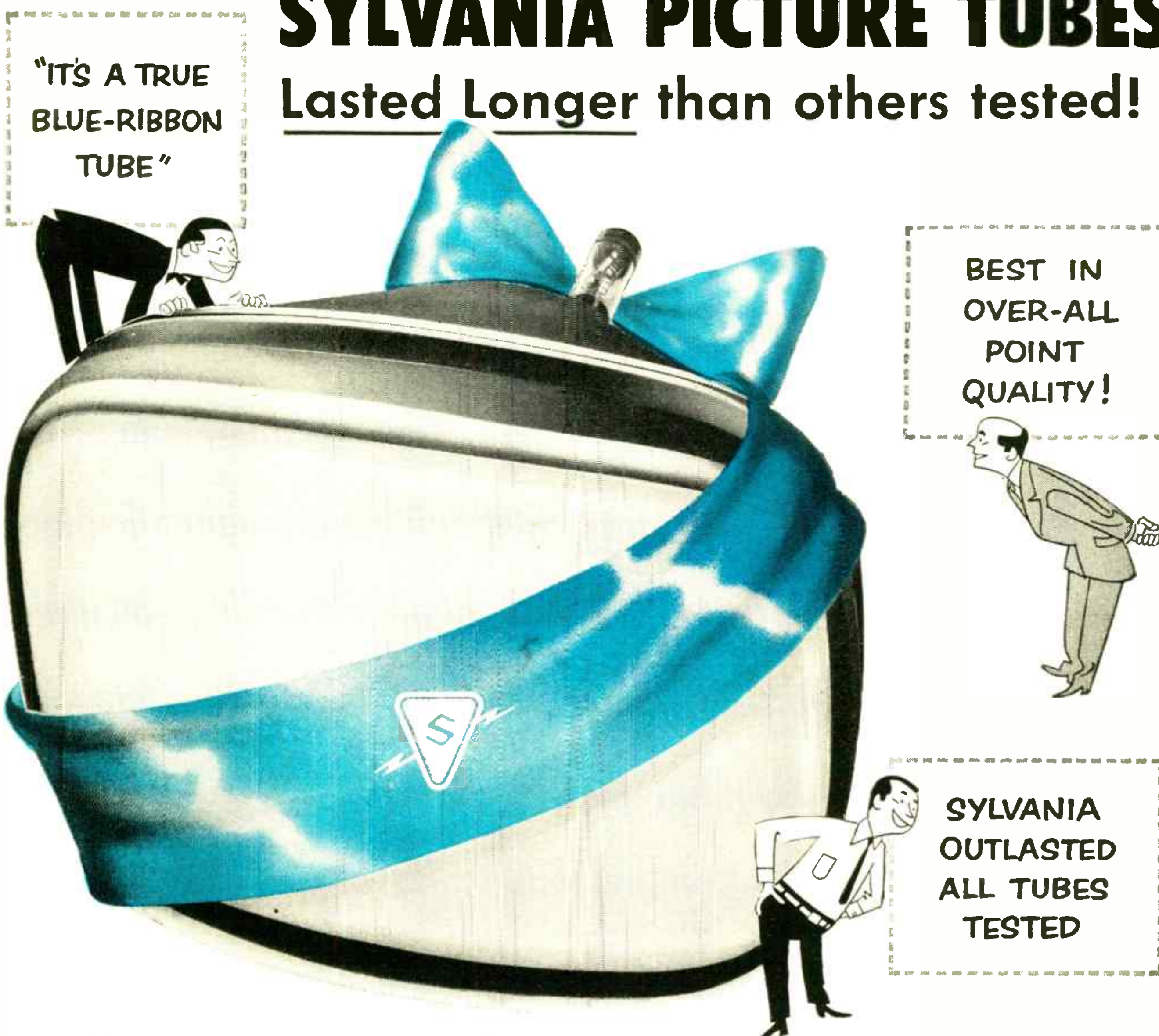
RAYTHEON

RAYTHEON MANUFACTURING COMPANY
Receiving Tube Division
Newton, Mass., Chicago, Ill., Atlanta, Ga., Los Angeles, Calif.

RAYTHEON MAKES ALL THESE:

SYLVANIA PICTURE TUBES

Lasted Longer than others tested!



Only Sylvania tubes showed NO FAILURES after 1400 hours . . . *at accelerated voltages*

Exhaustive tests conducted under the supervision of an outside impartial laboratory, the United States Testing Company, showed Sylvania Picture Tubes lasted longer than any others tested.

These tests included the picture tubes of nine leading manufacturers. All tubes were placed in identical test racks and tested under identical accelerated voltages. At the end of 1400 hours, only the Sylvania Picture Tubes showed *no failures.*

These tests definitely establish the outstanding dependability of Sylvania Picture Tubes. They prove that these tubes will best uphold your reputation for fine performance in the sets you manufacture, sell or service. Send today for complete details about Sylvania Picture Tubes. Sylvania Electric Products Inc., Dept. 3R-1701, 1740 Broadway, New York 19, New York.

SYLVANIA

RADIO TUBES; TELEVISION PICTURE TUBES; ELECTRONIC PRODUCTS; ELECTRONIC TEST EQUIPMENT; FLUORESCENT TUBES, FIXTURES, SIGN TUBING, WIRING DEVICES; LIGHT BULBS; PHOTOLAMPS; TELEVISION SETS


HERE'S WHY
ALLIANCE TENNA·ROTOR
IS THE ANSWER TO
UHF RECEPTION!
ONE ANTENNA
GETS ALL STATIONS!
UHF
VHF
UHF
VHF
UHF
VHF
UHF
VHF
ALLIANCE TENNA-ROTOR, properly installed, on one directional antenna, assures top gain from all stations—UHF and VHF.
● UHF is more critical—highly directional!
Tenna-Rotor is accurate—pin-points the antenna—puts it right on the beam!
● Many channels are changing!*
Tenna-Rotor gives directional all-channel reception—stops costly antenna alterations and re-alignments.
● Make ONE antenna installation the final installation!
It pays to insist on Alliance Tenna-Rotor!
Weather-sealed rotator unit
IMPORTANT NOTICE!
*Changes in television demand changes in present antennas! New UHF and VHF stations mean more channels! Current FCC rulings have assigned channel changes to nearly one-third of all VHF stations. This makes single-channel antennas and other fixed position antennas obsolete! Prepare now. Meet the coming changes in television with ALLIANCE TENNA-ROTOR.
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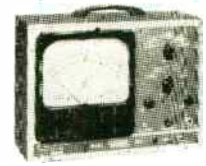
Automatic HIR with direction indicator control. Price $44.95
Sold by TV Dealers Everywhere
alliance
TENNA · ROTOR
(TV ANTENNA ROTATOR)

145K SIG. TRACER
KIT $19.95 WIRED $28.95

950K R-C BRIDGE & R-C-L COMP. KIT $19.95
WIRED $29.95

360K SWEEP GEN.
KIT $34.95 WIRED $49.95

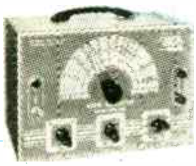


New 214K VTVM KIT
$34.95 WIRED $54.95
7½" METER

320K SIG. GEN.
KIT $19.95 WIRED $29.95

OVER 1/4 MILLION EICO INSTRUMENTS in use the world over!

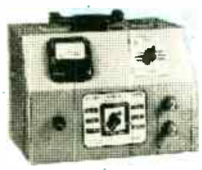
New 536K MULTIMETER
KIT $12.90 WIRED $14.90
1,000Ω/v; 31 ranges



New 377K SINE & SQUARE WAVE AUDIO GEN. KIT $31.95
WIRED $49.95

EICO new modern facilities for research, development and production—your greater assurance of . . .

LABORATORY PRECISION AT LOWEST COST



1040K BATTERY ELIM.
KIT $25.95 WIRED $34.95

NEW AUDIO GENERATOR

- ***Accuracy:*** ±3%
- ***Sine Wave Range:*** 20-200,000 cps in 4 bands
- ***Square Wave Range:*** 60-30,000 cps
- ***Freq. Response:*** ±1.5 db, 60 cps-150 kc.
- ***Output Voltage:*** 10 volts across 1000 ohms (rated load); 14 volts across 10,000 ohms; 8 volts across 500 ohms
- ***Distortion:*** less than 1% at rated output (100 mw)
- ***Hum:*** less than 0.4% of rated output
- Clear, three-dimensional drawings and simplified construction information. 15-page Instruction Book describes circuitry, applications and maintenance.

377K
KIT $31.95
WIRED $49.95

1171K RES. DECADE BOX
KIT $19.95 WIRED $24.95

625K TUBE TESTER
KIT $34.95 WIRED $49.95

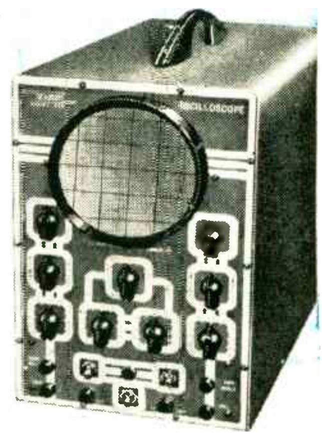
CRA PIX TUBE ADAPTOR
for Tube Tester $4.50

New 565K MULTIMETER
KIT $24.95 WIRED $29.95
20,000 Ω/v; 31 ranges

315K DELUXE SIG. GEN.
KIT $39.95 WIRED $59.95

HIGH VOLTAGE
PROBE $6.95

221K VTVM $25.95
WIRED $49.95



425K 5"-PUSH-PULL SCOPE
KIT $44.95 WIRED $79.95

You Build *EICO* Kits in One Evening, but . . . They last a Lifetime! and You SAVE OVER 50%

YOU be the judge. See the famous EICO line TODAY — in stock at your local jobber — and SAVE!

Write NOW for FREE newest Catalog 1-CA.

America's greatest instrument values bear the name—

EICO

See EICO's other ad on Inside Back Cover of this magazine.

ELECTRONIC INSTRUMENT CO., Inc., 84 Withers Street, Brooklyn 11, N. Y.

Prices 5% higher on West Coast. Specifications and prices subject to change without notice.

NEW TELEVISION TRENDS

Vital new developments in television . . .

By HUGO GERNSBACK

IT NOW BECOMES apparent that television, as far as entertainment is concerned, will take a distinctively new road in the near future. With a few exceptions, radio broadcasting in the past made it possible for listeners to receive almost every imaginable program that could be broadcast. (These few exceptions were primarily major prize fights which were *not* broadcast because the promoters felt that their gate receipts would suffer.)

With television, broadcasting no longer is blind. The promoters of sports, Broadway shows, operas, and similar events are convinced that television would be a far-too-powerful competitor if such entertainment were broadcast free of charge.

I foresaw this situation 20 years ago in an article entitled "The Tele-Theater" in the January-February 1932 issue of my former publication, TELEVISION NEWS. This situation was amplified in an editorial entitled "The Tele-Theater" in the January 1951 issue of RADIO-ELECTRONICS. It is now no longer news that recently important sports events have been televised exclusively to theater chains in various parts of the country, where admission is charged to view the event.

As this issue of RADIO-ELECTRONICS goes to press, the first closed circuit telecast of Metropolitan opera is about to be shown in a number of theaters in the U.S. (December 11th.)

To expand its activities, as well as its income, the Metropolitan Opera Association, Inc. arranged to have the entire opera "Carmen" broadcast in conjunction with the *Theatre Network Television, Inc.* This particular telecast runs for more than three hours, and takes in the entire opera from beginning to end. Over 30 theaters in the principal cities from coast to coast signed up as participants in this trial event. The price scale in each theater was determined by local management, but it was stressed that the tickets were sold at reasonable prices. The Metropolitan Opera Association, Inc. shares in the returns from the theaters on a percentage basis.

It appears certain that important Broadway plays will soon follow this innovation. The trend is bound to follow this particular pattern, and it looks as if the teletheater is with us to stay, for a long time to come.

At present it would probably not pay sponsors to offer free broadcasts to the televiewing public of Broadway plays, grand opera, and other important entertainment events. It will be possible, however, in the future, when there are as many television sets as radio receivers in the country.

The question has been frequently asked: "Where does the private television set owner fit in this type of arrangement?" At the moment he simply is not being considered at all, for the simple reason that the new trend is away from *broadcast* television. It is a *private* endeavor of a group of entrepreneurs bent on filling their theaters which have been more or less emptied by the terrific competition of broadcast television.

Fortunately, the television owner may not always be barred from seeing a Metropolitan Opera broadcast, or a Broadway play broadcast, *in his own home.* Once more science is coming to the rescue. Indeed, it may be quite possible that in a few years a television owner may not have to go to his local theater to see an important Metropolitan Opera. My editorial, "Magnetic Tape TV Recording," in the November 1952 issue of RADIO-ELECTRONICS, pointed out that it will soon be possible to record television programs on a magnetic tape. When the final bugs have been eliminated, the way will be open for a central distributing agency to sell magnetic television recordings or rent reels of important productions—the Metropolitan Opera included—to everybody in the land. All that the home television owner will need is a special television tape reproducer which can be put on top of or near the television receiver and connected to its circuits without disturbing it. Then by merely pressing the switch the recording will reel off and the action will appear on the screen.

It should be possible to mass-produce the magnetic tapes at a reasonable price so that play or opera performances can be sold or rented at a reasonable rate. Quite possibly Broadway producers and opera companies will realize even more money thus than from theater television. If only 25% of the television set owners would subscribe to the tape service, it would work out to a very substantial figure, exceeding the amount paid by the theaters many times. At this moment it is anyone's guess how much the magnetic tape reels will be sold or rented for.

Naturally, the television set owner still would have to pay a fee to participate in such an entertainment setup, but it is quite probable that most people would not object to this.

In the meanwhile, new owners of television sets will have little to complain about because the price of television receivers is continuously going down. This is also a well-defined trend. Already several of the large television manufacturers are selling high-grade 21-inch-screen sets below $200, which is an important reduction from former price levels for similar sets.

Indeed, the lower prices will probably continue for quite a while. With new engineering techniques, such as transistors, appliquéd—the so-called plated-circuits, it will be possible in the future to make still greater price concessions. The reason is that in television sets the labor cost is a very appreciable portion of the total manufacturing cost of the receiver. With the appliquéd circuits, the cost can be reduced still more. It therefore would appear that 21″ screen and larger sets selling around $150 and less are not at all impossible within the next few years.

This trend is in the right direction because it paves the way for color television. At one time it was thought that a good color television receiver would cost between $400 and $500, but in the light of new techniques it would appear that when and if color television sets are marketed, they will probably sell for between $200 and $250, and perhaps even lower.

Most likely these sets will also include magnetic tape equipment to view—at a cost—Broadway shows, operas and other closed circuit features not normally broadcast.

UHF OPENS UP

By RAYMOND F. GUY*

The author, left, congratulates Victor Bary on the record Portland installation.

MOMENTOUS events, of deep significance to the readers of RADIO-ELECTRONICS, are taking place in television. In the May, 1952, issue, an article by this author outlined the "TV Pattern for the Future", based upon events, developments, and trends immediately prior to the lifting of the television freeze. That long-awaited event is now history, and already the Federal Communications Commission is well advanced on its program of authorizing television station construction permits. Initiation of TV service in scores of communities is now imminent, millions of new receiver installations will be necessary, and the readers of these pages will be vitally concerned with the installation and servicing of these receivers. It is again timely to look to the present and future responsibilities and opportunities placed before you.

Following a number of years of basic research and investigation of u.h.f. wave propagation and the development of tubes and circuitry, the Radio Corporation of America and the National Broadcasting Company on December 29, 1949, placed in operation in the Bridgeport-Stratford (Connecticut) area their historic experimental station KC2XAK, the u.h.f. pathfinder for the industry. On August 23, 1952, this station signed off for the last time. Within four days, the antenna, tower, and apparatus had been completely dismantled and were on the way to Portland, Oregon.

Within 60 hours of its arrival at Portland, it had been installed on a hilltop site recommended by this writer and was ready to render the first TV broadcast to Portland. Within a few days the FCC granted special temporary authorization for the service to start and thus the Bridgeport veteran transmitter embarked on a new career in virgin territory as the world's first commercial u.h.f. TV station, bringing TV for the first time to nearly 1,000,000 people. Only about three weeks from the time the apparatus was signed off at Bridgeport, it began commercial operation in a city 3,000 miles away.

The excitement and impact of this momentous event in Portland and throughout the industry beggars description. Transcending all other topics of local conversation and news, it established a precedent which others will strive to equal, perhaps in your community. Coming unexpectedly soon, the rush to acquire receivers and converters sparked off crash programs among the manufacturers, distributors, dealers, and service companies to rush equipment to the area and meet the demand. During the first three months of TV service in Portland, it was anticipated that at least 60,000 receivers would be purchased and installed without substantially blunting the sharp edge of the feverish demand. In one large store alone, a million dollars worth of receivers were sold in 10 days and list prices are the order of the day.

What happened in Portland may happen in your community. The press and radio gave almost hourly bulletins on the activities at Council Crest Park where the new TV station was being built. Local columnists speculated with every new edition as to the probable opening date for the station. A contest was held—with a new TV set as a prize—for the citizen who most closely guessed the day, hour, and minute that the station would officially open. People from all over the area flocked by the thousands to the transmitter site to see their first TV station being built. All available parking space was filled and workmen engaged in the project in some cases had to park a quarter of a mile from the site. During the early afternoon hours a police detail was assigned to the area to regulate traffic and at times had to conduct sightseers in large groups on 20-minute cycles to give all of the sidewalk superintendents a view of the proceedings.

TV's debut in Denver was equally exciting. Eleven days after the FCC started on July 1 to make post-freeze grants, a construction permit was issued to KFEL-TV. Only one week later special temporary authority was granted by the FCC to begin telecasting, which was inaugurated within three days with an immediately available v.h.f. 500-watt RCA transmitter.

Television service thus has come with startling rapidity to the two largest markets heretofore without it. The imagination and enterprise which accomplished it will also bring it to many other communities in like manner. It is to your interest to keep informed and be prepared to take advantage of the opportunities it may present to you.

FCC processing procedure

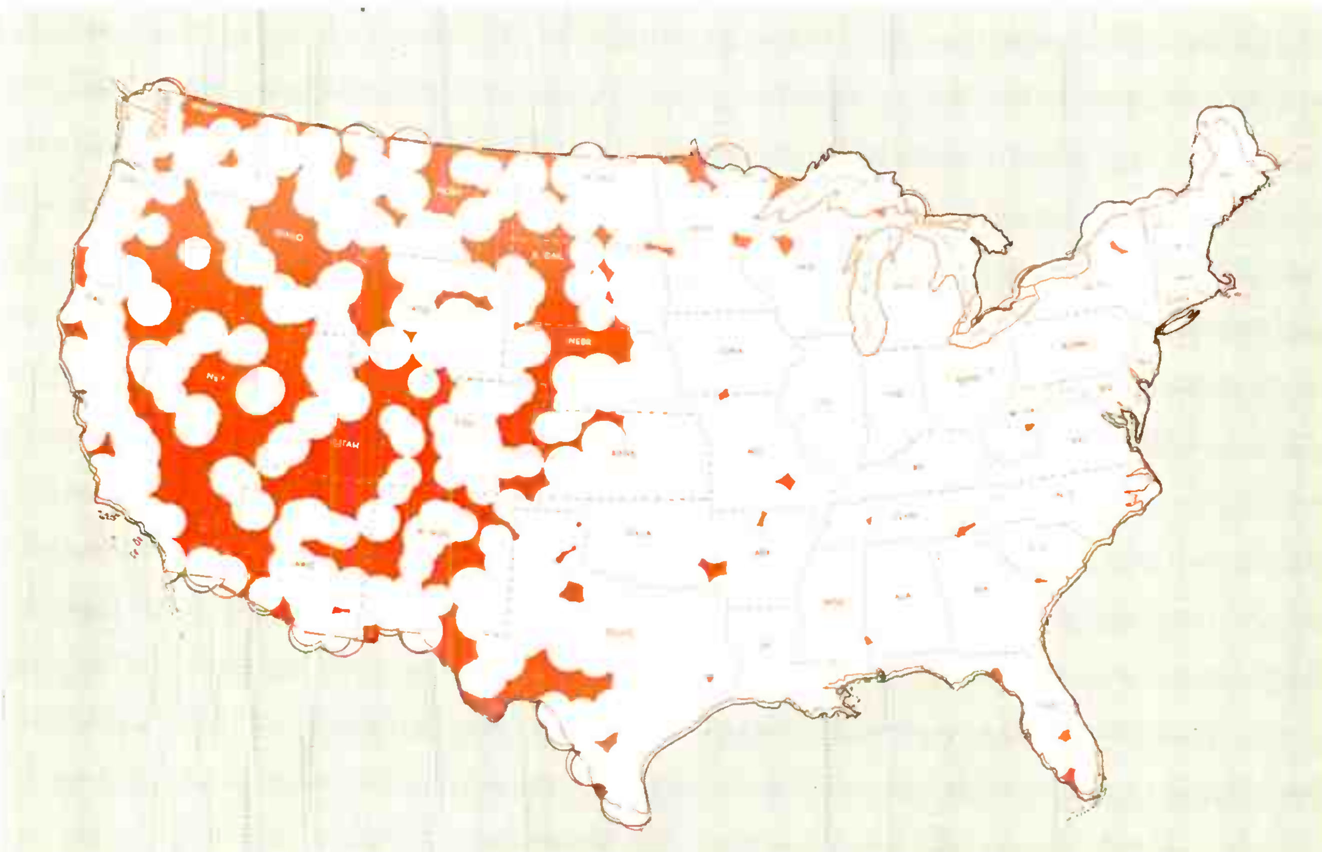
When will your community receive TV service or an extension of your present service? Unfortunately it is not possible to publish an explicit timetable. But it is possible to inform you of trends and possibilities.

When preparing its Sixth Report and Order (the TV thaw-out) of April 14, 1952, the Commission was faced with a truly monumental task in processing the hundreds of applications for station grants. Having adopted voluminous standards and rules as the framework for the great nation-wide service of the future, how could they best proceed with the granting of applications with promptness, fairness, and efficiency? In hundreds of cases an individual channel in a given community would be applied for by not only one but many different applicants. Under our democratic processes in such cases, public hearings are indicated to enable the FCC to determine which of the applicants is best qualified to serve the public interest, convenience, and necessity. Some of these cases apply to cities with existing service and others do not. In some instances, there would be but one applicant for a channel. In other cases, existing stations require only a change of frequency to conform with the new allocation plans.

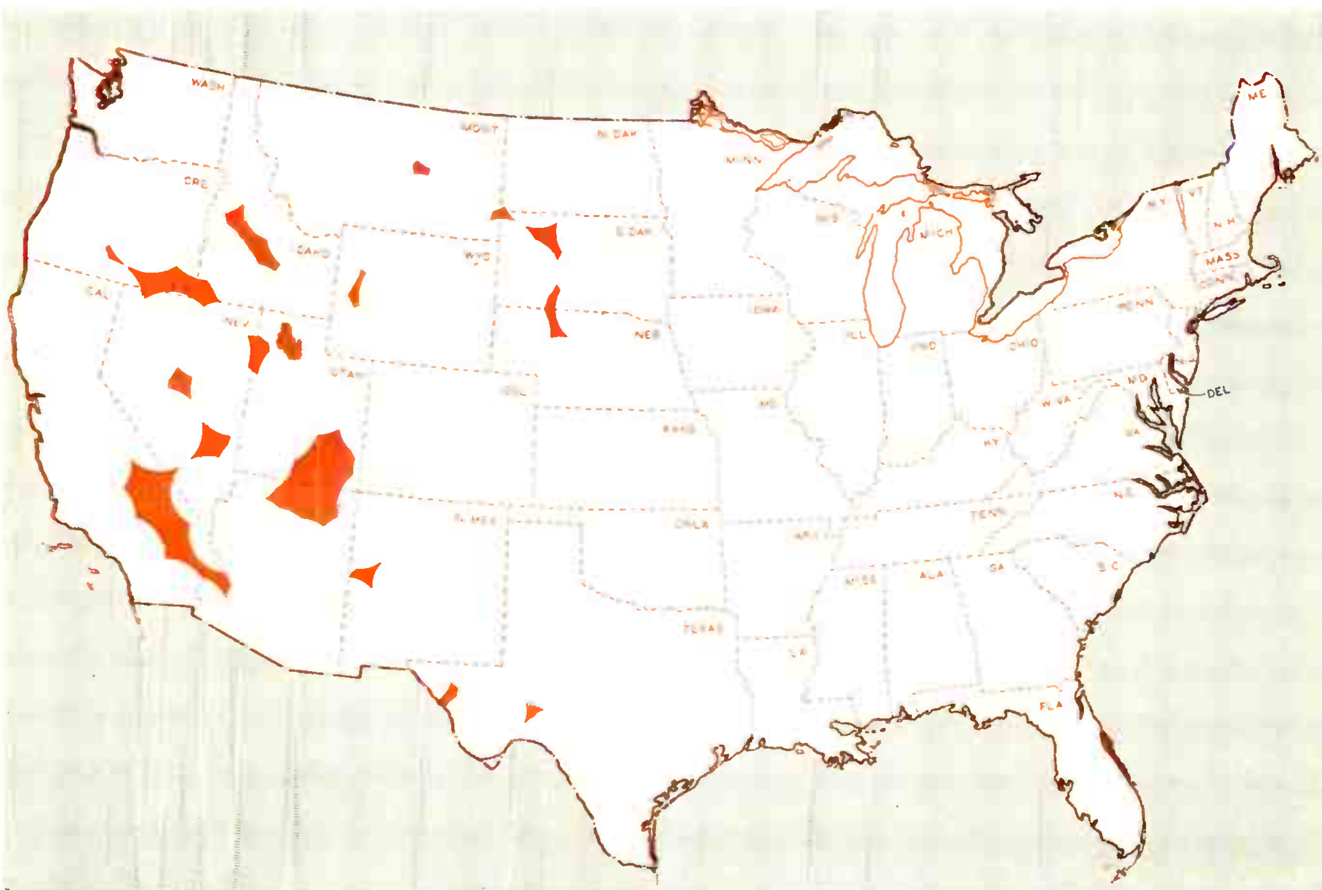
(Continued on page 32)

*Manager, Radio and Allocations Engineering, National Broadcasting Company, Inc.

POSSIBLE V. H. F. AND U. H. F. TV COVERAGE AS ESTIMATED LAST YEAR



EXTENT OF POSSIBLE TV COVERAGE ACCORDING TO PRESENT STANDARDS



Complex and difficult legal problems and lengthy procedures were involved.

The objective was to make television service available to the greatest number of people in the shortest possible time. Obviously it could not be done by processing applications in the order in which they were received, because uncontested applications from unserved areas would have had to await the completion of time-consuming hearings involving competitive applications (in many instances from large cities already well served). For many weeks prior to the April thaw, the Commission roughed out tentative processing procedures and priorities, with co-operation from the FCC Bar Association and the Society of Federal Communications Consulting Engineers. When the 3½-year freeze ended on April 14, 1952, the plan was ready.

Applicants were given until July 1 to submit new applications and amend old ones before any grants would be made. A number of procedural simplifications were adopted to save time and speed up the processing, and the following temporary priority system was established:

Priority A 1

The 30 existing stations which, under the new allocations plan, will be required to change their channel frequencies to reduce interference. These stations were listed in "TV Pattern for the Future" in the May issue of RADIO-ELECTRONICS. WKY-TV, Oklahoma City, is omitted in the new list.

Priority A 2

New stations in cities 40 miles or more from any existing TV transmitter. In other words the Commission will concentrate on providing service to unserved areas. (Portland, Ore., and Denver, Colo., are examples.)

Priority B 1

Stations for communities where only u.h.f. channels are allocated and where the separation may be less than 40 miles from an existing transmitter (excluding educational stations).

Priority B 2

U.h.f. stations for communities where all possible v.h.f. channels are in operation.

Priority B 3

Stations for cities having no service and which may be less than 40 miles from not more than one existing station.

Priority B 4

Stations for cities having only one existing station and which are 40 miles from any other TV transmitter.

Priority B 5

Stations for cities less than 40 miles from any two or more existing transmitters.

With 491 new applications on file on July 1, 1952, the Commission commenced the processing of the "post-freeze" applications for new television broadcast stations. Scores of competitive applications were designated for hearing and nearly 200 additional applicants were advised that their applications were competitive with others. In September the Commission announced, that, because of the limited number of examiners and other staff members engaged in hearing work, it would not have been possible to try such cases until the existing backlog was removed, and no useful purpose would have been served by designating additional applications for hearing them.

For this reason the interest of parties who had filed or who would file competitive applications would not have been adversely affected by the processing of only noncompetitive applications, for a time. It is likely that the hearings in the cases now designated for hearing and those additional competitive applications already processed by the Commission will not be concluded for a considerable period.

The Commission will continue to process noncompetitive applications in the order of priorities set forth. If mutually exclusive applications are amended so as to remove the conflict, the Commission will consider such applications at that time. The Commission will re-examine its backlog of hearing cases from time to time. When it appears that Commission personnel will be available for handling additional cases, the Commission will resume the processing of competitive applications. With the elimination, for the time, of competitive applications in favor of noncompetitive ones, many cities will receive grants much more quickly.

Small communities

Can small communities have TV stations? 835 cities, about 60 percent of the total list of 1,430 in the FCC assignment plan, have populations of 25,000 or less. Already, over 60 applications for stations in these communities are on file. The existing list of such grants will grow quickly.

The interests of the small communities have been well protected by channel assignments. Nearly 500 communities of less than 10,000 population are allocated one or more channels. Over 300 communities of less than 25,000 but more than 10,000 population are provided for.

Grades of service

U.h.f. is new to practically all service technicians. Terrain irregularities create greater losses and much more severe shadow areas in the ultra-high-frequency band than in the very-high-frequency channels. These effects do not occur abruptly. There is a gradual change as the frequency increases, starting with the lower frequencies of channel 2 and continuing on up to the top of the u.h.f. band. The FCC has attempted to take account of this change by authorizing higher power at the higher frequencies. Channels 2 through 6 will be limited to 100 kw effective radiated power, 7 through 13 to 316 kw, and all u.h.f. to 1,000 kw. These power differentials are intended to equalize the service radii of the various stations, and take into account the increased signal intensities needed at the higher frequencies to provide equivalent picture quality and freedom from noise and interference.

In standard broadcasting at 540 to 1600 kc, the primary service range of a station may be expressed with relative simplicity because the field intensity falls off at a fairly uniform rate, with large fill-in behind hills and obstacles. But with increasing frequency, fill-in diminishes and local scattering effects increase. These random effects are far more noticeable at v.h.f. and are severe at u.h.f. Therefore the local field intensities vary widely, depending on terrain conditions. For this reason the service ranges for television stations are expressed in statistical terms to more nearly reflect actual conditions.

Two grades of television service are recognized in the new rules and standards:

Grade A service

Grade A service is so specified that a quality acceptable to half the people (the median observer) is expected to be available for at least 90% of the time at the best 70% of receiver locations at the outer limit of this service. Expressed in terms of microvolts per meter Grade A service requires:

Channels 2–6	Channels 7–13
2,500	3,850

Channels 14–83 (u.h.f.)
5,000

Grade B service

Grade B service differs from Grade A in that the acceptable quality would be obtainable at only 50% of the locations instead of 70%. The field intensities in microvolts per meter are shown below for Grade B:

Channels 2–6	Channels 7–13
224	630

Channels 14-83 (u.h.f.)
1,585

Service ranges

When these grades of service are expressed in miles distance it becomes possible for the service technician to evaluate roughly the service he may expect in his area. Judging by the many and continuing requests received by this author from service organizations, dealers, and others for information on TV service ranges, this information may be of value. The tables at the right represent average values based upon FCC's methods of interpretation. The actual radii may vary widely downward, particularly in the u.h.f. channels, if terrain conditions are poor.

Transmitting Antenna Height in Feet		Grade A Service Radii (in miles) for Powers Shown (Effective Radiated Power)					Grade B Service Radii (in miles) for Powers Shown (Effective Radiated Power)				
		1 kw	10 kw	100 kw	316 kw	1,000 kw	1 kw	10 kw	100 kw	316 kw	1,000 kw
300	Ch 2-6	7	12	21			22	35	50		
	Ch 7-13	7	12	21	28		17	28	40	45	
	Ch 14-83	5	9	15	20	26	9	15	26	31	40
500	Ch 2-6	9	16	27			28	43	57		
	Ch 7-13	9	16	28	35		22	35	46	52	
	Ch 14-83	6.5	11.5	20	25	23	11.5	20	32	40	47
700	Ch 2-6	11	19	31				47	63		
	Ch 7-13	11	20	34	40			40	50	57	
	Ch 14-83	8	13.5	23	30	37		23	37	45	52
1,000	Ch 2-6	13	23	37			39	54	70		
	Ch 7-13	13.5	25	40			33	46	57	63	
	Ch 14-83	9	16.5	28	35	43	16.5	28	43	50	59
2,000	Ch 2-6	19	34	50			52	69	86		
	Ch 7-13	21	40	54	61		47	61	74	80	
	Ch 14-83	13	24	41	49	57	24	41	57	65	74

Antenna installations

Locating the u.h.f. receiving antenna will require more care than for v.h.f. in the marginal areas. In v.h.f. an increase in antenna height will normally produce higher field intensity and improve the margin of signal over noise levels. But, while the same relationship applies *on the average* over a large number of u.h.f. installations, the voltage picked up may vary widely and at random in individual cases. An increase in height may actually reduce the signal level. And large variations may occur with horizontal movement.

During the Bridgeport investigations, careful studies were made at 91 typical residential locations to determine the average variation of signal intensity as the antenna was moved horizontally at a 30-foot height. The movement was over a range of only about 5 feet in most cases, to cover several wavelengths. The maximum and minimum values of intensity were recorded and analyzed. At 20% of the locations the displacement over these few feet produced variations of more than 2 to 1. At 10% of the locations it produced variations of 3 to 1. At 5% of the locations it produced variations of 4 to 1. And in one location it was 7 to 1!

The optimum antenna locations for u.h.f. are relatively unpredictable and the service technician who is thorough and conscientious may find it necessary to explore for them while communicating with an observer at the receiver.

Flat or tubular plastic transmission line has very low losses when properly routed and dry. But it should be isolated from nearby metallic objects such as pipes, which change its characteristics markedly at u.h.f. It should be sheltered from rain and sleet if losses are of importance.

Frequency shifts

The frequency shifts which are scheduled for 30 stations previously referred to have in many cases been covered by applications and grants. The Commission proposes to permit the stations to work out the time schedules for the shifts at their own convenience, if possible. The schedules will be determined by procurement problems and most will take place early in 1953. Several were made in 1952.

New station grants

At the time of writing the number of applications for station construction permits on file was rapidly approaching 1,000. Of these, about 60% are for v.h.f. and the other 40% for u.h.f. grants. The total number of grants made since the Commission started processing is well over 100, of which about 80% are for u.h.f. stations.

Prior to revising its processing routine, the Commission granted an average of 1 construction permit per week for v.h.f. stations, and 5 per week for u.h.f. stations. If this rate were continued through 1952, the year-end total of new station grants would be 25 v.h.f. and 125 u.h.f. grants, or a total of 150. This author expects this total to be met and possibly exceeded because of the revised processing schedule. The accelerated processing may result in a large increase in the number of v.h.f. grants, if there are included power increases for existing v.h.f. stations in the lower priority categories.

New stations

Using temporary equipment, station owners in Denver and Portland have created brilliant examples of what can be done to establish service quickly. But transmitting equipment is not available to permit wide-scale duplication of these feats. On the basis of plans which many grantees have disclosed, we may expect to see about 12 more stations before the end of 1952, most of them in new television areas. Based upon similar information, 35 may be added in the first half of 1953, many of these also in new TV cities. From that point on, plans now being made will come to fruition with more rapid increases in the rate of new starts. Barring critical material complications it is estimated that 150 new stations may be added in 1953, frequency changes will be completed at the 30 stations slated to switch channels, and power will be increased by most of the existing 109 v.h.f. stations, if permitted.

Your writer believes that by the end of 1954 there may be 400 new stations; by the end of 1955 over 600, perhaps half in presently unserved cities; by 1956 750; and by 1957 possibly 1,000 or more.

Possible national service

In "TV Pattern for the Future" in the May issue a map was published showing the extent of possible national TV service from the combined u.h.f. and v.h.f. stations, with powers and standards *originally* proposed by the FCC. But those actually adopted went further than had been contemplated. The accompanying map shows the extent of the total possible service areas of all TV stations listed in the FCC allocation plan, utilizing the maximum powers now permitted and judging by the Commission's criteria for gauging the service areas. If these criteria are sound, the entire United States, excepting only the areas shown in color, could be given TV service.

Because of economic problems such a degree of service cannot be realized for a long time. The very small communities cannot support a television station, and particularly a station of maximum power. But when and if the time comes that a service can be supported, the spectrum space and the channels will be available. TV will not be handicapped by the saturation and lack of channels which have through the years prevented so many small communities from having standard broadcasting primary service.

There has been much discussion and speculation concerning the minimum size of a community necessary to support its own TV station. Estimates of 25,000 to 100,000 population frequently have been mentioned. There is evidence that it can be accomplished successfully at 25,000. It is this writer's opinion that the demand for TV is so great that people would pay almost any amount within reason to have it, and that the figure of 25,000 will shrink considerably as the ingenuity and resourcefulness of our industry is applied to the solution of this problem, which is altogether one of economics.

Installation and servicing

Denver and Portland were unprepared for the demand for receivers and technical service. Both receivers and service technicians were rushed in—the technicians to help with the overflow with which the local service companies were swamped. In all probability it will happen again elsewhere because the avalanche of demand in new TV cities comes almost overnight. Interest in and desire for TV have been whipped to a sharp edge and an overwhelming ready-made demand exists in all unserved communities.

TV receivers are relatively complicated instruments. Few owners attempt to build or maintain them, fortunately. But they are an essential, indispensable part of the TV system which starts in the camera tube and terminates in the home kinescope. You, Mr. Service Technician, have the responsibility for your part of the system! Its proper discharge will keep you on your toes and pay you well when "T day" comes to your community. END

TV DISTRIBUTION SYSTEMS

"Master antenna systems" are increasing in both importance and use

By ERIC LESLIE

The Electro-Voice 3100 has outputs for four receivers and a second unit.

FROM the earliest days of television, owners, dealers, and service technicians have needed some way of connecting two or more sets to an antenna. Two-set and larger *distribution systems* were soon worked out. These were originally rather crude and wasteful of the precious signal, but have so developed that today almost any number of receivers can be operated as part of a distribution system, and a signal of any desirable level can be applied to their inputs.

Earliest and simplest of all distribution systems is a simple resistor network. It matches the input impedance of the receiver to the line and isolates one receiver from another by the attenuation of the resistors. Fig. 1 is a diagram of a typical system. If signals are strong enough, more than two receivers may be connected by choosing the resistors so that the parallel resistance of all the branches is 300 ohms. Thus for three receivers, the resistors on each side of the receiver inputs would be 300 ohms each, giving us three 900-ohm branches which have a parallel resistance of 300 ohms.

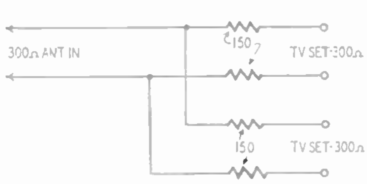


Fig. 1—Simplest distribution system.

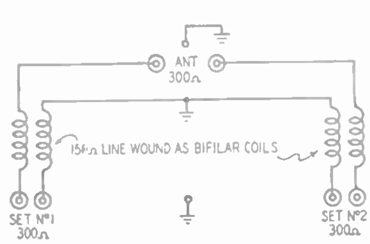


Fig. 2—An efficient two-set coupler.

Such systems work reasonably well in strong-signal areas, where some signal attenuation may be a good thing rather than the contrary. But energy is wasted. Even in a two-receiver setup half the signal is dissipated in resistors, and the proportion is increased with the number of receivers. A less wasteful method is needed even for moderate-signal areas.

A number of systems using methods similar to r.f.-transformer or impedance coupling were next to appear. Of these, possibly the Brach two-set *Mul-Tel* coupler is the best known. The antenna is divided into two artificial lines, as shown in Fig. 2. The correct impedances are approximated by bifilar windings, which also act as a high-pass filter, shorting out interference below about 50 mc.

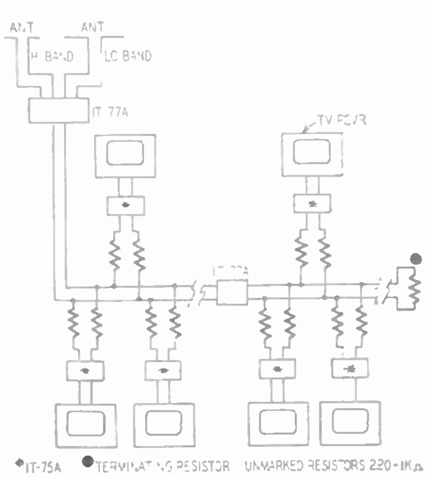


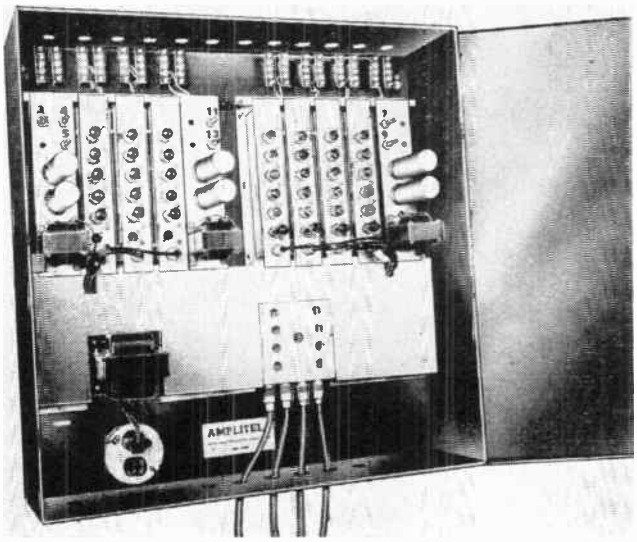
Fig. 3—A system made up of boosters.

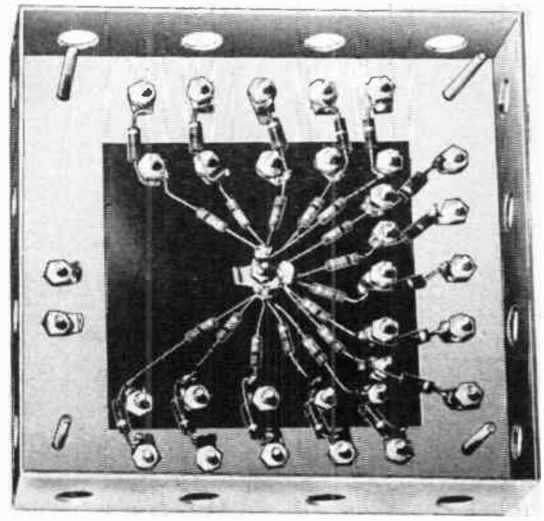
Interaction between receivers is reduced by impedance mismatch. The antenna looks into a matched 300-ohm impedance, but each receiver looks into a circuit of considerably higher impedance, formed by the line and the other receiver in series. So, while energy is transferred efficiently from the line to the receivers, any signal fed back from the receivers is greatly attenuated.

The *Mul-Tel* couplers may have two or four outputs, and where there is enough signal, a four-output unit may be fed to four other couplers rather than direct to receivers, making a 16-set distribution system.

A distribution system which will work where there is not enough signal for the types just described is often needed. A system that would pep the signal up a little to make up for the losses along transmission lines, rather than attenuate it, would be valuable in many installations. Ordinary TV boosters were first used to make up such a system. The simplest form appears in Fig. 3. Units marked IT-75A are home type boosters, the IT-77A's are commercial types. The isolating resistors prevent one TV set from radiating to another, and also cut down possibility of oscillation in the boosters themselves.

More than one television manufacturer modified his home type boosters for 24-hour operation, operating the tubes and parts at conservative ratings. Thus the IT (Industrial Television, Inc.) 77A's are commercial types, and 75A's home versions of the





Left—The *Amplitel* uses channel strips with several tubes each. Right—The junction boxes show ingenious design.

same booster, and some Blonder-Tongue boosters carry the same model number with the prefix CA for commercial and HA for home types. The next and obvious step was to put two outputs on a single booster.

The earliest two-output boosters were designed by coupling the coil in the r.f. amplifier's plate circuit to two output coils instead of one. More refined systems were developed to isolate the outputs from each other, and multiple-output *distribution amplifiers* were born. These may have two, four, or eight outlets in practical equipment. Amplification may be slight; in some cases there may be a slight loss through each unit. A typical system is that of Electro-Voice, using the model 3100 unit (See photo). This unit has four outputs for receivers and another line output to which a second distribution unit may be attached.

Where stations are weak, a booster may be added at the antenna, and where the signal is weakened in long runs of transmission line, an ordinary one-output *line* booster can bring it up to original (or greater) strength.

Another approach to the master antenna problem suggested itself—or rather was remembered, for it is an elaboration of the amplified master radio antenna system introduced by RCA in the 1920's. In this system there is a large central amplifier, with other amplifiers for receivers or groups of receivers if necessary. In its television form, the central amplifier is actually a number of single-channel amplifiers whose outputs are connected through a mixer and fed through coaxial lines to the various receivers.

The largest units of this type—made by RCA, Jerrold, G-E, and others—will be discussed in a separate article, on community antennas. A typical intermediate type is the *Amplitel*, made by Transvision for the company of that name. As shown, it consists of a number of channel units, or "strips." Each of these is a multitube amplifier, with the stages staggered to give full 6-mc bandwidth. Separate antennas are used for each strip. Since each antenna receives from a single station, high-gain Yagis are generally used, and a strong signal can be put into the amplifier. In the *Amplitel* system, the low-channel strip amplifiers have five tubes and have a voltage gain of about 7,000. The higher v.h.f. channel amplifiers have six tubes, but the gain is not as great—about 4,000.

The signals from the various strips are mixed in an ingenious way. Each amplifier is connected to the mixer by a section of 72-ohm line a quarter-wavelength long at its channel frequency. A quarter-wave line acts as an impedance transformer. In this case its 72-ohm impedance ($Z_m = \sqrt{Z_{in} \times Z_{out}}$) transforms the approximately 350-ohm output of the strip amplifier down to 15 ohms, the impedance of the mixing box, where Z_m is the impedance of the matching section, Z_{out} is the output impedance of the strip, and Z_{in} is the mixer input impedance. Although the ends of the matching sections are simply paralleled, the impedance remains at 15 ohms. Each line is a matching transformer *at its own frequency*, but presents a much higher impedance at any other frequency. Thus there is very little interaction between the various sections.

Output of the matching section is a group of five 75-ohm cables, paralleled to have a total impedance of 15 ohms. Each of these goes to a distribution box which feeds 15 receivers. As can be seen from the photo, each of the branches consists of two resistors, 1,000 ohms in series with the hot antenna lead, and 100 ohms between that and ground. The 100-ohm input is effectively shunted by the 1,000-ohm resistor and cable capacitances, giving an impedance of about 70 ohms, which can be transformed up to 300 ohms with a matching transformer whenever necessary.

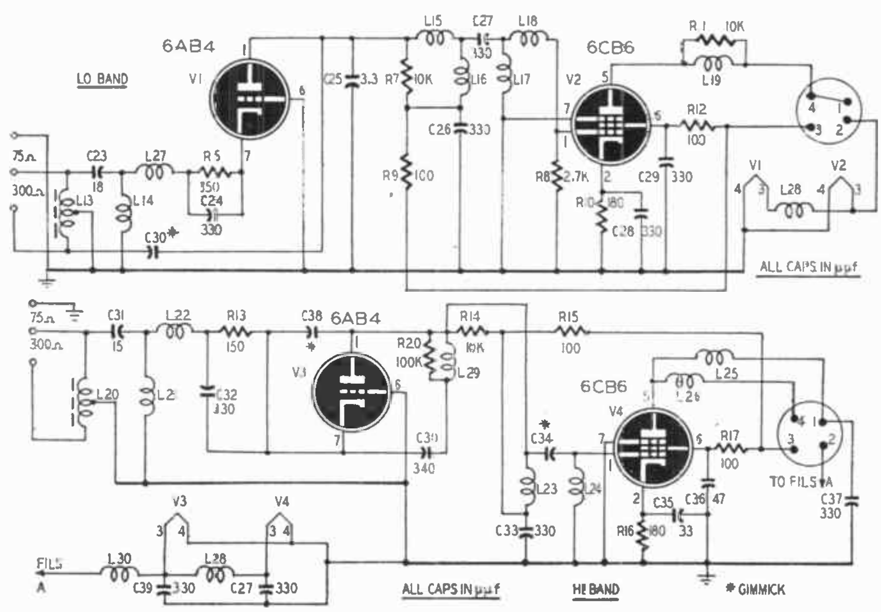


Fig. 4—High- and low-band strips of the Blonder-Tongue MA4-1. Constants vary slightly with frequency; these two are typical for channels 7-8 and 4.

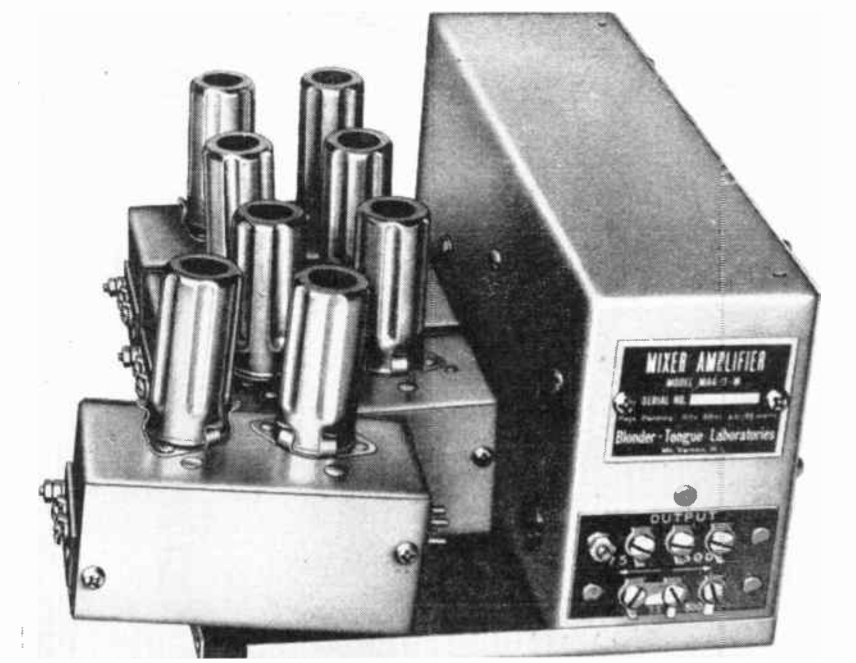
A link between the simple distribution systems (which are in effect wide-band boosters with some means of splitting the output and reducing interaction between sets), and the larger community type systems is the Blonder-Tongue mixer-amplifier system. The MA4-1 unit, which is the heart of this system accommodates four plug-in strips plus one wide-band input which can be used for strong signals (any signals that can tolerate 10 db attenuation). The output is distributed through 2- or 8-receiver (DA2-1 or DA8-1) distribution amplifiers, which add a little gain of their own. If long runs have to be made, a commercial type booster (CA-1) can step the signal up 28 db over the whole spectrum.

A system of this type permits using sensitive Yagis for the weaker signals, while putting stronger ones through the system without amplification, thus economizing on amplifier strips in areas where there is one strong station and others are desired, or where there is a local FM station, but TV stations are remote. Each of the strips has a gain of between 16 and 18 db. Two tubes are used, a 6AB4 and a 6CB6. Circuit is slightly different for high and low bands, as indicated in Fig. 4. Two of the units can be used in tandem, for more than four channels.

Lowest-priced of all the multiple-antenna systems, the MA4-1 is economically practical even for single TV receivers in bad areas, and can be used by stores, small apartments, groups of neighbors in fringe-area districts, and others who would find the simpler systems unsatisfactory and the large community systems expensive.

Some antenna systems resemble in their equipment the larger community types, though they may be intended chiefly for apartment-house application. A typical example is *Tacoplex*, which (though not normally sold as a community antenna system) includes a number of features not found in the simpler distribution systems. Fig. 5 shows a simplified diagram of a system using Taco units. Basic unit is a chassis-power supply, on which a number of strips and a mixer unit can be mounted. The mixer may or may not be electronic, depending on the signal level desired and the number of trunk lines to be fed.

Brach two-set coupler shown in Fig. 2.



Blonder-Tongue MA4-1 mixer-amplifier, described as usable "for 1 set or 2,000."

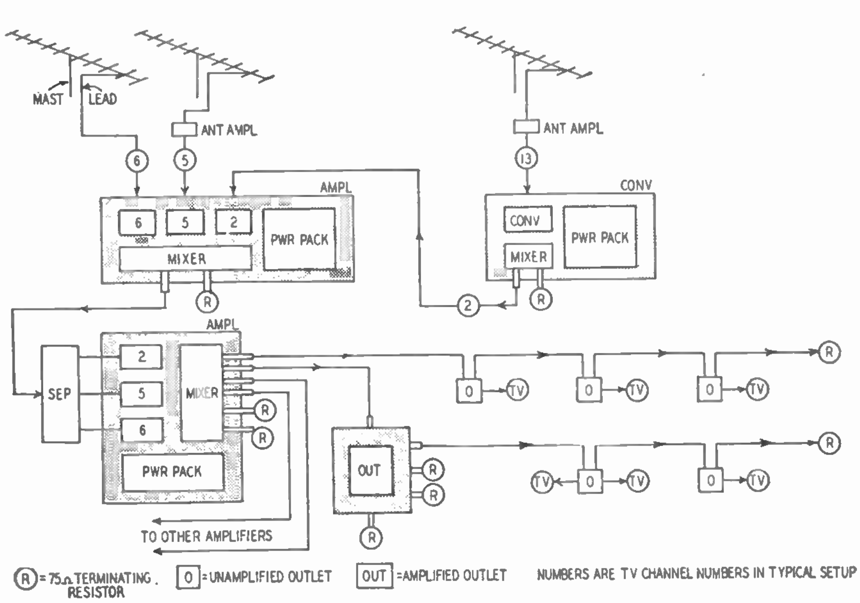


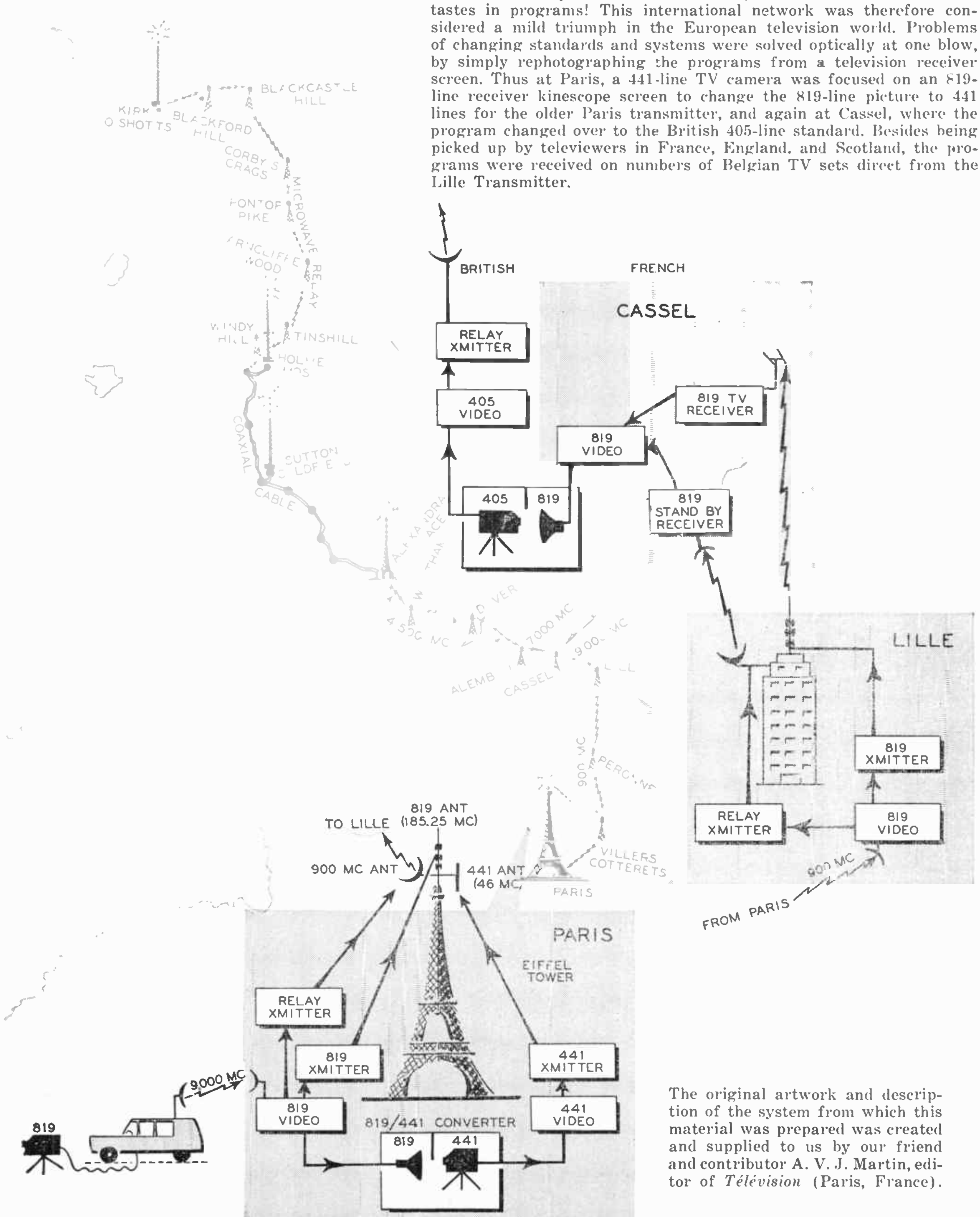
Fig. 5—Simplified drawing showing Taco components in a versatile system.

An installation may have a number of other refinements. For example, a weak signal from a high-band v.h.f. station (channel 13 in the diagram) may be received on an antenna cut to its frequency, boosted by an antenna-top amplifier, then fed to a converter which changes its frequency to that of an unused low-band channel (channel 2). This reduces attenuation in long runs of coaxial cable.

Where there are long runs of cable between the original mixer and the receivers, the cable may be terminated in a *signal separator,* a unit with one input for the composite signal, and separate outputs for each frequency being handled by the system. These single-channel signals are again amplified through strip amplifiers, mixed, and sent on to the various outlet boxes, which may also be either electronic or nonelectronic. END

EUROPEAN TV NETWORK

Microwave-relay or coaxial-cable runs thousands of miles long are impossible in Europe. In a scant 750 miles, the engineer has to contend with problems of national boundaries and differences in definition standards and systems of transmission, and even different national tastes in programs! This international network was therefore considered a mild triumph in the European television world. Problems of changing standards and systems were solved optically at one blow, by simply rephotographing the programs from a television receiver screen. Thus at Paris, a 441-line TV camera was focused on an 819-line receiver kinescope screen to change the 819-line picture to 441 lines for the older Paris transmitter, and again at Cassel, where the program changed over to the British 405-line standard. Besides being picked up by televiewers in France, England, and Scotland, the programs were received on numbers of Belgian TV sets direct from the Lille Transmitter.



The original artwork and description of the system from which this material was prepared was created and supplied to us by our friend and contributor A. V. J. Martin, editor of *Télévision* (Paris, France).

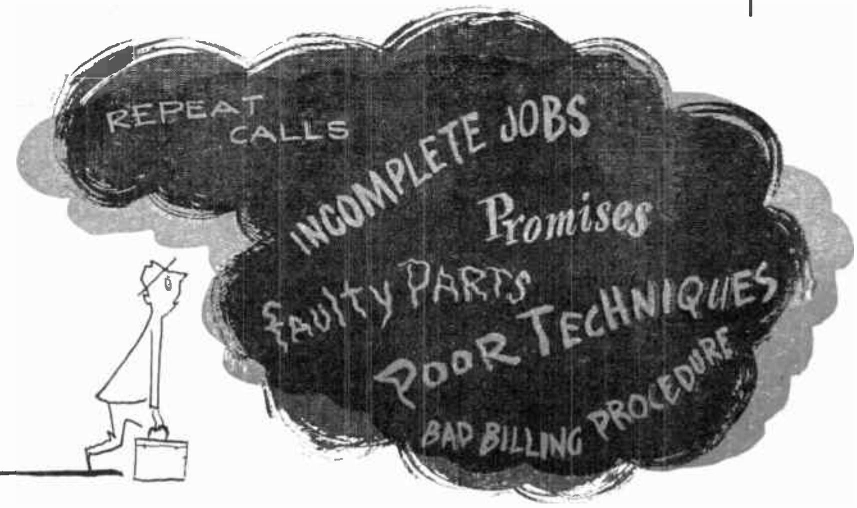
THE NEW UHF CHANNELS

Their channel limits, frequency of sound and picture carriers, and the equivalent wavelengths in inches.

(This material is abstracted from a table printed in "Application Data and Filing Information for Television Stations," a publication compiled by the Broadcast Engineering Section, Engineering Products Division, Radio Corporation of America, by whose courtesy it is here reproduced.)

Channel	Mc	Pix Carrier	Wave-lengths in inches	Sound Carrier	Wave-length in inches	Channel	Mc	Pix Carrier	Wave-lengths in inches	Sound Carrier	Wave-length in inches
14	470-476	471.25	25.0455	475.75	24.8087	49	680-686	681.25	17.3251	685.75	17.2114
15	476-482	477.25	24.7307	481.75	24.4997	50	686-692	687.25	17.1738	691.75	17.0621
16	482-488	483.25	24.4236	487.75	24.1983	51	692-698	693.25	17.0252	697.75	16.9154
17	488-494	489.25	24.1241	493.75	23.9043	52	698-704	699.25	16.8791	703.75	16.7712
18	494-500	495.25	23.8318	499.75	23.6173	53	704-710	705.25	16.7355	709.75	16.6294
19	500-506	501.25	23.5466	505.75	23.3371	54	710-716	711.25	16.5943	715.75	16.4900
20	506-512	507.25	23.2681	511.75	23.0635	55	716-722	717.25	16.4555	721.75	16.3529
21	512-518	513.25	22.996	517.75	22.7962	56	722-728	723.25	16.3190	727.75	16.2181
22	518-524	519.25	22.7303	523.75	22.5350	57	728-734	729.25	16.1847	733.75	16.0855
23	524-530	525.25	22.4707	529.75	22.2798	58	734-740	735.25	16.0527	739.75	15.9550
24	530-536	531.25	22.2169	535.75	22.0303	59	740-746	741.25	15.9227	745.75	15.8266
25	536-542	537.25	21.9688	541.75	21.7863	60	746-752	747.25	15.7949	751.75	15.7003
26	542-548	543.25	21.7261	547.75	21.5476	61	752-758	753.25	15.6691	757.75	15.5760
27	548-554	549.25	21.4888	553.75	21.3142	62	758-764	759.25	15.5452	763.75	15.4536
28	554-560	555.25	21.2566	559.75	21.0857	63	764-770	765.25	15.4233	769.75	15.3332
29	560-566	561.25	21.0293	565.75	20.8621	64	770-776	771.25	15.3034	775.75	15.2146
30	566-572	567.25	20.8069	571.75	20.6432	65	776-782	777.25	15.1852	781.75	15.0978
31	572-578	573.25	20.5891	577.75	20.4288	66	782-788	783.25	15.0689	787.75	14.9829
32	578-584	579.25	20.3759	583.75	20.2188	67	788-794	789.25	14.9543	793.75	14.8696
33	584-590	585.25	20.1670	589.75	20.0131	68	794-800	795.25	14.8415	799.75	14.7580
34	590-596	591.25	19.9623	595.75	19.8115	69	800-806	801.25	14.7303	805.75	14.6481
35	596-602	697.25	19.7617	601.75	19.6140	70	806-812	807.25	14.6209	811.75	14.5399
36	602-608	603.25	19.5652	607.75	19.4204	71	812-818	813.25	14.5130	817.75	14.4332
37	608-614	609.25	19.3725	613.75	19.2305	72	818-824	819.25	14.4067	823.75	14.3280
38	614-620	615.25	19.1836	619.75	19.0443	73	824-830	825.25	14.3020	829.75	14.2244
39	620-626	621.25	18.9983	625.75	18.8617	74	830-836	831.25	14.1988	835.75	14.1223
40	626-632	627.25	18.8166	631.75	18.6826	75	836-842	837.25	14.0970	841.75	14.0217
41	632-638	633.25	18.6383	637.75	18.5068	76	842-848	843.25	13.9967	847.75	13.9224
42	638-644	639.25	18.4634	643.75	18.3343	77	848-854	849.25	12.8978	853.75	13.8246
43	644-650	645.25	18.2917	649.75	18.1650	78	854-860	855.25	13.8003	859.75	13.7281
44	650-656	651.25	18.1232	655.75	17.9988	79	860-866	861.25	13.7042	865.75	13.6329
45	656-662	657.25	17.9577	661.75	17.8350	80	866-872	867.25	13.6094	871.75	13.5391
46	662-668	663.25	17.7953	667.75	17.6754	81	872-878	873.25	13.5159	877.75	13.4466
47	668-674	669.25	17.6357	673.75	17.5180	82	878-884	879.25	13.4236	883.75	13.3553
48	674-680	675.25	17.4790	679.75	17.3633	83	884-890	885.25	13.3326	889.75	13.2652

NEW TV AREAS what do they mean to the repair technician?



By JOHN F. RIDER*

MANY sections of the United States will receive television for the first time in the near future. Will the servicing personnel in these new areas make the same mistakes as those who have worked in TV areas for several years—or will they learn from the experiences of others? That's the big question.

The public has not been too happy with the TV technician. It is debatable where the fault lies. Experience has shown that certain acts of commission and omission by the TV service technician have irritated the public, and these operations have certainly been to the technicians' disadvantage. We are going to give a capsule review of a few of these malpractices in the hope that it will benefit service technicians in new TV areas, and those yet to be developed.

The solemn promise

Failure to inspect a defective television receiver, or to return a repaired television receiver on the date promised, has irked the public very much. It has been, and still is a deplorably common practice. It can be explained in many ways, but no amount of apology satisfies a disappointed customer. The housewife who waits all day for the service technician who never shows up, is not interested in explanations. Especially if she had something important to do, and changed her plans to keep the appointment.

It may be unfair to place the entire burden on the servicing industry. Where extenuating circumstances prevent keeping a promised date the courtesy of a phone call requesting a change of appointment is imperative. Regardless of how busy you are, or how difficult it may have been to procure a certain replacement part—both common excuses for broken promises—the customer is always right. It's an axiom of good public relations, and there is no way around it. The TV service technician or small shop is hurt badly if labeled unreliable. It reflects on his competence, too.

In the TV servicing business word-of-mouth advertising by the public can do much good or harm. The smaller the community, the more important this is. Even in large metropolitan centers, experience has shown that good publicity over the canasta or bridge table can help a small service shop grow, or drive it out of business and make the large service facility even larger.

The small service-shop owner cannot wage an advertising or sales-promotion war with the large facility. He does not have the necessary funds; therefore, he must do everything that will make his customers speak in his favor. One of these is to keep the promise to call or to deliver. Since the service facility rather than the customer sets the time and day, it is a solemn responsibility on the part of the facility to see that it is kept. We know one TV set owner who was so angry because of a broken promise that he asked all of his friends in the neighborhood not to patronize the local service shop, in order to teach him a lesson.

The repeat call

The repeat call is treated as a nuisance by many service organizations. It is handled as if the service shop were doing the set owner a favor. It's considered a profitless call, but whose fault was it in the first place? On second thought is it really profitless? Not only does it create good customer relations, but every service facility takes into account a certain number of repeat calls when it figures the costs on which it bases its service charges. (If it doesn't do this, it should.)

Making customers wait for you to correct an unsatisfactory repair is a sure way to make them angry. People let off steam by talking; panning the daylights out of a TV service facility always finds ready listeners and sympathetic ears.

Some service outfits wilfully ignore repeat calls. They know that it means the loss of a customer, but they feel that there are others. They forget that a dissatisfied customer—particularly one whose complaint is justified—can do more harm to an outfit's reputation than the praise of a dozen satisfied customers can possibly overcome.

We're not going to be so foolish as to say that there should be no repeat calls to begin with. Sometimes they can't be helped, but we do say they can be reduced substantially. Every well-conducted and well-managed service facility considers repeat calls a reflection on the technician who did the work. In some organizations he is not paid for making the repeat call. If too many occur, he's out of a job.

The fact that repeat calls are not asked for is no sign that every repair job was done properly. As self-protection, TV service shops should determine the customer's reaction to the repair a week or more after the receiver is restored to service.

Giving the public the benefit of the fact that they do not understand the workings of a television receiver, rather than condemning them for it, will reduce the widespread demands for legislation and licensing. The customer will respect a firm stand when a charge is warranted and the case is properly presented—that is, without arrogance or insolence. But it is equally important to admit it when the shop is at fault—not necessarily by merely saying so, but by doing whatever is required to produce a properly functioning receiver. Servicing is a technical business, but it is not without its selling aspects. Politeness and understanding are essential.

Using service data properly

Repeat calls are costly on several counts. Not only in the time involved, but also because they imply technical incompetence. This has been the loudest cry on the lips of the TV-receiver-owning public. It has to be anticipated in each new area, because fully trained and experienced personnel cannot be made available concurrent with the initial sale of TV receivers. But this is the industry's problem and not the public's. If receivers are sold, service should be available. If the servicing industry does not want competition from factory-service organizations, it must be ready for action when a new area opens up.

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The set-buying public has the right to expect that the individuals who offer their services and facilities as TV service technicians have some sort of technical background. As a rule, these men are experienced radio service technicians. The main fault lies in the fact that many of them, in areas where TV is anticipated, wait until demand for TV service arrives before they make any move to acquire the necessary background. This has been the pattern time and again, and each time it has harmed not only the men themselves but the industry of which they are a part.

With radio servicing as a background, a knowledge of TV can be developed by reading—that is, if it is impossible to attend a school. Admittedly, a reading knowledge alone is of limited usefulness when work must be done—at least in the beginning—but it is better than no background at all. As time passes, more and more experience is gathered and the end-product improves. In the meantime a definite mental attitude for self-improvement must prevail. This has been lacking in many instances. Its consequences have been costly.

Every individual knows the extent of his capabilities. The more limited his experience, the more imperative it is for the TV service technician to use every device which will help compensate for this shortcoming. The most valuable of these are the service notes. There are many important reasons why TV-set-manufacturers' service manuals must be read and used. Not only for the schematics and circuit voltages, but for the circuit descriptions, installation and disassembly notes, manufacturers' production changes, and the trouble-shooting charts. Cures for troubles which may have appeared in a particular receiver, and which the set manufacturer has incorporated in subsequent production runs of that model, are also contained in these notes.

The less experienced the individual, the more vital this information is. It is paradoxical, but the more-experienced TV service technician makes greater use of the set-manufacturer's service manuals than the inexperienced man. The reverse should be true. Trial-and-error methods of servicing are costly to the beginner and to the public. The inexperienced technician spends hours doing what might be done in a fraction of the time.

How much repair time can a technician afford to spend on a TV receiver, and how much repair time can he charge for? How high can the labor charge be without arousing the ire of the public? How can the public be pacified when the so-called repaired receiver is not functioning properly? . . . The answers to these questions lie in the full and proper use of the set-manufacturer's service manuals, in taking full advantage of the guidance which they offer, and in following the instructions which they contain. In addition, the proper use of service information increases your technical background. It compensates for limited experience or lack of school training.

The uncompleted repair job

When the public raises the cry of incompetence against the TV service technician, they group many things under one name. They hang the same label on the man who is careless as on the man who doesn't know. For example, tube failures are common faults in TV receivers. Simple tube replacements frequently correct a fault, but many times it is only a temporary repair. While time is of the essence in repair operations, the need for speed (and minimum cost) does not warrant a total disregard of other operations which may be necessary when a tube has to be replaced.

Tube failure may occur because of a defect in the circuit—the kind of a defect which eventually wears out the tube, but does not become evident immediately when a new tube is put into the socket. Perhaps thoughtlessness or carelessness on the part of the service technician accounts for his failure to make the necessary circuit tests. Or it may be that the service shop sets a time schedule for the field man which prohibits such tests. It is not uncommon for set manufacturers to recommend a circuit change in order to prevent frequent tube failures at one position in the receiver. The last item gets us back to the service manual again. Putting a new tube in this position will restore operation, but unless the circuit change also is made, the new tube will fail in a relatively short time.

Many tube replacements involve frequency-sensitive circuits. Not all brands of tubes may function equally well in a particular circuit nor does the first few minutes of operation of a new tube in a circuit indicate the performance an hour later.

In frequency-sensitive circuits, mere tube replacement may not always be the complete answer. The circuit may call for readjustment in order that the receiver perform *correctly*, not just "good enough." A complete readjustment may not be required, but the need for it should be checked. This increases the time spent on the job, and must be recognized in any field-service program which a service shop puts into effect. The lack of it accounts for some of the complaints that "After the service technician was here, the receiver did not function as well as before."

In any case operators in new TV areas should do everything they can to avoid such occurrences.

Replacement parts

Some service shops (not many, fortunately) have committed the unforgivable sin of using surplus parts as replacements in TV receiver repairs. This is too big a risk to take without knowing the history of the part, its age, or its electrical condition. The public and the set manufacturer have the right to expect better treatment. Using a part of this kind even occasionally, because it may not be convenient to get the exact replacement part, is no excuse. It just is not fit for this type of duty! It may work perfectly at first, but even this is no justification, because such a part cannot be guaranteed. If a service technician attaches any sort of a guarantee to a surplus part used for replacement purposes he should have his head examined.

We must stress one more point on the subject of replacement parts. This is the use of a compromise part as a replacement. By compromise we mean one that is not the exact equivalent of the part being replaced. This does not imply that every replacement part must be an exact duplicate. It is not always practical to procure exact duplicates and still satisfy the time requirements on repairs. But it should be standard practice to make certain that the replacement part you use fits the needs of the receiver to which it is applied; and that it does this without requiring major alterations on the chassis to accommodate the replacement part. The customer should not have to be charged for time spent in this manner.

Many replacement parts available on the open market from parts jobbers satisfy the physical and electrical performance requirements of the receiver. If they do not, get exact duplicates from the set manufacturers' distributor even if it means waiting for delivery. For its own protection, the servicing industry must pay closer attention to the replacement-parts situation. There is no such thing as "good enough" in this case. The public has every right to expect you to use the proper parts, and that they will perform perfectly.

Another point of deep concern to all service technicians and service shops—especially those just beginning their activities in new TV areas—is the charge for replacement parts. Although there is no apparent reason why the TV servicing business should be seasonal, it has its ups and downs. It has its seasons of great activity and slow periods.

Active periods must provide operating funds for the bad times. This cannot be done unless service charges are high enough to return a profit, and the parts used in repairs are sold to the set owner at list price, so that the full margin of profit is realized. This is an absolute must. Service facilities can juggle the labor costs if they wish, in accordance with the level of efficiency developed in the shop, but the full profit must be made on the parts.

Some TV service technicians base their selection of replacement parts on price alone. This is wrong. Price must be considered secondary to performance. The replacement part is paid for by the customer, and the technician should not lose sight of the difference in profit when the higher-priced item is sold. *You are not taking advantage of the public if price reflects quality.* Always bear in mind, whether buying or selling, that the best is the cheapest in the long run. If this approach requires greater selling pressure on the part of the service facility, then use it.

Improved techniques

Let's consider a few items that relate to servicing or trouble-shooting techniques. We say that these are native to old TV areas only because that is where TV now exists. The suggestion to improve techniques in TV areas yet to be opened fits the old areas too, because we think that many represent improvements that many old TV areas have yet to put into effect.

First there is the matter of capacitor testing. Leaky capacitors are a major item in TV receiver troubles. The standard procedure has been to check for low insulation resistance with an ohmmeter. This is *not* an adequate test. It can be misleading because the test conditions do not conform with the conditions of use.

The test voltage available in an ohmmeter is about 1 to 3 volts. In a few cases it may run as high as 30 volts. Even this highest voltage is not sufficient to show up capacitor leakage on an ohmmeter test, unless the insulation resistance has fallen to a very low level. The result is that many ohmmeter tests indicate a good capacitor, but when the part is reinstalled in the receiver its operation is faulty because its insulation resistance may have fallen below the value permitted by the circuit voltage.

The answer is to test for capacitor leakage by applying the same voltage as in the receiver, using a voltmeter and milliammeter as the indicators. With this test the findings are conclusive, and much time is saved.

Another prominent trouble-shooting weakness which has demonstrated itself in old TV areas is in placing too much dependence on d.c.-resistance values of certain components—especially coils and transformers. This is especially true when low values of resistance are involved. The problems associated with the measurement of very low ohmic values—crowded meter scales, contact resistance, and tolerance in the parts—have caused many substitutions which were never necessary.

D.c.-resistance ratings of windings are average values, and can vary by 10% or more in many instances and not indicate a fault. On the other hand, when the correct values are less than 1 ohm, a defect may not show up on a resistance test because an imperfect contact at a clip connection can add enough circuit resistance to offset the result of the fault.

An alternative, which will find increased application as suitable test equipment becomes available, is to measure an a.c. characteristic of the part. Many of the specifications for inductor type components are in a.c. values. In the meantime, determine the condition of the component by measurement under signal conditions with a scope and vacuum-tube voltmeter. Unfortunately, these pieces of equipment do not see as much use as they should. Properly used, they save much time because they lead to positive conclusions. This, in turn, saves much more time that would ordinarily be wasted in removing and substituting components unnecessarily.

Another item which should interest service technicians in new TV areas is the limited utility of tube checkers as guides to the condition of tubes used in TV receivers. This comment does not deny the general utility of a tube checker; it is still an important item, but no test equals the simple substitution.

Many tubes will show O.K. on a tube checker, yet will not perform well in a *multivibrator* stage of the television receiver. The same tube will more than likely work perfectly in some other socket.

Another interesting item is the measurement of grid waveforms and peak-to-peak voltages in stages which depend on the drive for the bias.

As far as test equipment is concerned, the greatest weakness has been the failure to use the scope for these measurements. Although a great many scopes have been sold to the servicing industry, they are not used as much as they should be. The scope has tremendous capabilities, and anyone who is active in television servicing, yet who is not familiar with scope applications, is not taking advantage of the greatest time-saving device available.

It must be admitted that the trace on the scope screen requires interpretation, but unlimited reference information is available for guidance in service manuals. A cardinal requirement for TV service technicians is to gather data from experience—that is, to associate changes in waveforms with certain types of defects. This is not too difficult. Even if it requires spending some time in supplementary study, it is more than worth while, because it leads to faster, more economical servicing.

The bill for service

The usual form of invoice for service submitted to the set owner by a TV service shop can be improved to make the life of the shop owner much easier. Making out a simple bill which lumps all the services into one sum and then shows the total price of the parts replaced as another sum, places the shop at a disadvantage. This is especially true where there is a substantial charge for labor and time, and a relatively small bill for parts.

The ratio between these two amounts is generally high—anywhere from 10 to perhaps 20 to 1 in favor of labor and time. The public just does not understand that the time and labor charge may not be any greater for replacing a $20 part than for a part that cost only $1. They cannot be expected to understand because no one has taken the trouble to tell them.

Recognizing the difficulty of educating the public, the best thing is to use the service bill for educational purposes. Make the bill show everything involved in completing the repair. Itemize the different operations separately—travel time, removing the chassis from the cabinet (if necessary), inspection, pickup and delivery, etc. Virtually every service job involves at least six or eight operations of this type. Show them all. Then list the charges for the parts replaced.

Making out bills in this fashion is the psychological approach. A $10 time and labor charge doesn't *look* so bad with respect to a $1 part, when handled in this fashion. It is a perfectly honest presentation. The additional time spent making out an invoice of this kind will save much explaining.

The points we have raised in this article are known to every person who has sold his services to the TV-set-owning public. Service facilities may have viewed some of them as relatively unimportant. This is completely wrong. Drops of water falling on a stone will eventually wear it away. Small things have irritated the TV set owner time and again. Patience will wear out in time.

The service technician views his activity as a profession. That is fine as far as it relates to ethics and pride in his work. But it is still a business, and the fundamentals of operation which are axiomatic in sound business must be practiced.

A number of actions of TV service facilities over the years have bothered the public. Men opening shops in new TV areas should learn from these. Public complaints have not always been just, but many of them are well-founded. They are not beyond correction; it does not make good sense for new shops to follow in the footsteps of some of the old ones and repeat their failings. Every one should learn from —*and profit by*—the experiences of others! END

NTSC COLOR TV

This newest system combines the best features of several methods of color television

By EDWARD SIEMINSKI*

A YEAR or so ago anyone who expressed a preference for a particular color-TV system[1] was likely to find himself in the center of a heated argument. Now, at last, time and technical progress are clearing the air, and a new system—NTSC—has emerged out of the confusion.

Named after its sponsor, the National Television System Committee, the new system is the joint development of a broad cross-section of the radio-television industry.

NTSC background

NTSC was created in 1940 by the Radio-Television Manufacturers Association (then called the RMA) to assist the FCC in developing and formulating a set of standards for black-and-white television. These standards are now the basis of our present TV system.

The committee was reactivated in the late 40's when the FCC was holding hearings to establish standards for U.S. color television. Its new purpose was to gather background information on the general problem.

In 1950 the famous "Ad Hoc" (single-purpose) Committee was set up under Dr. W. R. G. Baker for a concentrated study of the state of the art. It examined the work of several laboratories working on various systems of color transmission with the idea of deciding if one or more of their methods offered promise as a *compatible* color system. On the basis of the *ad hoc* report, the RTMA reorganized NTSC into nine panels made up of prominent engineers. In the spring of 1951 these panels launched an intensive and extensive program of organizing, selecting, and testing the best features of all color television systems. The panels will set up system standards based on the results of these tests, and NTSC is expected to embody these in a formal proposal to the FCC in the near future. The work being done by NTSC has become an outstanding example of engineering co-operation and achievement.

Before going into the wondrous complexity of NTSC transmission let us first review the current status of color TV in the United States.

Field-sequential color TV

The present U.S. standard system—the only one permitted for commercial color-TV transmissions—is the *noncompatible* field-sequential system sponsored by CBS[2]. A program transmitted by this method cannot be displayed either in monochrome or in color on a standard television receiver without extensive circuit modifications (especially in the horizontal and vertical sweep sections). There is practically no audience for these color programs. This lack of a large audience discourages sponsors. Lack of sponsors discourages station construction. Without stations, there will be no audience, and without a prospective audience there will be no receiver production. As yet, no way has been found to break this vicious circle.

Engineeringwise the field-sequential system suffers fundamental handicaps. Briefly, it transmits *three* complete pictures in sequence: representing first the red, then the green, then the blue light picked up by the camera televising a color scene. However, the 6-mc bandwidth of a regular television channel is just enough to carry only *one* such picture in full detail. The necessity for trimming all three color signals to crowd them into this meager channel space results in degraded picture detail, objectionable flicker, and color instability with fast motion.

The field-sequential method *does have* excellent color rendition and very desirable simplicity. Belaboring it here for its weaknesses is done only to indicate the room for improvement.

NTSC Color TV

NTSC transmission was born in the same ideas that inspired RCA's *dot-sequential system*, but the NTSC system is not sequential. It is a *simultaneous* system, since the three primary colors in the picture are encoded electrically, not one after the other, but *all three continuously*. Many independent laboratories have contributed to its development.

It is a high-efficiency system, in which the equivalent of a 12-megacycle-wide picture (4 mc for each color) is transmitted within a 6-megacycle-wide channel[3], the same bandwidth used for conventional television.

In a nutshell, the new system transmits an ordinary black-and-white television picture, to which is *added* a modulated subcarrier signal conveying information about the coloring in the picture. From that viewpoint it could be called "colored" television. Although a color receiver is needed to display the *colored* picture, the system is compatible; that is, it will reproduce the picture on an ordinary television set in black-and-white (monochrome) without altering the set in any way.

Most of us have been taught that for a circuit to carry more information in a unit time the bandwidth of the circuit must be increased (provided the information is sent strictly in its original form, as in standard AM broadcasting).

How does the NTSC overcome this rule? Theoretical analysis provides the answer. It shows that any conventional television scene, when translated into a video signal occupying a given channel, does not fill that channel space completely. In fact, there is a regular

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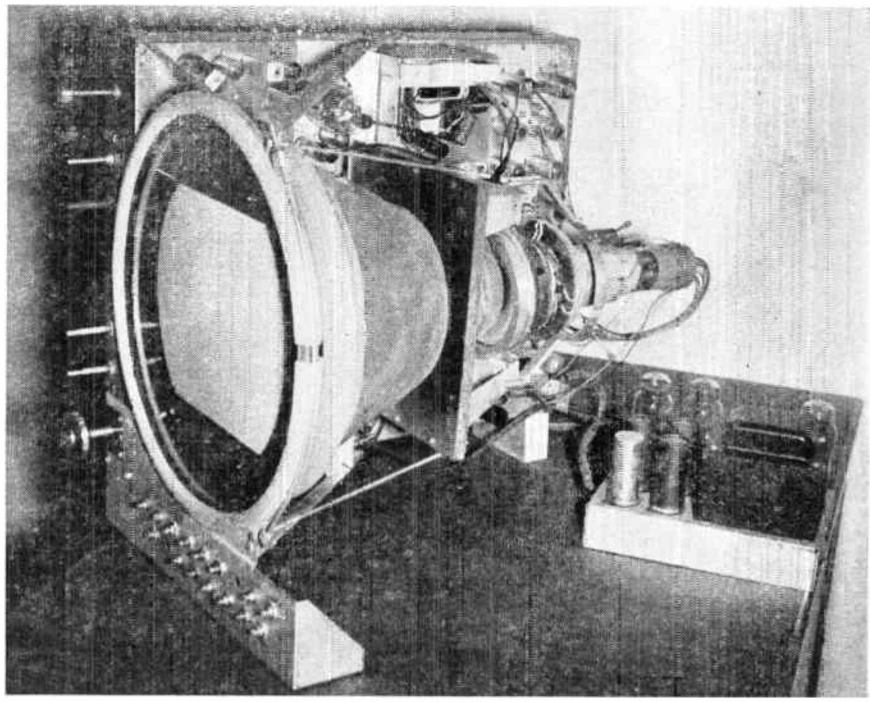


Developmental model of color-television receiver designed to the NTSC proposals. Chassis at right is a power supply.

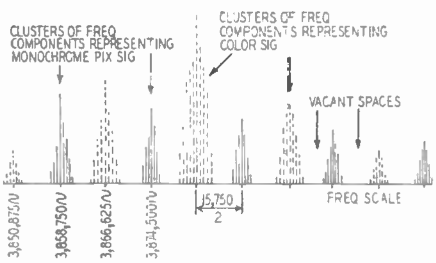


Fig. 1—Black-and-white TV signal sidebands form clusters separated by 15,750-cycle gaps. NTSC color-TV system uses these blank spots to send color signals.

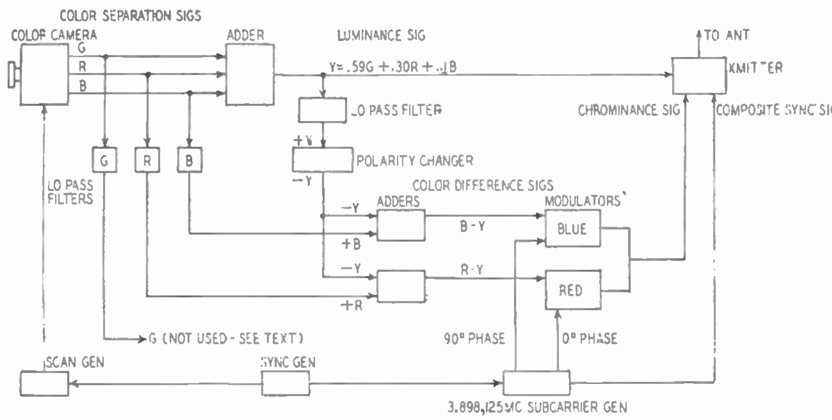


Fig. 2—Block diagram of the NTSC non-sequential color-TV transmitter.

series of vacant intervals in the transmitted frequency band. If the same theoretical analysis is applied to the *color* information of the televised scene, it, too, is revealed as a regular series of discrete frequency components separated by uniform gaps.

Obviously the gaps in the black-and-white picture signal can be utilized for transmitting some other kind of information. Why not the frequency components of the color signal? The monochrome signal and the color signal are then said to be "interleaved." Fig. 1 shows a small slice of the frequency band of the channel, indicating how frequency components of the picture signal and of the color signal are spaced over the same channel bandwidth.

To utilize this method it is necessary only to select a color subcarrier frequency which is calculated by multiplying half the horizontal line frequency by any odd number. *At this writing* the NTSC subcarrier frequency is: $\frac{15,750}{2} \times 495. = 3,898.125$ cycles.

On paper the idea may look fine, but does it work in practice? The answer is that it does—not perfectly, but quite acceptably. A fine-grain crawling checkerboard-like pattern is noticeable to anyone standing close to the picture tube and looking for it. The usual viewer does not see it, hence this interference is described as "low-visibility".

There is nothing quite as good as a block diagram for examining a complicated system. Fig. 2 is a simplified outline of the transmitter half of the system.

Color encoding

In Fig. 2. the camera supplies electrical signals G, R, and B, which correspond to the green, red, and blue components of the light in the televised scene. These separate color-signal voltages are combined in the proportions shown, to make up the *luminance* signal Y. The proportions of G, R, and B are based on the relative sensitivity of the human eye to light of those colors.

All information about variations in brightness—that is, the *detail* in the televised scene—is wrapped up in the *luminance* signal. All information concerning the *color* in the scene is restricted to the *chrominance* signal.

Now for the encoding of the color. [1] The R, G, and B voltages are fed through low-pass filters which cut down the bandwidth. passing the equivalent of three degraded single-color pictures. [2] Two of these, R and B, are added electrically to the *luminance* signal Y, whose polarity has been inverted to –Y, thereby creating *color-difference signals* R–Y and B–Y. A similar manipulation to obtain G-Y turns out to be superfluous, for the following reasons: G information already exists in the Y signal. We transmit R–Y and B–Y, and can easily extract G–Y from these signals at the receiving end. Therefore there is no point in handling G–Y since it is already present (although not apparent) in the transmitted intelligence.

[3] Continuing with Fig. 2, R–Y and B–Y modulate two sine-wave volt-

ages which have exactly the same frequency but are 90° out of phase. The combined result, the *chrominance* signal, becomes a two-phase subcarrier, with each phase amplitude-modulated by picture-coloring information.

Our video signal is now complete, the *luminance* and *chrominance* signals providing all the information needed to reconstruct the color scene. A station transmitter handles it substantially as it would any normal black-and-white picture. Fig. 3 shows the makeup of the transmitted frequency spectrum.

The synchronizing signal is the same as the one used for monochrome television, except that a color-sync signal is inserted on the "back porch" of each horizontal sync pulse (Fig. 4). In the receiver this burst synchronizes the local "color oscillator" which is used to demodulate the color signals.

The receiver

At the receiver, Fig. 5, all circuitry up to the output of the picture detector is conventional.

Let us start with the band-pass filter. This *rejects all* frequency components of the signal *except* the region containing the *chrominance* signal (see Fig. 3). The output of the band-pass filter feeds separate red and blue *chrominance demodulators.* The color-difference signals R–Y and B–Y are extracted by reversing the process of subcarrier modulation at the transmitter. The local *color oscillator* supplies two sine-wave signals having exactly the same frequency and phase as the subcarrier which was used for encoding at the transmitter. (These oscillators are synchronized with the color subcarrier by the bursts mentioned above.) The demodulation is a zero-beat form of heterodyning sometimes called "synchronous detection".

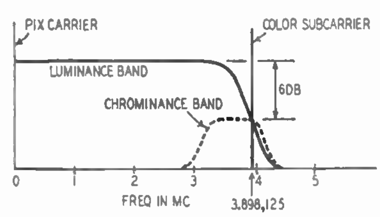
In the *matrix-circuit* block the R–Y and B–Y signals are mixed in predetermined polarities and proportions to produce the G–Y signal.

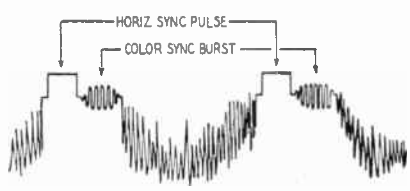
Finally, the three decoded *color-difference* signals are combined with the main *luminance* signal to reproduce the G, R, and B color signals which originally left the camera of Fig. 1. For example, adding R–Y to Y leaves R alone. The R, G, and B voltages are applied separately to the tricolor picture tube to re-create the scene.

Color reproduction

The great advantage of the NTSC system lies in its economical handling of color information. In Fig. 1 we noted that the R, G, and B signals were each limited to a bandwidth of about 1 mc implying the transmission of a limited amount of coloring information. The luminance information (picture detail) occupies the full 4-mc bandwidth.

This bandwidth relation makes sense when you understand how the eye sees.





Visible light produces three separate and distinct sensations: *brightness* (relative intensity or luminance), *hue* (recognition of red, orange, yellow, etc.) and *purity* or *saturation* (the degree to which the color is off-white, ranging from *zero saturation*, or white, to *100% saturation*, meaning a deep, vivid color, a pure *hue*). The human eye is extremely sensitive to brightness variations but surprisingly insensitive to changes in hue. The NTSC transmits picture information only to the extent that the human eye is capable of appreciating it.

One more puzzling question, *color mixing*, deserves attention. The tricolor picture tube operates on the principle of *additive* color mixtures. A good example of this is a cluster of partially overlapping colored *lights*, as in Fig. 6. The overlapped areas show some examples of *additive* mixing. Mixing colored paints, or looking through superimposed color *filters* are examples of *subtractive* color mixing.

The phenomenon of color sensation is in direct contrast to the sense of hearing. Most of us can identify the instruments being played from the general character of the sound, and a trained musician can even recognize the individual notes which make up complex musical tones. The eye has no corresponding ability to recognize the individual components of a color mixture. The eye perceives only *the overall result* of the mixing. With the proper set of primary colors, such as the red, green, and blue used in NTSC, we are able to reproduce practically the entire range of colors.

A word about the color picture tube, without which the NTSC system would be almost entirely useless. The shadow-mask type three-gun tricolor tube[4] has received much attention. Rapid progress has been made toward one or more color-tube designs suitable for mass production at reasonable prices.

Receivers for the tricolor tube are being developed by several companies. The big problem is to simplify the circuitry.

Test transmissions with the NTSC system have been made in New York, Chicago, Philadelphia, and Syracuse. Assuming that transmission standards are successfully formulated and the FCC adopts the system, it would probably take at least two years before the NTSC system could become a commercial reality. END

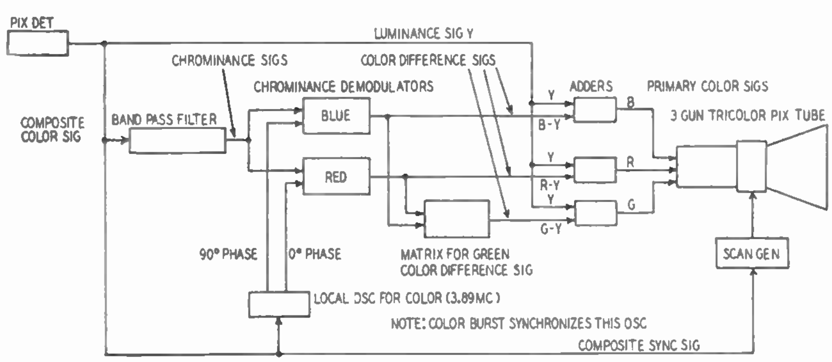
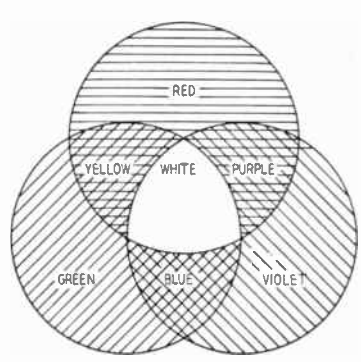


Fig. 3, top—Relative positions of the picture carrier and the color subcarrier in the upper sideband of transmitted signal. The vestigial lower sideband and the sound carrier have been omitted. Fig. 4, next to top—Color-sync bursts consisting of nine cycles of the 3.898125-mc color subcarrier are sent on the unused "back porch" of each regular horizontal sync pulse. Fig. 5, above—Block diagram of the receiver color circuits. All sections of the receiver ahead of the color unit are conventional. Fig. 6, right—Color combinations produced by blending colored *lights* (additive mixing).



References

[1]**Color Television Systems.** Fred Shunaman, RADIO-ELECTRONICS, January, 1951, page 20.

[2]***Color Television—U.S.A. Standard.*** P. C. Goldmark, J. W. Christensen, and J. J. Reeves, *Proceedings of the I.R.E.*, October, 1951, page 1288.

[3]**An Analysis of Color Television System.** A. V. Laughren and C. J. Hirsch, *Electronics*, February, 1951, page 92.

[4]**A New Picture Tube for Color TV.** RADIO-ELECTRONICS, June, 1950, page 27.

Propagation students and dx hounds had an interesting year

TV DX in 1952

By E. P. TILTON, W1HDQ

EXPERIENCED TV dx observers and amateurs who watch the 50-mc band for signs of dx all agree that 1952 was definitely subnormal in incidence of sporadic-E skip. For readers who may be just getting into this business of TV dx, sporadic-E skip is the means by which TV signals are bounced back to earth from the ionospheric E-layer, some 50 miles above the earth's surface, providing reception at distances ranging from 400 to 1,200 miles and more.

Ionospheric dx wasn't supposed to happen in the v.h.f. region, and the truth is that it occurs only a very small percentage of the time, but when it does develop it causes low-band TV signals to do amazing things. The reflection qualities of the sporadically ionized patches of the E layer become well-nigh perfect at times, with the result that signals from hundreds of miles away may come in with unbelievable strength, knocking out or seriously interfering with local stations.

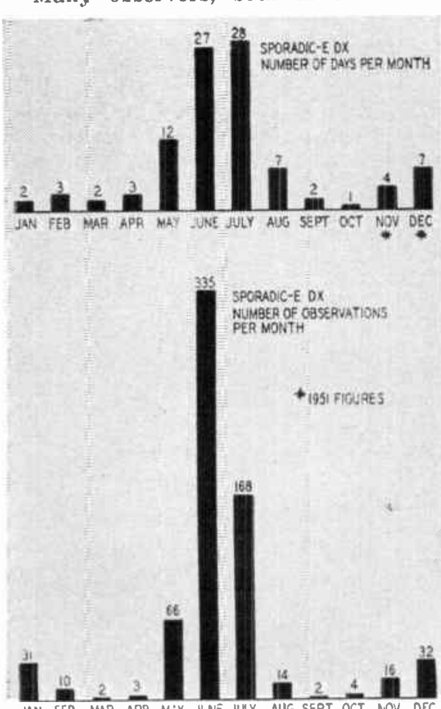
Many observers, both in television and amateur radio, have tried their hands at predicting the occurrence of sporadic-E skip in advance. They have met with a measure of success, and more is being learned about this amazing phenomenon all the time, but it is still very much a horse race. Perhaps that's just as well, for if we were able to turn on our TV sets or our 50-mc ham rigs at an appointed time to receive dx signals or work 50-mc stations halfway across the country on schedule, both pursuits would soon lose their appeal.

Meanwhile, we have a fascinating hobby, and one that is being put to good use. By careful observation and recording, v.h.f. amateurs and TV dx-ers have made available great masses of data for scientific study. During 1952 the people listed at the end of this article have contributed several hundred individual observations of TV dx, summaries of which appear in graph form herewith. A number of interesting facts are apparent from a study of these graphs.

A plot of the observations by months appears in Fig. 1. The upper portion shows the number of days that dx was observed; the lower shows the number of reports each month. Look back at a similar presentation[1] for 1951 and see how symmetrically these graphs rise and fall, showing the now well-established rhythm of the sporadic-E dx seasons. The major period is the months of May, June, and July, but another well-defined peak develops around Christmas time. Both periods are spread equally either side of the longest and shortest days of the year. Despite this cyclic effect, dx never quite runs out; there is rarely a month when no dx at all is reported by the sharper observers.

The effect of frequency shows clearly in Fig. 2. Breaking the observations down by channels, we see that the lowest, channel 2, accounted for 38% of the reports, with only 14% of the sta-

[1] TV DX in 1951—RADIO-ELECTRONICS, January, 1952, page 40.



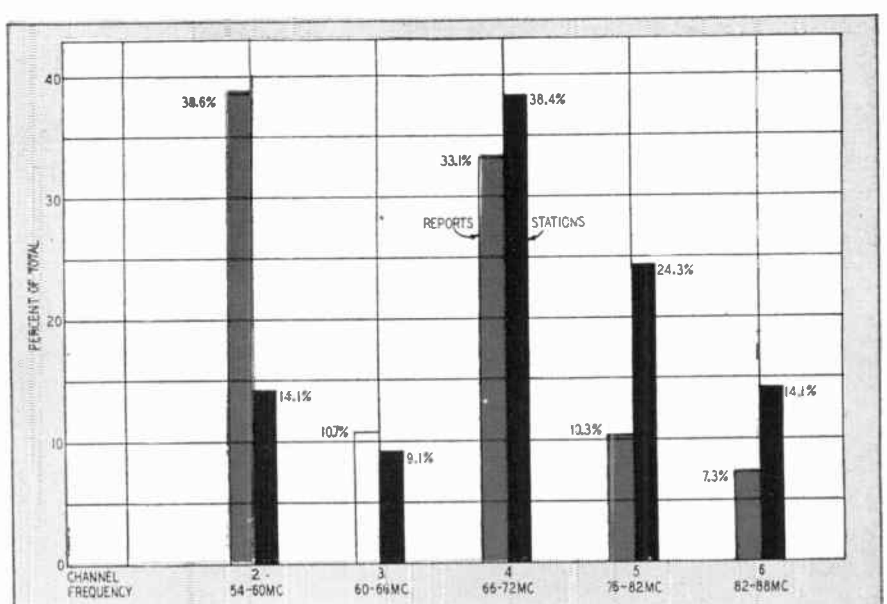


Fig. 1, left—A year of sporadic-E dx by months. The November and December figures are for 1951. Fig. 2, right—Dx reports by channels compared to the number of stations per channel. Black lines are stations, colored ones reports.

tions in North America. Percentages of reports and stations are just about equal for channel 3. The most heavily populated channel, 4, with 38% of the stations brought in only 33% of the reports. Channels 5 and 6 together having the same number of stations as channel 4, accounted for only 18% of the reports between them. There were no reports of high-band dx that could be positively identified with ionospheric effects.

Geographical location of the transmitting station is an important factor. Stations in the South and Middle West monopolize the top spots in the tabulation of reports by stations. As in 1951, KPRC, Houston, Texas, leads the pack by a 3-to-1 margin. The four Cuban stations, though their dx field is confined to little more than a 90-degree segment, are mentioned in 12% of the reports. Nearly half of the TV stations now using the low channels are above Latitude 40, but they accounted for less than 33% of the dx reported.

Some outstanding reports

TV dx observations come from some surprising places, some of them localities where there is no regular TV service. Observer Canning, Halifax, Nova Scotia, is 400 miles from the nearest TV station, yet his log includes 44 stations in 36 cities. He is the holder of the Western Hemisphere dx record, having logged PRF-3, Sao Paulo, Brazil, in the summer of 1951.

A growing group of dx-ers in the Halifax area keep in touch with each other by telephone. During the height of an aurora borealis display on September 29, several of them noted that the signal of WJAR, Providence, R.I., channel 11, was strong on both sound and video, but the two could not be received simultaneously. This condition had been noted previously when selective boosters were used, but this time removal of the boosters made only a slight improvement. If this was the result of auroral conditions it is the first time that aurora effects have been noted above 200 mc.

Strong but fading signals were received on channels 3 and 5 the same evening. On September 5, a coastal inversion brought in signals from WBZ, Boston, 4; WNBT, New York, 4; WABD, New York, 5; WFIL, Philadelphia, 6; and WJAR, 11. Audio only was heard from WCBS, New York, 2, bearing out the observation that tropospheric effects increase with frequency.

Several multiple-hop dx observations (in excess of 1,500 miles or so) were reported during the summer peak. Leader in this department was Observer Royal, of Red Bay, Ala. Bob caught KRON, San Francisco, 4; KING, Seattle, 5; KSL, Salt Lake City, 5; KOB, Albuquerque, 4; KPHO, Phoenix, 5; and KTLA, Los Angeles, 5, in a single evening. In a 24-hour period, June 13-14, Royal identified 26 dx stations. Another Florida observer, Simkin, of Orlando, reports 48 stations logged there, and another 11 picked up from a location in Arlington, Cal.

Florida Observers Hall of Miami and Sloan of Braden Castle, report fine tropospheric reception of the Cuban stations. Hall gets them more or less satisfactorily the year around, and Sloan pulls them through beginning in May. He also sees the Jacksonville station, WMBR, 4, most of the time over a 200-mile hop.

To the average home viewer who looks at one or two stations for his TV entertainment, the totals of stations logged by the more avid dx enthusiasts seem almost incredible. Observer Lowther, Alexandria, Ind., lists 55 stations identified over a 3½-year period, including such choice high-band tropospheric dx as WJAC, Johnstown, Pa., 13, 350 miles, WNBF, Binghamton, N. Y., 12,520 miles; and WJZ, 7, WOR, 9, and WPIX, 11, all of New York City, more than 600 miles!

In three weeks ending June 15, Observer Merkel of Detroit logged 31 stations, 14 of them in the high band. Observer Dull, Washington, D. C., had 31 calls on his list. Then he took his equipment on a vacation in southwestern Pennsylvania in July and August, running up a total of 49 stations in two months. Patrick of Abilene, Texas, has 40 stations in 18 states, Cuba, and Mexico. DeGroat, Salamanca, N. Y., has 26 low-band dx stations. Whitfield, Altoona, Pa., identified dx on 25 days between April 29 and August 13.

One of our northernmost observers, A. E. Wilson of Port Arthur, Ontario, logged a total of 25 low-band stations, all sporadic-E dx with the possible exception of Chicago and the Twin Cities, which might be just in the tropospheric range under the best conditions. His most consistent dx reception was WSB, Atlanta, Ga., 2, with KPRC, Houston, Tex., 2, came second. Practically all of Wilson's dx came from the area represented by the amateur W4 and W5 call areas, as does a large part of the 50-mc dx worked by our friends north of the border. Only toward the end of July was any eastern dx recorded.

Wilson noted interesting coincidence with weather conditions as indicated on weather maps telecast by several stations he received. On consecutive openings in June, weather maps showed pronounced cold fronts at right angles to the transmission path, just about midway between transmitting and receiving locations. On July 7, when WFMY, Greensboro, N. C., 2, was in solidly from 10:30 pm to midnight, a cold front extended along the line to the transmitting location. On July 27, when a cold front swung around to the midpoint of the path, New York, Boston, Philadelphia, and Washington appeared. Both amateur and TV dx-ers have noticed that sporadic-E skip is predominantly across areas of low barometic pressure; almost never in or across pronounced highs.

Unquestionably the most prodigious job of observation and reporting in 1952 was turned in by Louis M. Matullo, of Washington, Pa. He is able to do a phenomenal job of logging dx on both high and low channels from his 2,956-foot elevation in Southwestern Pennsylvania. Under normal conditions Mike receives 20 or more stations over a radius of nearly 300 miles, around three-fourths of his horizon. He has kept a daily record of stations received for more than a year. They include 53 calls, 37 of which have been received without the aid of sporadic-E skip. At least 18 different high-band stations have been logged, including WENR, 7, and WGN, 9, both of Chicago, nearly 500 miles away.

New receivers a factor

Much more high-band dx was reported in 1952 than in previous years, largely as a result of the improved high-band performance of the newer receivers. Increased awareness of the possibility of high-band dx was also a contributing factor. Observer Gehrlein, Erie, Pa., reports frequent reception of WSPD, Toledo, 13, 185 miles, and WXYZ, Detroit, 7, 165 miles. Runnells and Holmes of Ottumwa, Iowa, report WENR and WGN, 250 miles. McGough of Milwaukee staggers us with KLAC, Los Angeles, 13, on June 12. We'd like to know more about this one, as it exceeds by several hundred miles the best amateur or TV dx ever reported on frequencies above 100 mc. It can happen, though—200-mc radar sets have picked up targets 1,700 miles distant!

The period September 7–10 provided an unprecedented opportunity for high-band dx of a tropospheric nature. During that time amateurs using the 144, 220, and 420-mc bands worked dx beyond their wildest dreams.[2] The 9th was the biggest date, Matullo logging 37 stations at Washington, Pa., between 4:30 pm and 1:55 am the following morning! These included just about every high-band station to the south, west and northwest, within a radius of 500 miles. Landek, W9WOK, Bensenville, Ill., took time out from a big night of 144-mc amateur dx to log 27 stations on 11 channels in 10 states: Illinois, Indiana, Wisconsin, Michigan, Ohio, Iowa, Missouri, Minnesota, Pennsylvania, and Tennessee. The best dx was WICU, Erie, Pa., 12, 450 miles.

This all came about as a stable high-pressure center moved slowly across the Great Lakes and over to the Atlantic Seaboard, a stable air-mass boundary forming along its trailing edge.

TV dx was not without its humorous sidelights. One unintentional joker was a publicity blurb writer for one of the leading TV manufacturers. In a release sent to magazine editors he credited a Colorado owner of one of his client's new consoles with the "world's record for long-distance television reception."

[2] For a compilation of v.h.f. dx worked during this period, see November, 1952, *QST*, page 45.

The viewer in question had reported picking up stations as much as 1,200 miles away! The staff at RADIO-ELECTRONICS concludes that there is at least one person who doesn't read our TV dx reports!

And Observer Samuels, Mount Vernon, N. Y., says that the way of the TV dx-er is hard. Most people just don't appreciate it. When Dan called in his next-door neighbor to show off his reception of a Washington, D.C., station, over 200 miles to the south, the only comment was, "Lot of snow on it, isn't there?"

LIST OF OBSERVERS, 1952

Aliaga, Frank, El Paso, Tex.
Ambrose, G. W., Randallstown, Md.
Amery, Gordon, Braymer, Mo.
Ashcraft, Calvin E., Coolidge, Ariz.
Baldwin, G. H., Hamilton, Ont.
Bashta, William, Los Alamos, N. Mex.
Bedrosian, Peter, Newburyport, Mass.
Bente, Waldemar, Dennison, Ohio.
Billings, R. A., Shiro, Tex.
Canning, L. A., Halifax, N. S.
Cantwell, William, Denver, Col.
Carnes, P. C., Orangeburg, S. C.
Collier, J. W., Arlington, Va.
Conover, R., Stone Ridge, N. Y.
Croy, John E., Dayton, Ohio
DeGroat, F. E., Salamanca, N. Y.
Dochak, Mike, Sudbury, Ont.
DeGeer, M. W., Tulsa, Okla.
Dempster, M. K., Tyndall, S. Dak.
Dull, R. E., Washington, D.C.
Edens, L., San Antonio, Tex.
Elberburg, Columbus, Miss.
Evans, L. M., Gaylord, Mich.
Ferguson, G. A., San Antonio, Tex.
Foyer, Joe, Westville, Ill.
Gandol, Jose, Preston Orierte, Cuba.
Garcia, Albor Otero, Varadero Beach, Cuba.
Gehrlein, James, Erie, Pa.
Glenn, Quentin D., Carlisle, Pa.
Golden, S. J., Oak Bluffs, Mass.
Green, Vernon F., Saratoga, N. Y.
Green, M. F., Casper, Wyo.
Groves, A. L., Brooke, Va.
Hall, E. R., Miami, Fla.
Hammond, Clarence and Nina, Malin, Ore.
Hansen, Floyd, Waukegan, Ill.
Hart, Wm. C., Washington, Pa.
Hogan, Marvin H., Atlanta, Tex.
Huckert, Mrs. Joe, Hereford, Tex.
Henderson, Wayne, Sebring, Ohio.
Kern, Roy, Scranton, N. Dak.
Kindervater, John, Pottstown, Pa.
King, Virgil, Springfield, Ohio.
Kinney, Thomas A., Shelby, N. C.
La Bella, Victor, Middletown, Conn.
Landeck, John, Bensenville, Ill.
Lowther, G. W., Alexandria, Ind.
McGough, Robert, Milwaukee, Wis.
McKinney, J. J., Indianapolis, Ind.
McLaughlin, C. F., Birmingham, Ala.
McPherson, Ross, Woodstock, Ont.
Markle, Leonard, Greenfield, Ill.
Mayernick, Joseph, Monessen, Pa.
Mays, A. J., Devol, Okla.
Manning, Walter, Milwaukie, Ore.
Matullo, Louis, Washington, Pa.
Merkle, Bob, Detroit, Mich.
Meyer, Sgt. Danile, San Marcos, Tex.
Millot, Dan, Louisville, Ky.
Mulligan, Eldon, Ottawa, Ont.
Nichols, Dan, Mason, Mich.
Oberto, G. P., Richmond, Va.
Patrick, M. C., Abilene, Tex.
Penc, Stanley, Utica, N. Y.
Randall, John W., Hanover, Mass.
Rees, Mackworth G., Naples, Fla.
Richards, Warsaw, Ind.
Robins, Howard L., Tampa, Fla.
Royal, Robert, Red Bay, Ala.
Runnells, R. J., Ottumwa, Iowa.
Sagel, Leslie, Wildwood, N. J.
Samuels, Dan, Mt. Vernon, N. Y.
Schmidt, Harry, Markham, Ont.
Seay, J. Chester, Dothan, Ala.
Simkin, Gordon, Orlando, Fla. and Arlington, Calif.
Sloan, S. W., Braden Castle, Fla.
Stanek, John A., New Kensington, Pa.
Storie, Clarence A., Tulsa, Okla.
Storch, Clarence L., San Antonio, Tex.
Smith, B. L., Sundown, Tex.
Tisdale, J. W., Tulsa, Okla.
Tisdale, J. W., N. Little Rock, Ark.
Van Sandt, R. L., Ft. Worth, Tex.
Vanderstelt, Paul, Muskegon Heights, Mich.
Wallace, William, Santa Anna, Tex.
Warren, Bud, Cocoa, Fla.
Waterhouse, F. T., Springfield, Mass.
Whitfield, Lawrence A., Altoona, Pa.
Wilcox, W. W., Richmond, Va.
Wilkerson, S. W., Vancouver, B. C.
Wilson, A. E., Port Arthur, Ont.
Walker, John L., Albion, Pa.
Yeager, Claude C., Wichita, Kan.

96 observers, representing 29 States, plus Ontario, Nova Scotia, British Columbia and Cuba. END

Dx Reports by Station and Channel

Channel 2, 54-60 mc; 11 stations, 301 reports

KPRC, Houston, Texas	114	WCBS, New York City	24
CMQ, Havana, Cuba	32	WSB, Atlanta, Ga.	22
WMAR, Baltimore, Md.	28	WJBK, Detroit, Mich.	21
XEW, Mexico City	25	KNXT, Los Angeles, Calif.	7
WFMY, Greensboro, N. C.	25	KTSL, Hollywood, Calif.	2
KS2XBS, Chicago, Ill.	1		

Channel 3, 60-66 mc; 7 stations, 84 reports

KMTV, Omaha, Neb.	23	WBTV, Charlotte, N. C.	13
WTMJ, Milwaukee, Wis.	14	WKZO, Kalamazoo, Mich.	11
WPTZ, Philadelphia, Pa.	14	WDTV, Pittsburgh, Pa.	5
WLWC, Columbus, Ohio	4		

Channel 4, 66-72 mc; 30 stations, 258 reports

CMUR, Havana, Cuba	35	WHBF, Rock Island, Ill.	7
KRLD, Dallas, Texas	31	WNBW, Washington, D. C.	7
WKY, Oklahoma City, Okla.	30	WLWT, Cincinnati, Ohio	6
WMBR, Jacksonville, Fla.	17	WRGB, Schenectady, N. Y.	6
WTVJ, Miami, Fla.	17	WSM, Nashville, Tenn.	6
WTCN, Minneapolis, Minn.	15	WBKB, Chicago, Ill.	6
XHTV, Mexico City	14	KOB, Albuquerque, N. Mex.	5
WTAR, Norfolk, Va.	14	WBEN, Buffalo, N. Y.	4
WOAI, San Antonio, Texas	13	WNBK, Cleveland, Ohio	4
WOI, Ames, Iowa	13	KRON, San Francisco, Calif.	4
WMCT, Memphis, Tenn.	13	WWJ, Detroit, Mich.	4
WDAF, Kansas City, Mo.	12	KNBH, Los Angeles, Calif.	3
WBZ, Boston, Mass.	12	WAVE, Louisville, Ky.	1
WNBT, New York City	9	XELD, Matamoras, Mex.	1
WBRC, Birmingham, Ala.	8	WGAL, Lancaster, Pa.	1

Channel 5, 76-82 mc; 19 stations, 80 reports

WBAP, Ft. Worth, Texas	23	KSD, St. Louis, Mo.	2
CMQ, Havana, Cuba	10	WSAZ, Huntington, W. Va.	2
WOC, Davenport, Iowa.	7	WSYR, Syracuse, N. Y.	2
KTSP, St. Paul, Minn.	7	WABD, New York City	2
WTTG, Washington, D. C.	5	WAGA, Atlanta, Ga.	2
KEYL, San Antonio, Texas	5	WAVE, Louisville, Ky.	1
WNBQ, Chicago, Ill.	4	WEWS, Cleveland, Ohio	1
KTLA, Los Angeles, Calif.	3	KING, Seattle, Wash.	1
KPHO, Phoenix, Ariz.	2	KSL, Salt Lake City, Utah	1
KPIX, San Francisco, Calif.	1		

Channel 6, 82-88 mc; 11 stations, 57 reports

CMQ, Havana, Cuba	20	WTVR, Richmond, Va.	3
WDSU, New Orleans, La.	10	WHAM, Rochester, N. Y.	3
KOTV, Tulsa, Okla.	7	WOW, Omaha, Neb.	3
WTVN, Columbus, Ohio	5	WFIL, Philadelphia, Pa.	2
WFBM, Indianapolis, Ind.	3	WNHC, New Haven, Conn.	1

TWO MORE U.H.F. CONVERTERS

The Zenith v.h.f.-u.h.f. turret tuner and Mallory "Inductuner" preselector

By FRED KING*

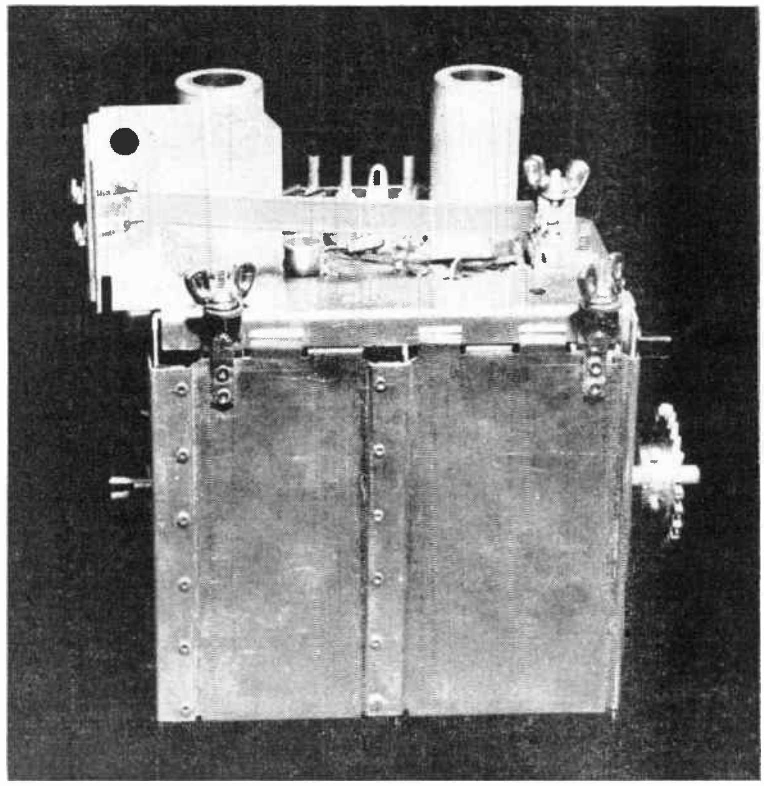


Fig. 1—The new Zenith v.h.f.-u.h.f. turret tuner with shields in place.

ZENITH sets now have a new turret tuner designed for top performance on both u.h.f. and v.h.f. channels. The over-all size has been reduced considerably, the channel strips are easier to replace, and special shielding and parts placement minimize oscillator radiation.

Fig. 1 shows the new tuner with all shields in place. The a.g.c., B plus, and heater leads terminate in a plug and the i.f. output terminates in a coaxial connector so that the entire unit can be removed from the chassis for repair or replacing channel strips without removing the chassis from the cabinet.

Fig. 2 is the tuner with external shields removed. Two sets of the removable channel strips are shown in the foreground. Those nearest the tuner are u.h.f. strips. The oscillator and interstage circuits are on the right-hand segments and the antenna-r.f.-input circuits are at the left.

Fig. 3-a is a block diagram of the tuner circuit with a pair of v.h.f. channel strips in position. The triode section of the 6U8 is the local oscillator; the pentode section functions as the mixer. The twin-triode 6BK7 is a cascode i.f. amplifier. Fig. 3-b is a block diagram of the tuner with a pair of u.h.f. strips in position. All the circuit changes indicated in going from Fig. 3-a to Fig. 3-b are made by simply turning the turret from a v.h.f. to a u.h.f. channel.

Fig. 4 is a simplified schematic of the tuner on u.h.f. channels. There are two tuned circuits in the preselector and a tuned multiplier circuit. These three resonant circuits and the two crystals are mounted in a casting.

To cover all 70 u.h.f. channels the oscillator tunes from 172 mc to 234 mc. The germanium multiplier crystal acts as a harmonic generator to provide u.h.f. oscillator power for the mixer.

The germanium multiplier crystal is capacitance-coupled to the oscillator and conducts only on the extreme peaks of the oscillator sine wave. The resultant straight-sided pulses in the multiplier circuit are rich in oscillator harmonics. The tuned output circuit of the multiplier selects the desired harmonic and applies it to the crystal mixer to beat with the incoming signal. The oscillator's third harmonic (516-702 mc) is used for the low u.h.f. channels and the fourth harmonic (688-936 mc) for the high u.h.f. channels. The mixer crystal is biased to operate at its point of maximum sensitivity, so that minimum oscillator power is required. The output of the mixer is at the 41-mc i.f. of the receiver. The 6BK7 and the pentode section of the 6U8 become additional 41-mc i.f. amplifiers to make up for the conversion loss in the crystal mixer.

The u.h.f. tuned circuits are very tiny. They are mounted in cylindrical holes in the casting about ¼-inch in diameter and ½-inch deep. The antenna and multiplier coils are less than ½ inch long and ⅛ inch in diameter. Series-tuning capacitance for the preselector and multiplier circuits is provided by 1-72 machine screws which enter one end of each coil through an insulating bushing. The inductive coupling between the two preselector circuits is provided by a small pin pressed into a recessed hole in the casting between the two coils. The junction between the coils is returned to the casting through this pin, which is an inductance common to both circuits. The casting shields the preselector and multiplier circuits from each other and from external influences.

The oscillator-interstage strip holds the oscillator coil with its disc ceramic capacitor, the cascode plate coil, and the mixer grid coil. The oscillator coil is adjusted to frequency by a small screw which enters the coil and changes its inductance. Each set of u.h.f. strips tunes over ⅓ of the band, so three sets cover all 70 channels.

Performance data supplied by the manufacturer is as follows:

Freq. (mc)	Channel	Noise Figure (db)	Image Rejection (db)	i.f. Rejection (db)	Relative Gain (%)
57	2	4.5	87	50	100
85	6	6.0	80	55	67
177	7	8.5	70	70	63
213	13	9.0	68	72	63
535	24	14.0	50	60	81
670	47	14.0	50	59	72
820	72	17.0	45	58	65

Mallory u.h.f. inductuner

As a result of considerable experience in the design and construction of variable-inductance tuning mechanisms, Mallory developed a special Inductuner for continuous coverage of the 470–890-mc u.h.f. TV band. These u.h.f. Inductuners are available as one-, two-, three-, and four-section ganged units. The three-circuit model is shown in Fig. 5. Some manufacturers use these as the tuning systems in their converters.

*Chief Engineer, WELI, New Haven, Conn.

ferent type sections. When used as preselectors with an external tank capacitance of 1 μμf, these units will tune the u.h.f. TV band with 10 mc to spare on each end. When used with a 6AF4 oscillator working on the low side of the signal, an external tank capacitance of 1.5 μμf is required.

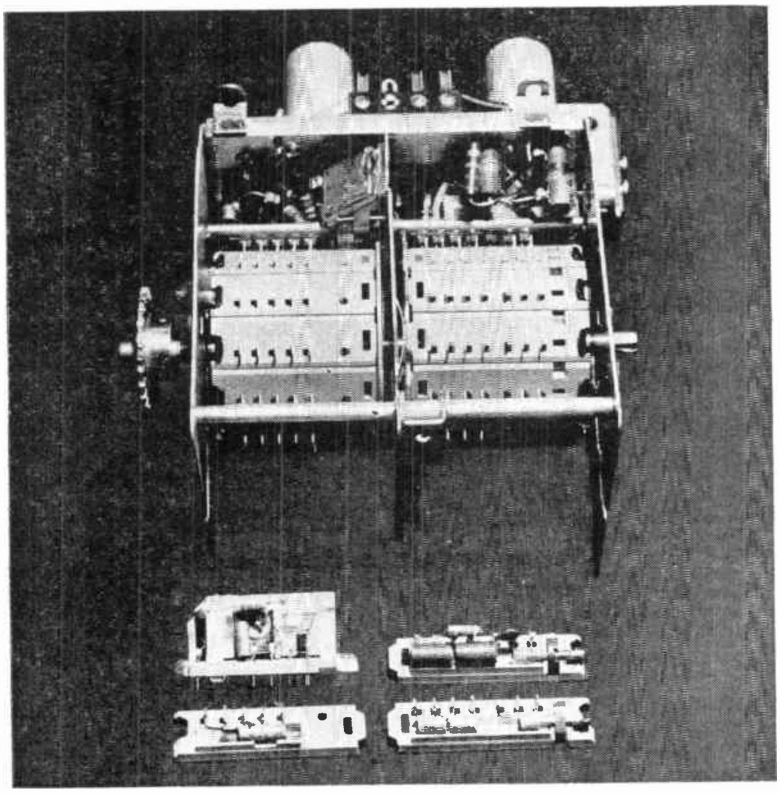


Fig. 2—The Zenith separate coil strip tuner with shielding removed.

Each Inductuner section employs a parallel-lines tuning system with the lines consisting of edge-mounted strips pressed into grooves in a mica-filled, phenolic-base material which provides mechanical strength and excellent electrical properties. They are arranged in a noninductive concentric path providing the required inductance range in 270° rotation of the shaft controlling the shorting bar. There are three different types of sections: wide-strip; narrow-strip; and shaped-strip tuning sections, to provide proper tracking in the preselector, mixer, and oscillator resonant circuits. Shaping of the elements provides more accurate tracking for various converter intermediate frequencies at approximately 40, 80, and 130 mc. The rotor arm which holds the dual contactor (shorting bar) is fastened securely to a phenolic shaft. Two-, three-, or four-section units may then be used without interaction.

Fig. 6 shows typical frequency versus dial-rotation curves for an 82-mc converter i.f. (channel 5 or 6). Measurements by the manufacturer show circuit parameters of individual Inductuner sections approximately as follows:

Distributed capacitance at maximum inductance .... 2 μμf
Maximum inductance .... .04 μh
Q at 100 mc. 180

These values vary slightly with different type sections.

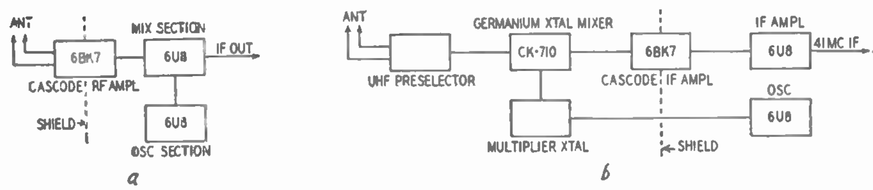


Fig. 3—(a) Block diagram of the Zenith tuner on v.h.f. channels. (b) Block diagram of the tuner circuit in one of the u.h.f. positions. Three sets of oscillator and preselector coil strips are required to cover all 70 u.h.f. channels.

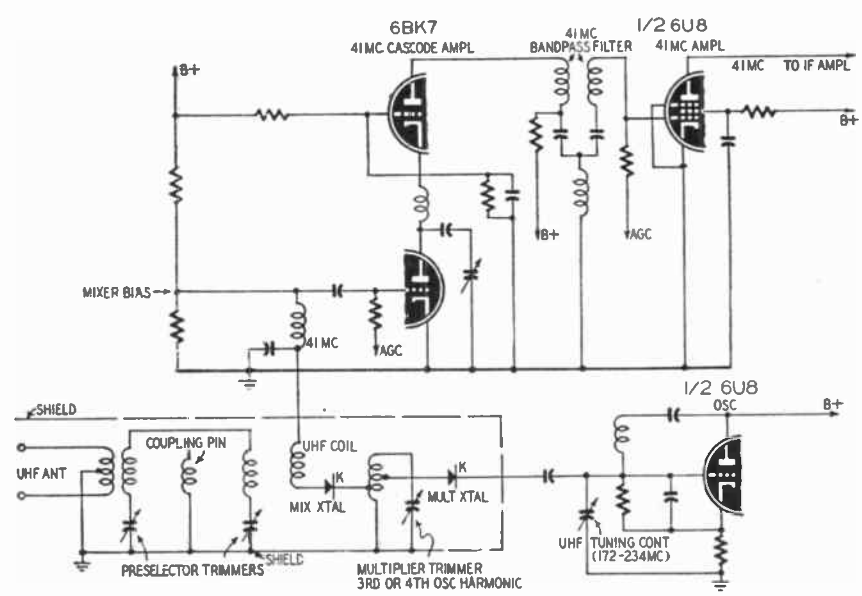


Fig. 4—Simplified schematic of the tuner circuit in one of the u.h.f. positions.

TV-101 u.h.f. converter

Figs. 7 and 8 show front and rear views of the Mallory TV-101 u.h.f. converter chassis. The schematic is shown in Figure 9. The converter—designed around a three-section Inductuner—covers channels 14 through 83. The antenna input impedance is 300 ohms, and the output impedance can be either 75 or 300 ohms. The popular line-up of preselector, crystal mixer, oscillator, and cascode i.f. amplifier is used. The gain is approximately 2 when used with the 300-ohm input and output. The converter i.f. is 82 mc so that either channel 5 or 6 may be used.

Preselector

The preselector uses two sections (2 and 3) of the Inductuner to provide double-tuned selectivity and an impedance match ahead of the mixer. The preselector elements are shaped to track with the oscillator. The antenna coupling method is a compromise between energy transfer (from different types of antennas or lines), alignment problems, oscillator radiation, and noise figure. The r.f. chokes across the antenna terminals to ground act as static drains. They also act as capacitors in the u.h.f. band. Their capaci-

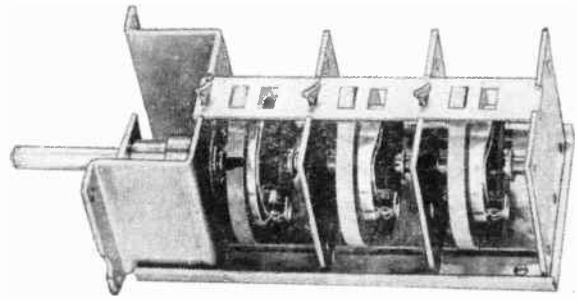


Fig. 5—A 3-section Inductuner. Note the concentric lines and wiper bars.

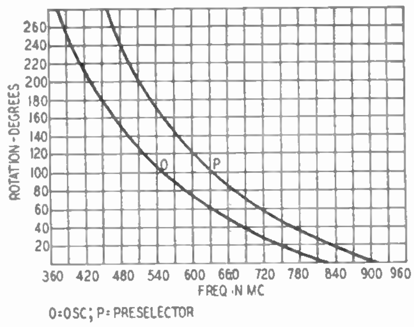
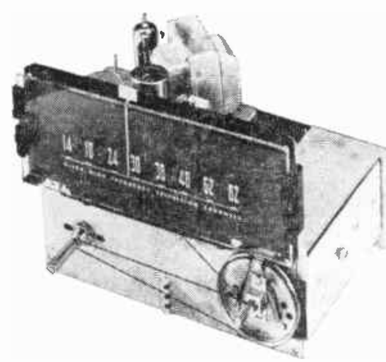


Fig. 6—Frequency versus dial-rotation curves for a converter i.f. of 82 mc.



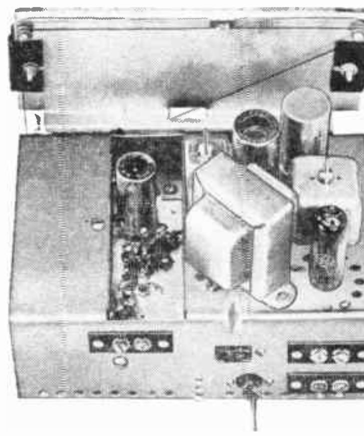


Fig. 7 (Left)—Mallory TV-101 u.h.f. converter.
Fig. 8 (Right)—Rear view of the Mallory TV-101.

tance to ground serves as an impedance tap-in on the first tuned circuit.

Oscillator

The oscillator tunes from 378 to 828 mc on the low side of the signal to develop a converter i.f. of 82 megacycles. Temperature compensation, careful location of parts, and isolating the i.f. and power-supply tubes from heat results in a stable oscillator. The drift is substantially zero at 700 mc. Drift is less than plus 400 kc at the low end of the u.h.f. band. At the high end, it is less than minus 750 kc. When operated with an intercarrier sound v.h.f. set, the converter stabilizes in about one minute. With split-sound receivers, a warmup period of three to five minutes may be required.

Oscillator injection voltage for the 1N72 crystal mixer is obtained by connecting to the 6AF4 heater, thus using the heater-cathode capacitance for coupling to the cathode. This results in less interaction between the preselector circuits and the oscillator. Measurements have shown that the maximum oscillator radiation is less than 2,000 μv per meter at the top of the u.h.f. TV band and less than 600 μv per meter at the low end at 100 feet from the converter.

Converter i.f. amplifier

The converter i.f. uses a 6BQ7 twin triode tube in a low-noise cascode circuit. The mixer output is transformer-coupled to the grounded-cathode first triode. Capacitance-coupling is used to the grounded-grid second triode. The circuit is neutralized by the r.f. choke in parallel with the grid-plate capacitance of the first triode. This choke also serves as the cathode return of the second stage.

The i.f. output circuit is a double-tuned transformer with a bandwidth of 14 megacycles at the half-power points with a center frequency at 82 mc. END

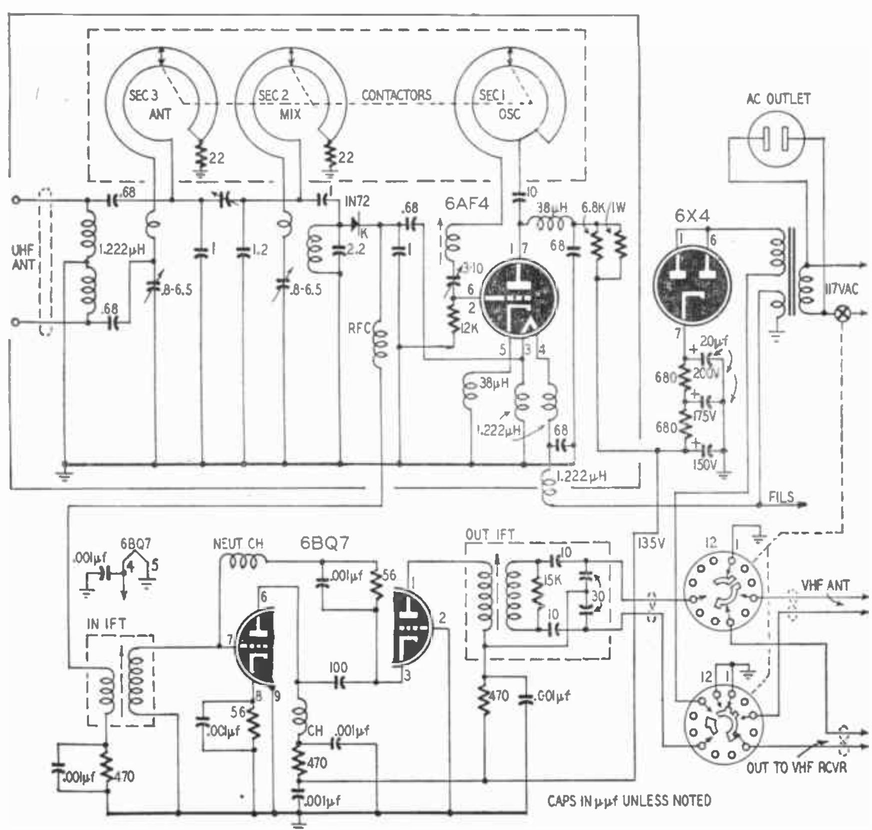


Fig. 9—Schematic of the TV-101 u.h.f. converter using the spiral Inductuner.

CIRCUIT SHORTS

Local-distance switching plus more anti-noise sync circuitry

By ROBERT F. SCOTT
Technical Editor

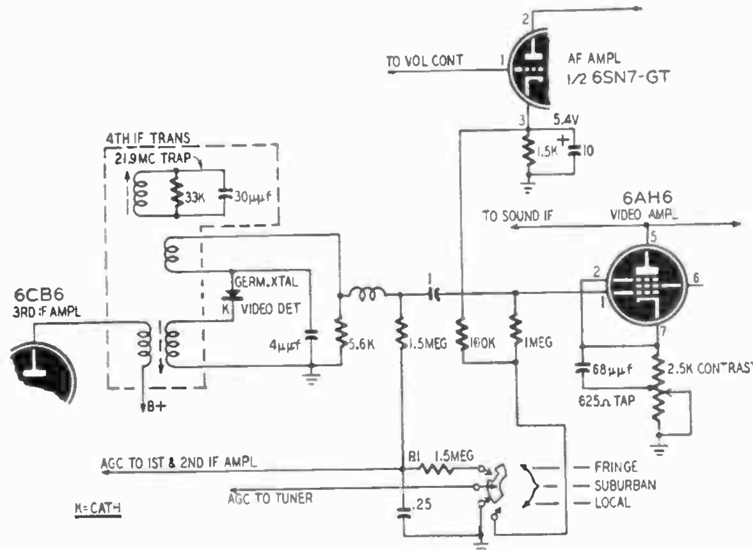


Fig. 1—Sensitivity-control switching in Motorola TS-400A TV chassis.

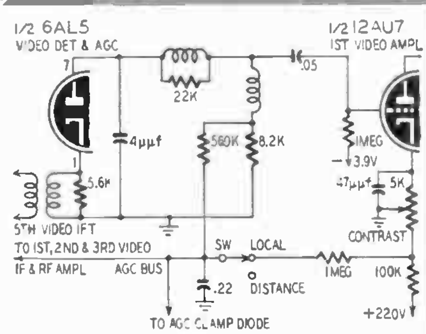


Fig. 2—Local-Distance switching used in Olympic TV models 762, 783, and 967.

MANY modern television sets have auxiliary controls on the back for adjusting the sensitivity for optimum performance in weak-, medium-, and strong-signal areas. Fig. 1 shows the area-control circuit used in the Motorola TS-395A and TS-400A chassis. Slightly different versions are used in other late Motorola receivers. The LOCAL, SUBURBAN, and FRINGE settings adjust the sensitivity of the receiver for strong, medium, and weak signals, respectively.

In the LOCAL position, full a.g.c.—taken from the video detector output—is applied to the first and second video i.f.-amplifier stages and through a 1.5-megohm isolating resistor (R1) to the r.f.-amplifier and mixer grids in the tuner. In the SUBURBAN position (that shown in Fig. 1) a.g.c. voltage is removed from the tuner, and the r.f.-amplifier and mixer grids are returned to ground. The FRINGE position is used when the incoming signals are weak, and the set must operate with maximum sensitivity. This grounds R1 and lowers the a.g.c. voltage on the i.f.-amplifier tubes to one-half the value applied in the LOCAL and SUBURBAN positions. In this position the video amplifier grid resistor is returned to ground to improve noise limiting ahead of the sync take-off point. The area selector control should be adjusted to the position which gives the clearest and most stable picture on all active channels.

Olympic local-fringe control

The Olympic model 762 receiver has the local-fringe circuit shown in Fig. 2. When the switch is set to LOCAL (in strong-signal areas), the r. f. amplifier and first, second, and third video-i.f. amplifiers are supplied with the full a.g.c. voltage across the 8,200-ohm video-detector load resistor. In this position the a.g.c. line is connected through a 1-megohm resistor to the junction of a 100,000-ohm resistor and the contrast control. The arm of the control is grounded and the 100,000-ohm resistor connects to plus 220 volts.

When the signal is strong, the contrast control is usually adjusted for maximum resistance in the cathode circuit of the video amplifier. This

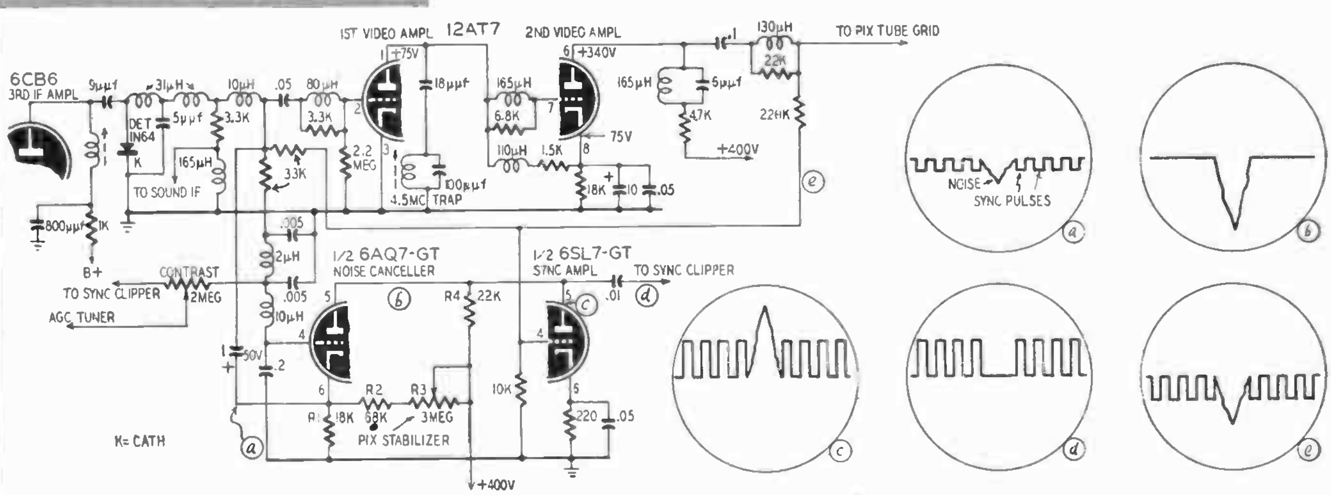


Fig. 3—Noise-canceller sync circuits of G-E 21T4 and 21T5 television receivers.

grounds the a.g.c. line through the 1-megohm resistor, and maximum a.g.c. voltage is used to reduce sensitivity and prevent overloading.

When the set is tuned to a weaker channel, the contrast control is moved up to reduce the bias on the video amplifier. A positive voltage now appears at the junction of the 1-megohm resistor and the lower leg of the contrast control. This positive voltage charges the 0.22-μf a.g.c. filter capacitor and bucks the negative a.g.c. voltage across the detector load. This positive voltage (a.g.c. delay bias) prevents the a.g.c. voltage from reducing the circuit gain until the incoming signal is strong enough to overcome it.

Advancing the contrast control to compensate for weaker signals brings more of its resistance into the voltage divider circuit and increases the delay bias applied to the line. The bias varies from 0 to about 4 volts as the contrast control is varied from maximum to minimum setting. Thus, varying the control automatically sets the a.g.c. delay bias to the proper point for best operation. In weak-signal areas the switch is set in DISTANCE position, disconnecting the a.g.c. bus from the contrast control circuit.

Noise-immune sync circuits

In past issues, we have discussed some of the various systems which manufacturers are using to insure maximum sync stability in the presence of severe noise.*

Now let's look at Fig. 3 which shows the G-E noise-canceller circuit used in the 21T4 and 21T5 models. The circuit is designed to prevent noise from entering the sync-clipper circuit and causing loss of sync through premature triggering of the sweep oscillators.

The composite video signal from the video detector is fed through a cascaded two-stage video amplifier into the grid of the picture tube along with any noise pulses which may be picked up with the signal. The negative-going sync pulses and noise (e) are tapped off the grid of the picture tube and fed to the grid of the sync amplifier (½ 6SL7-GT). This combination of noise and sync pulses is amplified and appears with positive polarity at the plate of the 6SL7.

At the same time that the amplified noise and sync pulses appear at the grid of the sync amplifier, the *unamplified* negative-going noise and sync pulses (a) from the video detector output are applied to the cathode of the 6AQ7 noise-canceller tube through a 1-μf coupling capacitor. The grid of the 6AQ7 is biased negatively from the a.g.c. line. The cathode is biased positive by returning it to a point on a voltage divider composed of R1, R2, and the PICTURE STABILIZER R3. Control R3 is set so the 6AQ7 is biased to cutoff until the negative-going noise pulse

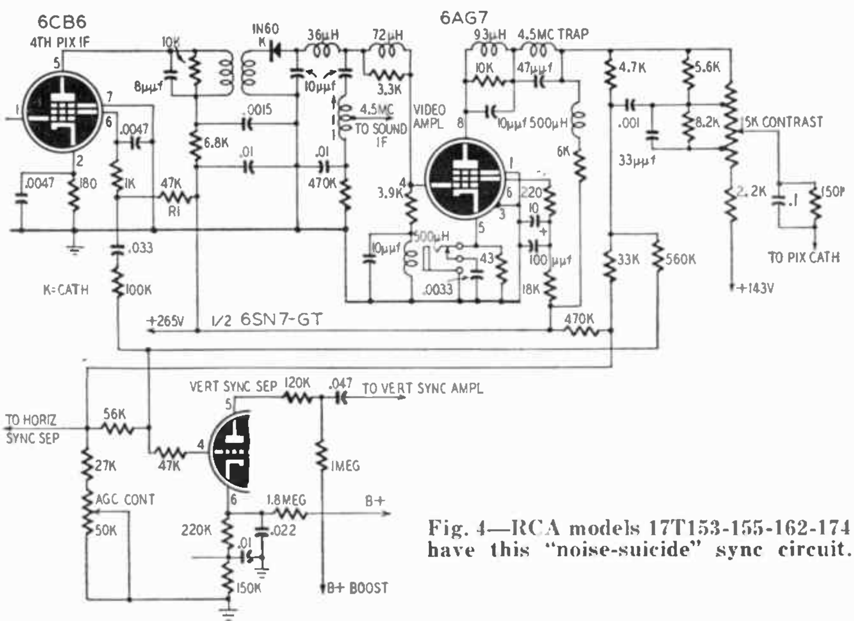


Fig. 4—RCA models 17T153-155-162-174 have this "noise-suicide" sync circuit.

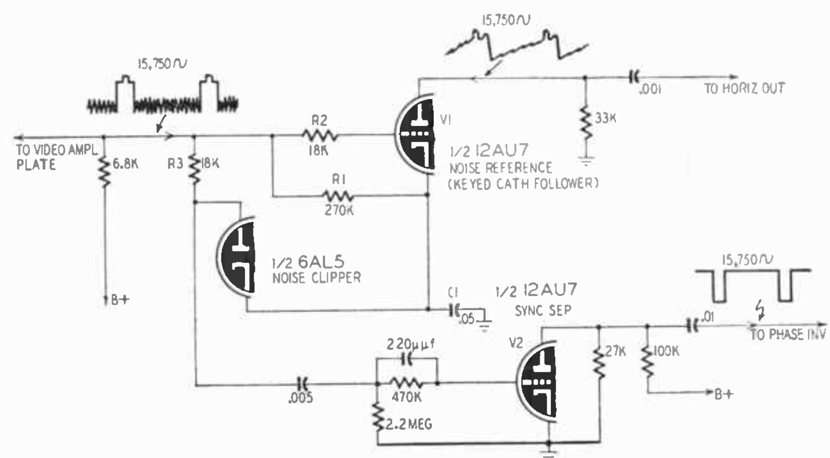


Fig. 5—Stromberg-Carlson receivers use this keyed noise-clipper sync circuit.

on the cathode exceeds the amplitude of the sync pulses. R4 is a load resistor common to the 6SL7 and 6AQ7. The 6AQ7 operates as a grounded-grid amplifier with input and output signals in phase. Since the two output signals are of opposite polarity, the waveform across R4 at any time will be the algebraic sum of the two signals. When the 6AQ7 conducts, it shunts the output of the sync amplifier and prevents any signal from being fed through to the sync clipper.

Waveforms *a*, *b*, *c*, *d*, and *e* show the operation of the circuit. Waveform *a* is the unamplified composite video with a superimposed noise burst. The waveform at the plate of the 6AQ7 during conduction is shown in waveform *b*. The pattern at *c* would appear at the plate of the 6SL7-GT if the 6AQ7 were heavily biased or removed from the circuit. The pattern at *d* shows the result of combining the waveforms at *b* and *c* in the common load resistor R4.

When the noise-pulse duration is longer than the time of several horizontal lines, all sync information is wiped out, but sync is not lost because of the flywheel characteristics of the sweep generator.

RCA noise-suicide circuit

A number of recent RCA TV receivers employ a *noise-suicide* circuit which prevents noise from causing vertical jitter in weak-signal areas. The video i.f. amplifier strip is designed so the grid of the fourth video i.f. tube (Fig. 4) does not draw grid current with normal signal levels. However, strong noise pulses drive the grid positive.

Each time a noise pulse arrives, grid current flows, and negative pulses appear in the plate and screen-grid circuits. The negative pulse across the 47,000-ohm screen resistor (R1) is tapped off and fed to the grid of the vertical sync separator (½ 6SN7-GT) through an R-C network consisting of a .033-μf capacitor and 100,000- and

* Zenith's Fringelock—July, page 38.
Philco noise-immune sync—September, page 45.

47,000-ohm resistors in series.

The negative noise pulse in the plate circuit of the 6CB6 is rectified by the video detector. The noise pulse next appears as an amplified *positive* pulse in the plate circuit of the 6AG7 video amplifier. This positive pulse is also fed to the grid of the vertical sync separator. The amplitudes of the positive and negative noise pulses are such that they cancel in the grid circuit of the vertical sync separator. Thus, noise is suppressed before it can reach the vertical oscillator and cause instability.

Another interesting feature of these sets is the use of separate vertical and horizontal sync separators. These provide better sync stability than do simpler systems in which vertical and horizontal sync signals are passed through a common separator-amplifier system.

Keyed noise clipper

To minimize the effects of noise bursts on the stability of the sweep oscillators, Stromberg-Carlson uses a *keyed* noise clipper in a number of its receivers. A typical circuit is shown in Fig. 5. The composite video signal is applied to the grid of V1 so the positive-going sync pulses arrive at the same instant that positive pulses (from the horizontal output circuit) are applied to its plate. This combination of positive pulses on plate and grid causes V1 to conduct. C1 charges rapidly to the peak of the sync pulses through the output resistance (1/gm) of the cathode follower noise reference tube V1. In the absence of pulses on the plate—about 90% of the total time—C1 tends to discharge through R1 in series with the internal resistance of the video amplifier. However, the time-constant of the discharge circuit is so long that the next sync pulse arrives on the grid before the charge on C1 can drop appreciably from the level of the sync tips.

The cathode of the 6AL5 diode noise clipper is biased positive to the level of the sync tips by the charge on C1. Noise pulses which exceed the sync level cause the diode to conduct and short-circuit the excess noise voltage to ground through C1 so it cannot appear at the input of the sync separator. The clipped portion of the noise pulse does not contribute substantially to the charge on C1 because R3 gives the charging circuit a time-constant which is long compared to the duration of the noise. Besides, any noise voltage which may be added to C1 will leak off through R1 and the video amplifier, so the charge on C1 is about normal when the next sync pulse arrives from the video circuits.

The noise pulse sees the grid-cathode circuit of V1 as a diode whose operation and characteristics are similar to those of the clipper diode. R2 in series with the grid of V1 gives the grid-cathode charging path a time-constant which is too long to permit noise to cause a substantial increase in the voltage across C1.

The ability of the noise clipper to distinguish between noise and sync pulses depends on maintaining the charge on C1 equal to the peak of the sync pulses. Its effectiveness in this operation is determined by the ratio of R2 to 1/gm.

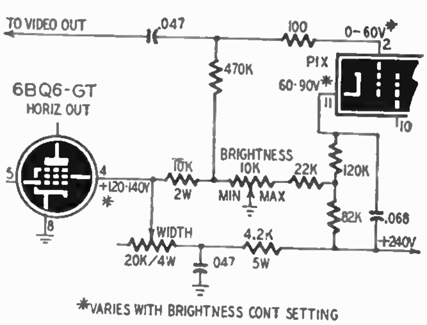


Fig. 6—Automatic width-control circuit in some recent Philco television models.

Automatic width control

Adjusting the brightness control on a TV set varies the bias on the picture tube and causes the beam current to change. If the second anode is supplied from a source which has poor regulation, the changing beam current shifts the load on the supply and causes the second-anode voltage to rise or fall. Increasing the bias on the picture tube—for a darker picture—lightens the load on the supply and the high voltage rises. This causes the picture to shrink. Decreasing the bias to give a bright picture increases the load on the supply, the high voltage drops, and the picture tends to expand since the reduced velocity of the electron beam makes it easy to sweep over a large area.

Philco TV receivers using the type 71 or 42 r.f. chassis and G-1 or G-2 deflection chassis incorporate a circuit which tends to keep the picture width constant regardless of the setting of the brightness control. The simplified circuit is shown in Fig. 6.

The grid and cathode of the picture tube and the screen grid of the 6BQ6-GT are supplied with voltages from two voltage dividers connected in parallel across the 240-volt B plus line. Both dividers return to ground through the arm of the brightness control. When the control is set for minimum brightness (maximum bias on the picture tube) the grid of the picture tube is at ground potential and its cathode is approximately 90 volts positive. This lightens the load on the high-voltage supply and the picture would expand if it were not for the fact that at this setting the 6BQ6 screen voltage is reduced to 120. This lowers the high voltage just enough to compensate for the increase brought about by the higher picture-tube grid bias.

Setting the control for maximum brightness raises the 6BQ6 screen voltage to 140 to compensate for the drop in high voltage when the bias on the picture tube is reduced. END

EQUIPMENT INVESTMENT

A RADIO-TV service technician—like the biggest industrial corporations—has a large part of his money tied up in tools and test equipment that either wear out in normal use or become obsolete as new methods or better devices come on the market. One of the vital dollars-and-cents factors that Big Business knows—but that the average technician doesn't even dream about—is that *it doesn't pay to use your equipment past a certain point in its life*, even though it may still be quite serviceable. Industrial engineers get fat fees for figuring out the point where it actually costs less to buy brand-new equipment than to continue using the old. You can do your own engineering with just a little simple arithmetic.

The Gawler-Knoop Co., of Caldwell, N. J., Wyncote, Pa., and Silver Spring, Md., have condensed the whole procedure into a few simple steps. Figures are based on an expected life of 10 years for electronic test equipment, an 8% return on your original investment, and a maintenance cost of 5% per year, with no salvage value at any time. (While these conditions apply more to laboratory instruments that get the best of care than to service-type equipment, the shorter life in service work is offset by the fact that your used equipment usually has some resale or trade-in value.)

OLD EQUIPMENT

A—Present book value $= (\text{original cost}) - \dfrac{(\text{original cost} \times \text{years in service})}{10}$

B—Depreciation cost $= \dfrac{\text{original cost}}{10}$ up to 10th year, "0" thereafter

C—Average interest cost $= \dfrac{(\text{present book value} \times 0.08)}{2} \times \dfrac{(11 - \text{years in service})}{10}$

D—Taxes and insurance = present value × 0.025

E—Maintenance and repair = original cost × 0.05 (may be higher for old equipment)

F—B + C + D + E = annual cost of old equipment)

NEW EQUIPMENT

G—Depreciation cost $= \dfrac{\text{original cost}}{10}$

H—Average interest cost $= \dfrac{\text{original cost} \times 0.08}{2} \times \dfrac{11}{10}$

I—Taxes and insurance = original cost × 0.025

J—Maintenance and repair = original cost × 0.05

K—G + H + I + J = annual cost new equipment

If new equipment will save labor, annual saving is:

L—Labor cost per hour $\times 40 \times 50 \times \dfrac{\text{hours saved per 8-hour day}}{8}$ = labor cost saved per year

If L is larger than K minus F, the new equipment will pay for itself in less than one year. L – (K – F) = annual savings from use of new equipment.

Note: As an example, a $1,000 purchase of new equipment is worth while to replace equipment 5 years old which originally cost $500, if the new gear will save 24 minutes per day with labor at $1.50 per hour. END

TELEVISION? it's a cinch!

By E. Aisberg

Translated from
La Télévision? . . . Mais c'est très simple!
by Fred Shunaman

First conversation: Frequencies, v.h.f., and video.

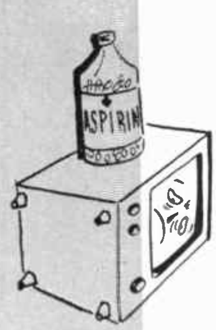
WILL—Ken, I need some advice for my Uncle Jack.

KEN—O.K.—something about his radio, I suppose?

WILL—Not exactly. He's interested in television now. He's had a bad attack of arthritis, so he hasn't been able to get out of the house for a couple of months. You know what a movie fan he's always been. So now that he can't get out to see five pictures a week, he wants to get a TV set to bring the movies to him.

KEN—Good idea! I'll be glad to lend a hand. Let's drop over to your uncle's right now, and see where we can put up the antenna.

WILL—That's not going to be so easy. Didn't you know my uncle has been living in northern Maine for almost a year now?



KEN—Why didn't you tell me? You'd better just get your uncle a case of aspirin. He won't get television in northern Maine—at least not till we get a few more stations.

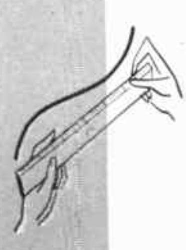
WILL—Why not? What about the programs from the Empire State Building?

KEN—He can't even get programs from Massachusetts stations. Sixty miles is about as far as you can be sure of getting dependable TV reception. Sometimes you may pick up programs a lot farther away. But your uncle in northern Maine hasn't much chance of getting entertainment out of a TV set.

The earth is round

WILL—If TV stations don't get out any better than that, why don't they increase their power?

KEN—Because it wouldn't help—much. Most television is transmitted between 54 and 216 megacycles, in what they call the very-high-frequency band—between 30 and 300 megacycles; or on *ultra-high frequencies*, which means in the spectrum between 300 and 3,000 megacycles. The u.h.f. TV band runs from 470 to 890. Now, the higher you go in frequency—or the shorter the waves get, if you like to put it that way—the more they act like light waves. Longer radio waves—like those in the broadcast band—can bend and follow the curve of the earth, but v.h.f. waves travel in straight lines and can't get around the bend in the earth's surface.



WILL—Does that mean that the receiving antenna must be in sight of the transmitting antenna to pick up TV signals?

KEN—Well, not quite. Of course, what the engineers call "optical visibility" is best for reliable reception. But v.h.f. waves are a lot longer than light waves and are not quite so set on following a straight line. V.h.f. waves do reach a little beyond the visible horizon, and can curve around small obstacles.

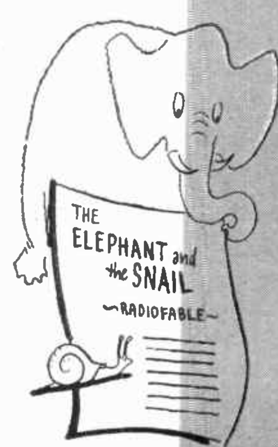
WILL—Wait a minute! I think I get it. Because the earth is round, its curvature hides the transmitting antenna after a certain distance. The waves travel in straight lines, so they just keep on going over our heads and out into space?

KEN—You've just described in one sentence what has been called "The Tragedy of Television."

WILL—Why "tragedy"?

KEN—Because that's what makes it tough or impossible for large areas of

Readers of RADIO-ELECTRONICS can start with this issue what is probably the world's greatest book on the fundamentals of television. It has already been published in the original French, in German and in Spanish, and is in process of translation into Italian. The author, E. Aisberg, is the publisher of the French magazines *Toute la Radio, Télévision,* and *Radio Constructeur et Dépanneur.* He has also written many books on electronic subjects, including the famous *La Radio—Mais c'est tres simple!* to which this book is the television sequel. *Television—It's a Cinch!* is translated from the original French by special arrangement with M. Aisberg. RADIO-ELECTRONICS has the exclusive North American rights for the translation of *La Television? . . . Mais c'est tres simple!* and no extract from it may be published without our permission and that of Mr. Aisberg.



"... getting an elephant in a snailshell."

the country to get good TV service. The transmitting range is so short that it would be too costly to put up enough stations to cover the whole country.

Getting up in the air

WILL—Isn't there any way of getting around this "tragedy"? Maybe people who live too far from TV stations could find some way of hooking onto those waves that are going by way over their heads. Why couldn't they use kites or captive balloons to hold up their antennas?

KEN—I don't think any TV set owner has gone that far, but some communications companies use antennas on captive balloons (Kytoons) to test sites for antenna towers. Most TV stations try to get their antennas as high as they can, though. That's why you see television antennas on the Empire State Building, on Mount Wilson, and on other such high points.

WILL—So you see there is a way out! Why do they make such a good start and then stop short?

KEN—I don't get you.

WILL—Why don't they put the transmitter in an airplane, and get up even higher? A plane flying around in the stratosphere could cover a quarter of the country, and my uncle Jack could see his flickers!

KEN—Congratulations, Will! You've just invented *stratovision.* That's what Westinghouse called just such a system some years ago. But they don't seem to have got it on a practical basis yet.

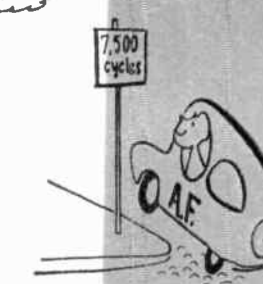
Shedding a little light

WILL—Then why in blazes do they have to keep television on such short waves? Just because it's so new is no reason for putting it in the third subbasement. Can't we reallocate or shut down three or four broadcast stations or commercial transmitters and put TV on the short or medium waves—where it really ought to be? Just think, if we only had one wavelength in the broadcast band we could put up three or four stations strong enough to cover the whole country. . . .

KEN—You're off the deep end that time, chum! Getting TV into the broadcast band would be about as easy as getting an elephant into a snailshell.

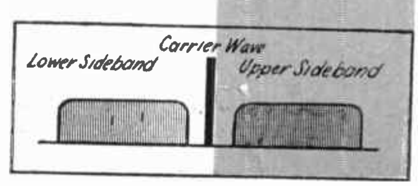
WILL—What's the connection between an elephant and television?

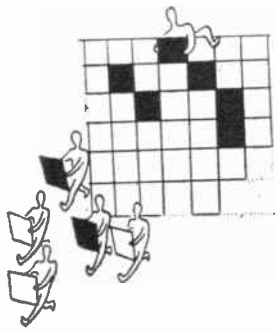
KEN—Easy, boy. Sit back and relax. Now think about the signals you get on your AM receiver. You have a carrier that sort of takes an audio signal along on its back. How wide a band does that need?



WILL—Well, the lowest audio notes are around 30 cycles and the highest about 15,000 cycles. I know for a fact, though, that most AM stations don't modulate much above 7,500 cycles.

KEN—In other words, when you remember that you have the audio signal on both sides of the carrier, most AM stations have a bandwidth of 15 kilocycles. Did you ever stop to figure out why an AM station should be limited to 15 kc?





Will—I may not know all the reasons, but the most important one is to cut down interference on adjacent channels. You couldn't get much above 5,000 cycles with the equipment they had when broadcasting started, and frequency allocations were made on that basis. Now the official signpost is 7,500 cycles for each sideband. Lots of stations go beyond that today, if they can do it without causing too much interference on neighboring channels. What's all this got to do with TV?

Ken—Plenty! But first, have you any idea of how television images are transmitted?

Will—Of course! You can't transmit a whole picture at one time, so it's broken down into very tiny elements and then these elements are transmitted successively . . .

Ken—Whoa! You lost me there, chum! What's this with "elements" and how do you mean "transmitted successively"?

Will—Ever look real close at a picture in a newspaper?

Ken—Yes.

Will—And it looked like what?

Ken—Like a bunch of dots—some light, some dark.

Will—It's the same in TV. We take a picture and break it down into little bits, some light, some dark. Only we don't call 'em dots, we say *elements* (or sometimes points).

Ken—And this business about "transmitted successively"?

Will—That's just the way the engineers say "one after another." The television transmitter changes each element into a voltage. Transmission is negative . . .

Ken—Hold it again! Just what is "negative transmission"?

Will—It just means that the dark part of a picture produces more voltage than a light part. A black element produces the strongest voltage.

Ken—And a point that isn't so black?

Will—Just that much less.

Ken—And what if you have just a white space?

Will—You can't catch me on that one. A white space gives zero voltage.

Ken—Or at least a very low one. But how do we manage to pick out all the points of a picture and then transmit them one after another?

Will—Easy. A scene is scanned exactly like you'd read the lines on the page of a book. You could think of each letter as an image element. All the lines on a page are scanned one after the other to form an image. When we've finished one page, we start scanning the next one . . .

Ken—Correct! And how fast is this "reading" done?

Will—Well, the pictures have to follow each other fast enough so the eye sees one continuous moving picture. The movies use 24 pictures a second. In television they follow each other at the rate of 30 a second.

Ken—Or about half a minute to read "Gone with the Wind"! But we're getting away from why we don't have a TV station in the broadcast band.

Will—Go ahead. I'm listening.

Ken—We've agreed that the voltage produced by any picture element depends on how dark it is. So when we transmit a signal that describes all the elements of a television scene, we're going to jump around from a very large voltage for a dark element to a very weak voltage for a bright one. And we're going to transmit all the elements of a complete picture in 1/30th of a second. Does that mean that the sidebands will be very wide?

Will—Does it?

Ken—It certainly does! This signal that expresses the brightness of each element in a TV picture is called a *video-frequency* signal. It's really a wide band of frequencies—something like the audio frequencies in an AM receiver.

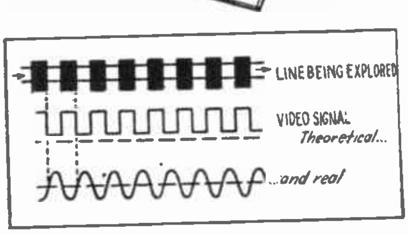
Will—I suppose it can even be zero frequency sometimes. If you televise an all-white or all-black surface, all the little elements will be the same, and will produce the same voltage while the whole surface is being scanned.

Ken—That's true. But if the elements along the line being scanned are *not* all of the same brightness, the signal voltage varies. Now, when is that variation fastest, or in other words, when will we get the highest video frequency?

Will—Probably when a lot of adjoining elements in a line differ in brightness.

Ken—Exactly. The frequency is maximum when we scan a line composed of elements which are black, white, black, white, successively. The highest frequency you could get would be with an image made of black vertical lines one element wide, separated by white intervals, also one element wide.

Will—Then each element would give us one cycle of signal, and . . .



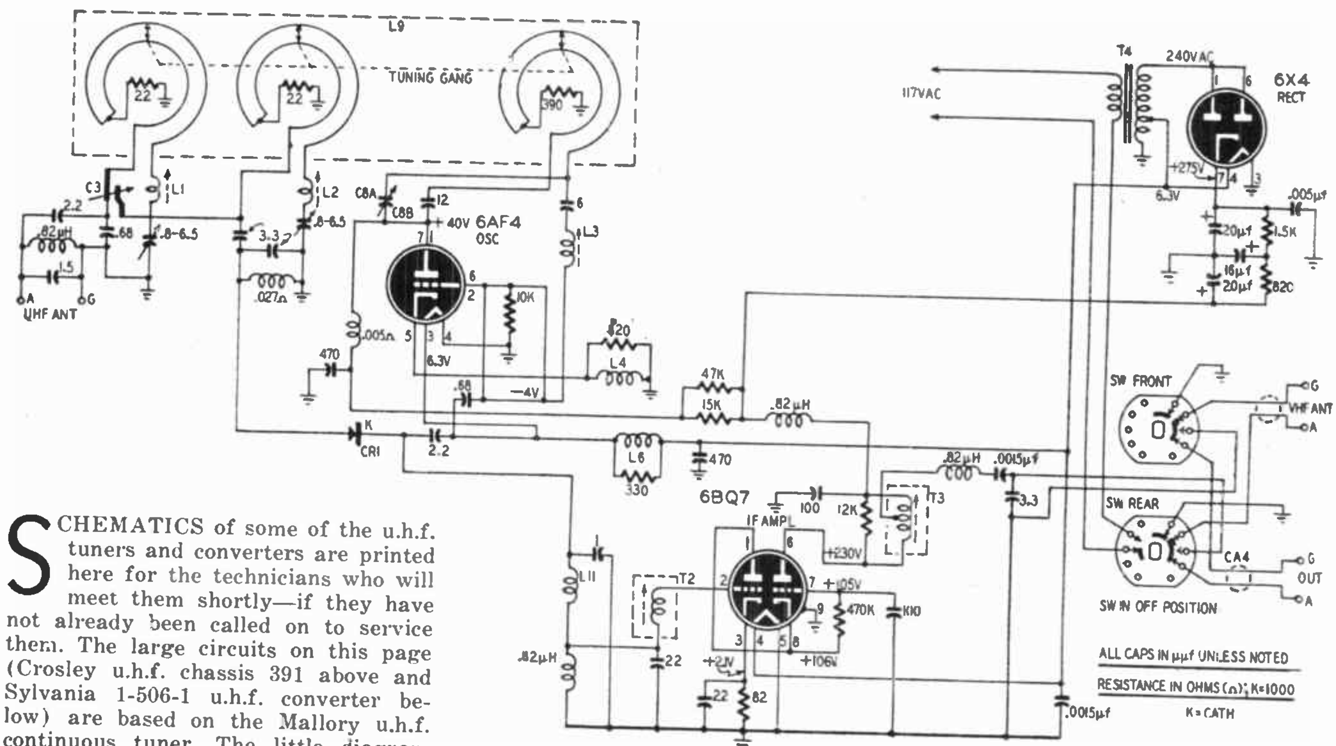
Ken—Easy, boy, easy! A white bar produces a very weak voltage and a black bar a very strong one. So scanning two adjoining elements—one black and the other white—produces a weak and a strong voltage. As we scan, the voltage alternates from weak to strong, back to weak, and so on. It takes two bars, one black and one white, to make one cycle. And since one cycle can interpret two elements of the image, the total number of cycles . . .

Will—Is half the number of image elements!

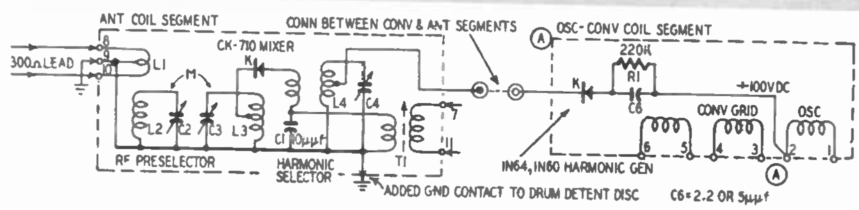
Ken—This time you're right.

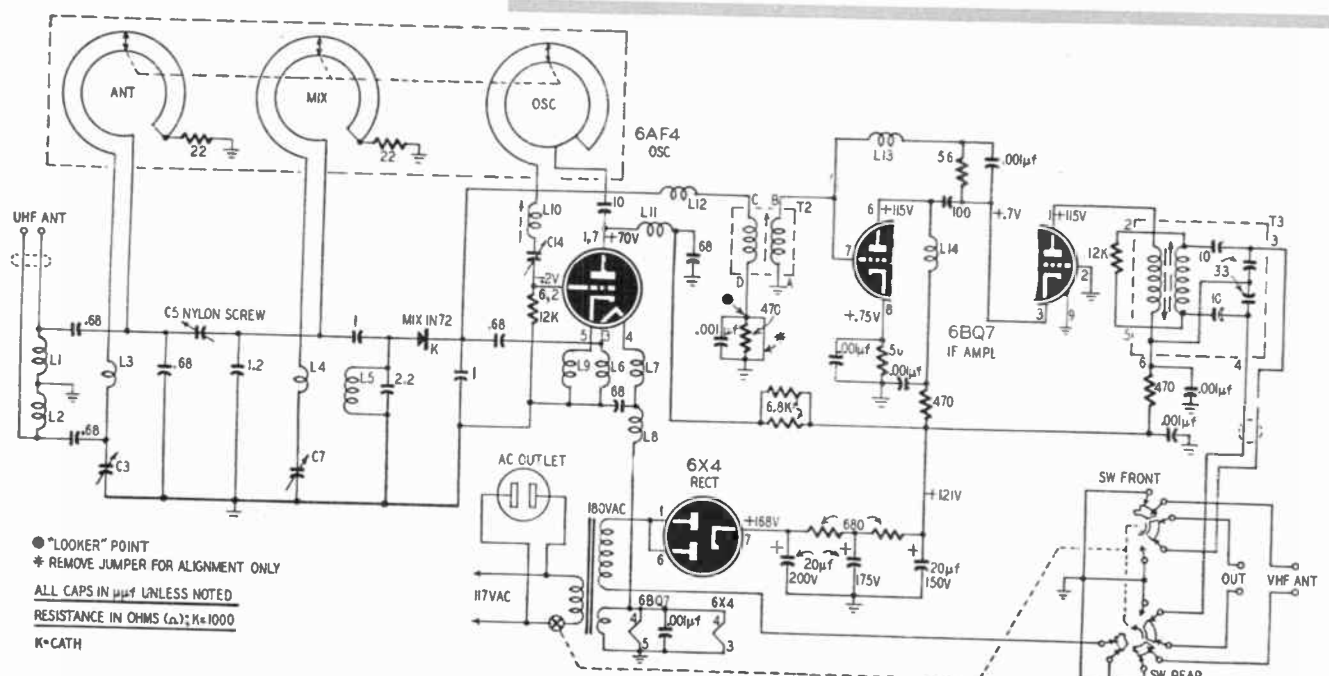
(*To be continued*)

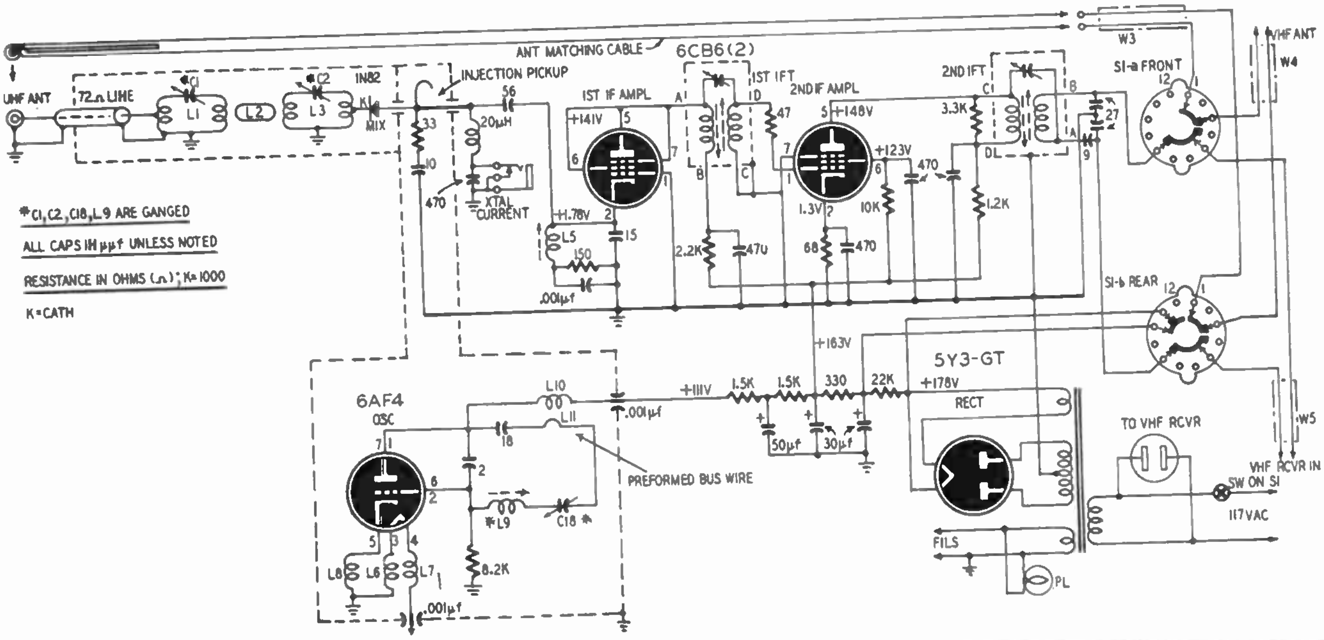
UHF circuitry



SCHEMATICS of some of the u.h.f. tuners and converters are printed here for the technicians who will meet them shortly—if they have not already been called on to service them. The large circuits on this page (Crosley u.h.f. chassis 391 above and Sylvania 1-506-1 u.h.f. converter below) are based on the Mallory u.h.f. continuous tuner. The little diagram between them is the newer Standard Coil u.h.f. strip. Some of its components are electrical rather than physical. C2, C3, and C4 are capacitances between the brass screw and silver tab on the ceramic coil form. C6 may be 5 μμf or 2.2 μμf depending on the channel. L4, C4, and C1 form a circuit tuned to the 2nd, 3rd, or 4th harmonic of the local oscillator.





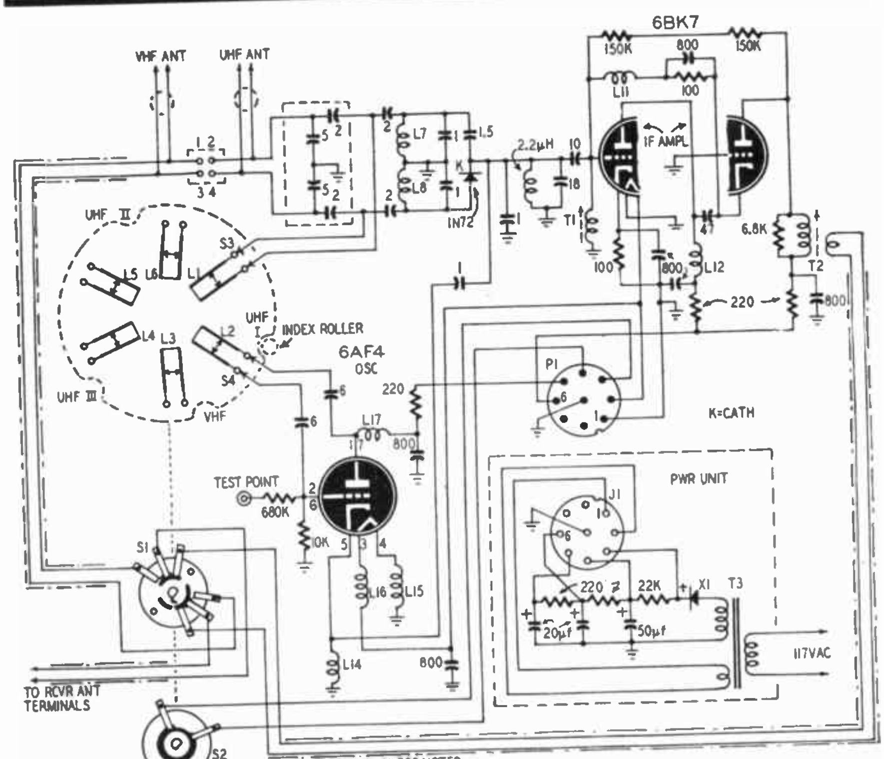


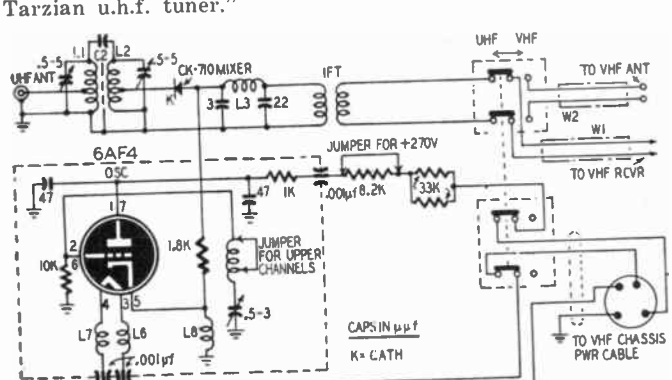
The circuit at the top of the page is the RCA u.h.f. selector U70. It covers the whole u.h.f. spectrum from channel 14 to 83. Its output may be on either channel 5 or 6, at 300 ohms, while the u.h.f. input may be either 75 or 300 ohms. (V.h.f. input is specified as 300 ohms balanced.) The TV receiver may be plugged into a receptacle on the selector, so that both v.h.f. receiver and selector can be operated by the selector's "on-off" switch. To receive v.h.f. programs, the switch is turned to V.H.F., which turns the selector on and puts it in stand-by condition. For u.h.f. signals, the switch is turned to U.H.F. and the v.h.f. receiver set to channel 5 or 6.

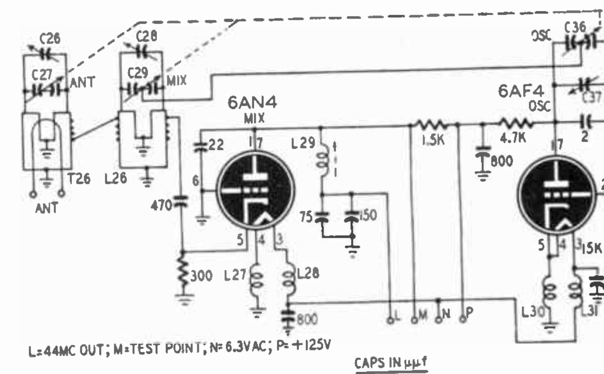
The schematic in the center is that of the G-E UHF-103 Translator described briefly in last month's issue ("More u.h.f. Converters", page 52).

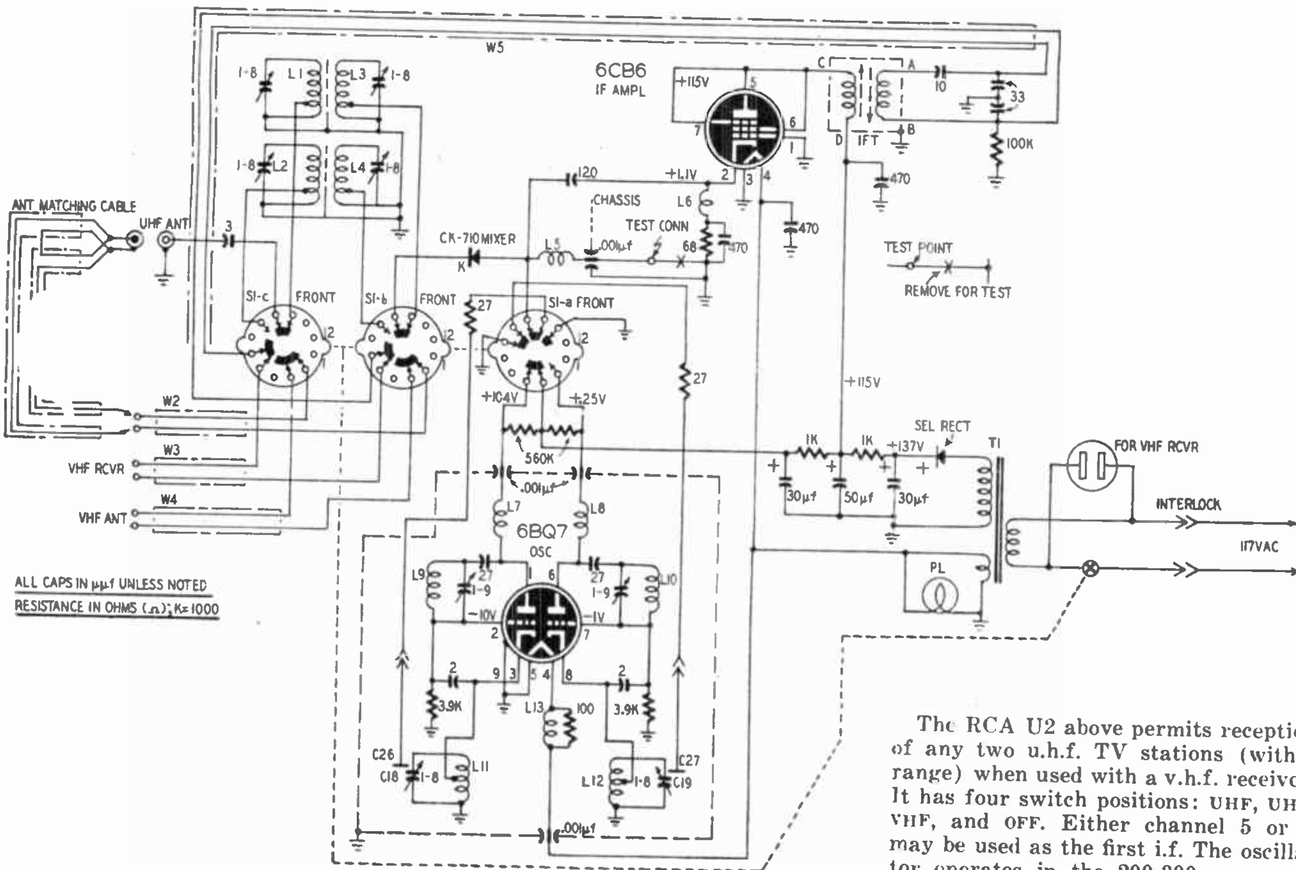
Circuit at lower left is the RCA U1 (U1A, U1B), an adapter which permits receiving any single u.h.f. TV station when employed with a v.h.f. receiver. Its output is also on channel 5 or 6. U1A has a 7-pin miniature adapter socket for use with sets having a 6AQ5 audio output stage; U1B has an octal socket for use with a 6K6 or 6V6 output socket.

Diagram at lower right is the tuner used with the Sylvania chassis 1-510-2 and labelled in their schematic "Sarkes Tarzian u.h.f. tuner."





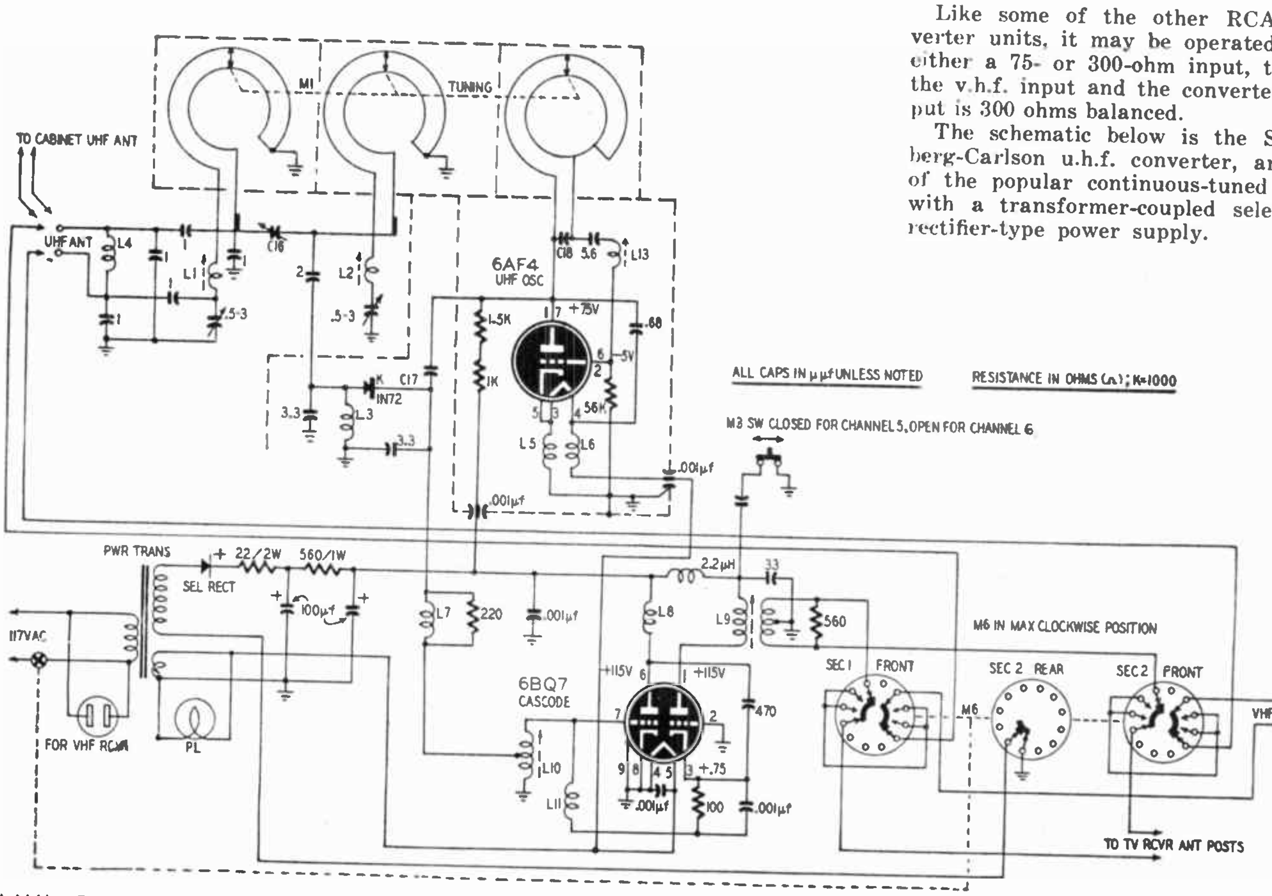




The RCA U2 above permits reception of any two u.h.f. TV stations (within range) when used with a v.h.f. receiver. It has four switch positions: UHF, UHF, VHF, and OFF. Either channel 5 or 6 may be used as the first i.f. The oscillator operates in the 200-300-mc range, and the second or third harmonic of the oscillator is applied to the crystal mixer. Normally the second harmonic is used for channels 14 to 46 and the third for 47 to 83.

Like some of the other RCA converter units, it may be operated with either a 75- or 300-ohm input, though the v.h.f. input and the converter output is 300 ohms balanced.

The schematic below is the Stromberg-Carlson u.h.f. converter, another of the popular continuous-tuned type, with a transformer-coupled selenium-rectifier-type power supply. END



TELEVISION ANTENNA PRODUCTS DIRECTORY

All Channel Antenna Corp.
70-07 Queens Blvd.
Woodside 77, N. Y.
Motorless all-direction, high-gain, broad-band, v.h.f. and u.h.f. antennas; bi-directional double-double V's; turnstile antennas; biconicals with mirror-image reflectors; super-directional fans, folded high-folded low, straight high-straight low, antennas; fan dipoles; v.h.f. and u.h.f. 5-, 8-, and 10-element Yagis; special u.h.f. high-gain reflectors; special-purpose antennas. 32 models. Masts; antenna switches.

Alliance Mfg. Co.
Lake Park Blvd.
Alliance, Ohio
Antenna rotators.

Alpar Mfg. Corp.
1486 El Camino Real,
San Carlos, Calif.
Standard aluminum vertical antennas or antenna towers in two types: tubular TV and amateur type in 12-foot sections to rise 132 feet; triangular broadcast and communications type in 12-foot sections to rise 300 feet.

American Phenolic Corp.
1830 S. 54 Ave.
Chicago 50, Ill.
In-line antennas, single-bay and stacked arrays, piggy-back and indoor antennas, u.h.f. antennas and reflectors. Lightning arresters, standoff insulators, and mast sections.

Antenna Products
3628 N. Lincoln Ave.
Chicago, Ill.
Folded dipole arrays, 5- and 8-element Yagi antennas; 6-, 8-, 10- and 12- element conical arrays; single and stacked V's; u.h.f. corner-reflector, Yagi, V and parabolic antennas. Thirty-two antenna models. Masts, fittings, mounts, wire, accessories.

Baker Mfg. Co.
Evansville, Wisc.
Forty-foot tower; 20-, 30- and 40-foot telescopic masts; double rock-up foot mount and peak roof mount.

Beacon Corp.
2846 Milwaukee Ave.
Chicago 18, Ill.
Spiral-type horizontal-element indoor antenna. One model, in aluminum or gold anodized finish.

Bell Television, Inc.
552 W. 53rd St.
New York 19, N. Y.
Amplified master antenna systems, individually engineered for each installation.

Birnbach Radio Co., Inc.
145 Hudson St.
New York 13, N. Y.
Indoor flexible folded dipoles, u.h.f. antennas, aluminum ground wire, rotator cable, RG-59/U coaxial cable, ground rods, loom, standoffs, guy wire, guy-wire kits, lightning arresters, filters, anchor bolts, mounting straps, clamps, couplers, switches.

Blaco Mfg. Co.
6541 Euclid Ave.
Cleveland 3, Ohio
Adjustable ground clamps and standoff straps.

Blonder-Tongue Laboratories
526-536 North Ave.
Westfield, N. J.
Line-amplifiers, mixer amplifiers, distribution units, line splitters, matching transformers, line-loss equalizers, weatherproof housings, remote-control units.

Camburn, Inc.
32-40 57th St., Woodside 77, N. Y.
Super-X conicals and biconicals, 5-, 8-, and 10-element Yagis, window antennas, masts, indoor dipoles, *Zoom-up* antennas, straight-line and V antennas. Installation accessories. Eighteen models.

Cass Machine Co.
691 Antoinette St.
Detroit 2, Michigan
Conical, single, stacked and double-stacked antennas; hi-low, in-line, and indoor antennas. Less mast or kit form. Side mounts, roof mounts, hardware. Thirty antenna models.

Channel Master Corp.
Ellenville, N. Y.
V.h.f. antennas including Yagis, broad-band Yagis, fan antennas, high-low combinations, and 10-element Yagis. U.h.f. triangular dipoles with or without screen, stacked V's, corner reflectors and Yagis. Combination u.h.f.-v.h.f. antennas. Telescoping masts, triangular towers, and other accessories.

Copperweld Steel Co.
Glassport, Pa.
Ground rods, stranded guy wire, grounding wire, and single conductor antenna wire.

Davis Electronics
4313 W. Magnolia Blvd.
Burbank, Calif.
Special type all-channel v.h.f. "Super-Vision" antenna. One model. U.h.f. antenna.

Easy-Up Tower Co.
427 Romayne Ave.
Racine, Wis.
TV towers, three models; roof mounts, twelve models; antenna accessories.

Energy Farm Equipment Co.
Monticello, Iowa
Hydraulic sectional TV mast, compressed height 22 feet, extended height about 60 feet.

The Finney Co.
4612 St. Clair Ave., Cleveland, Ohio
U.h.f. and v.h.f. ultra-high-gain fringe-area TV antennas. Communication and special purpose antennas.

Fretco, Inc.
1041 Forbes St.
Pittsburgh 19, Pa.
Yagis, conicals, v.h.f., u.h.f., broad-band, collinear arrays, "Fretarays," corner reflectors, dipoles, special arrays, slot antennas. Sixty models.

Gadgets, Inc.
3629 N. Dixie Dr.
Dayton, Ohio
"Circlatron" indoor circular adjustable dipole.

Gee-Lar Mfg. Co.
1330 10th Ave.
Rockford, Ill.
Single-, 2-, and 4-bay all-channel conical antennas. Three models.

General Cement Mfg. Co.
919 Taylor Ave.
Rockford, Ill.
Single-, 2-, and 4-bay all-channel conical antennas. U.h.f. double-X and special bow-tie conical.

Gleam Mfg. Co.
740 N. Leavitt St.
Chicago 13, Ill.
Model-boat type indoor antenna. One model.

Gonset Co.
801 S. Main St.
Burbank, Calif.
U.h.f. and v.h.f. fringe-area high-gain arrays. 375-ohm and 450-ohm open-wire line.

Don Good, Inc.
1014 Fair Oaks Ave.
South Pasadena, Calif.
U.h.f. and v.h.f. lead-in, open-line and sheathed against unfavorable atmospheric conditions. Two models (two colors each model). Interference traps and filters.

Hamilton Electronics Corporation
2726 Pratt Avenue,
Chicago 45, Ill.
Impedance-matching, isolating couplers for operating two to six TV receivers from a common antenna. Three models.

Haydon Products Corp.
1801 8th Ave.
Brooklyn 15, N. Y.
Stationary and adjustable chimney, wall, roof, eave, and pipe mounts; galvanized and stainless-steel strapping; mast-standoff and screw-eye insulators; hardware. Forty models.

Hi-Lo TV Antenna Corp.
3540 N. Ravenswood Ave.
Chicago 13, Ill.
Indoor, outdoor spiral antennas, v.h.f., high-low bands inductively coupled. Two models, with stand or window mount.

Hi-Par Products Co.
347 Lunenburg St.
Fitchburg, Mass.
Dipole-reflector antennas, single and stacked; conicals; double diamonds; 4-, 5-, and 8-element Yagis; in-line antennas; Twenty-four models.

Holub Industries, Inc.
413 DeKalb Avenue
Sycamore, Ill.
Installation tools and hardware: masonry drills, lead-in clamps, screw anchors, wire strippers.

Hy-Lite Antennae, Inc.
242 E. 137th St.
New York 51, N. Y.
Wide-band-V, conical-V and conical antennas; low- and high-band folded and straight dipoles; single-channel 4-, 5-, 8-, and 10-element Yagis. Twenty-two models.

I E Mfg.
325 N. Hoyne Ave.
Chicago, Ill.
Wide- and narrow-band antennas, u.h.f. antennas, straight conicals, fringe-area clover-leaf antennas.

Imperial Radar & Wire Corp.
4342 Bronx Blvd.
Bronx 66, New York
Open-line lead-in wire, open-wire matching transformers, feed-through insulators; antenna and mast accessories.

Insuline Corp. of America
3603 35th Ave.
Long Island City, N. Y.
Yagi, stacked-Yagi, biconical, stacked-biconical, conical, stacked-conical, folded-dipole, stacked-folded-dipole, simple-dipole, stacked-simple-dipole, flexible-indoor, indoor-dipole, and window antennas. Masts, accessories, kits and preassembled units. Sixty-five models.

Javex
P. O. Box 646, Redlands, Calif.
Custom-molded wall-plate antenna outlets in single-, double-, triple-, switching and dual-coupler types for flush mounting; antenna couplings, connectors, polarized plugs and sockets, combination plugs, sockets, terminals and junctions, feed-throughs, and antenna weatherheads.

Jerrold Electronics Corp.
26th and Dickinson Sts.
Philadelphia 46, Pa.
Master antenna systems for apartment houses, dealers, and communities; single-channel and wide-band amplifiers; distribution amplifiers; solderless co-axial-line connectors; antenna-and line-matching transformers; all TV distribution-system accessories.

JFD Mfg. Corp.
6101 16th Ave.
Brooklyn 25, N. Y.
"Jet 283" u.h.f.-v.h.f. all-channel conical, bow ties with straight reflectors, corner reflectors, and 6-element Yagis, ultra-V beams, rhombics, double and stacked V's. All-aluminum and part-aluminum conicals, single-stacked and 4-bay. All- and part-aluminum Yagis, single-channel, dual-channel and broad-band, single-stacked and 4-bay (in 5-, 10-element wide-spaced *Baline* models). 151 antenna models. Antenna kits, jumper bars, aluminum and steel telescoping masts, lock-joint and fitted-joint masts. Lightning arresters, single-channel boosters, two- and four-set couplers, pre-amplifying couplers, three- and four-way antenna switches. Mast mounts. Installation accessories. Wave traps. "NUT" universal Standoffs. Over 600 TV products.

Jontz Mfg. Co.
1101 E. McKinley
Mishawaka, Ind.
Towers, masts, and roof mounts.

Kay-Townes Antenna Co.
Box 586
Rome, Ga.
Broadside arrays, end-fire conicals, double-reflector conicals, V's, and special types; five models. Masts, two types—24-foot and 34-foot. Chimney mounts, roof mounts, installation accessories.

Kenwood Eng. Co., Inc.
265 Colfax Ave.
Kenilworth, N. J.
Eave, wall, and parapet antenna mounts. Antenna accessories and hardware.

LaPointe Plascomold Corp.
155 W. Main St.
Rockville, Conn.
Q-Tee, broad-band, v.h.f. (three

models—single, double, quad); heavy-duty Q-Tee (three models—single, double, quad); Ultra Q-Tee, all v.h.f.-u.h.f. channels (2-83), (three models—single, double, quad). Ultra Q-Tee Suburban, broad-band v.h.f. fringe-area u.h.f. (three models—single, double, quad).
V.h.f. antennas: single-channel 4-, 5-, 12 element Yagis; broad-band collinear arrays; dipole-and-reflector models, conicals. Eighteen models. U.h.f. antennas: single-channel, 8-and 12-element Yagis; collinear, broad-band arrays; side-by-side-stack collinear broad-band arrays; broad-band primary-area V antenna and reflectors.

Louis Bros.
3543 E. 16th St.
Los Angeles 23, Calif.
Conical, folded-dipole, Yagi, double-V, and all-channel u.h.f. and v.h.f. antennas. Masts and antenna kits. Sixty-five models.

Mechanical Steel Tubing Corp.
1801 8th Ave.
Brooklyn 15, N. Y.
Dualcote and *Alumacote* steel TV masts, 5- and 10-foot sections, 15-, 18-, and 20-gauge. Twenty-four models.

Mosley Electronics
2125 Lackland Rd.
Overland 14, Mo.
Weatherproof lead-in entrances; lead-in flush sockets; TV-antenna switches; 2-set TV couplers; open-wire accessories; 300-ohm transmission line plugs, sockets, connectors, and splicers; rotator-cable connectors.

Neal Electronics Co.
505 Seminole
Huntsville, Alabama
Five- and 10-element extra-high-gain Yagis; all-channel Yagi. U.h.f. Yagis, conicals, V's, and square-corner antennas now in process.

Ohio Aerial Co.
4553 Lewis Ave.
Toledo 12, Ohio
Conical antenna (triple front-horizontal reflector bars) and stacked arrays. No distribution outside Michigan and Ohio.

Peerless Products Industries
812 N. Pulaski Road
Chicago 51, Ill.
Indoor adjustable dipoles. Three models.

Penn Boiler & Burner Mfg. Corp.
Fruitville Road
Lancaster, Pa.
Sectional towers, 10-foot sections, guy supported, to 100 feet and more; telescopic towers (with detachable hoist), 3 sections, guy supported, with maximum height of 29 feet plus pole height. Two models.

Philson Mfg. Co., Inc.
60-66 Sackett St.
Brooklyn 31, N. Y.
Straight and folded dipoles, conicals, Yagis, double-V's, in-line antennas, and mounting brackets. Six different antenna types.

Plymouth Electronics Corp.
50 Kingsbury St.
Worcester 10, Mass.
Roof, wall, and chimney mounts; guy wire; channel-transfer switches; couplers; interference filters. Fourteen models.

Radelco Mfg. Co.
7580 Garfield Blvd.
Cleveland 25, Ohio
"Bar-X" all-channel, v.h.f. antennas, six models; hi-low all-channel, v.h.f. antennas, six models; in-line, all-channel, v.h.f. antennas, three models; all-channel u.h.f., one model; indoor antenna, one model; single-channel Yagis; masts, wall and chimney mounts, ground rods, lightning arresters, other accessories.

The Radiart Corp.
3455 Vega Ave., Cleveland 13, Ohio
Broad-band and cut-to-channel antennas in all popular types. Thirty-eight models for v.h.f. U.h.f. models to be released soon. Indoor antennas, stacking kits, chimney mounts, lightning arresters.

Radio Corporation of America
415 S. 5th Street, Harrison, N. J.
Twelve-channel TV antennas, folded dipoles with reflectors, V attachments, reversible-beam arrays. Arresters, mounting brackets, guy rings, other accessories.

Radio Merchandise Sales, Inc.
2016 Bronxdale Ave.
Bronx, N. Y.
Five-, 8-, and 10-element arrays, conicals (quick-rig and preassembled), end-fire-V arrays and conical V's; corner arrays, folded hi-low, straight hi-low, for v.h.f. and u.h.f.; window antennas, indoor antennas, masts, kits. Antenna switches, set couplers, chimney mounts, and all accessory hardware. Over twenty-six antenna models.

The Radion Corp.
1130 W. Wisconsin Ave.
Chicago, Ill.
Porcelain and phenolic lightning arresters; indoor TV antennas, V-type straight dipoles for v.h.f. and u.h.f.; printed circuit antennas for v.h.f. and u.h.f.; conical and folded dipole outdoor antennas; masts, mounts, and related accessories.

Ramsey Radio & Television Co.
Box 297, Ramsey, Ill.
Welded tubular-steel towers for roof or ground mounting, in 10-foot sections, five models; telescoping steel masts, two models.

Ray Co.
441 Summit St., Toledo, Ohio
Four-way, motorless, nondirectional; diamond stacked dipole array. Six models.

Rohn Mfg. Co.
2108-10 Main St., Peoria 5, Ill.
Self-supporting steel towers, foldover towers and kits, drive-in tower bases, tower accessories. Six models.

Walter L. Schott Co.
3225 Exposition Place
Los Angeles 18, Calif.
Directional, conical, and double-V wide-band arrays in various models; antenna kits; u.h.f. broad-band, corner-reflector, fan and double-V antennas. Fifteen models.

S/C Laboratories, Inc.
37 George St., Newark 5, N. J.
Six- and 8-element standard conicals; 6- and 8-element deluxe conicals; folded v.h.f. high-band adapter; dual-V.

Snyder Mfg. Co.
22nd and Ontario Sts.
Philadelphia 40, Pa.
"Directronic" antennas, outdoor and indoor, for v.h.f. and u.h.f.; Yagis, biconicals; fringe-area high-gain "Directronics"; u.h.f. corner-reflector, Yagi, and bow-tie types; end-fire V's; kits; preassembled units; 300-ohm flat and *Tri-A* transmission lines; masts; antenna-mounting accessories. Thirty models.

South River Metal Products Co., Inc.
377-379 Turnpike
South River, N. J.
Mounting brackets, chimney mounts, wall brackets, snap-in mounts, vent-pipe mounts, adjustable wall brackets, peak and flat-roof mounts, eave mounts, guy rings and clamps, banding, banding replacement kits, ground rods, screw-type insulators, standoffs, mast tubing.

Spirling Products Co., Inc.
62 Grand St., New York 13, N. Y.
Indoor antennas. Four models.

Tabet Mfg. Co., Inc.
254 W. Tazewell St.
Norfolk 10, Va.
Sectional aluminum towers. Three models (Economy, 24 feet; Standard, 30 feet; Reinforced, 90 feet maximum height). Tower sections and equipment.

Technical Appliance Corp.
1 Taco St.
Sherburne, N. Y.
Broad-band, all-channel antennas, conical and high-low types for v.h.f.; u.h.f.-v.h.f. fan and reflector types; twin-driven 5-element and 10-element Yagis; indoor, simple-dipole and folded-dipole antennas. Seventy-three models. Accessories, mast mounts, lightning arresters, antenna amplifiers. Master antenna-distribution systems.

Tel-A-Ray Enterprises, Inc.
Box 332, Henderson, Ky.
U.h.f.-v.h.f. 3-, 5-, and 8-element Yagis. Broad-band butterfly antennas, window, attic, and 1-, 2-, and 4-bay arrays. Broad-band u.h.f. antennas. Fifty-six models. Steel towers.

Television Laboratories, Inc.
5045 W. Lake St., Chicago 44, Ill.
Printed-circuit antennas, built-in u.h.f. and v.h.f. antennas, under-rug antennas. Eleven models.

Television Radio Electronics
Route No. 1, Box 291
Merced, Calif.
V.h.f. 10-element in-line Yagi, u.h.f. 5-element Yagi with screen or reflector; corner-reflector u.h.f. bow-tie antennas; 5-element cut-to-channel v.h.f. antennas.

Telrex, Inc.
Asbury Park, N. J.
V.h.f. conical-V-beams, Yagis, window antennas, indoor "Bat-Wings"; u.h.f. conical-V-beams, duplex Yagis, double-V-beams, corner reflectors; masts and accessories. Sixty models.

Tempo TV Products
2450 Ramona Blvd.
Los Angeles 33, Calif.
Fourteen sizes of steel telescopic masts, from 20 to 80 feet.

Tennalab
Quincy, Ill.
V.h.f. multichannel Yagis; v.h.f. and u.h.f. single-channel Yagis; v.h.f. all-channel array. Forty-nine models.

Tenna-Trailer Co.
321 N. Plum St., Pontiac, Ill.
Portable two-wheeled unit with telescoping 50-foot mast for demonstrating TV in fringe areas. Lightweight 50-foot mast for permanent installations. Three models.

Thomas Mold & Die Co.
Box 126, Wooster, Ohio
Hydraulic-telescoping, 40-, 60-, 80-, and 100-foot steel or aluminum masts. Masts to 200 feet and mobile units to specifications.

Tricraft Products Co.
1535 N. Ashland Ave.
Chicago 22, Ill.
Loaded dipoles, hi-low folded dipole and reflector, single and stacked conical types, cut-to-channel Yagi, all-wave Yagi, electrically loaded and covered-spiral indoor types, window antennas. u.h.f. antennas, masts; kits and preassembled units. Twenty-nine models.

Trio Mfg. Co.
Griggsville, Ill.
Wide-band high-gain *Zig-Zag* antennas for all v.h.f. channels. Eight models.

TV Development Corp.
2024 McDonald Ave.
Brooklyn 23, N. Y.
All-band conicals, V's, folded and straight dipoles with reflectors, indoor antennas, and masts. Six models.

T-V Products Co.
152 Sandford St.
Brooklyn 5, N. Y.
Wide- and narrow-band arrays, 5- and 10-element Yagis, single and twin-driven-, preassembled- and plug-in type conicals, hi-low folded and straight dipoles, in-line antennas, V-type end-fire arrays, u.h.f. broad-band and single-channel types. Chimney, wall, and peak roof mounts, mast-joiners, antenna hardware. 132 models.

Unimac Division
Marvin Radio-Television
8906 Buckeye Rd.
Cleveland, Ohio
Chimney mounts. 6-, 12- and 18-inch wall mounts.

Universal Products
4100 Taylor Ave., Racine, Wis.
Conical antenna, one model; roof mounts, four models; steel towers, three models; masts, four models.

Video Electronic Laboratory
304 Ridgers Road
Des Moines, Iowa
Broad-band antennas; 90° corner reflectors, and V-type dipole and reflectors for v.h.f. band. U.h.f. corner reflectors and horizontally polarized helicals. Ten models.

Walnut Machine Co., Inc.
1525 S. Walnut St.
South Bend 14, Ind.
Aluminum all-channel v.h.f. antenna. One model.

Ward Products Corp.
Div. of the Gabriel Co.
1523 E. 45th St.
Cleveland 3, Ohio
Combination u.h.f.-v.h.f. antennas, folded dipoles, in-lines, conicals, Yagis, in kit form and as preassembled units. Twenty-five models.

Wells & Winegard
1511 Mt. Pleasant St.
Burlington, Iowa
Wide- and narrow-band arrays, combination-channel Yagis, and high-gain all-channel primary- and fringe-area arrays. Six models.

Western Coil & Electrical Co.
215 State St., Racine, Wis.
TV towers, guyed-triangular-pyramid, straight-side, and self-supporting types. TV hardware, fixed and rotary type guy rings.

Wincharger Corp.
E. 7th and Division Sts.
Sioux City 2, Iowa.
Telescoping masts, guyed and self-supporting towers and accessories. Receiving- and transmitting-antenna masts and towers in all heights from 5 to 500 feet. Thirty models.

Wind Turbine Co.
E. Market St., West Chester, Pa.
"Trylon" antenna masts and towers. Nine models.

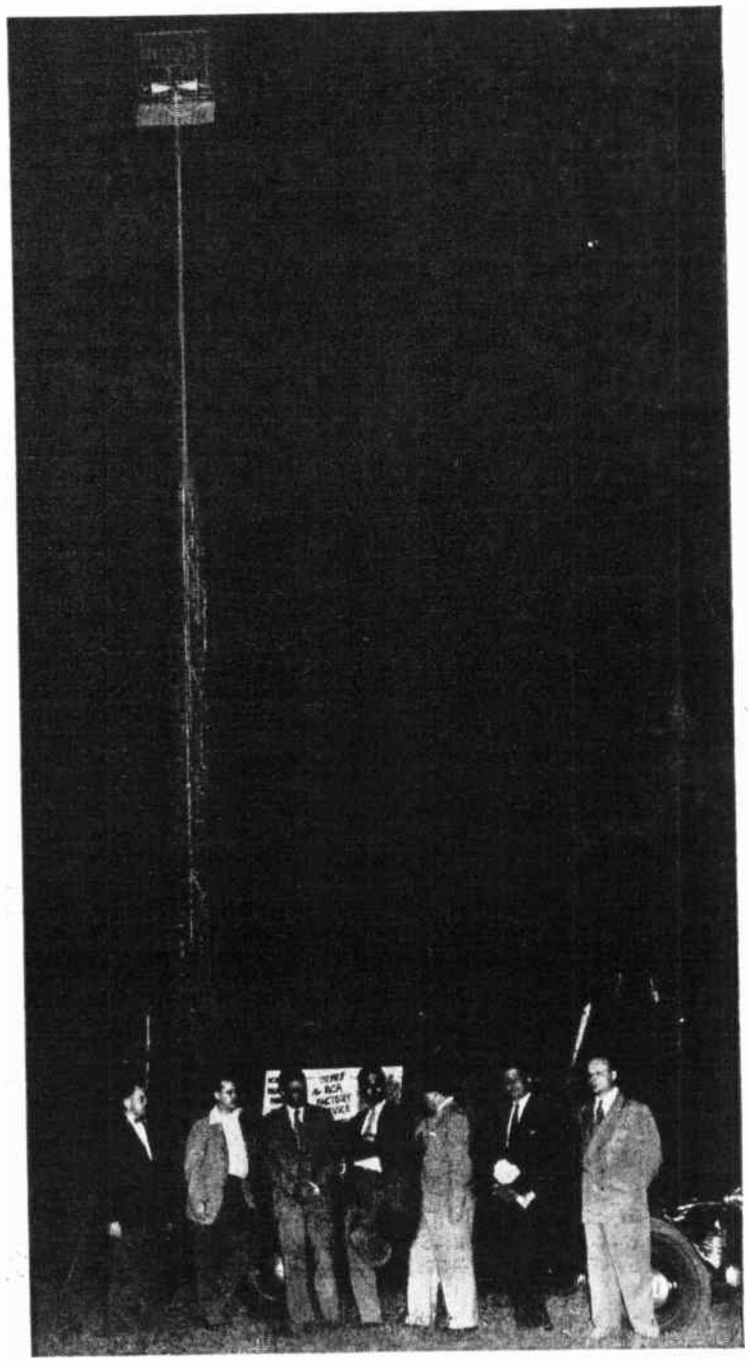
Winpower Mfg. Co.
Newton, Iowa
Four-post, pyramidal self-supporting, TV towers. Two models, 5 and 10 feet.

END

TV comes to PORTLAND

Record installation speed gives "City of Roses" first commercial u.h.f. station

By VICTOR BARY*



This survey crew checked KPTV's first broadcast. The corner-reflector antenna can be raised 70 feet above the street.

THE FCC's announcement last April of the v.h.f.-u.h.f. allocations plan for new television stations ended the work of various experimental u.h.f. television stations throughout the country.

One of these, RCA-NBC station KC2XAK in Stratford (near Bridgeport), Connecticut (RADIO-ELECTRONICS, August, 1950), played a major part in speeding up the "thaw" by broadcasting continuously for two years and eight months according to strict commercial standards, and by making its facilities and test data available to the entire TV industry and to the public. During the 32 months of its career, KC2XAK broadcast u.h.f. TV programs 14 hours a day, 5 days a week, and served as the experimental guinea pig for the TV industry.

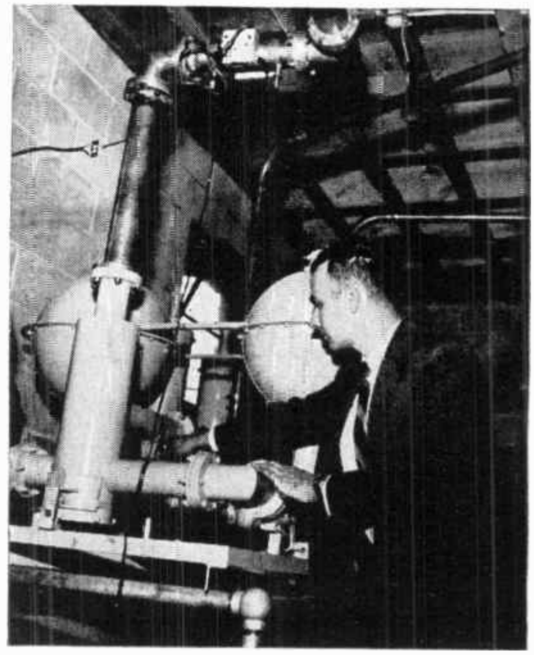
Aside from its routine program operations this pioneer station furnished answers to vital problems of tube and component performance at u.h.f., circuit stability data, and transmitting-antenna design information. It also helped TV-receiver manufacturers design and field-test u.h.f. receivers, antennas, and converters, and aided test-equipment manufacturers in designing and testing frequency- and modulation-monitoring equipment for future commercial service. The final sign-off took place on August 23. Bill McAlister and myself, who had started with KC2XAK as the two-man operational staff and had lived with it through its more than two-and-a-half years' existence, were assigned to go along with the station and get it going again in its new home.

Just 26 days later, on September 18, 1952, the KC2XAK transmitter came on the air again as a television station in Portland, Oregon. Under new call letters, it then became the world's first commercial u.h.f. TV station two days afterward when it signed on the air officially as KPTV, channel 27, ending the television famine for a city of over half a million people. In transmitting a test pattern exactly 10 days after the first piece of electronic equipment was moved into the still-uncompleted transmitter building, KPTV not only surprised the broadcast industry, but set off the frantic rush of receiver sales and installations which will keep Portland's radio and TV technicians red-eyed and sleepless for many a month.

Operation on TV channel 27, 548–554 mc, instead of the original 529–535 mc meant that a new antenna and filterplexer had to be built, the transmitter retuned, and a new control crystal ground. In a brief 26 days we tagged, dismantled, and packed the complete transmitter and tower, anxiously followed their progress on the 3,000-mile haul from the East to the West Coast, and reassembled it at its new location.

After the transmitter was retuned to the new frequency at Bridgeport, it was broken down into paired frames and racks; heavy or fragile components were removed, packed, and crated in-

* Engineer, National Broadcasting Co.



Right—Victor Bary checks KPTV's "filterplexer," which feeds sound and video signals to a single transmitting antenna. Above—KPTV's chief station engineer Russ Olsen (seated) and Bill McAlister of NBC.

dividually, and loaded immediately aboard a transcontinental motor van. The tower and antenna were disassembled, marked, and loaded aboard a fast-freight railroad car—the tower destined for Portland, and the antenna to be returned to RCA in Camden, New Jersey, as it was unsuitable for operation at the higher frequency. The transmitter reached Portland September 8, and the tower and new antenna arrived three days later.

We went to work immediately, keeping the same floor plan and general layout used in Bridgeport. In this way, we were able to use the original interconnecting cables, so that work proceeded rapidly. An Indian-head monoscope and synchronization generator were added to the original video equipment, along with additional amplifiers for the temporary studio. When the 60-kva service line was finally brought in five days later we were able to fire up and deliver full power to the dummy load the same day.

Meanwhile, the tower had been erected, the 3⅛-inch transmission line installed, and the new transmitting antenna checked. KPTV's owner was kept informed of our daily progress, and made immediate application for temporary authorization to broadcast. Work went on without interruption and in the next five days, a film camera chain was set up and checked, and a sound-isolated studio was constructed—complete with video- and audio-monitoring equipment and program lines. Construction work on the building itself was still going on, and we were forced to compete for work space with bricklayers, carpenters, plumbers, and electricians. The complex co-ordinated effort—including authorization from the FCC, and the Portland City Commission, and planning, manufacturing, and construction by RCA, NBC, and the Empire Coil Company—culminated in the station's official sign-on on September 20. KPTV's ground-breaking ceremony in August had set off a flood of local rumors and speculation as to the opening day. Daily construction progress was reported in print and picture.

Needless to say, KPTV's early arrival surprised even the most optimistic prognosticator: Portland was able to see its first televised World Series.

A rapid, but extensive reception survey was undertaken by RCA as soon as the channel 27 test pattern hit the air, and the coverage proved immensely gratifying, with good clear pictures being received 25 to 30 miles away. Usable-picture reports also came from Salem (45 miles away) and other localities, with one report of good reception (the furthermost one at that time) at 90 miles distance.

Dominating the city from a height of over 1,000 feet, the 17-kilowatt effective radiated power developed from the basic 1-kilowatt transmitter output by the RCA TFU-24 antenna, is beamed downward over a service area which is topographically a virtual plain, an ideal situation for good u.h.f. reception. Terrain and foliage-shadow problems, though minimized by the exceptional transmitting height, were nevertheless present and accounted for poor pictures in some areas. A rough estimate based on this early survey showed 10% of the locations checked were getting poor signals or none at all. Many of these locations, behind high hills, tall buildings, or shadowed by high trees, were able later to get acceptable pictures with higher-gain antennas, with elevated antennas, or by reorienting so that they worked from a strong reflection; and by using more sensitive u.h.f. converters. From the installer's viewpoint, each of these cases was a "special," as the time required to search for a signal, and substitute higher-efficiency components meant losing valuable time at a period when the technician could least afford it.

Performance reports on various makes of converters and antennas showed that good results were obtained with both built-in (turret-strip) and external converters; with dipole antennas (single and stacked "bow-ties"); as well as with Yagis, corner reflectors, parabolas, and vees. Performance of dual-purpose antennas could not be evaluated fairly as no v.h.f. signal was available but the dual's performance on u.h.f. did not always match the ones designed strictly for u.h.f. reception. Three days after KPTV's test signals appeared on the air, not a turnbuckle, stand-off insulator, spool of lead-in or guy wire or other equipment needed for antenna installation could be bought from local suppliers. Receivers and converters were arriving hourly by truck, railroad, and air freight. These were rushed immediately to hastily-set-up test points in warehouses, where they were checked over by crews working round-the-clock. The larger service organizations imported experienced crew chiefs to train and instruct local teams in the techniques of handling u.h.f. TV, and to assist independent service technicians in getting started.

Two days after the first test pattern transmission, KPTV signed on officially, with a program originating in the temporary studio in the transmitter building. The opening program included an address by Herbert Mayer, head of KPTV and the Empire Coil Co.; a documentary film on the history of u.h.f. TV; the NBC network's All-Star Review, and the Show of Shows. Later, the 1952 World Series played to standing-room-only audiences in automobile showrooms, furniture stores, and appliance stores throughout town.

After a hectic three weeks I left KC2XAK-KPTV and Portland to return East. Bill McAlister stayed on to help put on the finishing touches, wrap up loose ends, and train a technical staff, as well as to help plan and construct KPTV's proposed studios in the heart of the city.

Television had come to Portland at last.

END

KINESCOPE REPLACEMENT CHART

By E. W. SCOTT

This chart simplifies comparisons of the principal characteristics of most television picture tubes

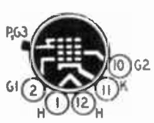


Fig.1

Fig.2

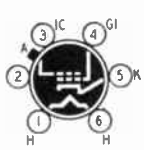


Fig.3

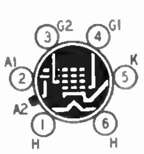


Fig.4

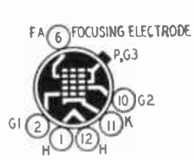


Fig.5

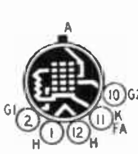


Fig.6

Fig.7

Tube type	Bulb diameter or diagonal (inches)	Over-all length	Ion trap type	Base diagram Fig. No.	Anode connector	Notes
10-inch glass round, 50 degrees						
10BP4	10 1/2	17 5/8	Double	1	Cavity	
10EP4	10 1/2	17 5/8	Double	1	Ball	
10FP4	10 1/2	17 5/8	None	1	Cavity	
10MP4	10 1/2	17	Single	2	Cavity	
10CP4	10 1/2	16 5/8	None	1	Ball	
10-inch glass round, 50 degrees, electrostatic focus						
10DP4	10 1/2	17 5/8	None	5	Cavity	a
12½-inch glass round, 50 degrees						
81034	12 9/16	17 7/8	Single	1	Cavity	p
12LP4	12 7/16	18 3/4	Double	1	Cavity	
12TP4	12 7/16	18 3/4	Double	1	Cavity	a
12VP4	12 7/16	18	Single	2	Cavity	
12WP4	12 7/16	17 3/4	Single	7	Special	
12KP4	12 7/16	17 5/8	None	1	Cavity	
12QP4	12 7/16	17 1/2	Single	1	Ball	
12JP4	12 3/16	17 1/2	None	1	Ball	d
12RP4	12 3/16	17 1/2	Single	1	Ball	d
12CP4	12 1/16	18 5/8	None	3	Cavity	a, b, c
12½-inch glass round, 40 degrees, electrostatic focus						
12AP4	12 3/16	25 3/8	None	4	Cap	a, c
12½-inch metal round, 54 degrees						
12UP4	12 7/16	18 5/8	Double	1	Cone	a
14-inch glass rectangular, 70 degrees						
14BP4	13 11/16	16 13/16	Double	1	Cavity	
14EP4	13 11/16	16 13/16	Double	1	Cavity	
14CP4	13 11/16	16 3/4	Single	1	Cavity	
14DP4	13 11/16	16 3/4	Double	1	Cavity	
14-inch glass rectangular, 70 degrees, h.v. electrostatic focus						
14GP4	12 21/32	17 3/16	Single	5	Cavity	
15-inch glass round, 50 degrees						
15CP4	15 3/4	21 7/8	Double	1	Cavity	a
15-inch glass round, 57 degrees						
15AP4	15 3/4	20 7/8	None	1	Ball	a
15DP4	15 3/4	20 7/8	Single	1	Ball	a
81014	15 3/4	20 7/8	Single	1	Cavity	k
16-inch glass round, 50-60 degrees						
16MP4	16 1/8	21 3/4	Double	1	Cavity	
16FP4	16 1/8	21 1/4	Single	1	Ball	a
16JP4	16 1/8	20 3/4	Double	1	Cavity	
16LP4	15 7/8	22 1/4	Double	1	Cavity	f, g
16CP4	15 7/8	21 1/2	Double	1	Cavity	a, f, g
16HP4	15 7/8	21 1/4	Double	1	Cavity	f
16DP4	15 7/8	20 3/4	Double	1	Cavity	a
16-inch glass rectangular, 70 degrees						
16UP4	17 1/8	18 1/8	Single	1	Cavity	a
16TP4	16 5/16	18 1/8	Single	1	Cavity	
16QP4	16 1/8	19 1/3	Double	1	Cavity	a, e
16KP4	16 1/8	18 3/4	Single	1	Cavity	
16RP4	16 1/8	18 3/4	Single	1	Cavity	
16XP4	16 1/8	18 3/4	Double	1	Cavity	a
16-inch glass round, 70 degrees						
16ZP4	15 7/8	22 1/4	Double	1	Cavity	h
16WP4	15 7/8	17 3/4	Double	1	Cavity	a, h
16SP4	15 7/8	17 5/16	Single	1	Cavity	h
16YP4	15 7/8	17 5/16	Single	1	Cavity	h
16VP4	15 7/8	17 3/16	Single	1	Cavity	a
16-inch metal round, 53 degrees						
16AP4	15 7/8	22 5/16	Double	1	Cone	a
16-inch metal round, 60 degrees						
16EP4	15 7/8	19 5/8	Double	1	Cone	a
16-inch metal round, 70 degrees						
16GP4	15 7/8	17 11/16	Single	1	Cone	a, i
16-inch glass round, 60 degrees, self focus						
16ACP4	15 7/8	20 7/8	Single	6	Cavity	

Tube type	Bulb diameter or diagonal (inches)	Over-all length	Ion trap type	Base diagram Fig. No.	Anode connector	Notes
17-inch glass rectangular, 70 degrees						
17BP4	16 3/4	19 5/8	Single	1	Cavity	
17AP4	16 3/4	18 5/8	Single	1	Cavity	
17JP4	16 3/4	19 9/16	Single	1	Cavity	
17QP4	16 3/4	19 9/16	Single	1	Cavity	m
17UP4	16 3/4	19 9/16	Single	1	Cavity	m
17YP4	16 3/4	19 9/16	Single	1	Cavity	m
17-inch glass rectangular, 70 degrees, electrostatic focus						
17FP4	16 3/4	19 5/8	Single	5	Cavity	s
17HP4	16 3/4	19 9/16	Single	5	Cavity	r
17LP4	16 3/4	19 9/16	Single	5	Cavity	m, r
17RP4	16 3/4	19 3/4	Single	5	Cavity	r
17VP4	16 3/4	19 9/16	Single	5	Cavity	m, r
17KP4	16 3/4	19 5/8	Single	6	Cavity	t
17SP4	16 5/8	19 3/16	Single	6	Cavity	m, t
17-inch metal rectangular, 70 degrees						
17CP4	17	19	Single	1	Cone	a
17-inch metal rectangular, 70 degrees electrostatic focus						
17GP4	17	18 1/16	Single	5	Cone	a, s
17TP4	16 13/16	19 5/16	Single	5	Cone	a, r
19-inch glass round, 66 degrees						
19FP4	18 7/8	22	Double	1	Cavity	a
19DP4	18 7/8	21 1/2	Double	1	Cavity	e
19GP4	18 7/8	21 1/4	Single	1	Cavity	a
19-inch metal round, 66 degrees						
19AP4	18 3/4	22	Single	1	Cone	a
19-inch glass rectangular, 70 degrees						
19JP4	18 5/8	21 3/16	Single	1	Cavity	a
19EP4	17 1/8	21 1/2	Double	1	Cavity	
20-inch glass round, 54 degrees						
20BP4	20 3/8	28 3/4	None	1	Cap	a
20-inch glass rectangular, 70 degrees						
20DP4	20 3/32	21 7/8	Single	1	Cavity	
20CP4	20 7/32	21 13/16	Single	1	Cavity	a, n
20-inch glass rectangular, 70 degrees, electrostatic focus						
20MP4	20 9/32	22 1/8	Single	5	Cavity	r
20HP4	20 7/32	22 1/8	Single	5	Cavity	a, n, r
20LP4	20 7/32	22 1/8	Single	5	Cavity	r
20FP4	20 3/32	22 1/8	Single	5	Cavity	a, n, s
20GP4	20 3/32	22 1/8	Single	5	Cavity	s
20-inch glass rectangular, 70 degrees, self-focus						
20JP4	20 7/32	22 1/8	Single	6	Cavity	
21-inch metal rectangular, 70 degrees						
21DP4	22 5/8	21	Single	5	Cone	a, s
21GP4	22 5/8	21	Single	6	Cone	a, t
21AP4	20 3/4	22 5/8	Single	1	Cone	
21MP4	21	22 5/8	Single	5	Cone	a, r
21-inch glass rectangular, 70 degrees						
21FP4	21 11/32	23 3/8	Single	5	Cavity	m, r
21KP4	21 11/32	23 3/8	Single	6	Cavity	m, t
21EP4	21 11/32	23 3/8	Single	1	Cavity	o
21WP4	20 5/8	22 5/8	Single	1	Cavity	
21WP4X	20 5/8	22 1/8	Single	1	Cavity	q
22-inch metal round, 70 degrees						
22AP4	21 11/16	22 7/8	Single	1	Cone	a
24-inch metal round, 70 degrees						
24AP4	24 1/8	24 7/16	Single	1	Cone	a
24-inch metal round, 70 degrees, l.v. electrostatic focus						
24BP4	24 1/8	24 7/16	Single	5	Cone	a
27-inch metal rectangular, 90 degrees						
27AP4	26 7/8	21 7/8	Single	1	Cone	
27-inch glass rectangular, 90 degrees						
27EP4	27	23 3/32	Single	1	Cavity	
30-inch metal round, 90 degrees						
30BP4	30 1/8	23 9/16	Single	1	Cone	a

The modern TV service technician has found that many of the big-screen picture tubes of a few years ago are either practically extinct or—like the 20AP4—now cost several times as much as newer tube types of equal size or larger. Converting the set to use one of the new tube types is often the most practical and economical solution to the problem.

At this point, the technician has the problem of selecting the most suitable replacement tube. The logical solution is to select a tube which can be installed with the fewest possible changes in the circuit and the receiver cabinet. This tabulation of magnetic-deflection tubes has been prepared to help the technician select the logical tube for any conversion or replacement.

Tubes are listed according to size, shape, diagonal deflection angle, and method of focusing. Types with angles of 50 to 60 degrees can usually be interchanged without modifying the receiver circuits. The flyback transformer and yoke should be replaced when the replacement tube is a round type with a 66- to 70-degree deflection angle or a rectangular type having a 70-degree *diagonal* deflection angle.

Sweep and operating voltages to give adequate picture size and brightness with the new tube can be obtained by selecting suitable horizontal-output and deflection components, and applying conversion techniques described in the many conversion articles which have been published in RADIO-ELECTRONICS. A complete tabulation of yokes, horizontal-output and flyback transformers, and other conversion components is included on page 66 of this issue.

Note: Recently-made RCA 10BP4, 12LP4, and 16AP4 tubes have a new type gun. Although they operate satisfactorily with double-field beam-benders used with earlier types they are designed to work with single field beam-bender. If trouble develops, substitute a single-field PM type ion-trap magnet designed for the 16GP4.

FOOTNOTES

a—Tube has no exterior conductive coating. Add 500-μμf, high-voltage filter capacitor when using tube as replacement for type having exterior coating. When this type is replaced by tube having outside coating, ground the coating to the chassis.
b—Triode type tube; has no No. 2 grid. For circuitry, refer to diagrams of sets using triode and tetrode types. Alter receiver circuits where necessary to suit tube being used for replacement.
c—This tube has 2.5-volt, 2.1-amp heater; all others have 6.3-volt, 600-ma heaters.
d—Faceplate curvature has 20-inch radius; all others in this group have 40-inch radius.
e—Requires JETEC-RTMA type 106 focus coil; others in this group use type 109 focus coil.
f—Faceplate curvature has 56-inch radius; others in this group have 27-inch radius.
g—Deflection angle is 50 degrees. The deflection angle for other tubes in this group is 60 degrees.
h—Radius of faceplate curvature is 56 inches.
i—Radius of faceplate curvature is 40 inches; all others in this group have 27-inch radius.
j—17BP4-A and B have outside conductive coatings; 17BP4 has not.
k—Identical to 15DP4 except it has gray faceplate and cavity type anode contact.
m—Cylindrical face.
n—Tube with suffix "A" has external conductive coating.
o—Tube with suffix "A" has cylindrical face.
p—Identical to 12QP4 except that anode contact is recessed-cavity type.
q—Experimental type—first run.
r—Tube has low-voltage electrostatic focus electrode.
s—Tube has high-voltage electrostatic focus electrode.
t—Self-focus tube.

END

TELEVISION COMPONENTS

THE SUCCESS of any TV conversion or repair job in terms of customer satisfaction depends on high-quality materials and high-grade workmanship. From the technician's viewpoint, there's also the question of profit. The technician has the ability and equipment to do the job profitably, so he needs only to supply high-quality, long-lasting components to win and hold a satisfied customer. This tabulation will enable him to select the desired components for any job quickly and accurately.

Before beginning any service job that requires the replacement of the horizontal output transformer or deflection yoke, it is advisable—whenever possible—to check the tubes and all operating voltages to insure that the balance of the set is working with maximum efficiency. Do not operate a television receiver with the deflection yoke disconnected or the plate cap removed from the horizontal output tube. The first is likely to cause damage to the focus control potentiometer and the latter will quickly damage the output tube.

After installing the new components, carefully readjust the horizontal frequency and drive controls and the setting of the ion trap in accord with the set manufacturers' service instructions. Failure to do this may result in abnormal or subnormal sweep, high and boosted B plus voltages, and a damaged picture tube.

When yoke and output transformer are to be replaced, manufacturers' matched sets are desirable whenever possible. When using unmatched units, try connecting the width coil and deflection yoke across the various taps on the secondary of the transformer to determine which gives the best performance.

Corona and arc-over often occur after a new high-voltage transformer has been installed. Higher operating voltages, changes in lead dress, grime-encrusted insulation materials, and poor placement of parts often combine to cause these troubles.

Corona which occurs from a high-voltage point close to the chassis, high-voltage cage, or other grounded body will often cause a shiny spot to appear on the grounded body directly opposite the spot where corona occurs. A pitted or burned spot will be seen at the point of an arc. These troubles can be eliminated by rounding off all sharp edges and by increasing separation between ground and the high-voltage component. One quick method of eliminating these troubles is to coat the high-voltage point with anti-corona dope or lacquer and use a large ball-peen hammer to make a concave dimple in the cage cover directly opposite the point where the corona or arc occurred.

HORIZONTAL OUTPUT AND H.V. TRANSFORMERS

Mfr. and Type No.	Max. kv	Defl. Angle (deg.)	Core	Typical Output Tubes	H.V. Rect. Tubes	Mfr.'s Matching Yoke	Equiv. G-E-RCA Transformer
DUMONT H1A1	13	70	Ferrite	6BG6-G 6BQ6-GT	1B3-GT 1X2	Y2A1 Y2A2	77J1
G-E 77J7	15	70	Ferrite	6AV5-GT 6BQ6-GT 6AU5-GT 6BG6-G	1X2-A		
HALL FB400	10	50–57	Pow. iron	6BG6-G	1B3-GT	DF600	211T3
HALL FB401	14	70	Ferrite	6BG6-G 6BQ6-GT	1B3-GT 1X2-A	DF601 DF602	77J1
HALL FB402	13.5	50–57	Pow. iron	6BG6-G	1B3-GT	DF600	211T5
HALL FB403	13	70	Pow. iron	6BG6-G	1B3-GT	DF601	
HALL FB404	14	70	Air	6BG6-G	1B3-GT 1X2-A	DF603	74951
HALL FB405[23]	15	70	Ferrite	6CD6-G	1B3-GT 1X2-A	DF601	79C30-2, -4 79038-1[24]
HALL FB406[23]	15	70	Ferrite	6CD6-G	1B3-GT 1X2-A	DF601	79C30-1, -3[24]
MERIT HVO-5	14	70	Ferrite	6BG6-G 6CD6-G 6BQ6-GT	1B3-GT or 1X2-A for all types	MD-12	211T5
MERIT HVO-6	14	70	Ferrite	6BG6-G 6CD6-G 6BQ6-GT 6AU5-GT		MDF-70	77J1
MERIT HVO-7	14	70	Ferrite	6BG6-G 6CD6-G 6BQ6-GT 6AU5-GT 6AV5-GT		MDF-70	
MERIT HVO-8	14	70	Ferrite	6BG6-G 6CD6-G 6BQ6-GT		MDF-30	
MERIT HVO-9	18	70	Ferrite	6CD6-G 6BG6-G 6BQ6-GT		MDF-70 MDF-71	
MERIT HVO-10	15	70	Ferrite	6CD6-G 6BG6-G 6BQ6-GT 6AU5-GT 6AV5-GT		MDF-70	
RAM XO32[3]	13		Ferrite	6BG6-G 6BQ6-GT 6AU5-GT for all types to and including XO47	1B3-GT or 1X2-A for all types	Y70F08	
RAM XO35	14.5		Ferrite			Y70F08 Y70F10	204T3
RAM XO45	14	70	Ferrite			Y70F14 Y70F17 Y70F30	RTO-068, -076, -090
RAM XO47	12–14		Ferrite			Y70F08	
RAM XO49[25]	13.5–15	70	Ferrite	6BG6-G 6BQ6-GT 6AU5-GT 6CD6-G		Y70F10 Y70F14	
RAM XO50[26]	14	70	Ferrite	Same as XO32		Y70F08 Y70F10	
RAM XO51[27]	14	70	Ferrite	Same as XO32		Y70F14 Y70F17 Y70F30	
RAM XO53[9]	15–16	70	Ferrite	6BQ6-GT		Y70F08 Y70F10	
RAM XO54[28, 29]	12–14	70		6BQ6-GT		Y70F30	
RAM XO64[28, 30]	12–14	70		6BQ6-GT		Y70F30/3	

LINEARITY COILS

Mfr. and Type No.	RCA-G-E Equiv.	Inductance (mh)
DU MONT L1A1		
G-E RLD-016		
MERIT MWC-1		0.3–27
MERIT MWC-2		0.1–4.0
MERIT MWC-3		20–60
RAM 201R3		5.0–20.0
RAM 201R5[22]		0.55–2.3
RAM 201R10		3.5–29.5

Mfr. and Type No.	RCA-G-E Equiv.	Inductance (mh)
RCA 201R3		5.5–20.0
RCA 201R5		0.55–2.3
RCA 207R1		1.3–4.3
RCA 209R1		1.3–4.1
RCA 213R1		1.5–8.3
STAN S-958	201R3	
STAN S-980	77J4	
TECH 1R3	201R3	
TECH 1R5[22]	201R5	
TECH 9R1	209R1	

FOR CONVERSION OR REPAIR

HORIZONTAL OUTPUT AND H.V. TRANSFORMERS (continued)

Mfr. and Type No.	Max. kv	Defl. Angle (deg.)	Core	Typical Output Tubes	H.V. Rect. Tubes	Mfr.'s Matching Yoke	Equiv. G-E–RCA Transformer
RAM XO65[28 31]	14–15	70		6BQ6-GT		Y70F20	
RAM XO66[3]	14	70		Same as XO32		Y70F08	
RAM XO68[28]	11–13.5	70	Air	6BG6-G		Y70F30[3]	
RAM XO69[28]	16–17.5	70		6AV5-GT		Y70F14	
RAM XO70	13	70	Ferrite	Same as XO32		Y70F08	
RAM XO71	15	70	Ferrite	6CD6-G		Y70F10	
RAM XO72	15	70	Ferrite	6BQ6-GT		Y70F10	
RCA 211T1	9	50–57	Pow. iron	6BG6-G	1B3-GT	201D12 207D1	
RCA 211T3	8.75	50–57	Pow. iron	6BG6-G	1B3-GT	201D12	
RCA 223T1	14	70	Ferrite	6AU5-GT	1B3-GT	209D1	
RCA 224T1	14	66–70	Ferrite	6BQ6-GT	1B3-GT	209D1 211D2	
RCA 225T1	16	66–70	Ferrite	6BQ6-GT 6AU5GT	1B3-GT	209D1 211D1	
RCA 230T1	18	66–70	Ferrite	6CD6-G	1B3-GT	211D1 211D2	
RCA 231T1[2 32]	15	50–70	Ferrite	All types	1B3-GT 1V2, 1X2-A	All	
RCA 232T1[2 28 32]	16	50–70	Ferrite	All types	1X2-A, 1V2, 1B3-GT	All	
ROOT SRJ1	14	70	Ferrite	6BG6-G 6BQ6-GT 6CD6-G	1B3-GT 1X2		77J1
ROOT SR-25[33]	21	90		(2) 6BQ6-GT	(2) 1B3-GT		
STAN S-948	9	50–57	Pow. iron	6BG6-G	1B3-GT		211T1
STAN S-968	12	50–57	Pow. iron	6BG6-G	1B3-GT		211T3
STAN S-978	13.5	50–57	Pow. iron	6BG6-G	1B3-GT		211T5
STAN S-988	14.3	50–57	Pow. iron	6BG6-G	(2) 1B3-GT		211T5
STAN S-999	14.5	70	Ferrite	6BQ6-GT	1X2		77J1
STAND A-8119	13	53	Pow. iron	6BG6-G	(2) 1B3-GT	DY-1	211T5
STAND A-8127	10	53	Pow. iron	6BG6-G	1B3-GT	DY-1	211T3
STAND A-8128	11	53	Pow. iron	6BG6-G	1B3-GT	DY-1	
STAND A-8129	13	70	Ferrite	6BG6-G	1B3-GT	DY-7	
STAND A-8130	14	70	Ferrite	6BG6-G	1B3-GT	DY-7	
STAND A-8131[17]	13	70	Air				
STAND A-8133	12.5–15	70	Ferrite				74951
TECH 15T1	10	53	Ferrite	6BG6-G	1B3-GT		215T1
TECH 11T5	13.5	60					211T5
TECH 23T1	14	70	Ferrite	6AU5-GT	1B3-GT		223T1
TECH 7J1	15	70	Ferrite	Most types	1X2-A		77J1
TODD CS21	15	50–70	Ferrite				
TODD CS24	15	70	Ferrite				
TODD CS24-AGC	16	70	Ferrite				
TODD CS21-AGC	16	70	Ferrite				
TODD CS-U[33]	10–14	50–70	Ferrite				
TODD CS-30	23	70–90	Ferrite				
TRIAD D-1	14	70	Ferrite	6BG6-G 6BQ6-GT	1X2-A 1B3-GT		77J1
TRIAD D-2	14	70	Ferrite	6BG6-G	1B3-GT 1X2-A		
TRIAD D-11	10	70	Iron	6BG6-G 6BQ6-GT	1X3	Y-11	
TRIAD D-14	14	70	Ferrite	6BG6-G 6BQ6-GT	1B3-GT	Y-12 Y-17	77J1
TRIAD D-15[1]	14	70	Ferrite	6BG6-G 6BQ6-GT	1B3-GT	Y-12	
TRIAD D-19[6]	16	70	Ferrite	6AV6-GT 6BQ6-GT	1B3-GT	Y-17 Y-19	225T1
TRIAD DA-20	14	70	Air	6AV6-GT 6BQ6-GT	1B3-GT	Y-20	74951

FOCUS DEVICES

Mfr. and Type No.	JETEC-RTMA Equiv.	C-R Tube High Volts (kv)	D.c. Res. (ohms)	Current (ma)
G-E RLF-038			1,400	30
HALL EM700	106	to 10	247	75–200
HALL EM 701	109	to 16	470	75–140
MERIT MF-1	106	10	247	200
MERIT MF-2	109	14	470	150
MERIT MF-3[15]		14	360	150
MERIT MF-4		15	1,000	75
MERIT MF-5		15	1,500	75
QUAM QF1[16]	106	to 12	Permanent Magnet Type,	
QUAM QF2[16]	109	above 12		
RCA 202D1	106	8–12	247	75–200

Mfr. and Type No.	JETEC-RTMA Equiv.	C-R Tube High Volts (kv)	D.c. Res. (ohms)	Current (ma)
RCA 202D2	109	9–14	470	75–140
STAND FC-10			247	200
STAND FC-11			470	140
STAND FC-12			370	165
TECH 2D1	106	10–12	247	115
TECH 2D2	109	12–16	470	95
TECH 2D1PM[16 20]	106			
TECH 2D2PM[16 21 37]	109[43]			
TRIAD B-160	23		160	210
TRIAD B-247	24		247	170
TRIAD B-470	25		470	125
TRIAD B-1000	25		1,000	85

WIDTH COILS

Mfr. and Type No.	No. Matching Horiz. Output Transformer	Inductance (mh)
DUMONT W1A1[39]	H1A1	
G-E RLD-019	RTO-085	
MERIT MWC-1[14,39]	HVO-6, -7 HVO-8, -9	
MERIT MWC-2	HVO-5, -9	
MERIT MWC-3	HVO-8, -9	
RAM 201R1	XO32	.05–0.25
RAM 201R4	XO35	0.17–0.61
RAM 201R10	XO45	3.5–29.5 (Pri.) 0.16–0.7 (Sec.)
RAM 201R11[39]	XO32, XO35 XO53	3.2–9.0
RCA 201R1		.05–0.25
RCA 201R2		85–240
RCA 201R4		0.17–0.61
RCA 206R1		0.47–1.7
RCA 211R1		1.65–9.2
RCA 212R1		2.9–16.0
STAN S-957	S-998	.05–0.25
STAN S-981[39]	S-999	
STAN S-984		
STAND WC-5[1]	All Stancor	4.0–39 A.g.c. winding 2.7–7.6
TECH 1R1	11T1, 15T1	
TECH 1R4	11T5	
TECH 1R4-AG[39]	11T1, 11T5	
TECH 1R4-J	TJ1	
TECH 1R4-E[39]	TJ1	

ION TRAPS

Mfr. and Type No.	Single or Double	PM or EM	Field Strength (gauss)
CLAR TV-2	Single	PM	
CLAR TV-3	Double	PM	
G-E RET-003	Single	PM	42
G-E RET-005	Single	PM	35
PERF IT135	Single	PM	35
PERF IT145-15	Double	PM	45[35] 15[36]
QUAM 1T1	Double	PM	38
QUAM 1T2	Double	PM	46
QUAM 1T3	Single	PM	42
RCA 203D1	Double	EM	
RCA 203D3[34]	Double	EM	55[35] 15[36]
TECH L1T1	Single	PM	35–45
TECH L1T2	Double	PM	45
TECH L1T3	Double	PM	

TV-TUBE MASKS

Mfr. & Type No.	Size Tube (inches)	Color	Material
CRON CK-14	14" rect.	Gold	Glass
CRON CK-16	16" rect.	Gold	Glass
CRON CK-17	17" rect.	Gold	Glass
CRON CK-20	20" rect.	Gold	Glass
CRON CK-21	21" rect.	Gold	Glass
JFD BR63-14	14" rect.		Plastic
JFD BR63-16	16" rect.		Plastic
JFD BR63-17	17" rect.		Plastic
JFD BR63-19	19" rect.		Plastic
JFD BR63-20	20" rect.		Plastic
JFD BR63-16R	16" round		Plastic
JFD BR63-19R	19" round		Plastic
TELE 712W	12½" round	Gold	Lucite
TELE 714R	14" rect.	Gold	Lucite
TELE 716R	16" rect.	Gold	Lucite
TELE 716W	16" round	Gold	Lucite
TELE 717R	17" rect.	Gold	Lucite
TELE 719W	19" round	Gold	Lucite
TELE 720R	20" rect.	Gold	Lucite
TELE 721R	21" rect.	Gold	Lucite
TELE 724W	24" round	Green	Lucite
TELE 227R	27" rect.	Green	Lucite

Note: Croname mask and escutcheon assemblies listed above consist of a heavy green-sprayed aluminum mask, ¼-inch tempered safety glass and a gold-finished escutcheon.

Tele Plastics masks listed above mount from rear of the cabinet. Masks which mount from the front of the cabinet have suffix "S." For example: 720W-S, and 727R-S.

MOUNTING SLEEVES

Mfr. and Type No.	Tube Types
TECH PL-4	Long-neck 16" metal round
TECH PL-4S	Short-neck 16" metal round
TECH PL-17R	17" metal rectangular
TECH PL-19	19" metal round

Note: Set consists of polyethylene sleeve, retainer ring, and rubber band. Insulated for more than 30,000 volts.

Footnotes for TV components tables:

1. Has a.g.c. winding which can be left open if not required.
2. Tapped secondary to match yokes from 8 to 30 mh and provide up to 15 kv output (16 kv with 232T1).
3. For type 630 circuits.
4. Damping resistors built-in. R-C network supplied.
5. Complete with built-in R-C network.
6. Especially for 19-inch round and 20-inch rectangular tubes.
7. Designed for autotransformer type flyback transformer.
8. Has focus-coil mounting bracket.
9. Cosine yoke.
10. Equivalent to 201D1.
11. Same as 201D1 with different terminal connections.
12. Same as 201D1 with molded core.
13. Equivalent to 201D1, 203D3 and 201D12.
14. Also used as horizontal linearity coil.
15. For 10- or 12-inch tubes.
16. PM focus magnets with adjustable centering controls.
17. Any 70-degree yoke.
18. Equivalent of 209D1, 206D1, and Y2A.
19. Same as 211D1 except for clamping networks.
20. Any voltages suitable for 10- or 12-inch tubes.
21. Any voltages suitable for any 70-degree tubes.
22. Tapped linearity coil.
23. Coil and terminal assembly only. Core pieces to be taken from transformer being replaced.
24. Admiral part number.
25. Has separate a.g.c. or width-coil winding.
26. Has separate a.g.c. winding.
27. Similar to XO45, but operates on lower voltage.
28. Autotransformer.
29. Used in CBS sets.
30. Used in early Emerson sets.
31. Used in late Emerson sets.
32. Universal type.

DEFLECTION YOKES

Mfr. & Type No.	Defl. Angle (deg.)	Max. Tube Size (inches)	Induct. Horiz. Winding (mh)	Induct. Vert. Winding (mh)	Core
DUMONT Y2A1[5]	70	Any	10.5	42.0	Ferrite
DUMONT Y2A2	70	Any	10.5	42.0	Ferrite
DUMONT Y2A3[7]	70	Any	10.5	42.0	Ferrite
DUMONT Y2A5[5 7]	70	Any	10.5	42.0	Ferrite
G-E RLD-024[5 8]	70	24	15.0	30.0	Ferrite
G-E RLD-025[5]	70	24	15.0	30.0	Ferrite
HALL DF600	53	16	8.3	50.0	Iron
HALL DF601	70	24	8.5	50.0	Ferrite
HALL DF602	70	24	13.5	50.0	Ferrite
HALL DF603	70	24	30.0	3.5	Ferrite
HALL DF604	70	24	30.0	50.0	Ferrite
MERIT MD-12[13]	53	16 round	8.3	50.0	
MERIT MD-13	53	16 round	30.0	50.0	
MERIT MDF-30[18]	70	24	30.0	3.0	Ferrite
MERIT MDF-70[18]	70	24	10.3	45.0	Ferrite
MERIT MDF-71	70	24	30.0	50.0	
RAM Y70108[5]	70	16	8.3	50.0	Iron wire
RAM Y70F08[5]	70	17	8.3	50.0	Ferrite
RAM Y70F10[5]	70	24	10.3	50.0	Ferrite
RAM Y70F14[5]	70	20	14.0	50.0	Ferrite
RAM Y70F17[5]	70		17.0	50.0	Ferrite
RAM Y70F20[5]	70		20.0	50.0	Ferrite
RAM Y70F30[5]	70		30.0	50.0	Ferrite
RAM Y70F30/3[5]	70	24	30.0	3.3	Ferrite
RCA 201D12[11]	50–57	16	8.3	50.0	Iron wire
RCA 205D1[11]	50–57	12	12.5	50.0	Molded iron
RCA 206D1[9]	66–70	17	10.3	41.5	Ferrite
RCA 207D1[12]	50–57	16	8.4	55.0	Molded iron
RCA 209D1[9]	66–70	17	13.3	41.0	Ferrite
RCA 211D1[9]	66–70	21	13.3	41.0	Ferrite
RCA 211D2[4 9 32]	66–70	21	13.3	41.0	Ferrite
STAND DY-1[10 38]	53		8.3	50.0	Molded iron
STAND DY-8[9 38]	70		8.5	50.0	Ferrite
STAND DY-9[9 38]	70		13.5	50.0	Ferrite
STAND DY-10[9 38]	70		30.0	3.5	Ferrite
TECH 11D1	70	Any 70°	13.3	41.5	Ferrite
TODD CF303	70	24	30.0	3.0	Ferrite
TODD CF850	50–66	16	8.3	50.0	Ferrite
TODD CF1041	70	24	10.0	41.0	Ferrite
TODD CF1050	70	24	10.0	50.0	Ferrite
TODD CF1156	90	30	11.0	56.0	Ferrite
TODD CF1441	70	24	14.0	41.0	Ferrite
TODD CF1450	70	24	14.0	50.0	Ferrite
TODD CF1850	70	24	18.0	50 0	Ferrite
TODD CF2056	90	30	20.0	56.0	Ferrite
TODD CF3050	70	24	30.0	50.0	Ferrite
TRIAD Y-11[5]	50	12	8.3	50.0	Iron
TRIAD Y-12[5 9]	70	12	8.3	50.0	Ferrite
TRIAD Y-17[5 9]	70	17	13.5	41.5	Ferrite
TRIAD Y-19[9]	70	17	23.0	41.5	Ferrite
TRIAD Y-20[9]	70	24	30.0	3.3	Ferrite

33. Composite 90-degree deflection and high-voltage supply.
34. Universal ion trap. May be used as single-field type by removing small ring-shaped magnet.
35. Large magnet.
36. Small magnet.
37. For tubes up to 70 degrees.
38. Available with or without leads and networks.
39. Has a.g.c. winding.

CODE — MANUFACTURER

CLAR—Clarostat Mfg. Co., Inc., Dover, N. H.
CRON—Croname, Inc., 3701 Ravenswood Ave., Chicago 13, Ill.
DU MONT—Allen B. Du Mont Laboratories, Inc., Electronic Parts Sales, 35 Market St., East Paterson, N. J.
G-E—General Electric Co., Receiver Parts Sales, Bldg. 5, Syracuse, N. Y.
HALL—The Halldorson Co., 4500 Ravenswood Ave., Chicago 40, Ill.
JFD—JFD Mfg. Co., Inc., 6101-6123 16th Ave., Brooklyn 4, N. Y.
MERIT—Merit Transformer Corp., 4427 N. Clark St., Chicago 40, Ill.
PERF—Perfection Electric Co., 2635 S. Wabash Ave., Chicago 16, Ill.
QUAM—Quam-Nichols Co., 33rd Place and Cottage Grove Ave., Chicago 16, Ill.
RAM—Ram Electronic Sales Co., South Buckhout St., Irvington-on-Hudson, N. Y.
RCA—Radio Corp. of America, Tube Dept., Harrison, N. J.
ROOT—Square Root Mfg. Corp., 391 Saw Mill River Rd., Yonkers, N. Y.
STAN—Stanwyck Winding Co., Inc., P. O. Box 70, Newburgh, N. Y.
STAND—Standard Transformer Corp., 3580 Elston Ave., Chicago 18, Ill.
TECH—Tech Master Products Co., 443 Broadway, New York, N. Y.
TELE—Tele Plastics Co., Division of Willmax Mfg. Co., 202 Broadway, Brooklyn 11, N. Y.
TODD—Todd-Tran Corp., 158 Gramatan Ave., Mt. Vernon, N. Y.
TRIAD—Triad Transformer Mfg. Co., 4055 Redwood Ave., Venice, Calif.

END

TV SERVICE CLINIC

Conducted by
MATTHEW MANDL*

Appearance of screen when cosine yoke is used without the corrector magnets.

MANY queries regarding the features and installation factors of the Standard cascode tuner have been received by the Clinic. When old tuners are replaced with the cascode type a 2-1 improvement in gain can be realized. Besides this, there is a reduction of 35 to 50% in noise (snow effect) over a pentode tuner. These advantages are due to the cascode principle, plus use of the 6BQ7, 6BK7, or the newer 6BZ7 tubes. (A detailed discussion of the cascode type front end is given in RADIO-ELECTRONICS, April, 1952, page 46.)

The cascode tuner made by the Standard Coil Products Co. is model TV-2000, 2300 series and is designed to replace most of the older tuners of conventional size. The Standard tuner is 4 19/32 inches deep and 3¼ inches wide. Another model, the TV-2032, is electrically identical to the TV-2000 except that both the fine tuning and station selector shafts are extra long so that they may be cut as desired.

The tuner is for use with intercarrier or other receivers where sound take-off is not within the tuner circuit (at mixer output). For receivers requiring a 21.25-mc sound take-off coil, part No. XM-752 must be used, as shown in Fig. 1. This coil can be mounted on the chassis near the tuner. The capacitor designated C_T is not supplied with the tuner or coil and should be approximately 2 to 4 μμf. If greater audio output is required, the circuit shown in Fig. 2 can be used.

The output intermediate frequency is set at 22.3-mc at the factory, but the output is adjustable between 19 and 26 megacycles to suit the particular i.f. input system of the receiver. A screw set at an angle on top of coil L9 permits changing the output frequency within the range provided. The tuner tracking is preset at the factory and no other adjustments are normally necessary. If required, the oscillator coils can be adjusted individually for the different channels by centering the fine tuning control and using a noninductive screwdriver through the hole adjacent to the selector shaft.

In fringe areas best results are obtained by using the maximum plate voltage of 250. An a.g.c. (or manually controlled) bias of -0.8 to -1.1 volts applied to the white a.g.c. lead gives best sensitivity. The black lead goes to the 6.3-volt a.c. source for the heater, while the red lead requires 135 volts plus and the blue 250 volts.

For u.h.f. reception, individual channel strips are available. These can replace any unused channel plug-in coils at the v.h.f. frequencies (channels 2 to 13). A separate u.h.f. strip must be used for every u.h.f. channel desired. Once the oscillator and antenna coil strips have been inserted, the selector shaft is rotated to the u.h.f. channel strip's operating position.

If the fine tuning doesn't produce the best picture at the mid-point of its range, the u.h.f. oscillator slug can be adjusted as previously mentioned for the v.h.f. stations. The u.h.f. strips contain an r.f. preselector, a crystal mixer, and a crystal harmonic generator to convert the ultra-high frequency carrier to the receiver i.f.

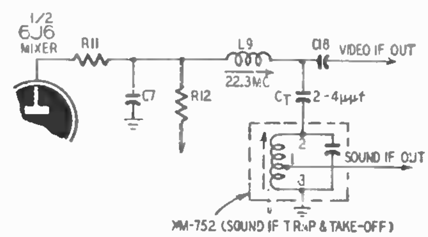


Fig. 1—How a sound take-off and trap can be installed in the cascode tuner.

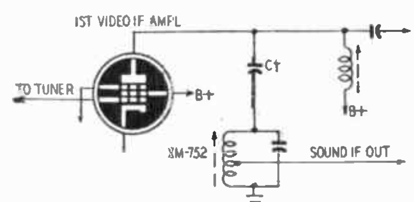


Fig. 2—Circuit for more sound output.

Conversion to 21 inches

I would like to convert a 630 type receiver to a 21-inch tube. The receiver already uses a 16HP4 tube with a high-voltage doubling system. What wiring changes and tube types do you recommend? W. H., Astoria, L. I.

The 16HP4 has a 60-degree deflection angle. This means the present horizontal output transformer and yoke will not give satisfactory results for the 21-inch tubes, which have 70 degrees of deflection. Thus, a wide-angle transformer and yoke are necessary.

You could use a 21EP4A, which is a rectangular tube with a cavity high-voltage contact, single-magnet ion trap, and a 70-degree deflection angle. This is the curved-face tube which minimizes room glare. If a cosine yoke (wide-focus) is used, corrector magnets will have to be installed (see a discussion of this in the June, 1952, issue of RADIO-ELECTRONICS, Television Service Clinic). Without the corrector magnets, pincushioning and nonlinearity will be difficult to correct. The photograph shows a test pattern on a 21EP4A tube without the use of corrector magnets. Despite the best adjustments of linearity controls, the inner circle shows defects in linearity.

A self-focus tube such as the 21KP4A tube can also be used. The existing focus-coil assembly must be removed from the tube neck because focus is correct when the ion trap is placed at maximum brilliancy. The focus coil can be replaced with a resistor of the same d.c. resistance value.

16GP4 to 17BP4

What electrical changes would be necessary to change a receiver's 16GP4 to a 16RP4 or a 17BP4? E. C., New Orleans, La.

As the 16GP4 is a 70-degree deflection tube, no changes should be necessary. If a 16RP4 is used, a double-magnet ion trap is necessary and the high voltage must be applied to the cavity contact receptacle of the glass tube. The 17BP4A has an external conductive coating and the 17BP4 does not. Both tubes use a single-magnet ion trap and a cavity-type high-voltage contact. END

* Author: Mandl's Television Servicing.

TV BOOSTER

Manufacturer	Model	Band selection	Channel tuning	Tube(s)	Circuit	Instal-lation	Other features
Alliance Manufacturing Co. **Lake Park Blvd., Alliance, Ohio**	Tenna Scope AB	Sep. amps switching	Slug	2—6J6	T.p.t.g.	St.	Auto.
	Cascamatic BB	Automatic wide-band	Slug	2—6J6 1—6BK7A	Cascode	St.	Auto.
Anchor Radio Corporation **2215 So. St. Louis Ave.** **Chicago 23, Ill.**	ARC-101-75	All-channel switching	Slug	1—6AK5	T.p.t.g.	St.	Gain control
	ARC-101-100	All-channel switching	Slug	2—6AK5	2-stage	St.	Gain control
Approved Electronic Inst. Corp. **928 Broadway, New York 10, N. Y.**	A-TVB	Chan. 12-13	Untuned	2—6J6	2-stage	St.	
	A-UHF	U.h.f.	Untuned	2—6AF4	2-stage	St.	A.c. operation
	B-VHF	V.h.f.	Untuned	2—6AF4	2-stage	St.	A.c. operation
The Astatic Corporation **Conneaut, Ohio**	CT-1	Tuned ckts. switching	Slug	1—6BQ7 1—6J6	2-stage neut. p p.	St.	Auto., by-pass switch, 72-or 300-ohm input and output
Blonder-Tongue Labs. Inc. **526-536 North Ave.** **Westfield, N. J.**	HA-2 Antensifier	All-channel wide-band	Untuned	3—6J6 1—12AV7	4-stage cascaded	St.	Auto. 24 db gain By-pass switch
	HA-3 B-T Booster	All-channel wide-band	Untuned	3—6J6	3-stage cascaded	St.	Auto. 16 db gain control switch
	CA-1 Commercial Antensifier	All-channel wide-band	Untuned	2—6J6 2—6BQ7	4-stage cascaded	St.	28 db gain control On-Off sw. Pilot light
	CSI-(channel No.) Channel strip Amplifier	Single channel	Factory preset	1—6AB4 1—6CB6	2-stage cascaded	St. or Ant.	Plugs into B-T mixer-amplifier
David Bogen Co., Inc. **29 Ninth Ave.** **New York 14, N. Y.**	BB1-A, BB1-B	Sep. amps switching	Slug	2—6J6	T.p.t.g.	St.	Auto.
	BIB-1	Wide-band		4—6J6	S-t.4-stage	St.	Auto.
	AMB-1	Wide-band		4—6J6	S-t.4-stage	Ant.	Control at set
Brach Manufacturing Corp. **200 Central Ave., Newark, N. J.**	50825	Sep. amps wide-band	Slug adjust.	1—6AK5 1—6CB6	T.p.t.g.	St.	
	91630	Sep. amps wide-band	Untuned	3—6J6 1—12AU7	Cascade p.p.	St.	
Electro-Voice, Inc. **Buchanan, Mich.**	3000	Sep. amps wide-band	Untuned	4—6J6	2-stage broad-band	St.	Auto. 1- or 2-ant. input
	3002	Sep. amps wide-band	Untuned	2—6BK7	1-stage wide-band	St.	Auto.
	3010	Sep. amps wide-band	Untuned	4—6J6	2-stage broad-band	Ant.	Auto. 1-or 2-ant. input
	3012	Sep. amps wide-band	Untuned	2—6BK7	1-stage wide-band	Ant.	Auto. 1- or 2-ant. input
I.D.E.A. Inc. **7900 Pendleton Pike** **Indianapolis 26, Ind.**	Regency DB-520	All-channel switching	Slug	1—6J6	T.p.t.g.	St.	Pwr. outlet for revr.
Industrial Television, Inc. **369 Lexington Ave.** **Clifton, N. J.**	IT-102A	All-channel broad-band	Untuned	2—6BK7	4-stage	Rear	18 db gain Auto
	IT-90AB	All-channel sep. amps	Untuned	1—6AK5 1—6CB6 2—6BQ7, 1—6X4	3-stage cascode	Rear	Auto., sep. gain control for each band
	IT-96AB	Single channel	Fixed	1—6J6	2-stage	Rear	Auto.

CHARACTERISTICS

Manufacturer	Model	Band selection	Channel tuning	Tube(s)	Circuit	Instal-lation	Other features
J F D Manufacturing Co. 4101-23 Sixteenth Ave. Brooklyn 4, N. Y.	VB (chan. No.)[1]	Single channel	Factory preset	1—6J6	T.p.t.g.	Rear	
	SW (chan. No.)[1]	Single channel	Factory preset	1—6J6	T.p.t.g.	Rear	Bypass switch
	EC4	All-channel broad-band	Untuned	2—6BQ7	2-stage	Rear	4 outputs
The La Pointe-Plascomold Corp. Rockville, Conn.	Vee-D-X Outboard	Single channel	Slug Adjust.	1—6J6	T.p.t.g.	Rear	Auto.
	Vee-D-X Rocket	Single channel	Slug Adjust.	1—6J6	T.p.t.g.	Ant.	Auto.
Mark Simpson Mfg. Co., Inc. 32-28 49th St., Long Island City 3, N. Y.	Sky Chief	All-channel switching	Slug	2—6J6	T.p.t.g.	St.	
	Super Sky Chief	All-channel switching	Slug	4—6J6	T.p.t.g.	St.	2 separately tuned sections
National Co., Inc. 61 Sherman St., Malden, Mass.	TVB-2BX	All-channel turret	Capacitor	1—6AK5	T.p.t.g.	St.	Separate output tuning control
The Radiart Corporation 3455 Vega Ave., Cleveland 13, Ohio	TVB-1	All-channel switching	Slug	1—6J6	T.p.t.g.	St.	
Radio Merchandise Sales, Inc. 2016 Bronxdale Ave. New York 60, N. Y.	SP-6	All-channel switching	Slug	1—6AK5	T.p.t.g.	St.	Gain control
	SP-6J	All-channel switching	Slug	1—6J6	T.p.t.g. (neut.)	St.	
Regency—See I.D.E.A.							
Sutton Electric Co. 426 West Short St. Lexington, Ky.	16B	All-channel switching	Slug	1—6J6	T.p.t.g.	St.	
	5A	Single channel	Fixed	1—6J6	T.p.t.g.	Ant.	Auto., sep. power lead
	SEC	Booster-converter	Slug	1—6AF4 1—6J6	T.p.t.g.	St.	All v.h.f. and u.h.f. channels
Tech-Master Products Company, 443-445 Broadway, N. Y. 13, N. Y.	TVB	All-channel switching	Capacitor	1—6AK5	Tuned plate	St.	Kit form
Technical Appliance Co. Sherburne, N. Y.	Taco 1628	Single channel	Factory preset	1—6AK5	T.p.t.g.	Ant.	Auto.
The Turner Company Cedar Rapids, Iowa	TV-2	Continuous 54–216 mc	Inductuner	1—12AT7	Cascode	St.	Auto.
Videon Electronic Corp. 222 East Ohio St. Indianapolis 4, Ind.	B-132 B-133	All-channel switching	Slug	1—6J6	T.p.t.g.	St.	A.c. outlet for TV
	B-222	All-channel switching	Slug	1—6J6	T.p.t.g.	St.	

TERMS AND ABBREVIATIONS

Wide-band—Operating over one or both v.h.f. bands without tuning.
Switching—Using separate amplifiers for each band.
All-channel—Refers to v.h.f. channels only; a booster which tunes channels 2-13.
T.p.t.g.—Tuned-plate tuned-grid.
S-t 4-stage—Stagger-tuned 4-stage amplifier
St.—Standard mounting. (In separate cabinet)
Rear—Mounted at rear of set. Does not need tuning for each station.
Ant.—Antenna mounting.
Auto—Turns on and off automatically with the receiver.
All other terms are self-explanatory.

[1] These are made for all v.h.f. TV channels. In addition, there are two 2-channel models, one for channels 4 and 5, the other for channels 7 and 9.

END

Directory of TV Receiver Characteristics

Manufacturer	Model	Chassis Number	AM-FM-SW	C-R Tube Type, or Size (In)	C-R Tube Anode KV	Number of Tubes	Intercarrier Sound	Type A.G.C. (Keyed or Standard)	No. Video I.F. Stages	Video I. F. (MC)	U.H.F. Tuning	Speaker Size (In)	Tuner Type	Accessories Remarks
Admiral Corp. 3800 Cortland St. Chicago 47, Ill.	17DX10, 17DX11, 17DX12	19B1	No	17BP4A	15	19	Yes	Ord	3	25.75	Strip	5 EM	Tur	No
	121DX11	19F1A	No	21WP4X	15	19	Yes	Ord	3	25.75	Strip	5 EM	Tur, C	No
	121DX12[3], 121DX16[3], 221DX15, 221DX16, 221DX17, 221DX26, 221DX38	19C1	No	20DP4A	15	19	Yes	Ord	3	25.75	Strip	10 EM	Tur, C	No
	222DX15	19H1	No	21WP4X	15	19	Yes	Ord	3	25.75	Strip	10 PM	Tur, C	No
	222DX15S, 222DX16, 222DX17, 222DX26, 222DX27, 222DX48, 222DX49	22C2	No	21EP4A	14.5	22	Yes	Key	3	25.75	Strip	10 PM	Tur, C	No
	228DX16, 228DX17	23A1	No	27EP4	17	23	Yes	Key	3	25.75	Strip	(2)10PM	Tur, C	No
	321DX26, 321DX26A, 321DX27A	19E1	AM[13]	20DP4A	15	21	Yes	Ord	3	25.75	Strip	6 PM	Tur, C	3 Pl
	321DX15, 321DX16, 321DX17	19E1	AM[13]	20DP4A	15	21	Yes	Ord	3	25.75	Strip	12 PM	Tur, C	3 Pl
	322DX16	22E2	AM[13]	21EP4A	14.5	24	Yes	Key	3	25.75	Strip	12 PM	Tur, C	3 PJ
Andrea Radio Corp. 27-01 Bridge Plaza North Long Island City 1, N. Y.	Brewster C-VL-17	VL17	FM	17CP4	13.5	24	No	Key	4	26.2	Ex Conv	12	Con	No
	Caronia CO-VL-19	VL19	AM-FM	19AP4	13.5	29	No	Key	4	26.2	Ex Conv	12	Con	Ph
	Fleetwood CO-VL-16	VL16	FM	16GP4	13.5	26	No	Key	4	26.2	Ex Conv	12	Con	No
	Gotham T-VL-17	VL17	FM	17CP4	13.5	24	No	Key	4	26.2	Ex Conv	7½	Con	No
	Sutton C-VL-16	VL16	FM	16GP4	13.5	26	No	Key	4	26.2	Ex Conv	12	Con	No
Arvin Industries, Inc. Columbus, Ind.	6173TM	TE331	No	17LP4	15	22	Yes	Ord	4	45.75	Ex Conv	5	Sw, C	No
	6173TM-UHF	TE332	No	17LP4	15	24	Yes	Ord	4	45.75	Int Tune	5	Sw, C (VHF) Con (UHF)	
	6213TM	TE319	No	21MP4	15	22	Yes	Ord	4	45.75	Ex Conv	6	Sw, C	No
	6213TM, TB-UHF	TE330	No	21MP4	15	24	Yes	Ord	4	45.75	Int Tune	6	Sw, C (VHF) Con (UHF)	
	6215CM, CB	TE319	No	21MP4	15	22	Yes	Ord	4	45.75	Ex Conv	10	Sw, C	No
	6215CM, CB-UHF	TE330	No	21MP4	15	24	Yes	Ord	4	45.75	Int Tune	10	Sw, C (VHF) Con (UHF)	
	7210CM, CB; 7212CFP; 7212MEA; 7214CM; 7216CB; 7218CM, CB; 7219CM	TE337	No	21MP4	15	26	Yes	Key	4	45.75	Ex Conv	10	Sw, C	PJ
	7210CM, CB-UHF; 7212CFP-UHF; 7212MEA-UHF; 7214CM-UHF; 7216CB-UHF; 7218CM, CB-UHF; 7219CM-UHF	TE341	No	21MP4	15	28	Yes	Key	4	45.75	Int Tune	10	Sw, C (VHF) Con (UHF)	PJ
	7276CB-UHF; 7279CM-UHF	TE340	No	27	18	28	Yes	Key	4	45.75	Int Tune	10	Sw, C (VHF) Con (UHF)	PJ

Atlantic Video Corp. **(Sterling)** **18 Clinton St.** **Brooklyn, N. Y.**	S20CM, S20SM, S20DCM, S21CM, S21SM, S21DCM	S20	No	20-21	14	20	Yes	Key	3	23.4	Strip	12	Tur,C7	No
	S20TM, S21TM	S20	No	20-21	14	20	Yes	Key	3	23.4	Strip	4x6	Tur,C7	No
	S24SM	S20	No	24	16	20	Yes	Key	3	23.4	Strip	12	Tur,C7	No
	S24TM	S20	No	24	16	20	Yes	Key	3	23.4	Strip	8	Tur,C7	No
	X20SM, X21SM, 620CM, 621CM, 720DCM, 721DCM	630	Am[6]	20-21	16	30	No	Key	4	25.7	Strip	12	Tur, C	No
	X24SM	630	AM[6]	24	18	30	No	Key	4	25.7	Strip	12	Tur, C	No
	X27SM, 1127CM	630	AM[6]	27	20	31	No	Key	4	25.7	Strip	12	Tur, C	No
	X30SM	630	AM[6]	30	25	31	No	Key	4	25.7	Strip	12	Tur, C	No
	520TM, 521TM	630	AM[6]	20-21	16	30	No	Key	4	25.7	Strip	4x6	Tur, C	No
	824TM	630	AM[6]	24	18	30	No	Key	4	25.7	Strip	8	Tur, C	No
	927TM	630	AM[6]	27	20	31	No	Key	4	25.7	Strip	8	Tur, C	No
	1230TM	630	AM[6]	30	25	31	No	Key	4	25.7	Strip	8	Tur, C	No
Automatic Radio & **Mfg. Co., Inc.** **122 Brookline Ave.,** **Boston, Mass.**	5116		No	17	14	21	Yes	Ord	3	25.75		8	Sw	No
	5120		No	20	14	21	Yes	Ord	3	25.75		8	Sw	No
	5160		No	17	14	21	Yes	Ord	3	25.75		8	Sw	No
	5217		No	17	14	21	Yes	Ord	3	25.75		5½	Sw	No
	5220		No	20	14	21	Yes	Ord	3	25.75		5½	Sw	No
Bace Television Corp. **Green & Leuning St.** **So. Hackensack, N. J.**	Remote Control TM-24	630K3CB Remote Control	No	24	15	31	No	Key	4	26.25	Strip	12	Tur, C	RC
	P-80-82-83-84-85	630K3CB	No	21	14	30	No	Key	4	26.25	Strip	12	Tur, C	BAR
	P-80-Chinese	630K3CB	No	21 & 24	14	30	No	Key	4	26.25	Strip	12	Tur, C	No
	Remote Control 27	630K3CB	No	27	21	41	No	Key	4	26.25	Strip	12	Tur, C	
Bell Television, Inc. **552 West 53rd Street** **New York 19, N. Y.**	R917	1731	No	17	10	31	No	Key	4	25.75	Int Conv	12	Tur	RC
	R921	2131	No	20CP4	12	31	No	Key	4	25.75	Int Conv	12	Tur	RC
	R924	2431	No	24AP4	15	31	No	Key	4	25.75	Int Conv	12	Tur	RC
Bendix Radio **Baltimore 4, Md.**	1702	T5	No	17BP4	12	17	Yes	Ord	2	26.75	Ex Conv	6	Sw	No
	17K2	T9	No	17BP4	12	22	Yes	Key	3	26.75	Ex Conv	10	Sw	No
	20K2	T9	No	20	12	22	Yes	Key	3	26.75	Ex Conv	12	Sw	No
	20L2	T9	No	20	12	22	Yes	Key	3	26.75	Ex Conv	6	Sw	No
	21T3, 21X3	T14	No	21	14	24	Yes	Key	4	45.75	Strip	6	Tur, C	No
	21K3, OAK3	T14	No	21	14	24	Yes	Key	4	45.75	Strip	10	Tur, C	No
	21KD	T14	No	21	14	24	Yes	Key	4	45.75	Strip	12	Tur, C	No
	KM17C	T14	No	17	14	24	Yes	Key	4	45.75	Strip	6	Tur, C	No
	TM17C	T14	No	17	14	24	Yes	Key	4	45.75	Strip	10	Tur, C	No
Capehart-Farnsworth Corp **Ft. Wayne, Ind.**	1T172MA	CX37	No	17	14	21	Yes	Key	4	45.75	Strip	6	Tur, C	PJ
	1C213M, -B, 2F213F, 3C212MA, -BA, 4H212MA, -BA, 4T213M, -B, 5F212MA, 6F213B, 7F212MA, 8F212BA, 9F212MA	CX37	No	21	14	21	Yes	Key	4	45.75	Strip	12	Tur, C	PJ
	10W212M	CX36TVR	AM	21	14	28	Yes	Key	4	45.75	Strip	12	Tur, C	Ph
	11W212MA	CX37-C305	AM-FM	21	14	30	Yes	Key	4	45.75	Strip	2-12	Tur, C	Ph
	12F272M	CX40	No	27	20	27	Yes	Key	4	45.75	Strip	10	Tur, C	PJ
Cascade Television Co. **153 Chestnut Ave.** **Irvington 11, N. J.**	503-1	K3		17	13	30	No	Key	4	26.25	Strip	12	Tur, C	PJ
	503-2	DXC		17	13	30	No	Key	4	26.25	Strip	12	Tur, C	PJ
	503-3	K3-1		21	15	30	No	Key	4	26.25	Strip	12	Tur, C	PJ
	503-4	DXC-1		21	15	30	No	Key	4	26.25	Strip	12	Tur, C	PJ
	LD-27	K3-2		27	16	36	No	Key	4	26.25	Strip	12	Tur, C	RCS
	F42-4X3	K3-3		51	25	42	No	Key	4	26.25	Strip	12	Tur, C	RCS
Certified Radio Labs. **5507-13th Ave.** **Brooklyn 19, N. Y.**	5320		No	20DP4	16	20	Yes	Ord	4	25.75	Strip	12	Tur, C	No

Manufacturer	Model	Chassis Number	AM-FM-SW	C-R Tube Type, or Size (In)	C-R Tube Anode KV	Number of Tubes	Intercarrier Sound	Type A.G.C. (Keyed or Standard)	No. Video I.F. Stages	Video I. F. (MC)	U.H.F. Tuning	Speaker Size (In)	Tuner Type	Accessories Remarks
Conrac, Inc.	35M61; 35W61; 36B61; 36P61; 37P61; 38M61; 38B61; 39M61	61		21AP4	18	24	Yes	Ord	4	25.75	Strip	12	Tur, C	CJ, PJ
Glendora, Calif.	40M64; 40B64; 41B64; 41P64; 42P64	64		24AP4	18	24	Yes	Ord	4	25.75	Strip	12	Tur, C	CJ, PJ
	Fleetwood	600		21AP4 or 24AP4	18	27	Yes	Ord	4	25.75	Strip	Not supplied	Tur, C	RC
	45M67; 45P67	607		27	20	28	Yes	Ord	4	25.75	Strip	12	Tur, C	RC
Crosley Div.,	EU-17TOL, -17TOLB,	385	No	17	13.5	18	Yes	Ord	3	26.4	Int Conv	5¼	Sw	No
Avco Mfg. Corp.	EU-17COL, -17COLB	396	No	17	13.5	20	Yes	Ord	3	26.4	Int Tune	5¼	Sw	No
1325 Arlington St.	EU-17TOLU, -17TOLBU, -17COLU	380	No	17	14	22	Yes	Key	4	26.4	Ex Conv	5¼	Con	No
Cincinnati, Ohio	EU-17TOM, -17TOB, -17COM	386	No	21	13.5	18	Yes	Ord	3	26.4	Int Conv	5¼	Sw	No
	EU-21TOL, -21TOLB	393	No	21	13.5	20	Yes	Ord	3	26.4	Int Tune	5¼	Sw	No
	EU-21TOLU, -21TOLBU	387	No	21	13.5	18	Yes	Ord	3	26.4	Int Conv	10	Sw	No
	EU-21COL, -21COLB	394	No	21	13.5	20	Yes	Ord	3	26.4	Int Tune	10	Sw	No
	EU-21COLU, -21COLBU													
	EU-21CDB, -21CDM, -21CDN, EU-21COB, -21COMA	381	No	21	14	22	Yes	Key	4	26.4	Int Conv	10	Con	No
	EU-21CDBU, -21CDMU, -21CDNU, EU-21COBU, -21COMU	390	No	21	14	25	Yes	Key	4	26.4	Int Tune	10	Con	No
	EU-21PDBU, -21PDMU	392	AM-FM	21	14	31	Yes	Key	4	26.4	Int Tune	10	Con	Ph
	EU-30COBU, -30COMU	388	No	30	23	34	Yes	Key	4	26.4	Int Tune	10	Con	No
De Wald Radio &	ET-170, GT-174		No	17	13.5	21	Yes	Ord	3	25.75	Strip	6½	Tur, C	No
TV Mfg. Co., Inc.	ET-172		No	17	13.5	21	Yes	Ord	3	25.75	Strip	10	Tur, C	No
35-15 57th Ave.	ET-190, GT-201D		No	20	13.5	21	Yes	Ord	3	25.75	Strip	10	Tur, C	No
Long Island City, N. Y.	ET-200		No	20	13.5	21	Yes	Ord	3	25.75	Strip	6½	Tur, C	No
	GT-210		No	21	13.5	21	Yes	Ord	3	25.75	Strip	6½	Tur, C	No
	GT-211		No	21	13.5	21	Yes	Ord	3	25.75	Strip	10	Tur, C	No
Allen B. DuMont	Devon	RA-160		17KP4	16	26	Yes	Gate	4	45.75	Strip	6	Tur, C	PJ
Laboratories, Inc.,	Banbury, Flanders, Whitehall, Wickford, Wimbledon	RA-162A		21KP4A	16	26	Yes	Gate	4	45.75	Strip	10	Tur, C	PJ
35 Market Street,	Banbury, Dynasty, Newbury, Somerset	RA-162B		21KP4A	16	27	Yes	Gate	4	45.75	Strip	10	Tur, C	PD, PJ
East Paterson, N. J.	Clinton	RA-164		17HP4	14	21	Yes	Key	3	25.75	Strip	5	Tur, C	No
	Beverly, Milford,[3] Ridgewood, Shelburne, Wakefield	RA-165		21FP4A	14	21	Yes	Key	3	25.75	Strip	10	Tur, C	No
Electro Technical Industries 1432 N. Broad St., Phila. 21, Pa.	Telekit 19C-Universal	19C		17–21	16	16	Yes	Ord	3	25.75	Ex Conv	4x6	Sw	No
Emerson Radio	711	120164B	No	21	15	22	Yes	Ord	3	45.75	Strip	6	Tur, C	PJ
& Phono. Corp.	716	120163D	No	17	14	22	Yes	Ord	3	45.75	Strip	6	Tur, C	No
111 8th Ave.,	719	120163D	No	17	14	22	Yes	Ord	3	45.75	Strip	12	Tur, C	No
New York 11, N. Y.	720	120169B	No	21	15	23	Yes	Ord	3	45.75	Strip	12	Tur, C	PJ
	721	120166D	No	17	14	23	Yes	Ord	3	45.75	Strip	6	Tur, C	No
	723	120164B	No	21	15	22	Yes	Ord	3	45.75	Strip	6	Tur, C	PJ
	727	120168D	No	17	14	23	Yes	Ord	3	45.75	Strip	6	Tur, C	No
	731	120167D, 120152B	AM	17	14	23	Yes	Ord	3	45.75	Strip	6	Tur, C	Cl, Ph
	733	120169F, 120152F	AM	21	15	23[5]	Yes	Ord	3	45.75	Strip	6	Tur, C	Ph
	736	120171B	No	21	15	23	Yes	Ord	3	45.75	Strip	6	Tur, C	PJ

Fada Radio & Electric Co., Inc. 525 Main St., Belleville, N. J.		17C2, 17C2BM, 17C4	No	17BP4 or 17RP4	13	21	Yes	Ord	3	26.1	Strip	10	Tur, C	No
		17T6, 17T6BM, 17T9, 17T9BM	No	17BP4 or 17RP4	13	21	Yes	Ord	3	26.1	Strip	6	Tur, C	No
	21C2		No	21AP4	16	21	Yes	Ord	3	26.1	Strip	10	Tur, C	No
	21T, 21TBM		No	21EP4	16	21	Yes	Ord	3	26.1	Strip	6	Tur, C	No
	24T2, 24T2BM		No	24AP4	16	21	Yes	Ord	3	26.1	Strip	8	Tur, C	No
		173T, 173TBM, 175C, 175CBM, 177CD	No	17BP4 or 17RP4	13	20	Yes	Ord	3	26.1	Strip	6	Tur, C	No
	215C		No	21AP4	16	21	Yes	Ord	3	26.1	Strip	10	Tur, C	No
	DL21T, DL21TBM		No	21EP4	16	21	Yes	Ord	3	26.1	Strip	6	Tur, C	No
Firestone Tire and Rubber Co. Akron, Ohio	13-G-107	700140	No	20CP4	13	20	Yes	Ord	3	25.7	Ex Conv	5	Sw	No
	13-G-109	700104	No	17HP4	12	20	Yes	Ord	3	25.7	Ex Conv	8	Sw	No
	13-G-109A	700104	No	17HP4	12	20	Yes	Ord	3	25.7	Ex Conv	5	Sw	No
	13-G-110	MS31C A	No	21MP4	16	23	Yes	Key	3	26.2	Strip	8	Tur, C	No
	13-G-114	81700	No	17HP4	12	20	Yes	Ord	3	25.7	Ex Conv	5	Sw	No
	13-G-115	MS31C A	No	21MP4	16	23	Yes	Key	3	26.2	Strip	6	Tur, C	No
	13-G-116	MS31C A	No	21MP4	16	23	Yes	Key	3	26.2	Strip	6	Tur, C	No
	13-G-117	817D1	No	17HP4	12	20	Yes	Ord	3	25.7	Ex Conv	8	Sw	No
	13-G-119	MS31C A	No	21MP4	16	23	Yes	Key	3	26.2	Strip	12	Tur, C	No
	13-G-120	MS31C A		21MP4	16	23	Yes	Key	3	26.2	Strip	12	Tur, C	No
	13-G-121	82001	AM-FM	20HP4A	14	26	Yes	Ord	3	25.7	Ex Conv	8	Sw	No
	13-G-122	82001	No	20CP4	14	21	Yes	Ord	3	25.7	Ex Conv	10	Sw	No
	13-G-124	82000	No	20HP4A	14	21	Yes	Ord	3	25.7	Ex Conv	5	Sw	No
	13-G-125	81700	No	17HP4	13	21	Yes	Ord	3	25.7	Ex Conv	5	Sw	No
	13-G-126	82001	AM-FM	21	14	26	Yes	Ord	3	25.7	Ex Conv	8	Sw	No
General Electric Company Receiver Department Electronics Park Syracuse, N. Y.	17C125	E	No	17BP4A	14–16	20	Yes	Spec.	3	45.75	Int Conv (3)	8	Sw	No
	17T10, 17T11, 17T12	A/K	No	17BP4A	13	20	Yes	Spec.	3	45.75	Int Conv (3)	5¼	Sw	No
	20C106	A/K	No	20CP4A	13	20	Yes	Spec.	3	45.75	Int Conv (3)	12	Sw	No
	20C107	E	No	20CP4A or 20DP4A	14–16	20	Yes	Spec.	3	45.75	Int Conv (3)	10	Sw	No
	21C200	A/K	No	21EP4B	13	20	Yes	Spec.	3	45.75	Int Conv (3)	12	Sw	No
	21C201, -202, -206, -208U, 21214, 21T1U	E	No	21EP4B	16	20	Yes	Spec.	3	45.75	Int Conv (3)	12	Sw	No
	21C204, 21C208, 21T1	E	No	21EP4A	16	20	Yes	Spec.	3	45.75	Int Conv (3)	12	Sw	No
	21T2, 21T4, 21T5	A/K	No	21EP4B	13	20	Yes	Spec.	3	45.75	Int Conv (3)	5¼	Sw	No
Hoffman Radio Corp. 6200 S. Avalon Los Angeles, Calif.	7M103, 7B104, 7P104	190	No	17	13.5	24	Yes	Key	4	25.5	Strip	5[16]	Tur, C	No
	7M109, 7B110, 7P111	200	No	17	13.5	18	Yes	Ord	3	26.25	Strip	5	Tur, C	No
	7M109B, 7B110B, 7P111B	210	No	17	16	18	Yes	Ord	3	26.25	Strip	5	Tur, C	No
	7M112, 7B113, 7P114	202	No	17	15.5	18	Yes	Ord	3	26.25	Strip	5	Tur, C	No
	7M112B, 7B113B, 7P114B	212	No	17	16	18	Yes	Ord	3	26.25	Strip	5	Tur, C	No
	7M302, 7B104, 7P304	190	No	17	13.5	24	Yes	Key	4	25.5	Strip	5[16]	Tur, C	No
	20M101F, 20B102F	194	No	20	13.5	24	Yes	Key	4	25.5	Strip	5	Tur, C	No
	21M106, 21B107, 21P108	191	No	21	13.5	24	Yes	Key	4	25.5	Strip	5[16]	Tur, C	No
	21M118, 21B119, 21P120	198	No	21	16	25	Yes	Key	4	45.75	Strip	5PM	Tur, C	Tun
	21M121, 21B122, 21P123	211	No	21	16	18	Yes	Ord	3	26.25	Strip	5	Tur, C	No
	21M300, 21B301	191	No	21	13.5	24	Yes	Key	4	25.5	Strip	5[16]	Tur, C	No
	21M305, 21B306, 21P307	201	No	21	15.5	18	Yes	Ord	3	26.25	Strip	8	Tur, C	No
	21M308, 21B309, 21P310	196	No	21	16	24	Yes	Key	4	45.75	Strip	5[18]	Tur, C	No
	21M311, 21B312, 21P313	198	No	21	16	25	Yes	Key	4	45.75	Strip	5PM	Tur, C	Tun
	21M503, 21B504, 21P505	191	No	21	13.5	24	Yes	Key	4	25.5	Strip	5[18]	Tur, C	No
	21M506, 21B507, 21P508	211	No	21	16	18	Yes	Ord	3	26.25	Strip	5	Tur, C	No
	21M700, 21B701, 21P702	196	No	21	16	24	Yes	Key	4	45.75	Strip	5	Tur, C	No
	21M703, 21B704, 21P705	198	No	21	16	25	Yes	Key	4	45.75	Strip	5	Tur, C	No
	21M900, 21B901, 21P902	192	AM-FM	21	13.5	33	Yes	Key	4	25.5	Strip	12	Tur, C	Ph
	21M903, 21B904, 21P905	213	No	21	16	20	Yes	Ord	3	26.25	Strip	8	Tur, C	No
	27M709, 27B710, 21P711	197	No	27	21	30	Yes	Key	4	45.75	Strip	5[18]	Tur, C	No
	21M906B, 21B907B, 21P908B	199B	AM-FM	21	21	24	Yes	Key	4	45.75	Strip	5[18]	Tur, C	Ph

Manufacturer	Model	Chassis Number	AM-FM-SW	C-R Tube Type or Size (In)	C-R Tube Anode KV	Number of Tubes	Intercarrier Sound	Type A.G.C. (Keyed or Standard)	No. Video I.F. Stages	Video I. F. (MC)	U.H.F. Tuning	Speaker Size (In)	Tuner Type	Accessories Remarks
Industrial Television, Inc.	IT-76R	1376	No	20	14	20	Yes	Ord	3	21.25	Strip	8	Tur	No
369 Lexington Ave., Clifton, N. J.	IT-82R	No	No	20	16	26	No	Ord	3	21.9	Strip	12	Tur	RC, Com
Jackson Industries Inc.	17XC, 217C	317A	No	17	13.5	20	Yes	Key	3	25.75	Strip	6	Tur, C[7]	No
500 E. 40th Street	17XT, 217T, 277T	317A	No	17	13.5	20	Yes	Key	3	25.75	Strip	4x6	Tur, C[7]	No
Chicago 15, Ill.	20XC, 220C	320A	No	20	13.5	20	Yes	Key	3	25.75	Strip	6–8	Tur, C[7]	No
	20XT, 377T	320A	No	20	13.5	20	Yes	Key	3	25.75	Strip	4x6	Tur, C[7]	No
	221T, 477T	321A	No	21	13.5	20	Yes	Key	3	25.75	Strip	4x6	Tur, C[7]	No
	317C	317A	AM	17	13.5	20	Yes	Key	3	25.75	Strip	6	Tur, C[7]	No
	320C	320A	AM	20	13.5	20	Yes	Key	3	25.75	Strip	4x6	Tur, C[7]	No
	321C	321	AM	21	13.5	20	Yes	Key	3	25.75	Strip	6–8	Tur, C[7]	No
	621C	321	AM-FM	21	13.5	20	Yes	Key	3	25.75	Strip	6–8	Tur, C[7]	No
Jewel Radio Corp.	17TW7	TV7	No	17	15.5	21	Yes	Ord	3	26.0	Strip	5	Tur, C[7]	PJ, VHB
900 Passaic Ave.	20CW7, 20TW7[3]	TV7	No	20	15.5	21	Yes	Ord	3	26.0	Strip	10	Tur, C[7]	PJ, VHB
E. Newark, N. J.	21CW7, 21TW7[3]	TV7	No	21	15.5	21	Yes	Ord	3	26.0	Strip	10	Tur, C[7]	PJ, VHB
	620CW7,	TV7	No	21	15.5	21	Yes	Ord	3	26.0	Strip	6	Tur, C[7]	PJ, VHB
	621CW7	TV7	No	21	15.5	21	Yes	Ord	3	26.0	Strip	6	Tur, C[7]	PJ, VHB
Kaye-Halbert Corp.	None	253DX		20–24	16	24	No	Key	3	25	Strip	12	Tur, C	RC
3623 Easthams Dr.	None	243		20–24	16	24	Yes	Key	3	25	Strip	12	Tur, C	RC
Culver City, Calif.														
J. H. Keeney & Co., Inc.	22F17TMX	No	No	17	11.5–13.5	20	Yes	Key	3	26.75	Strip	5	Tur, C	No
2600 West 50th St.	22F21TMX	No	No	21	11.5–13.5	20	Yes	Key	3	26.75	Strip	8	Tur, C	No
Chicago 32, Ill.	C-17TM[14]	No	No	17	11.5–13.5	18	Yes	Ord	3	26.75	Strip	5	Tur	No
	C-21TM[14]	No	No	21	11.5–13.5	18	Yes	Ord	3	26.75	Strip	5	Tur	No
	C-21CM[14]	No	No	21	11.5–13.5	18	Yes	Ord	3	26.75	Strip	8	Tur	No
	K-17TM	No	No	17	11.5–13.5	18	Yes	Ord	3	26.75	Strip	5	Tur	No
	K-17CM	No	No	17	11.5–13.5	18	Yes	Ord	3	26.75	Strip	8	Tur	No
	K-21TM	No	No	21	11.5–13.5	18	Yes	Ord	3	26.75	Strip	5	Tur	No
	K-21CM	No	No	21	11.5–13.5	18	Yes	Ord	3	26.75	Strip	8	Tur	No
Lion Manufacturing Corp.	21537	537	No	21	14	21	Yes	Ord	3	26.4	Strip	6	Tur, C	RC
2640 Belmont Ave., Chicago 18, Ill.	21638, 21739, 21840	537	No	21	14	21	Yes	Ord	3	26.4	Strip	10	Tur, C	RC
The Magnavox Co.	MV45L (Normandy)	CT341K, -351J,												
Fort Wayne, Indiana		-362L[17]	No	21	14	21	Yes	Key	3	25.75	Int Conv	12	Sw	No
	MV68L (French Provincial)	CT342K, -352J	AM-FM	21	14	31	Yes	Key	3	25.75	Int Conv	(2) 12	Sw	Ph
	MV90L (Wedgewood)	CT342K, -352J	AM-FM	21	14	31	Yes	Key	3	25.75	Int Conv	12	Sw	Ph
	MV91L (Wedgewood)	CT346K, -353J	AM-FM	21	14	24	Yes	Key	3	25.75	Int Conv	12	Sw	Ph
	MV92L (Belvedere)	CT352J	AM-FM	21	14	31	Yes	Key	3	25.75	Int Conv	(2) 12	Sw	Ph
	MV93L (Belvedere)	CT363L, -373M	AM-FM	21	14	31	Yes	Key	3	45.75	Int Conv	(2) 12	Sw	Ph
	MV94L (French Provincial)	CT352J, -362[17],												
		-373M[17]	AM-FM	21	14	31	Yes	Key	3	25.75	Int Conv	(2) 12	Sw, C	Ph
	MV100L (Contemporary)	CT341K, -351J	No	21	14	21	Yes	Key	3	25.75	Int Conv	12	Sw	No
	MV102L (Empire)	CT341K, -351J,												
	MV103L (Holiday)	-362L[17], -372M[17]	No	21	14	21	Yes	Key	4	25.75	Int Conv	12	Sw	No
	MV104H (Envoy)	CT347K, -357K	No	20	14	21	Yes	Key	3	25.75	Int Conv	8	Sw	No
	MV106L (Constellation)	CT341K, -351J,												

The Magnavox Co. (*Continued*)	MV107L (Playhouse)	-362L[17], -372M[17]	No	21	14	21	Yes	Key[*]	3	25.75	Int Conv	12	Sw, C	No
	MV108L (Cosmopolitan)	CT362L, -372M	No	21	14	21	Yes	Key	3	45.75	Int Conv	12	Sw, C	No
	MV110M (International)	CT358A	No	27	20	27	Yes	Key	4	45.75	Int Conv	12	Sw, C	Ph
Majestic Radio & Television Division of the Wilcox Gay Corp. 70 Washington St. Brooklyn 1, N. Y.	17T20, 17T21	Series 106	No	17	13	19	Yes	Ord	3	24.75	Strip	6	Tur	No
	17C30, 17C31	Series 106	No	17	13	19	Yes	Ord	3	24.75	Strip	10	Tur	No
	21	Series 106	No	16	13	19	Yes	Ord	3	24.75	Strip	6	Tur	No
	21C30, 21C31, 21D40, 21D41, 21D50, 21D51, 21F90, 21F91	Series 111	No	21	14	19	Yes	Ord	3	24.75	Strip	10	Tur, C	No
	21F88, 21F89, 32, 33	Series 108	No	21	13	19	Yes	Ord	3	24.75	Strip	10	Tur	No
	21P60, 21P61	Series 110	AM-FM	21	14	19	Yes	Ord	3	24.75	Strip	10	Tur, C	Ph
	21P62, 21P63	Series 110	AM-FM	21	14	19	Yes	Ord	3	24.75	Strip	(2) 10	Tur, C	Ph
	21T20, 21T21, 21T22, 21T23	Series 111	No	21	14	19	Yes	Ord	3	24.75	Strip	6	Tur, C	No
	22, 30	Series 106	No	17	13	19	Yes	Ord	3	24.75	Strip	6	Tur	No
	24, 25	Series 108	No	20	13	19	Yes	Ord	3	24.75	Strip	10	Tur	No
	26, 27	Series 108	No	20	13	19	Yes	Ord	3	24.75	Strip	6	Tur	No
	34, 35, 36	Series 108	No	21	13	19	Yes	Ord	3	24.75	Strip	6	Tur	No
Mars Television 112-33 Colonial Ave. Corona, L. I., N. Y.	Dartmouth, Regency[10]	630	FM[7]	20–21	13.5	32	No	Key	4	26.25	Strip Int Tun[7]	10–12	Tur or Con[7]	PJ
	Dorset, Mandarin, Miami	630	FM[7]	20–21–24	13.5	32	No	Key	4	26.25	Strip IntConv[7]	10–12	Tur or Con[7]	PJ, Ph[7]
	Hampton, Versailles	630	FM[7]	20–21	13.5	32	No	Key	4	26.25	Strip IntConv[7]	10	Tur or Con[7]	PJ
	Pasadena	630	FM[7]	20	13.5	32	No	Key	4	26.25	Strip IntConv[7]	10	Tur or Con[7]	PJ
	Riviera	630	FM[7]	20	13.5	32	No	Key	4	26.25	Strip IntConv[7]	(2) 5x7	Tur or Con[7]	PJ, Ph[7]
Mattison Television & Radio Corp. 893 Broadway, New York 3, N. Y.	Ambassador (17X-BB-6AB, 21X-BB-6AB, 27X-BB-6AB)	630-6AB	No	17, 21, 27	15–16	32	No	Key	4	25.75	Strip	12	Tur, C	Ph
	Berkshire (21X-BE-6A), Dorcrest (21X-DO-6A), Heritage (21X-HE-6A)	630-6A	No	21	15	30	No	Key	4	25.75	Strip	12	Tur, C	Ph
	Cathay (20X-CC-6A), Continental (20X-CFO-6A), Diplomat (20X-CFDD-6A)	630-6A	No	20	15	30	No	Key	4	25.75	Strip	12	Tur, C	Ph
	Chinese Quadrille (17X-CFOO-6A, 21X-CFOO-6A) Quadrille (17X-CFOS-6A, 21X-CFOS-6A)	630-6A	No	17–21	15		No							Ph
	Riviera (21X-R1-6A, 27X-R1-6AB)	630-6AB	No	21–27	15–16	32	No	Key	4	25.75	Strip	12	Tur, C	Ph
	Silver Rocket 630	630-6A	No	17,20,21,24	15	29	No	Key	4	25.75	Strip	12	Tur, C	Ph
	Silver Rocket 630	630-6AB	No	17,20,21,24	15	31	No	Key	4	25.75	Strip	12	Tur, C	Ph, TB
John Meck Industries Plymouth, Ind.	JM717C	9032	No	17HP4	12.5	20	Yes	Ord	4	26.1	Strip	8	Tur	No
	JM720C	9032	No	20HP4	12.5	20	Yes	Ord	4	26.1	Strip	8	Tur	No
	JM721C	9032	No	21FP4	12.5	20	Yes	Ord	4	26.1	Strip	8	Tur	No
	MM616T	9033	No	17HP4	12.5	19	Yes	Ord	3	26.1	Strip	5	Tur	No
Midwest Radio & Television Corp., 901-911 Broadway Cincinnati 2, Ohio	N-20	BT-20	AM-FM	20	14	24	Yes	Key	4	25.75		12ED	Sw	No
	NC-20	BT-20	AM-FM	20	14	24	Yes	Key	4	25.75		12ED	Sw	3Pl
	NV-20	CV-20	No	20	14	24	Yes	Key	4	25.75			Sw	No
Mitchell Manufacturing Company 2525 Clybourn Avenue Chicago 14, Ill.	T-172	MR	No	17TP4	14.1	19	Yes	Ord	3	26.4	Strip	8	Tur	No
	T-212	MS	No	21MP4	14.1	19	Yes	Ord	3	26.4	Strip	8	Tur	No

Manufacturer	Model	Chassis Number	AM-FM-SW	C-R Tube Type, or Size (In)	C-R Tube Anode KV	Number of Tubes	Intercarrier Sound	Type A.G.C. (Keyed or Standard)	No. Video I.F. Stages	Video I. F. (MC)	U.H.F. Tuning	Speaker Size (In)	Tuner Type	Accessories Remarks
Motorola, Inc., 4545 Augusta Blvd., Chicago, Ill.	17F13	TS408	AM	17	16	17	Yes	Ord	3	21	IntTun& Ex Conv	10	Sw, C	Ph
	17K14, 17K15	TS408	No	17	16	17	Yes	Ord	3	21	IntTun& Ex Conv	8	Sw, C	No
	17K16	TS408	No	17	16	17	Yes	Ord	3	21	IntTun& Ex Conv	6 x 9	Sw, C	No
	17T11, 17T12	TS408	No	17	16	17	Yes	Ord	3	21	IntTun& Ex Conv	6	Sw, C	No
	17T13	TS410	No	17	16	16	Yes	Ord	3	21	IntTun& Ex Conv	6	Sw	No
	21C1	TS292	No	21	18	17	Yes	Ord	3	21	IntTun& Ex Conv	6	Sw, C	No
	21F2, 21F3	TS292	AM-FM	21	18	17	Yes	Ord	3	21	IntTun& Ex Conv	10	Sw, C	Ph
	21K4, 21K5, 21K6, 21K7	TS292	No	21	18	17	Yes	Ord	3	21	IntTun& Ex Conv	10	Sw, C	No
	21T3	TS501	No	21	18	17	Yes	Ord	3	21	IntTun& Ex Conv	6	Sw, C	No
	21T4	TS324, TS292	No	21	18	17	Yes	Ord	3	21	IntTun& Ex Conv	6	Sw, C	No
	21T5	TS324	No	21	18	17	Yes	Ord	3	21	IntTun& Ex Conv	6	Sw, C	No
	27K1	TS601	No	27	20	18	Yes	Ord	3	21	IntTun& Ex Conv	10	Sw, C	No
Muntz T.V. 1735 Belmont Ave., Chicago, Ill.	2055	17B2	No	20CP4A	16	17	Yes	Ord	3	22	Strip	5¼	Sw	No
	2158A, 2159A, 2162A[3]	17B6	No	21EP4A	16	17	Yes	Ord	3	22	Strip	10	Tur, C	No
	2763A, 2765A	17B8	No	27NP4A	18	18	Yes	Ord	3	22	Strip	10	Tur, C	No
Olympic Radio & Television Olympic Bldg. Long Island City, N. Y.	17C44	TK	No	17HP4	15	19	Yes	Ord	3	26.25		10	Tur, C	Cl
	17K32	TG	AM	17HP4	14	27	Yes	Ord	4	25.75	Strip	10	Tur, C	Ph
	17K41, 17K42	TK	AM	17HP4	15	19	Yes	Ord	3	26.25	Strip	10	Tur, C	Ph
	17T34	TG	No	17HP4	14	22	Yes	Ord	4	25.75	Strip	5	Tur, C	No
	17T40, 17T48	TK	No	17HP4	15	19	Yes	Ord	3	26.25	Strip	5	Tur, C	No
	20C45, 20C52	TL	No	20HP4A	15	19	Yes	Ord	3	26.25	Strip	10	Tur, C	Cl
	20C53, 20D29, 20T46[3], 20T47[3]	TL	No	20HP4A	15	19	Yes	Ord	3	26.25	Strip	10	Tur, C	No
	20K43	TL	AM	20HP4A	15	19	Yes	Ord	3	26.25	Strip	10	Tur, C	Ph
	21D29, 21T27[3]	TH	No	21AP4	15	22	Yes	Ord	4	25.75	Strip	10	Tur, C	No
	21K26	TH	AM	21AP4	15	22	Yes	Ord	4	25.75	Strip	10	Tur, C	Ph
Pacific Mercury Television Mfg. Corp. 5955 Van Nuys Blvd. Van Nuys, Calif.	2081	150-4	AM	20CP4	15	23	Yes	Key	3	26.1	Strip	8	Tur	Ph
	2113, 2115	150-81	No	21MP4	15	21	Yes	Key	3	26.1	Strip	8	Tur, C	No
	2116, 2117, 4421	150-81	No	21MP4	15	21	Yes	Key	3	26.1	Strip	5	Tur, C	No
	2152	150-81	No	21MP4	15	21	Yes	Key	3	26.1	Int Conv	10	Tur, C	No
	2181	150-61	AM	21MP4	15	23	Yes	Key	3	26.1	Strip	8	Tur, C	Ph
	2192	150-10	AM	21MP4	15	23	Yes	Key	3	26.1	Strip	8	Tur, C	Ph
	2401	150-51	No	24AP4	15	21	Yes	Key	3	26.1	Strip	10	Tur, C	No
	4317	150-9	No	17HP4	14	21	Yes	Key	3	26.1	Strip	5	Tur	No
	4320	150-15	No	20HP4	15	21	Yes	Key	3	26.1	Strip	5	Tur, C	No
	4721	150-10	AM	21MP4	15	23	Yes	Key	3	26.1	Strip	5	Tur, C	No

Packard-Bell Co. 12333 Olympic Blvd. Los Angeles 64, Calif.	2721 Sup. Dlx.	2720	No	21	15	27	Yes	Key	4	25.0	Strip	10	Tur, C	PJ, CJ
	2722	2720	No	24	15	27	Yes	Key	4	25.0	Strip	10	Tur, C	PJ, CJ
	2723 Std., 2724	2710	No	21	15	27	Yes	Key	4	25.0	Strip	6	Tur, C	PJ, CJ
	2723 Dlx.	2710	No	21	15	27	Yes	Key	4	25.0	Strip	10	Tur, C	PJ, CJ
	2921	2921	AM	21	15	29	Yes	Key	4	25.0	Strip	10	Tur, C	Ph
	2922	2922	AM	24	15	29	Yes	Key	4	25.0	Strip	(2) 6x9	Tur, C	Ph
Philharmonic Radio & TV 235 Jersey Ave. New Brunswick, N. J.	817		No	17BP4	12	19	Yes	Ord	3	25.75	Strip	5	Sw,	PJ
	920		No	20CP4	12	19	Yes	Ord	3	25.75	Strip	5	Tur, C	PJ
	921		No	21EP4	12	19	Yes	Ord	3	25.75	Strip	5	Tur, C	PJ
	924		No	24AP4	12	19	Yes	Ord	3	25.75	Strip	(2) 8	Tur, C	PJ
	8117		No	17BP4	12	19	Yes	Ord	3	25.75	Strip	8	Sw	PJ
	9120		No	20CP4	12	19	Yes	Ord	3	25.75	Strip	8	Tur, C	PJ
	9121		No	21EP4	12	19	Yes	Ord	3	25.75	Strip	8	Tur, C	PJ
	9820		No	20CP4	12	19	Yes	Ord	3	25.75	Strip	10	Tur, C	PJ
	9821		No	21EP4	12	19	Yes	Ord	3	25.75	Strip	10	Tur, C	PJ
	9821 Decorator models		No	21EP4	12	19	Yes	Ord	3	25.75	Strip	(2) 8	Tur, C	PJ
Philmore Manufacturing Co., Inc. 113 University Place New York, N. Y.	CP	731D	No	17–24	15	31	No	Key	4	25.75	Strip	12	Tur, C	PJ
	CP	731S	No	17–24	15	30	No	Key	4	25.75	Strip	12	Tur, C	PJ
Radio Craftsmen, Inc. 4401 N. Ravenswood Chicago 40, Ill.	C202	None	No	17HP4, 21FP4A or 24BP4A	16	27	No	Key	4	26.1	Strip	None	Tur, C	No
Raytheon Television and Radio Corporation 5927 West Dickens Ave. Chicago, Ill.	M-1733A	17T1	No	17HP4	12.5	18	Yes	Ord	3	25	UHFT	5	Con, C	No
	M-1734A	17T2	No	17HP4	12.5	20	Yes	Ord	3	25	Int Tune	5	Con, C	No
	C-1735A	17T1	No	17HP4	12.5	18	Yes	Ord	3	25	UHFT	6	Con, C	No
	C-1736A	17T1	No	17HP4	12.5	18	Yes	Ord	3	25	UHFT	6	Con, C	No
	M-2107A	21T1	No	21FP4A	12.5	18	Yes	Ord	3	25	UHFT	5	Con, C	No
	C-2108A	21T1	No	21FP4A	12.5	18	Yes	Ord	3	25	UHFT	10	Con, C	No
	C-2109A	21T2	No	21FP4A	12.5	20	Yes	Ord	3	25	Int Tune	10	Con, C	No
	C-2110A	21T1	No	21FP4A	12.5	18	Yes	Ord	3	25	UHFT	10	Con, C	No
	C-2111A	21T1	No	21FP4A	12.5	18	Yes	Ord	3	25	UHFT	10	Con, C	No
	C-2112A	21T3	AM	21FP4A	17.5	29	Yes	Key	4	25	Int Tune	10	Con, C	No
	C-2113A	21T3	AM	21FP4A	17.5	29	Yes	Key	4	25	Int Tune	10	Con, C	No
	C-2114A	21T3	AM	21FP4A	17.5	29	Yes	Key	4	25	Int Tune	10	Con, C	No
	C-2115A	21T3	AM	21FP4A	17.5	29	Yes	Key	4	25	Int Tune	10	Con, C	No
	C-2116A	21T3	VHF-AM	21FP4A	17.5	29	Yes	Key	4	25	Int Tune	10	Con, C	No
	RC-2117A	21T3	AM	21FP4A	17.5	29	Yes	Key	4	25	Int Tune	10	Con, C	No
	C-2118A	21T3	AM	21FP4A	17.5	29	Yes	Key	4	25	Int Tune	10	Con, C	No
RCA Victor Division Radio Corporation of America Camden, N. J.	17T200 Shelley	KCS72	No	17QP4	13.6	23	Yes	Key	3	21	Ex Conv	5	Sw, C	PJ
	17T201 Hadley	KCS72	No	17QP4	13.6	23	Yes	Key	3	21	Ex Conv	5	Sw, C	PJ
	17T202 Kentwood	KCS72	No	17QP4	13.6	23	Yes	Key	3	21	Ex Conv	5	Sw, C	PJ
	17T211 Ashton	KCS72	No	17QP4	13.6	23	Yes	Key	3	21	Ex Conv	8	Sw, C	PJ
	17T220 Albury	KCS72	No	17QP4	13.6	23	Yes	Key	3	21	Ex Conv	8	Sw, C	PJ
	17T250DE Brett	KCS74	No	17QP4	15.0	23	Yes	Key	4	41	Ex Conv, X	8	Sw, C	PJ
	17T261DE Ainsworth	KCS74	No	17QP4	15.0	23	Yes	Key	4	41	Ex Conv, X	12	Sw	PJ
	21T207 Crandall	KCS72A	No	21AP4	13.6	23	Yes	Key	3	21	Ex Conv	8	Sw	PJ
	21T208 Lambert	KCS72A	No	21AP4	13.6	23	Yes	Key	3	21	Ex Conv	8	Sw	PJ
	21T217 Brookfield	KCS72A	No	21AP4	13.6	23	Yes	Key	3	21	Ex Conv	8	Sw	PJ
	21T218 Lansford	KCS72A	No	21AP4	13.6	23	Yes	Key	3	21	Cx Conv	12	Sw	PJ
	21T227 Lindale	KCS72A	No	21AP4	13.6	23	Yes	Key	3	21	Ex Conv	12	Sw	PJ
	21T228 Brandon	KCS72A	No	21AP4	13.6	23	Yes	Key	3	21	Ex Conv	12	Sw	PJ
	21T229 Belgrove	KCS72A	No	21AP4	13.6	23	Yes	Key	3	21	Ex Conv	8	Sw	PJ
	21T159DE Selfridge	KCS68F	No	21AP4	17.5	25	Yes	Key	4	41	Ex Conv, X	8	Sw, C	PJ
	21T165DE Meredith	KCS68F	No	21AP4	17.5	25	Yes	Key	4	41	Ex Conv, X	12	Sw, C	PJ
	21T166DE Farrington	KCS68F	No	21AP4	17.5	25	Yes	Key	4	41	Ex Conv, X	12	Sw, C	PJ
	21T174DE Bancroft	KCS68F	No	21AP4	17.5	25	Yes	Key	4	41	Ex Conv, X	12	Sw, C	PJ

Manufacturer	Model	Chassis Number	AM-FM-SW	C-R Tube Type, or Size (In)	C-R Tube Anode KV	Number of Tubes	Intercarrier Sound	Type A.G.C. (Keyed or Standard)	No. Video I.F. Stages	Video I. F. (MC)	U.H.F. Tuning	Speaker Size (In)	Tuner Type	Accessories Remarks
RCA Victor Division (*Continued*)	21T175DE Benton	KCS68F	No	21AP4	17.5	25	Yes	Key	4	41	Ex Conv, X	12	Sw, C	PJ
	21T176DE Suffolk	KCS68F	No	21AP4	17.5	25	Yes	Key	4	41	Ex Conv, X	12	Sw, C	PJ
	21T177DE Donley	KCS68F	No	21AP4	17.5	25	Yes	Key	4	41	Ex Conv, X	12	Sw, C	PJ
	21T178DE Rockingham	KCS68F	No	21AP4	17.5	25	Yes	Key	4	41	Ex Conv, X	12	Sw, C	PJ
	21T179DE Clarendon	KCS68F	No	21AP4	17.5	25	Yes	Key	4	41	Ex Conv, X	12	Sw, C	PJ
	21T242 Westland	KCS72D1	AM	21AP4	13.6	29	Yes	Key	3	21	Ex Conv	12	Sw	3 Pl
	21T244 Penfield	KCS72D2	AM-FM	21AP4	13.6	33	Yes	Key	3	21	Ex Conv	12	Sw	3 Pl
	21T197DE Sunderland	KCS68H	AM-FM	21AP4	17.5	34	Yes	Key	4	41	Ex Conv, X	12	Sw, C	3 Pl
Regal Electronics Corp. 603 West 130th St. New York 27, N. Y.	17C[11], 17H[11], 17T[3,11]	CH-20-98	No	17	12.5	20–21	Yes	Ord	2[11]	26.1	Strip	8	Tur, C	No
	20C[11], 20T[3,11]	CH-20-98	No	20	14	20–21	Yes	Ord	2[11]	26.1	Strip	8	Tur, C	No
	21C[11], 21H[11], 21T[3,11]	CH-20-98	No	21	14	20–21	Yes	Ord	2[11]	26.1	Strip	8	Tur, C	No
Scott Radio Labs. Plymouth, Ind.	817TU-817CU	9030	No	17HP4	12.5	20	Yes	Ord	4	26.1	Strip	10	Tur, C	No
	820TU-820CU	9030	No	20HP4 or 21FP4	12.5	20	Yes	Ord	4	26.1	Strip	10	Tur, C	No
	1510TA	9029	AM-FM	20HP4 or 21FP4	12.5	20	Yes	Ord	4	26.1	Strip	12[12]	Tur, C	Ph
	924XW	9031	No	24AP4	16.5	20	Yes	Ord	4	26.1	Strip	10	Tur, C	No
	1000XTC	9031	AM-FM	24AP4	16.5	20	Yes	Ord	4	26.1	Strip	15[12]	Tur, C	Ph
Sentinel Radio Corporation 2100 Dempster Street Evanston, Illinois	1U454TM		No	17HP4	15	18	Yes	Ord	3	26.4	Strip	6	Tur, C	No
	1U455TM, -TB		No	21FP4A	15	18	Yes	Ord	3	26.4	Strip	6	Tur, C	No
	1U456CM, -CB, 1U457CM, -CB		No	21FP4A	15	18	Yes	Ord	3	26.4	Strip	10	Tur, C	No
	1U458TM			17HP4	15	26	Yes	Key	4	26.4	Strip	6	Tur, C	No
	1U459TM, -TB			21FP4A	15	26	Yes	Key	4	26.4	Strip	6	Tur, C	No
	1U460CM, -CB, 1U461CM, -CB, -FP			21FP4A	15	26	Yes	Key	4	26.4	Strip	10	Tur, C	No
	1U462CM, 1U463CM, -CB			27EP4	17	19	Yes	Ord	3	26.4	Strip	12	Tur, C	No
Setchell-Carlson, Inc. New Brighton, Minn.	53, 531	152	No	21FP4A	15	22	Yes	Key	4	25.6	Strip	10	Tur, C	HSHV, UC
	53WR, 531WR, 5301, 5302	152	AM	21FP4A	15	25	Yes	Key	4	25.6	Strip	10	Tur, C	HSHV, UC
Shaw Television Corp. 195 Front St., Brooklyn 1, N. Y.	221, 1521, 2021, 2221, 2321, 2421, 2621, 3021, 3221, 3421, 3521, 3621, 3721	224X	No	21MP4	15	23	No	Ord	3	26.75	Strip	12 & (2) 5	Tur, C	PJ
	221, 1521, 2021, 2221, 2321, 2421, 2621, 3021, 3221, 3421, 3521, 3621, 3721	224XR5	AM-FM	21MP4	15	28	No	Ord	3	26.75	Strip	12 & (2) 5	Tur, C	Ph
	2724, 2824	224X	No	24AP4	15	23	No	Ord	3	26.75	Strip	12 & (2) 5	Tur, C	PJ
	2724, 2824	224XR5	AM-FM	24AP4	15	28	No	Ord	3	26.75	Strip	12 & (2) 5	Tur, C	Ph
Sheraton Television Corp. 370 7th Ave. New York 1, N. Y.	17MT20	530-DX	No	17	14	23	Yes	Key	4	26.75	Strip	6	Tur, C	PJ
	21BT10, 21MT10	530-DX	No	21	14	23	Yes	Key	4	26.75	Strip	6	Tur, C	PJ
	21BC10, 21BD10, 21MC10, 21MD10	530-DX	No	21	14	23	Yes	Key	4	26.75	Strip	12	Tur, C	PJ
	27MC10, 27MD10	530-DX	No	27	18	32	Yes	Key	4	26.75	Strip	12	Tur, C	PJ
Harold Shevers, Inc. 123 W. 64th St. New York City 23, N. Y.		B217[8]		17–21	12–14	17	Yes	Ord	3	25	Strip	6 in Table 10 in Console	Tur	No
		P217		8AP4	8	17	Yes	Ord	3	25	Strip	4x6	Tur	P
		227[8]		17	9	27	Yes	Ord	4	23.75	Strip	6	Tur	A.C.-D.C.
		318[8]		21	14	18	Yes	Ord	3	25	Strip	6	Tur	No
		319[8]		21	12	19	Yes	Ord	3	25	Strip	6	Tur	A.C.-D.C.
		323[8]		21	14	23	Yes	Ord	3	23.75	Strip	6	Tur	RC

Sonora Radio & Telev. Corp.	421, 422	BRT	No	17TP4	14	19	Yes	Ord	3	26.4	Strip	8	Tur	No
2023 W. Carroll, Chicago 12, Ill.	423, 424, 425, 426	BST	No	21MP4	14	19	Yes	Ord	3	26.4	Strip	8	Tur	No
Sparton Radio-Television	5301 (Danbury)	21S173	No	17	14	21	Yes	Ord	3	26.25	Strip	6	Tur, C	No
2400 E. Ganson St.	5325 (Devonshire)	25D173A	No	17	14	25	Yes	Key	4	26.25	Strip	6	Tur, C	No
Jackson, Mich.	5340 (Glenhurst)	21S213	No	21	14	21	Yes	Ord	3	26.25	Strip	6	Tur, C	No
	5342 (Gilmore)	25D213	No	21	16	25	Yes	Key	4	26.25	Strip	6	Tur, C	No
	5362 (Radford)	25D173A	No	17	14	25	Yes	Key	4	26.25	Strip	10	Tur, C	No
	5380 (Courtland)	21S213	No	21	14	21	Yes	Ord	3	26.25	Strip	10	Tur, C	No
	5382 (Carrington), 5384 (Crestwood), 5386 (Courtney)	25D213	No	21	16	25	Yes	Key	4	26.25	Strip	10	Tur, C	No
	5392 (Cambridge)	25D213	AM-FM[9]	21	16	25	Yes	Key	4	26.25	Strip	10	Tur, C	No
Starrett Television	17CG	17S1	No	17	13.3	20	Yes	Ord	3	25.75	Strip[19]	8	Tur[7]C[7] Sw[7] C[7]	No No
601 W. 26th St.	17TG, 17TW	17S1	No	17	13.3	20	Yes	Ord	3	25.75	Strip[19]	5	Tur[7]C[7] Sw[7] C[7]	No No
New York 1, N. Y.	20TG, 20TW	18S1	No	20	13.3	20	Yes	Ord	3	25.75	Strip[19]	5	Tur[7]C[7] Sw[7] C[7]	No No
	20CD, 20C2	18S1	No	20	13.3	20	Yes	Ord	3	25.75	Strip[19]	8	Tur[7]C[7] Sw[7] C[7]	No No
Stewart-Warner Electric	20C—9124-A		AM-FM	20CP4	12.5	31	Yes	Key	4	26.75	Strip	12	Tur	PJ
1300 N. Kostner Ave.	21T—9132-A		No	21AP4	12.5	26	Yes	Key	4	26.75	Strip	6	Tur, C	PJ
Chicago 51, Ill.	21T—9210-A, 21T—9211-B, -C		No	21AP4	12.5	19	Yes	Ord	3	26.75	Strip	6	Tur, C	PJ
	21C—9211-D, -E, -F		No	21AP4	12.5	19	Yes	Ord	3	26.75	Strip	6x9	Tur, C	PJ, CC
	27C—9212-A		No	27NP4	18	21	Yes	Ord	3	26.75	Strip	6x9	Tur, C	PJ
Stromberg-Carlson Co.	Classic 21 (521C5Dec.)	No	No	21	17	24	Yes	Key	4	26.4	Strip	8	Tur, C	PJ
Rochester 3, N. Y.	Classic 21 (521C5O)	No	No	21	17	24	Yes	Key	4	26.4	Strip	8	Tur, C	PJ
	Classic 21 (521C5M)	No	No	21	17	24	Yes	Key	4	26.4	Strip	8	Tur, C	PJ
	Yorkshire (521CDM)	No	No	21	17	24	Yes	Key	4	26.4	Strip	8	Tur, C	PJ
	Invader II (521CM)	No	No	21	17	24	Yes	Key	4	26.4	Strip	8	Tur, C	PJ
	Panavue (521T)	No	No	21	17	24	Yes	Key	4	26.4	Strip	5½	Tur, C	PJ
Sylvania Electric Corp.	105	504-1	No	17	16	24	Yes	Key	4	26.8	UHFT	6½	Sw	No
Radio & Tel. Division	120	510-1	No	21	16	23	Yes	Key	4	45.75	UHFT	6½	Sw	No
254 Rano St.	126	510-1	No	21	16	24	Yes	Key	4	45.75	UHFT	8	Sw	No
Buffalo, N. Y.	150	437-3	No	17	16	24	Yes	Key	4	26.4	Ex Conv	6½	Sw	No
	155	437-3	No	17	16	24	Yes	Key	4	26.4	Ex Conv	6½	Sw	No
	172, 176, 177	508-1	No	21	17	28	Yes	Key	4	45.75	UHFT	10	Sw, C	Halo
	175	508-1	No	21	17	28	Yes	Key	4	45.75	UHFT	6½	Tur, C	Halo
	178	508-1 TV 603-1 Radio	AM-FM	21	17	28	Yes	Key	4	45.75	UHFT	12	Sw, C	Halo, Ph
	187	509-1	No	27	22	35	Yes	Key	5	45.75	Int Tune	10	Sw-v.h.f. Con-u.h.f.	Halo, RC
Tech-Master Products Co.		C30	No	24	15.5	30	No	Ord	4	26.4	Strip	12	Tur, C	PJ
443 Broadway,		630D24	No	Up to 24	16	30	No	Key	4	25.75 -26.4	Strip	12	Tur, C	K[15]
New York 13, N. Y.		630S24	No	Up to 24	16	30	No	Key	4	25.75 -26.4	Strip	12	Tur, C	K
		1930RC	No	21	16	30	No	Key	4	26.4	Strip	12	Tur, C	PJ
		2430	No	Up to 24	16	30	No	Key	4	26.4	Strip	12	Tur, C	PJ
		2431	No	Up to 24	16	31	No	Key	4	26.4	Strip	12	Tur, C	PJ
		2431C	FM	Up to 24	16	31	No	Key	4	26.4	Strip	12	Con	PJ
		5219	No	17	16	19	Yes	Ord	3	26.4	Strip	8	Tur	A.C.-D.C.
		5321	No	21	16	21	Yes	Ord	3	26.4	Strip	8	Tur	A.C.-D.C.

Manufacturer	Model	Chassis Number	AM-FM-SW	C-R Tube Type, or Size (In)	C-R Tube Anode KV	Number of Tubes	Intercarrier Sound	Type A.G.C. (Keyed or Standard)	No. Video I.F. Stages	Video I. F. (MC)	U.H.F. Tuning	Speaker Size (In)	Tuner Type	Accessories Remarks
Tele King Corp. 601 W. 26th St. New York, N. Y.	K11, K11B	TVJ	No	21	14–15	17	Yes	Ord	3	25.1	Int Conv	4x6	Sw	No
	K72, K72B, K74	TVJ	No	17	14–15	17	Yes	Ord	3	25.1	Int Conv	4x6	Sw	No
	KC11, KC11B, KD11. KD11B, KD12C, KD12M, KD13	TVJ	No	21	14–15	17	Yes	Ord	3	25.1	Int Conv	10	Sw	No
	KC71, KC72B	TVJ	No	17	14–15	17	Yes	Ord	3	25.1	Int Conv	10	Sw	No
	KD11X, KD11XB	TVJ	AM	21	14–15	17	Yes	Ord	3	25.1	Int Conv	10	Sw	3P1
	KD27, KD28	TVJ27	No	27	17–18	17	Yes	Ord	3	25.1	Int Conv	10	Sw	No
	KD71X, KD71XB	TVJ	AM	17	14–15	17	Yes	Ord	3	25.1	Int Conv	10	Sw	3P1
Trad Television Corp. 1001 1st Ave., Asbury Park, N. J.	C2052	T1853	No	20HP4	13.5	18	Yes	Ord	3	26.75	Strip	8	Tur	No
	C2152	T1853	No	21FP4	13.5	18	Yes	Ord	3	26.75	Strip	10	Tur	No
Transvision, Inc. 460 North Ave., New Rochelle, N. Y.	A-5		FM[7]	17–21	12	25	No	Ord	4	26.25	Ex Conv	6x9	Sw	RC[7], Ph[7]
Trav-Ler Radio Corp. 571 West Jackson Blvd. Chicago 6, Illinois		217-31	No	17	11.2	21	Yes	Ord	3	26.25	Strip	4x6	Tur, C	No
		217-32	No	17	11.2	21	Yes	Ord	3	26.25	Strip	4x6	Tur, C	No
		217-33	No	17	11.2	21	Yes	Ord	3	26.25	Strip	4x6	Tur, C	No
		217-37	No	17	11.2	21	Yes	Ord	3	26.25	Strip	4x6	Tur, C	No
		220-34	No	20	11.2	21	Yes	Ord	3	26.25	Strip	4x6	Tur, C	No
		220-35	No	20	11.2	21	Yes	Ord	3	26.25	Strip	4x6	Tur, C	No
		221-36	No	21	11.2	21	Yes	Ord	3	26.25	Strip	6x9	Tur, C	No
Video Products Corp. Red Bank, New Jersey	530	530DX		16–21	14	23	Yes	Key	4	26.25	Strip	12	Tur, C	PJ
	630	630DXC, 630K3C		16–21	14	30	No	Key	4	26.25	Strip	12	Tur, C	PJ
		630K24, 630K24-DXC		24	15.5	30	No	Key	4	26.25	Strip	12	Tur, C	PJ
Westinghouse Electric Corp. Television-Radio Division Sunbury, Penna.	H-667T17, H-668T17	V-2216-1	No	17	13.5	22	Yes	Key	3	45.75	Int Conv	5¼	Sw	No
	H-676T21	V-2217-1	No	21	13.5	22	Yes	Key	3	44	Int Conv	5¼	Sw	No
	H-681T17	V-2215-1	No	17	13.5	22	Yes	Key	3	44	Int Conv	5¼	Sw	No
	H-681T17	V-2215-2 & -3	No	17	13.5	22	Yes	Key	3	44	Int Conv	5¼	Sw, C	No
	H-678K17, H-679K17	V-2216-1	No	17	13.5	22	Yes	Key	3	44	Int Conv	10	Sw	No
	H-688K24	V-2219-1	No	24	16	24	Yes	Key	3	44	Int Conv	10	Sw	No
	H-689T16	V-2214-1	No	16	13.5	22	Yes	Key	3	44	Int Conv	5¼	Sw	No
	H-673K21, H-690K21, H-691K21	V-2217-1	No	21	13.5	22	Yes	Key	3	44	Int Conv	10	Sw	No
	H-692T21	V-2217-2	No	21	13.5	22	Yes	Key	3	44	Int Conv	5¼	Sw	No
	H-695K21	V-2217-2,	No	21	13.5	22	Yes	Key	3	44	Int Conv	10	Sw	No
		V-2217-3	No	21	13.5	22	Yes	Key	3	44	Int Conv	10	Sw, C	No
	H-699K17, H-702K17, H-703K17, H-705K17	V-2216-2	No	17	13.5	22	Yes	Key	3	44	Int Conv	10	Sw	No
	H-700T17, H-701T17	V-2216-2	No	17	13.5	22	Yes	Key	3	44	Int Conv	5¼	Sw	No
	H-704T17	V-2216-2,	No	17	13.5	22	Yes	Key	3	44	Int Conv		Sw	No
		V-2216-4, -5	No	17	13.5	22	Yes	Key	3	44	Int Conv	5¼	Sw, C	No
	H-706T16	V-2207-1	No	16	13.5	21	Yes	Key	3	44	Ex Conv	5¼	Sw	No
	H-708T20	V-2220-1.							3	44	Ex Conv		Sw	No
		V-2220-3, -11	No	20	13.5	21	Yes	Key	3	44	Ex Conv	5¼	Sw, C	No
	H-710T21	V-2217-2				22			3	44	Int Conv		Sw	No
	H-711T21	V-2217-3, -4				22			3	44	Int Conv		Sw, C	No
		V-2217-5	No	21	13.5	23	Yes	Key	3	44	Int Conv	5¼	Sw, C	No
	H-713K21	V-2217-2	No	21	13.5	22	Yes	Key	3	44	Int Conv	10	Sw	No
	H-714K21, H-720K21	V-2217-2	No	21	13.5	22	Yes	Key	3	44	Int Conv	10	Sw	No
	H-721K21	V-2217-3 & -4	No	21	13.5	22	Yes	Key	3	44	Int Conv	10	Sw, C	No

(*Continued on Page 84*)

TRAIN *FASTER* — TRAIN *BETTER* — TRAIN *EASIER*
IN 10 MONTHS — OR LESS — FOR
RADIO-TELEVISION

Our 21st Year Training Men for Greater Incomes and Security in Radio-Television

I SEND YOU
18 BIG KITS

of Radio Television parts and equipment. Much of your training will be actual construction and experimentation . . . the kind of truly PRACTICAL instruction that prepares you for your Radio-Television career.

Frank L. Sprayberry
President
Sprayberry Academy of Radio

NEW! NO OBLIGATION PLAN

You Have No Monthly Payment Contract to Sign
Pay For Your Training as You Earn and Learn

You can get into Radio-Television, today's fastest growing big money opportunity field, in *months* instead of years! My completely new "package unit" training plan prepares you in as little as 10 months or even less! *No monthly payment contract to sign—thus NO RISK to you!* This is America's finest, most complete, practical training—gets you ready to handle any practical job in the booming Radio-Television industry. Start your own profitable Radio-Television shop . . . or accept a good paying job. I have trained hundreds of successful Radio-Television technicians during the past 21 years—and stand ready to train you, even if you have no previous experience! Mail coupon and get all the facts—FREE!

YOU BUILD the Television set and the powerful superhet radio receiver shown above. IN ADDITION to the other test units shown here (many are not shown because of lack of space). All equipment I send you is YOURS TO KEEP.

Approved for Veterans under the G. I. Bill

Valuable Equipment Included With Training

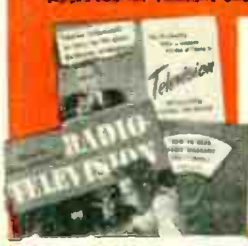
The new Sprayberry "package" plan includes many big kits of genuine, professional Radio-Television equipment. You perform over 300 demonstrations, experiments and construction projects. You build a powerful 6-tube 2-band radio set, multi-range test meter, signal generator, signal tracer, many other projects. All equipment and lessons are *yours to keep* . . . you have practically everything you need to set up your own profitable Radio-Television service shop.

Earn Extra Money While You Learn!

All your 10 months of training is IN YOUR HOME in spare hours. Keep on with your present job and income while learning. With each training "package" unit, you receive extra plans and "Business Builder" ideas for spare time Radio-Television jobs. New television stations everywhere, open vast new opportunities for trained Radio-Television Technicians—and those in training. If you expect to be in the armed forces later, there is no better preparation than practical Sprayberry Radio-Television training.

SPRAYBERRY ACADEMY OF RADIO
111 NORTH CANAL ST.
Dept. 20-S, Chicago 6, Ill.

MAIL COUPON TODAY! NO OBLIGATION



I invite you to get all the facts—
FREE TO YOU 3 BIG RADIO-TELEVISION BOOKS

I want you to have ALL the facts about my new 10-MONTH Radio-Television Training—without cost! Rush coupon for my three big Radio-Television books: "How to Make Money in Radio-Television." PLUS my new illustrated Television Bulletin PLUS an actual sample Sprayberry Lesson—ALL FREE. No obligation and no salesman will call. Mail coupon NOW!

SPRAYBERRY ACADEMY OF RADIO, Dept. 20-S
111 North Canal St., Chicago 6, Ill.

Please rush to me all information on your 10-MONTH Radio Television Training Plan. I understand this does not obligate me and that no salesman will call upon me. Be sure to include 3 books FREE.

Name ____________________ Age ______

Address ____________________

City ______________ Zone ____ State ________

Manufacturer	Model	Chassis Number	AM-FM-SW	C-R Tube Type, or Size (In)	C-R Tube Anode KV	Number of Tubes	Intercarrier Sound	Type A.G.C. (Keyed or Standard)	No. Video I.F. Stages	Video I. F. (MC)	U.H.F. Tuning	Speaker Size (In)	Tuner ype	Accessories Remarks
(Continued from Page 82)	H-715K21, H-721K21	V-2217-5	No	21	13.5	23	Yes	Key	3	44	Int Conv	10	Sw, C	No
	H-718K20	V-2220-2 & -4	No	20	13.5	21	Yes	Key	3	44	Ex Conv	$5\frac{1}{4}$	Sw, C	No
	H-723K21	V-2217-55	No	21	13.5	21	Yes	Key	3	44	Int Conv	10	Sw	No
		V-2217-5	No	21	13.5	23	Yes	Key	3	44	Int Conv	10	Sw, C	No
	H-724T20, H-725T20	V-2220-2 & -4	No	20	13.5	21	Yes	Key	3	44	Ex Conv	$5\frac{1}{4}$	Sw, C	No
	H-730C21	V-2218-1	AM-FM	21	13.5	29	Yes	Key	3	44	Int Conv	10	Sw	Ph
		V-2218-11 & -2 (Radio V-2180-9)	AM-FM	21	13.5	29	Yes	Key	3	44	Int Conv	10	Sw, C	Ph
	H-732C21	V-2218-1	AM-FM	21	13.5	29	Yes	Key	3	44	Int Conv	10	Sw	Ph
	H-733C21	V-2218-11 & 2 (Radio V-2180-10)	AM-FM	21	13.5	29	Yes	Key	3	44	Int Conv	10	Sw, C	Ph
	H-754K21	V-2217-4	No	21	13.5	22	Yes	Key	3	44	Int Conv	10		
		V-2217-5	No	21	13.5	23	Yes	Key	3	44	Int Conv	10	Sw, C	No
Zenith Radio Corporation Chicago 39, Illinois	K1812R, K1812E	19K22	No	17	14	19	Yes	Key	3	41.25	Strip	4	Tur	RC[7]
	K1815R, K1815E. K1810R, K1820E,	19K20	No	17	14	19	Yes	Key	3	41.25	Strip	$5\frac{1}{4}$	Tur	RC[7]
	K1846R, K1850R, K1850E	19K20	No	17	14	27	Yes	Key	3	41.25	Strip	10	Tur	RC[7]
	K1880R	19K20 & 8H20Z	AM-FM	17	14	27	Yes	Key	3	41.25	Strip	10	Tur	No
	K2229K, K2229E, K2235R, K2258R	19K23	No	21	14	19	Yes	Key	3	41.25	Strip	$5\frac{1}{4}$	Tur	No
	K2286R	19K23 & 7K21	AM	21	14	26	Yes	Key	3	41.25	Strip	$7\frac{1}{2}$	Tur	Ph
	K2230R, K2230E, K2240R, K2240E, K2260R, K2263E, K2266R, K2267E, K2268R	21K20 or 21K20Z	No	21	18	21	Yes	Key	3	41.25	Strip	$5\frac{1}{4}$ 10	Tur	No
	K2287R	21K20 or 21K20Z & 8H20Z	AM-FM	21	18	29	Yes	Key	3	41.25	Strip	12	Tur	Ph
	K2290R, K2291E	21K20 or 21K20Z & 10H20Z	AM-FM	21	18	31	Yes	Key	3	41.25	Strip	12	Tur	Ph
	K2872R, K2873E	28K20	No	27	18.5	28	Yes	Key	3	41.25	Strip	(2) 10	Tur	No

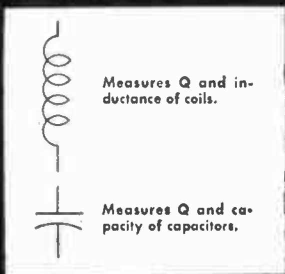
A.C.-D.C.	Receiver operates on a.c. or d.c.
BAR	Available with built-in bar
C	Cascode
CC	Casters on cabinet
CJ	Color jack
Cl	Clock
Com	Commercial
Con	Continuous
Ex. Conv.	External converter needed
HALO	Halolight
HSHV	Hermetically sealed high-voltage unit
Int. Conv.	Internal converter (number after indicates number of u.h.f. channels)
Int. Tune.	82-Channel tuner
K	Kit
P	Portable
PD	Phono drawer
Ph	Phono
PJ	Phono jack
3Pl	3-speed player
RC	Remote control
RCS	Remote chassis and ext. speakers
Strip	Snap-in coil strips to be added to 12-channel v.h.f. turret tuner
SW	Switch
TB	Tunable v.h.f. booster
Tun	V.h.f.-u.h.f. TV tuner
Tur	Turret
UC	Unitized construction
UHFT	Provisions for u.h.f. tuning
VHB	Vertical and horizontal blanking
X	Exchange tuner
1	Projection tube.
2	For custom installations.
3	Has 5" speaker.
4	Other sizes optional.
5	Plus 5 tubes for AM radio.
6	Built-in AM radio optional.
7	Optional.
8	Table models have 6" speakers; 10" speakers in consoles.
9	8-tube AM-FM chassis.
10	Has phono jack. Not available with phonograph.
11	Deluxe model with 21 tubes and 3 video stages available.
12	Coaxial speaker.
13	Built-in 2-tube AM tuner.
14	Made under Croydon trade-name for E. C. Bonia Inc., 500 Fifth Ave., N.Y.C.
15	Major components mounted.
16	Also uses 6x11 speaker.
17	Has cascode tuner and 45-75 mc video i.f.
18	Also available with 12" speaker.
19	External converter needed with switch type tuners.

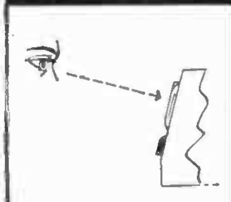
NEW *Heathkit* "Q" METER KIT

• A HIGH QUALITY Q METER AT LOW COST.

MODEL QM-1
SHIPPING
WT. 12 LBS

$39.50





Slant face cabinet for ease in reading the meter.

- First Q METER within the price range of all.
- Read Q's of 0-500 directly on calibrated scale.
- Stable oscillator supplies R.F. frequencies of 150 kc to 18 megacycles.
- Calibrated capacitor with range of 40 mmf to 450 mmf with vernier of ± 3 mmf.
- Simple, easy operation.
- Can be used to measure small inductances or capacitors.
- Measures Q of condensers, RF resistance and distributed capacity of coils.
- Measures capacity by substitution, capacity by resonance, inductance by resonance.
- Slanted panel for convenient operation.

Another outstanding example of progressive HEATHKIT engineering. Now a highly desirable Q METER within the price range of all laboratories, schools and experimenters. No longer is it necessary to deny yourself the many measurement advantages offered by this instrument.

Use the new HEATHKIT Q METER for the following simple basic measurements: capacity by substitution, capacity by resonance, inductance by resonance and Q at the OPERATING frequency all can be read on the calibrated scales. The method used to obtain information regarding the Q of condensers, RF resistance, distributed capacity in coils, etc., is only slightly more involved. In the HEATHKIT Q METER, the generated RF signal is coupled through a cathode follower and injected across a low impedance condenser which is included in the resonant circuit under test. Large 4½" 50 microampere Simpson meter reads Q directly. The resonating condenser and vernier condenser are calibrated in mmf for substitution method capacity tests. The resonating condenser is also calibrated in effective capacity for resonance tests. The inductance calibration serves for rapid determination of the approximate inductance of a coil. The HEATHKIT Q METER has a generator frequency range of 150 kc to 18 megacycles. Vernier capacity covers $\pm$ 3 mmf and the resonating condenser is calibrated from 40 mmf to 450 mmf actual capacity or 40 mmf to 350 mmf effective capacity. Meter reads Q directly up to 250. Higher and lower full scale readings can be obtained by varying the injection voltage levels.

The entire kit consists of 12AT7, 6AL5, 6C4, OD3 and 6X5 tubes, 50 microampere Simpson meter, power transformer, cabinet and all other parts necessary for construction as well as instructions for assembling, testing and operation of the completed instrument.

Heathkit DECADE RESISTANCE KIT

The HEATHKIT DECADE RESISTANCE KIT is widely used by schools, experimenters and laboratories because of the extremely wide resistance range offered and the useful, dependable service provided. The DECADE consists of 5 rotary 2 deck ceramic wafer switches with silver plated contacts and twenty 1% precision resistors in a circuit which provides the resistance range of 1 ohm to 99,999 ohms in 1 ohm steps. The HEATHKIT DECADE RESISTANCE KIT is simple to construct and is housed in a beautiful polished birch cabinet with an attractive panel. The DECADE will furnish years of accurate trouble-free service.

Individual decade sections of above can be purchased separately for special applications.

MODEL DR-1
SHIPPING
WT. 4 LBS.

$19.50

NEW *Heathkit* DECADE CONDENSER KIT

Extremely useful in all experimental and design work such as determination of condenser values for: compensating networks, filters, bridge impedances, tuned circuits, etc. *Uses all precision silver mica condensers within $\pm 1\%$ accuracy.* Values run in three decades from 100 MMFD to 0.111 MFD in steps of 100 MMFD. Smooth acting, positive detent, highest quality ceramic wafer switches make all capacitor values easy to set up and keep losses to a minimum. Low loss dielectric terminal board mounts on outside of panel for easy cleaning. Heathkit binding posts accommodate a wide variety of test leads. Comes complete with all parts, including polished birch cabinet.

Individual decade sections of above can be purchased separately.

MODEL DC-1
SHIPPING
WT. 4 LBS.

$16.50

EXPORT AGENT
ROCKE INTERNATIONAL CORP.
13 E. 40th ST.
NEW YORK CITY (16)
CABLE ARLAB N.Y.

The HEATH COMPANY

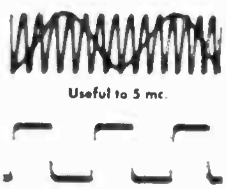
. . . BENTON HARBOR 20, MICHIGAN

NEW *Heathkit* OSCILLOSCOPE KIT

• NEW WIDE BAND VERTICAL AMPLIFIER ± 2 DB 10 CYCLES TO 1 MC.

Direct plate connections for modulation tests.

Displays TV sync pulses correctly.



Useful to 5 mc.

Good square wave response at 100 kc.

MODEL O-8

SHIPPING WT. 29 LBS.

$43.50

- New wider band vertical amplifier ± 2 db from 10 cycles to 1 megacycle useful to over 5 megacycles.
- High sensitivity in vertical amplifier. .025 volts RMS per inch deflection.
- New 3 step input attenuator input ranges X1, X10, X100.
- New 5CP1 intensifier type tube for greater brilliance.
- Terminal board and rear cabinet opening provisions for direct connections to deflecting plates.
- Newly styled formed and ventilated aluminum cabinet.
- Wide band sweep generator, 15 cycles to over 100 kc. Will synchronize with 5 megacycle signal.
- 10 tube circuit featuring push pull operation of vertical and horizontal amplifiers.
- Internal synchronization on either positive or negative peaks.
- Reproduces faithfully the front and back porches of TV sync pulses. Excellent square wave reproduction to over 100 kc.
- Optional Intensifier kit available for 2200 volt operation.

Proudly announcing the new 1953 HEATHKIT Model O-8 OSCILLOSCOPE featuring the finest performance ever offered in this extremely popular kit instrument. Improved wider band vertical amplifier featuring a new 3-step input attenuator affording smooth control of the excellent .025 volts per inch vertical sensitivity. Possibility of overloading the vertical input circuit is minimized. Greater band width in the vertical channel is a decided advantage to TV service men. Permits clear observation of all TV sync pulse detail and excellent square wave reproduction over 100 kc. 5CP1 intensifier type CR tube provides a brilliant trace with normal accelerating voltages. A handsome, ventilated cabinet with smooth rounded corners and a snug fitting drawn panel adds to the smartly styled professional appearance. Longer life is assured through cooler instrument operation. Push pull output stages in both vertical and horizontal amplifiers for balanced deflection of the spot. All of the many fine features of the previous model have been retained. Rear cabinet access to terminal board for direct connection to CR plates. The entire kit of all 10 tubes, parts, cabinet and panel as well as detailed construction manual for assembly and operation of the instrument included.

INTENSIFIER KIT: For extreme trace brilliance in special applications such as photography, group demonstrations or operation in brightly lighted areas an optional Intensifier kit providing 2200 volt operation of the CR tube is available. Kit includes high voltage filter condenser, high voltage selenium rectifier, etc. $7.50.

Heathkit SCOPE DEMODULATOR PROBE KIT

Trouble shooting or aligning TV, RF, IF and video stages requires demodulation of high frequency signals before Oscilloscope observation. The HEATHKIT SCOPE DEMODULATOR PROBE KIT was specifically developed for this application. Kit consists of a probe housing, crystal diode detector circuit, shielded cable and spade lugs. Assembly is simple and the probe will quickly prove its usefulness as an Oscilloscope accessory.

No. 337
SHIP. WT. 1 LB.
$4.50

NEW *Heathkit* VOLTAGE CALIBRATOR KIT

MODEL VC-1
SHIPPING WT. 5 LBS.
$9.50

Use the Heathkit Voltage Calibrator with your oscilloscope to measure peak-to-peak TV complex waveshapes. TV manufacturer's specifications indicate correct peak-to-peak voltages and this kit will permit making these important measurements. A big help to engineers in circuit work. Makes peak-to-peak voltage measurements of complex waveshapes of all kinds. Flat topped semi-square wave output of calibrator assures fast and easy measurement of any voltage between .01 and 100V peak-to-peak.

The Voltage Calibrator can remain connected to your oscilloscope at all times for instant use. "Signal" position connects signal under study directly through calibrator and into scope input circuit for direct observation. Eliminates transfering leads from calibrator. *A wonderful scope accessory.*

Heathkit ELECTRONIC SWITCH KIT

A few dollars spent for this accessory will increase the usefulness of a scope immeasurably. An electronic switch will open up a whole new field of scope applications for you. The S-2 allows TWO SIGNALS to be observed at the SAME TIME — this important feature allows you to immediately spot phase shift, clipping, distortion, etc. The two signals under observation can be superimposed or separated for individual study. Each signal input has an individual gain control for properly adjusting scope trace patterns. Has both coarse and fine frequency controls for adjusting switching time. Multivibrator switching frequency is from less than 10 cps to over 2000 cps in three overlapping ranges. Kit comes complete including 5 tubes, power transformer, all controls, instruction manual, etc. *Every scope owner should have one!*

MODEL S-2
SHIPPING WT. 11 LBS.
$19.50

EXPORT AGENT
ROCKE INTERNATIONAL CORP.
13 E. 40th ST.
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CABLE ARLAB N.Y.

The HEATH COMPANY
... BENTON HARBOR 20, MICHIGAN

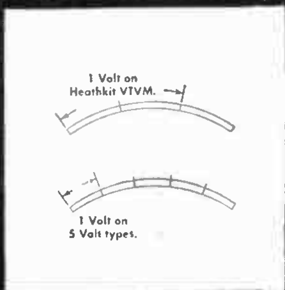
Heathkit VACUUM TUBE VOLTMETER KIT

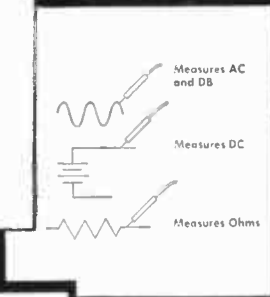
• NEW 1½ VOLT RANGE ON 1953 VTVM.

MODEL V-6

SHIPPING WT., 7 LBS.

$24.50





- New 1½ volt low range gives over 2" of scale per volt instead of less than ¾" found on 5 volt range type.
- Increased accuracy due to expanded scales.
- New 1500 volt DC high range gives 50% greater coverage.
- Seven ranges in all. 1½, 5, 15, 50, 150, 500 and 1500 volts DC (1000 volts maximum AC only).
- Provides proper service ranges 150 volts for AC DC work and 500 volts for AC type service.
- High input impedance, 11 megohms minimizes circuit loading.
- Variety of accessory probe kits available.
- 1% precision resistors in multiplier circuits.
- 200 microampere Simpson meter.
- Center scale zero adjust.
- Transformer operated.
- Test leads included.
- New cabinet styling.
- Large, clearly marked meter scales indicate ohms, AC volts, DC volts and DB.

The 1953 Heathkit V-6 VTVM has improved ranges! The lowest range has been moved way down to 1.5V full scale. This gives 3½" of actual scale length for the 1.5V covered — *that's 2⅓ inches per volt!!* Now you can make your low level measurements faster and with greater accuracy.

And the upper range has been moved up. *Readings up to 1500V DC* can be readily made with new, improved VTVM — plus readings up to 1000V on AC. Higher ranges for extended use.

New vertical chassis mounting gives added chassis space for really easy wiring — no tight corners to worry about. Uses only highest quality components throughout. Simpson 200 microampere meter movement combined with 1% precision resistors in multiplier circuit insure highly accurate and dependable readings.

AC and DC voltage ranges are 0-1.5V-5V-15V-50V-150V-500V-1500V. (1000V max. reading on AC) — a total of seven ranges for convenient, accurate readings. Instrument also measures resistance from .1 ohm to over 1 billion ohms in seven handy ranges of RX1, X10, X100, X1000, X10K, X1 Meg., — all convenient multiples of 10 with no skips. Has Db scale in red for easy indentification.

New panel has tough *baked on enamel finish* for freedom from scratches and maximum durability. Modern styled, formed, compact cabinet with rounded edges and crackle finish is truly handsome.

Comprehensive, detailed instruction manual with step-by-step instructions, figures, pictorials, etc. makes assembly a cinch.

Be sure and look over the special accessory VTVM probes below — for added usefulness.

Heathkit R. F. PROBE KIT

SHIP. WT 1 LBS. **$5.50**

No. 309

Extends RF range of HEATHKIT 11 megohm VTVM to 250 megacycles ± 10%.

Heathkit 30,000 V. D.C. PROBE KIT

SHIP. WT. 2 LBS **$5.50**

No. 336

Provides DC multiplication factor of 100 for any 11 megohm VTVM.

Heathkit PEAK TO PEAK VOLTAGE PROBE KIT

SHIP. WT. 2 LBS. **$6.50**

No. 338

Reads on DC scale of any 11 megohm VTVM 5 kc to 5 megacycle range.

NEW Heathkit BATTERY TESTER KIT

The new Heathkit Battery Tester measures all types of dry batteries between 1½ volts and 150 volts under actual load conditions. Readings are made directly on a three-color GOOD-WEAK-REPLACE scale that your customers can readily understand. Operation is extremely simple and merely requires that the leads be connected to the battery under test. Only one control to adjust in addition to a panel switch for A or B battery types.

The Heathkit Battery Tester features compact assembly. An accurate meter movement and wire wound control mount in the portable, rugged plastic case.

Use the BT-1 to check portable radio batteries, hearing aid batteries, lantern batteries and photo flash gun batteries.

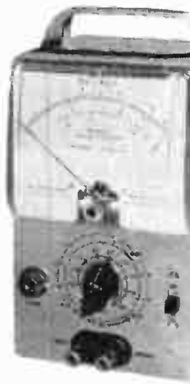
MODEL BT-1

SHIPPING WT. 3 LBS.

$7.50

Heathkit AC VACUUM TUBE VOLTMETER KIT

A new AC VTVM that makes possible those sensitive AC measurements required by laboratories, audio enthusiasts and experimenters. Ten full scale ranges of .01, .03, .1, .3, 1, 3, 10, 30, 100 and 300 volts RMS. 10 DB ranges from −52 to +52 DB. Frequency response within 1 DB from 20 cycles to 50 kc. Simpson 200 microampere meter with large plainly marked meter scales. Precision multiplier resistors. Two amplifier stages using miniature tubes. A unique bridge rectifier meter circuit and a clean layout of parts. Order the AV-2 today and become acquainted with the interesting possibilities offered by this instrument.



MODEL AV-2

SHIPPING WT. 5 LBS.

$29.50

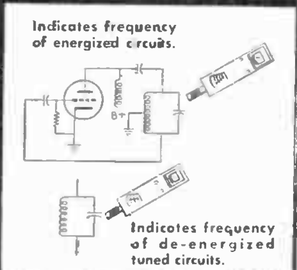
EXPORT AGENT
ROCKE INTERNATIONAL CORP.
13 E. 40th ST.
NEW YORK CITY (16)
CABLE: ARLAB-N.Y.

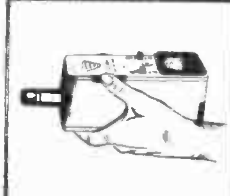
The HEATH COMPANY

. . . BENTON HARBOR 20, MICHIGAN

NEW *Heathkit* GRID DIP METER KIT

• CONVENIENT ONE HAND OPERATION.





Complete unit easily held and operated with one hand.

MODEL GD-1

SHIPPING WT. 4 LBS.

$19.50

- New GRID DIP METER with assembled calibrated coils.
- Uses quality Simpson 500 microampere meter.
- One hand operation, extremely compact. Only 2½" wide by 3" high by 7" long.
- Variable meter sensitivity control.
- Uses newest type 6AF4 high frequency triode in a Colpitts oscillator circuit.
- Continuous coverage from 2 megacycles to over 250 megacycles in 6 ranges.
- Head phone monitoring jack.
- AC power transformer operated for maximum safety.

Here is the GRID DIP METER KIT you have been asking for. This new HEATHKIT instrument is compact, highly sensitive and easy to use. Housed in a handsome formed aluminum cabinet—rounded corners—durable oven baked finish on panel and cabinet. The entire instrument can be easily held and operated in one hand, tuning accomplished with the thumb wheel drive. This excellent design feature leaves the other hand entirely free for making circuit adjustments. The instrument with many applications — with oscillator energized, use it for finding the resonant frequency of tuned circuits, locating parasitics, determining characteristics of filter circuits, roughly tuning transmitter stages with power off, and neutralizing transmitters. Useful in TV and radio repair work for alignment of traps, filters, IF stages, peaking and compensation networks within the 2 to 250 megacycle range. With the oscillator not energized, the instrument acts as an absorption wave meter and indicates the frequency of radiating power sources. Locates spurious oscillations, as a relative indication of power in various transmitter stages, etc. Phone jack permits monitoring of AM transmitter for determination of radiated hum, audio quality, etc. (Head phones not included). Complete kit includes plug-in coils, tube, all necessary parts and detailed assembly and instruction manual.

Heathkit IMPEDANCE BRIDGE KIT

MODEL IB-1B

SHIPPING WT. 15 LBS.

$69.50

The HEATHKIT IMPEDANCE BRIDGE is especially useful in educational training programs, industrial laboratories and for experimental work. Use it for measuring AC and DC resistance value of resistors, determination of condenser capacitance and dissipation factor, finding coil inductance and storage factor, electrical measurements work, etc. Quality components. GR 1000 cycle hummer, GR main control, Mallory ceramic wafer silver plated contact switches, ½% precision resistors, etc. The basic circuit is a self powered, 4 arm bridge. Choice of Wheatstone, Capacitance comparison, Maxwell or Hay bridge circuits. Resistance from 10 milliohm to 10 megohm. Capacitance 10 mmf to 100 mfd. Inductance 10 microhenry to 100 henries. Dissipation factor .002 to 1. Storage factor (Q) 1 to 1000. The IMPEDANCE BRIDGE has provisions for external generator use for measurement at other than the 1000 cycle level. Take the guess work out of electrical measurements. The HEATHKIT IMPEDANCE BRIDGE mounted in a beautiful polished birch cabinet with large easy reading panel calibrations will furnish years of accurate, trouble free measurement service.

Heathkit HANDITESTER KIT

The HEATHKIT Model M-1 HANDITESTER fulfills requirements for a portable volt ohm milliammeter. This kit features precision 1% resistors, 3 deck switch for trouble free mounting of parts, specially designed battery bracket, smooth acting ohms adjust control, beautiful molded bakelite case and a 400 microampere meter movement. 5 convenient AC and DC voltage ranges as follows: 10 - 30 - 300 - 1000 - 5000 volts. Ohms ranges 0 - 3000 and 0 - 300,000. DC milliampere ranges 0 - 10 milliamperes and 0 - 100 milliamperes. The instrument is easily assembled from complete instructions and pictorial diagrams. Test leads are included. Carry the HEATHKIT M-1 HANDITESTER in your tool box at all times for those simple jobs and eliminate that extra trip for additional testing equipment.

MODEL M-1

SHIPPING WT. 3 LBS.

$13.50

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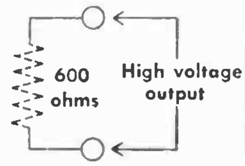
NEW *Heathkit* AUDIO GENERATOR KIT

• RANGE EXTENDED TO 1 MEGACYCLE



Low impedance output
High voltage output

Sine wave output from 20 cycles to 1 megacycle.

MODEL AG-8

SHIPPING WT. 16 LBS.

$29.50

- Improved design — new low price.
- Frequency coverage in five ranges from 20 cycles per second to 1 megacycle.
- Response flat 1 DB from 20 cycles to 400 kilocycles. Down 3 DB at 600 kilocycles. Down only 8 DB at 1 megacycle.
- Five calibrated output voltage ranges, continuously variable 1 mv, 10 mv, 100 mv, 1 v, 10 v.
- Low impedance output circuit. 600 ohms.
- Distortion less than .4 of 1% from 100 cycles per second through the audible range.
- New HEATHKIT universal type binding posts.
- Durable infra-red baked enamel panel.
- Transformer operated for safe operation.
- Sturdy, ventilated steel cabinet.

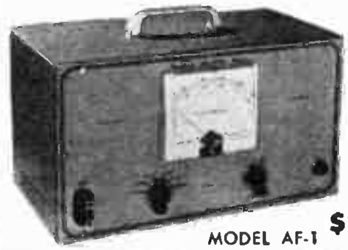
A new Audio Generator with features heretofore found in only the most expensive generators. Such features as complete coverage from 20 cycles to 1 Mc — response flat ±1 db from 20 cycles to 400 Kc, down 3 db at 600 Kc and down only 8 db at 1 Mc.

And it has calibrated output . . . Calibrated continuously variable and step attenuator output controls allow you to easily set calibrated output voltage. Moreover, distortion is less than .4 of 1% from 100 cps through the audible range.

Oscillator section consists of a two stage resistance coupled amplifier (6SJ7 and 6AK6) utilizing both positive and negative feedback for oscillator operation and reduction of distortion. Oscillator section drives a cathode follower output power amplifier (6AK6) which isolates the oscillator from variations in load and presents a low impedance output (600 Ohms). Power supply is transformer operated and utilizes 6X5 rectifier with 2 sections of RC filtering.

An unbeatable dollar value — for here is an audio generator with wide frequency coverage, excellent frequency response, stepped and continuously variable calibrated output, high signal level, low impedance output, and low inherent distortion.

Heathkit AUDIO FREQUENCY METER KIT

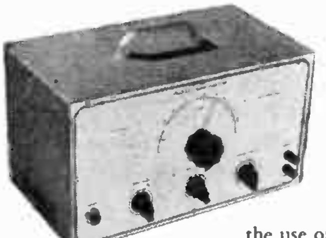


The HEATHKIT AUDIO FREQUENCY METER provides a simple and easy way to check unknown audio frequencies from 10 cycles to 100 kc between 3 and 300 volts RMS. The instrument features 7 ranges for accuracy and wide coverage. The meter itself has a quality 200 microampere Simpson movement and large clearly marked scales. The AUDIO FREQUENCY METER is transformer operated and features a voltage regulator tube to maintain constant plate voltage on the second stage. Kit supplied complete with all necessary construction material and a detailed construction manual.

SHIPPING WT. 15 LBS.

MODEL AF-1 **$34.50**

NEW *Heathkit* AUDIO OSCILLATOR KIT



MODEL AO-1

SHIPPING WT. 14 LBS.

$24.50

A new Audio Oscillator with both sine and square wave coverage from 20 to 20,000 cycles . . . An instrument designed to completely fulfill the needs of the audio engineer and enthusiast — Has numerous advantages such as high level output (up to 10V obtainable across the entire range), distortion less than .6%, and low impedance output.

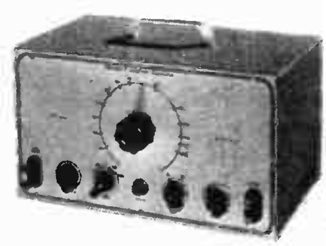
Special design features include the use of a thermistor in the second amplifier stage for keeping the output essentially flat across the entire range.

A cathode coupled clipper circuit produces good, clean, square waves with rise time of only 2 microseconds. Oscillator section uses 1% precision resistors in range multiplier circuit for greatest accuracy.

You'll like the operation of this fine new kit.

Heathkit SQUARE WAVE GENERATOR KIT

The HEATHKIT SQUARE WAVE GENERATOR is an excellent square wave frequency source with wide range coverage from 10 cycles to 100 kc continuously variable. This feature makes it useful for TV and wide band amplifier work as well as audio experimentation. The output voltage is continuously variable between 0 and 20 volts. The circuitry consists of a multivibrator stage, a clipping and squaring stage and a cathode follower low impedance output stage. The power supply is transformer operated and utilizes a full wave rectifier circuit with two sections of filtering. Another excellent HEATHKIT value at this remarkable low price. Kit includes all necessary construction material as well as complete instruction manual for assembly and operation.



MODEL SQ-1

SHIPPING WT. 14 LBS.

$29.50

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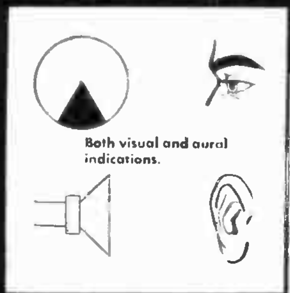
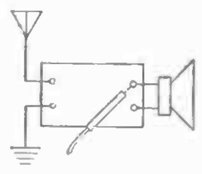
NEW *Heathkit* VISUAL-AURAL SIGNAL TRACER KIT

• NEW NOISE LOCATOR AND WATTMETER CIRCUITS.



Both visual and aural indications.



Traces signals from antenna clear through speaker.

MODEL T-3

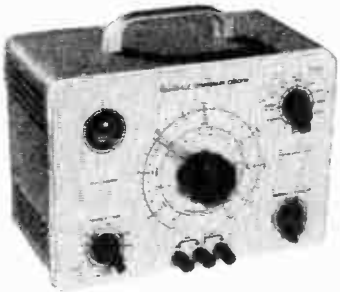
SHIPPING WT. 8 LBS.

$22.50

- Permits visual signal observation as well as aural operation.
- Two separate input channels.
- Tremendous RF channel sensitivity. Adequate for actual signal detection at receiver input.
- Separate high gain RF and low gain audio channels.
- A unique and useful noise locater circuit.
- Built-in calibrated wattmeter.
- Two separate shielded probes for RF and audio application.
- Additional test leads supplied.
- Substitution test speaker and output transformer eliminates necessity for speaker removal in service work.
- Utility amplifier. Check record changers, tuners, microphones, instrument pickups, etc.
- VTVM and Scope panel terminals.
- 5 tube transformer operated circuit.

The new HEATHKIT VISUAL AURAL SIGNAL TRACER represents one of the most convenient and useful instruments the service man can use in AM, FM and TV service work. The electron ray beam indicator constantly monitors both input channels for visual observation of the signal. Now, see and hear the signal level for easier estimation of signal strength and gain per stage in a receiver circuit. Separate high gain channel and special shielded demodulator probe for RF circuit work. Low gain channel for audio circuit investigation and for use as a noise locater. In this feature, approximately 200 volts DC is applied to a suspected circuit component and the action of the voltage in the component can be seen and heard to determine satisfactory operation. This feature alone will prove tremendously helpful in locating the source of objectionable noises in coils, transformers, resistors, condensers, cold solder joints, controls, etc. A convenient wattmeter permits rapid preliminary check for voltage distribution circuit breakdown as well as transformer failures. Use the T-3 as a universal test speaker and substitution transformer and save service time by eliminating the necessity for speaker removal on every service call. Additional service uses are: as a utility amplifier for checking the output of record changers, tuners, microphones, instrument pickups, etc. Separate panel terminals permit utilization of other shop equipment such as your Oscilloscope or VTVM. Entire kit supplied complete with 5 tubes, all necessary construction material along with a detailed step by step instruction manual for the assembly and operation of the instrument.

NEW *Heathkit* CONDENSER CHECKER KIT



MODEL C-3

SHIPPING WT. 7 LBS

$19.50

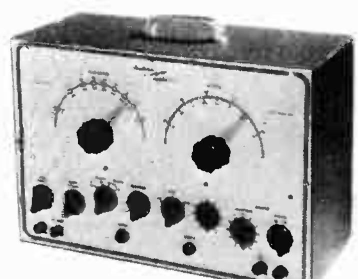
Announcing the new improved Model C-3 HEATHKIT CONDENSER housed in a new smartly styled professional appearing cabinet featuring rounded corners and snug fitting drawn panel. Adequate provisions for ventilation insures longer instrument life through cooler operation. Use the C-3 to accurately measure those unknown condenser and resistor values. All readings of condensers and resistors are read directly on the calibrated scales. Range of condenser measurements is from .00001 mfd to 1000 mfd. Calibrated resistance measurements can be made from 100 ohms to 5 megohms. A leakage test with a choice of 5 DC polarizing voltages will quickly indicate condenser operating quality under actual voltage load conditions. The spring return leakage test switch automatically discharges the condenser under test and eliminates shock hazard. An electron ray beam indicator tube is used in a new leakage test circuit for added sensitivity. The instrument is transformer operated for safety and will prove an extremely welcome addition to your shop equipment. The kit is furnished complete with all necessary parts, test leads and includes a step by step detailed construction manual for assembly and operation.

Heathkit TV ALIGNMENT GENERATOR KIT

MODEL TS-2

SHIPPING WT. 20 LBS.

$39.50



Here is an excellent TV ALIGNMENT GENERATOR designed to do TV service work quickly, easily and properly. The Model TS-2 when used in conjunction with an Oscilloscope provides a means of correctly aligning TV receivers. The instrument furnishes a frequency modulated signal covering in 2 bands the range of 10 to 90 megacycles and 150 to 230 megacycles. An absorption type frequency marker covers from 20 to 75 megacycles in 2 ranges: therefore you have a simple, convenient means of checking IF's independent of oscillator calibration. Sweep width is variable from 0 to 12 megacycles. Other excellent features are horizontal sweep voltage controlled with a phasing control — both step and continuously variable attentuation for setting the output signal to the desired level — a convenient stand by switch — and blanking for establishing a single trace with a base reference level. Make your work easier, save time and repair with confidence. Order your HEATHKIT TV ALIGNMENT GENERATOR now.

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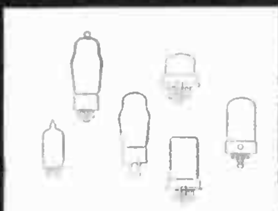
Heathkit TUBE CHECKER KIT

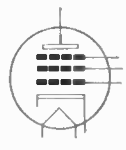
MODEL TC-1

SHIPPING WT. 12 LBS.

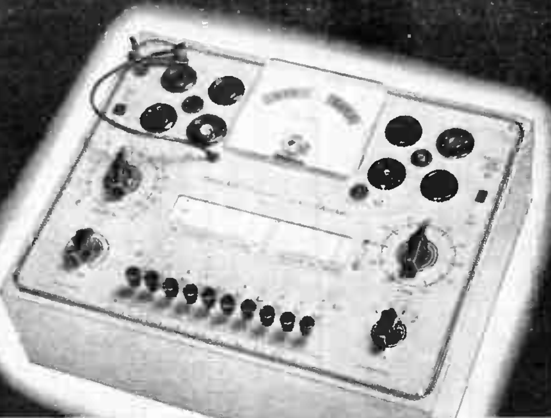
$29.50



Checks 7, 8, 9 prong tubes, octals, loctals, 7 and 9 prong miniatures, 5 prong Hytrons, pilot lights.



Checks for opens, shorts, emission, filament and filament tap continuity.



- Beautiful counter type birch cabinet.
- 4½" Simpson 3 color meter.
- Simplified setup procedure.
- Built-in gear driven roll chart.
- Checks emission, shorted elements, open elements and continuity.
- Complete protection against obsolescence.
- Sockets for every modern tube.
- Blank for new types.
- Individual element switches.
- Contact type pilot light test socket.
- Line adjust control.

PORTABLE TUBE CHECKER KIT MODEL TC-1P

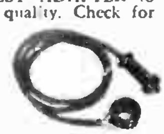
Same as TC-1 except supplied with polished birch cabinet (with removable lid) instead of counter type cabinet. Shipping weight 14 lbs. $34.50

No. 365 Polished Birch Tube Checker Cabinet only. Shipping Weight 7 lbs. $7.50

With the HEATHKIT TC-1 TUBE CHECKER test all types of tubes commonly encountered in AM-FM and TV receiver circuits. Test setup procedure is simplified, rapid and flexible. Tube quality is read directly on a beautiful 4½" Simpson three color BAD - ? - GOOD scale that your customers can readily understand. Panel sockets accommodate 4, 5, 6 and 7 prong tubes, octals, loctals, 7 and 9 prong miniatures, 5 prong Hytrons, a blank socket for new tubes and a contact type socket for quick checking of pilot lights. Built-in gear driven roll chart for instant reference. Neon short indicator, individual three position lever switch for each tube element, spring return test switch, line set control to compensate for supply voltage variations. At this low price, no service man need be without the advantages offered by the HEATHKIT TUBE CHECKER.

Heathkit TV PICTURE TUBE TEST ADAPTER

Use your HEATHKIT TUBE CHECKER with this new TV TEST ADAPTER to determine picture tube quality. Check for emission and shorts, independent of TV power supply. Consists of standard 12 pin TV tube socket, 4 feet of cable, octal socket connector and data sheet. Quickly prove TV picture tube condition to yourself and your customer.



No. 355 Ship. Wt. 1 lb. $4.50

Heathkit RESISTANCE SUBSTITUTION BOX KIT

MODEL RS-1

SHIPPING WT. 3 LBS.

$5.50

NEW HEATHKIT RESISTANCE SUBSTITUTION BOX KIT provides switch selection of any single one of 36 RTMA 1 watt 10% standard value resistors, ranging from 15 ohms to 10 megohms. This coverage available in 2 ranges in decades of 15, 22, 33, 47, 68 and 100. Housed in rugged plastic cabinet featuring new HEATHKIT universal type binding posts. The entire kit priced less than the retail value of the resistors alone.

Heathkit BATTERY ELIMINATOR KIT

A clean 6 volt d-c supply source is definitely required for successful automobile radio servicing. Has a continuously variable d-c output from 0 to 8 volts. It can be safely operated at a steady 10 ampere level and will deliver up to 15 amperes for intermittent periods. The voltage output terminals are completely isolated from the chassis to accommodate additional service applications such as supplying bias voltages or d-c substitution voltages for battery operated tube filament circuits.

The output of the Battery Eliminator is constantly monitored by a d-c voltmeter and a d-c ammeter. The circuit features an automatic overload relay of self resetting type. For additional protection, a panel mounting fuse is provided. Build this kit in a few hours and pocket a substantial savings.

MODEL BE-3

SHIPPING WT. 20 LBS.

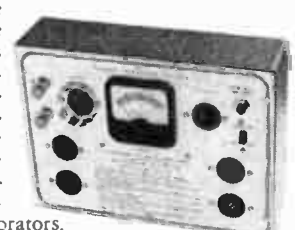
$24.50

Heathkit VIBRATOR TESTER KIT

Repair time is valuable, and the Heathkit Vibrator Tester will save you hours of work. Instantly tells the condition of the vibrator under test — and the check is thorough and complete. Checks vibrator for proper starting, and the easy-to-read meter indicates the quality of output on large BAD-GOOD scales. Tests both interrupter and selfrectifier types of vibrators. Five different sockets for checking hundreds of vibrators.

Operates from any battery eliminator capable of delivering continuously variable voltage from 4 - 6V at 4 amps. The Heathkit BE-3 Battery Eliminator is ideal for operating this kit.

Faulty vibrators can be spotted within seconds and you're free to go on to other service jobs.



MODEL VT-1

SHIPPING WT. 7 LBS.

$14.50

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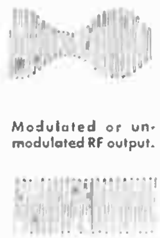
Heathkit SIGNAL GENERATOR KIT



Modulated or unmodulated RF output.

400 cycle sine wave output.

MODEL SG-7

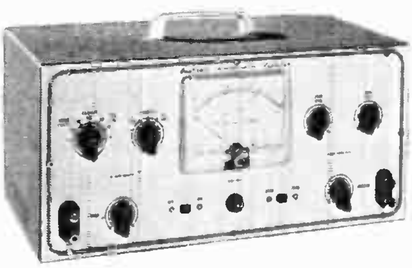
SHIPPING WT. 7 LBS.

$19.50

- Step attenuated RF ouput.
- 6 to 1 vernier dial ratio.
- Turret mounted coil sub-assembly.
- Pre-calibrated and adjusted coils.
- Hartley RF oscillator circuit.
- Colpitts oscillator 400 cycle sine wave output.
- Modulated or unmodulated RF output.
- Frequency coverage on fundamentals 160 kc to 50 megacycles in five ranges. 51 megacycles to 150 megacycles on calibrated harmonics.
- RF output in excess of 100,000 microvolts.
- Audio output 1½ to 2 volts.
- AC transformer operated.
- Professionally styled cabinet.
- Infra red baked enamel panel

The new HEATHKIT Model SG-7 SIGNAL GENERATOR easily fulfills requirements for a controllable, modulated or unmodulated source of variable frequency. A convenient 400 cycle sine wave output is available for audio work. All RF oscillator coils are precision wound and adjusted to calibration before shipment thereby assuring maximum accuracy. The coils, band switch and tuning condenser all mount as a turret assembly so as to offer the advantage of short wiring leads and easy mounting of parts. The RF output circuit is of the low impedance type obtained by the use of cathode coupling to the output jacks. The level of RF output is varied by means of the RF step and RF output control. Use the HEATHKIT SG-7 as an RF signal source modulated or unmodulated for radio repair, laboratory work, experimental testing, 400 cycle sine wave audio testing, checking RF stages, alignment of both AM and FM IF stages, marker generator for TV alignment, etc. The kit is transformer operated and utilizes miniature tubes for ease in handling high frequency. Panel jacks and a convenient switching system permit either external or internal modulation. The entire kit is supplied complete with tubes and all necessary material as well as a detailed step by step instruction manual for the assembly and operation of the instrument.

Heathkit INTERMODULATION ANALYZER KIT



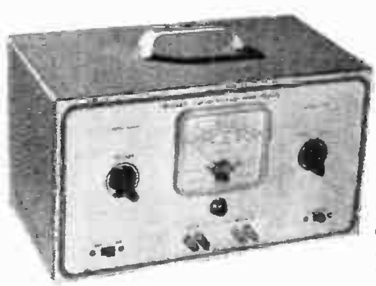
MODEL IM-1

SHIPPING WT. 18 LBS.

$39.50

The HEATHKIT MODEL IM-1 is an extremely versatile instrument specifically designed for measuring the degree of interaction between two signals caused by a specific piece of apparatus, or a chain of equipment. It is primarily intended for tests of audio equipment but may be used in other applications such as making tests of microphones, records, recording equipment, phonograph pickups and loud speakers. Use it for checking tape or disc recordings, as a sensitive AC voltmeter, as a high pass noise meter for adjusting tape bias, cutting needle pitch or other applications. High and low test frequency source, intermodulation section, power supply and AC voltmeter all in one complete unit. Percent intermodulation is directly read on three calibrated ranges, 30%, 10% and 3% full scale. Both 4 to 1 and 1 to 1 ratios of low to high frequencies easily set up. At this low kit price YOU can enjoy the benefits of Intermodulation analysis for accurate audio interpretations.

Heathkit LABORATORY REGULATED POWER SUPPLY KIT



MODEL PS-2

SHIPPING WT. 20 LBS.

$29.50

New HEATHKIT LABORATORY POWER SUPPLY provides continuously variable regulated DC voltage output from 160 volts to 400 volts depending on load. Panel terminals supply separate 6.3 V. AC supply at 4 amperes for filament circuits. A 3½" plastic cased panel mounted meter provides accurate metered output for either voltage or current measurements. Exceptionally low ripple content of .012% admirably qualifies the HEATHKIT LABORATORY POWER SUPPLY for high gain audio applications. Ideal for laboratory work requiring a reference voltage for meter calibration or for plotting tube characteristics. In service work, it can be used as a separate variable voltage supply to determine the desirable operating voltage in a specific circuit. Use it as a DC substitution voltage in trouble shooting TV circuits exhibiting symptoms of extraneous undesirable components in plate supply circuits. Entire kit, including all 5 tubes now available at this low price.

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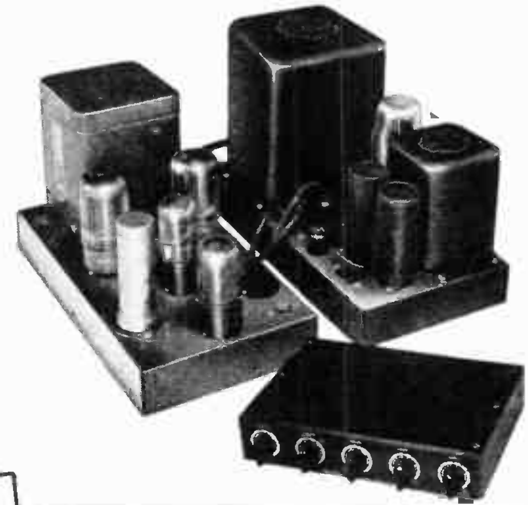
Heathkit WILLIAMSON TYPE AMPLIFIER KIT

The new HEATHKIT WILLIAMSON TYPE AMPLIFIER incorporates the latest improvements described in Audio Engineering's "Gilding the Lily." 5881 output tubes and a new Peerless output transformer with additional primary taps afford peak power output of well over 20 watts. Frequency response ±1 db from 10 cycles to 100 kc. allows reproduction of highs and lows with equal crispness and clarity. Harmonic and intermodulation distortion have been reduced to less than ½ of 1% at 5 watts. This eliminates the harsh unpleasant qualities which contribute to listening fatigue. Make this amplifier the heart of your radio system to achieve the fine reproduction that is the goal of all music lovers.

The HEATHKIT PREAMPLIFIER (available separately or in combination with the amplifier kit) features inputs for magnetic or low level cartridges, crystal pickups and tuners, turnover control for LP or 78 type records, individual bass and treble tone controls each providing up to 15 DB of boost or attenuation. Special notched shafts on preamplifier controls and switches adaptable to custom installation. The preamplifier can be mounted in any position and a liberal length of connecting cable is supplied. No radio experience is required to construct this amplifier. All punching, forming, or drilling has already been done. The complete kit includes all necessary parts as well as a detailed step by step construction manual with pictorial diagrams to greatly simplify the construction.

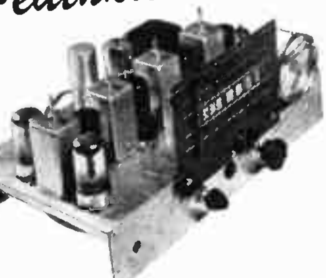


ACROSOUND TRANSFORMER OPTION. If desired, the output transformer with the kit will be the Acrosound output transformer, type TO-300. The use of this transformer permits ultra-linear operation as described in Audio Engineering's "Ultra-Linear Operation of the Williamson Amplifier."

PRICES OF VARIOUS COMBINATIONS

W-2 Amplifier Kit (Incl. Main Amplifier with Peerless Output Transformer, Power Supply and WA-P1 Preamplifier Kit) Shipping Weight 39 lbs.	$69.50
W-2M Amplifier Kit (Incl. Main Amplifier with Peerless Output Transformer and Power Supply) Shipping Weight 29 lbs. Shipped express only	$49.75
W-3 Amplifier Kit (Incl. Main Amplifier with Acrosound Output Transformer, Power Supply and WA-P1 Preamplifier Kit) Shipping Weight 39 lbs. Shipped express only	$69.50
W-3M Amplifier Kit (Incl. Main Amplifier with Acrosound Output Transformer and Power Supply) Shipping Weight 29 lbs. Shipped express only	$49.75
WA-P1 Preamplifier Kit only. Shipping Weight 7 lbs. Shipped express or parcel post.	$19.75

Heathkit FM TUNER KIT



MODEL FM-2
SHIPPING
WT. 9 LBS.

$22.50

The HEATHKIT MODEL FM-2 TUNER specifically designed for simplified kit construction features a preassembled and adjusted tuning unit. Three double tuned IF transformers and a discriminator transformer are used in an 8 tube circuit. Smooth tuning is obtained through a 9 to 1 ratio vernier drive using a calibrated six inch slide rule type dial. The usual frequency coverage of 88 to 108 megacycles is provided. Experience the thrill of building your own FM tuner. Operate it through your amplifier or radio and enjoy all the advantages of true FM reception. Transformer operated power supply to simplify connections to all types of audio systems. The kit is supplied complete with all 8 tubes and necessary material required for construction. A complete instruction manual simplifies assembly and operation.

Heathkit HIGH FIDELITY 20 WATT AMPLIFIER KIT

The HEATHKIT MODEL A-8 amplifier kit was designed to deliver high fidelity performance with adequate power output at moderate cost. The frequency response is within ± 1 DB from 20 to 20,000 cycles. Distortion at 3 DB below maximum power output at 1000 cycles is only .8%. The amplifier features a Chicago power transformer in a drawn steel case and a Peerless output transformer with output impedances of 4, 8, and 16 ohms available. Separate bass and treble tone controls permit wide range of tonal adjustment to meet the requirements of the most discerning listener. The amplifier uses a 6SJ7 voltage amplifier, a 6SN7 amplifier and phase splitter and two 6L6's in push pull output and a 5U4G rectifier. Two input jacks for either crystal or tuner operation. The kit includes all necessary material as well as a detailed step by step construction manual.

MODEL A-8
SHIPPING WT. 19 LBS.

$33.50

MODEL A8-A features an added 6SJ7 stage (preamplifier) for operating from a variable reluctance cartridge or other low output level phono pickups. Can also be used with a microphone. A 3 position panel switch affords the desired input service. $35.50

Heathkit ECONOMY 6 WATT AMPLIFIER KIT

MODEL A-7
SHIPPING
WT. 10 LBS.

$14.50

The HEATHKIT Model A-7 amplifier features beam power, push pull output with frequency response flat±1½DB from 20 to 20,000 cycles. Separate volume, bass and treble controls. Two input circuits, output impedances of 4, 8, and 15 ohms. Peak power output rated at full 6 watts. High quality components, simplified layout, attractive gray finished chassis, break off type adjustable length control shafts and attractive lettered control panel.

THE MODEL A7A amplifier incorporates a preamplifier stage with special compensated network to provide the necessary voltage gain for operation with variable reluctance or low output level phono cartridges. Excellent gain for microphone operation in a moderate powered sound system....................$16.50

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Heathkit SUPERHETERODYNE RECEIVER KITS

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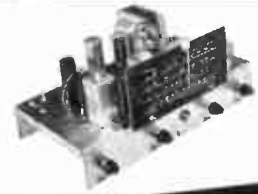

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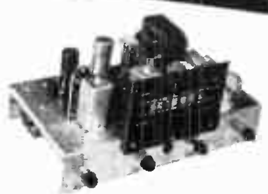

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Part II

A driver circuit which preserves its balance with age or changing tube constants

PUSH-PULL DRIVERS

By GEORGE FLETCHER COOPER

THE previous article indicated how important it was to preserve an accurate balance in the push-pull stages of an amplifier and described some of the phase splitters which are used, but which fail to guarantee the needed permanent balance. There are two basic ways to solve the problem. One of these will be the subject of this article.

The best way to produce two equal voltages with opposite phases is to pass a current through two equal resistors in series. If we use the simple equivalent for a tube we have the arrangement shown in Fig. 1. We can match the resistances as closely as we like, and obtain virtually perfect balance. Most of our problems will arise from the difficulty of achieving this ideal circuit when we must add the supply voltages and input for the tube. So long as we are concerned only with the ideal case we can see that the tube load is 2R, which should be equal to the optimum load given in the tube characteristics, and the gain of the stage to *each* push-pull grid is:

$$\frac{\mu R}{R_p + 2R}$$

or half the gain for a single-ended load of 2R.

Now let us consider the practical applications of the circuit. Terminal G must be grounded, because that is what the push-pull stage demands. The practical circuit must therefore look something like Fig. 2-a. This, of course, is still a rather theoretical circuit, because the grid of the tube is floating about in mid-air: we proceed to fix the working point of the tube by adding the components R_g, R_k and C_k (Fig. 2-b). These are the standard components for the tube. R_k sets the tube to its correct bias, C_k eliminates the negative feedback caused by R_k at all frequencies for which $2\pi f\, C_k R_k \gg 1$ and R_g is the usual grid resistor, which normally must not exceed about 500 kilohms for tubes operated with cathode bias.

We can apply the input signal between X and Y, provided that the source has no ground on it. For practical purposes this implies the use of an input transformer, giving the circuit shown in Fig. 3, which now includes a decoupling resistor R_s in the supply lead. We can draw the exact equivalent circuit for this arrangement in two different ways, depending on whether we are interested in the low-frequency or the high-frequency end of the response. For the low-frequency end we have Fig. 4.

What happens in the circuit

The general form of Ohm's law—I=E/Z—can be applied to this circuit fairly easily, though the expressions are rather long because they contain nine variables. We can see by straightforward reasoning what will happen, however. At low frequencies C_k will no longer act to decouple the cathode resistor R_k, so that the gain will fall in just the way I described in one of the early articles on Audio Feedback Design. As we usually take a cathode resistor approximately equal to R_p/μ the gain will fall by about 4–6 db if we use a triode, or 6 db if we use a pentode. This drop applies to the current round the loop, and affects both the push-pull outputs equally: it does not affect the balance of the outputs at all. Notice, however, that this is because we took output B from the top of R_{L2}, not from the cathode of the tube. By taking output B from the cathode we will add a new effect, because as the current drops, due to the feedback, the impedance across which the voltage is taken rises, so that the output voltage at B will not drop as much as it does at A.

In the other half of the push-pull drive, the current flows through R_{L1} and the parallel combination of R_s and C_s. The impedance thus rises from R_{L1} to $(R_{L1} + R_s)$, giving, if the current were constant, a rise in response of $20 \times \log\,(1 + R_s/R_{L1})$ db. This rise in response is not balanced by anything which happens in the R_{L2} circuit, so that at very low frequencies we have an unbalance of about R_s/R_{L1}. This calculation applies fairly well to a pentode, but the unbalance is not so great with a triode, because of the effect of the finite tube impedance.

It is attractive to suggest that we should take $R_k = R_s$ and $C_k = C_s$, and derive output B from the cathode. Then the circuit would stay balanced right down to the lowest frequencies. Can we do this? The answer is no. A typical value of R_k will be 500 ohms (or 470 if you stick to preferred numbers, which make arithmetic so tedious), and C_k can be 100. This gives us $\omega C_k R_k = 1$ if $\omega = 20$ (using ω to denote $2\pi f$). The characteristic frequency is about 3 cycles per second. We could use an electrolytic capacitor of 100 μf for C_s, but it is bulky and expensive: we are much more likely to use a 1-μf capacitor with R_s = 5–10 kilohms. Remember why we insert this decoupling circuit. We decouple tubes because the plate supply unit has a finite impedance, and the current drawn by one tube affects the voltage supplied to another. This finite supply-unit impedance, with its current fluctuations, is in series with R_s, so our elegant calculations on this single stage are vitiated by the external circumstances. We must just decouple cathode and plate efficiently.

At high frequencies the circuit takes the form shown in Fig. 5. C_1 and C_2 are the capacitances of the following push-pull stage, and will be equal; C_1 is the capacitance from the bottom of the input-transformer secondary to ground, together with the cathode-heater capacitance of the tube. In addition to these there is the important

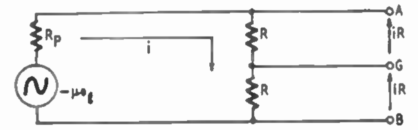


Fig. 1—The best type of phase splitter, shown above, is simply two resistors with their junction grounded. The voltages have to be equal and opposite as long as the two resistors maintain their equal resistance. This circuit also has some practical applications.

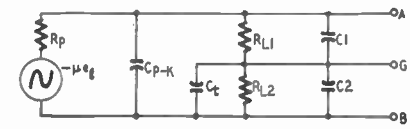


Fig. 5—This is the equivalent circuit of Fig. 3 for signals at the high end.

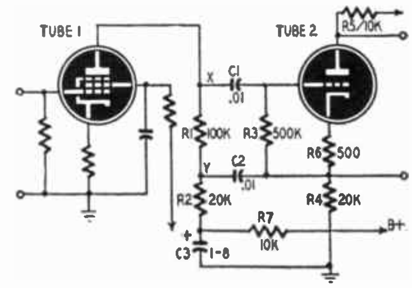


Fig. 7—This more refined circuit overcomes the reduced gain by taking advantage of the cathode-follower circuit's high input impedance. By using a pentode in the first stage, the combined gain of the two stages is excellent.

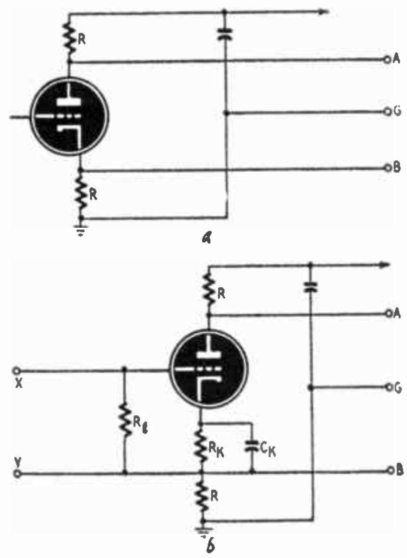


Fig. 2—Two steps toward making a more practical circuit from the one shown in Fig. 1 above. A tube is inserted between the two resistors to supply the necessary current through them and to modulate that current as desired.

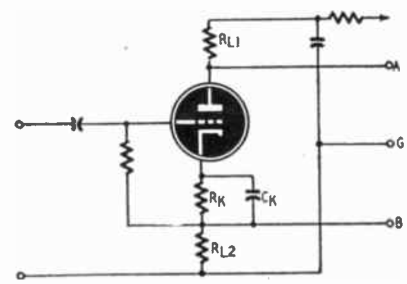


Fig. 6—By grounding one side of the input and using a blocking capacitor, we can abandon the unpopular transformer input. This reduces the gain because of degenerative cathode feedback.

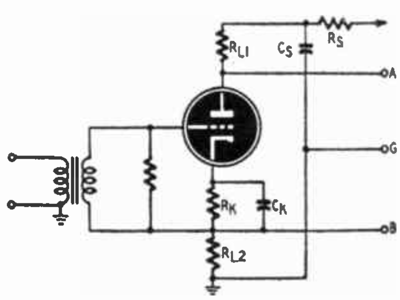


Fig. 3—A practical form of the circuit. Transformer input solves problems of providing a grid return path and of balancing the input to ground.

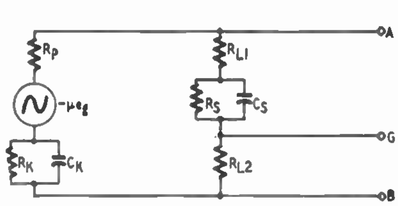


Fig. 4—How the circuit of Fig. 3 appears to low audio-frequency signals.

plate-grid capacitance, which provides a "Miller" capacitance in parallel with that of the grid and cathode and affects the overall frequency response. It does not have any effect on the balance, however, so we need not discuss it here. We can concentrate our attention on the unbalance effect produced by the capacitor C_t.

We can get an idea of what this capacitance will do by putting in some numbers. Typical values of R_{L1} and R_{L2} will be 50 kilohms, so that for a top frequency of 16,000 cycles, a capacitance of 200 μμf will be tolerable, from the frequency-response point of view. If feedback is being applied round this stage, the phase shift will be an embarrassment, but in any event we shall be using a modification which eliminates some of this capacitance.

The practical applications

We very rarely want to use an input transformer, and the reader may ask why we have spent so long considering this circuit, which in spite of its very good balance presents difficulties in connecting the input. The answer is that we can apply our analysis to other arrangements which have a grounded input. Knowing that we have a good arrangement so far as the push-pull character is concerned, we can press on to an examination of other input circuits, without having to worry about the output circuit.

Fig. 6 is a conventional arrangement, in which a blocking capacitor has been added in series with the grid circuit. So far as B is concerned, this stage is just a cathode follower and since R_{L2} is large there will be slightly less than unity gain from the input to output B. As we have already shown, the phase-splitter is well balanced, so that in this form we need to apply to the input just about the same voltage as each of our final push-pull tubes will require. We can omit C_k, because we have already so much feedback from R_{L2} that a little extra will not make any difference.

Two important problems

Before adding some notes on the design of this circuit, two matters have to be discussed. The cathode of the tube is suspended, like Mahomet's coffin, between heaven and earth. Usually it will be at least 50 volts above ground, and we must take care not to let it exceed the maximum voltage given by the tube maker, which is often 90 volts. When a separate heater winding can be provided for this tube there is no problem at all, but I prefer to moor my heater center-point to a +20-volt point obtained by tapping with high resistors across the plate supply. This not only helps to reduce the heater-cathode voltage in this phase-splitter stage, but also reduces the hum in earlier stages of the amplifier.

The second point becomes important only in advanced feedback circuits, or if the following tubes draw grid current. At B, the apparent generator impedance is that of a cathode follower, and is low: at A, the impedance is that of a tube with a great deal of current feedback, and is very high.

The design conditions are fairly easily studied. We take our selected tube, say one-half of a 12AT7, and choose the bias resistor, 500 ohms, and the plate load, say 50 kilohms. This 50 kilohms we split in two, giving 25,000 ohms for each of the resistors R_{L1} and R_{L2}.

Applying this load line to the tube characteristics with a supply of 250 volts we get a current of 3-4 ma, and a bias of 1.5-2 volts. The cathode is then between +75 and +100 v, and the stage gain will be

$$\frac{\mu R_{L1}}{R_p + (\mu+1)\, R_{L2}} \simeq \frac{40 \times 2,500}{15,000 + (41 \times 25,000)} \simeq 0.98$$

The input impedance (by virtue of the negative feedback caused by the cathode resistor) is very high indeed. This fact enables us to get adequate gain in a complete amplifier in spite of the wastage in the phase-splitter. Let us see why we have such a high input impedance. Suppose that we apply 1 volt positive to the input terminal: the cathode will rise to 0.98 volts, leaving only 0.02 volts across the grid leak. If this is 100 kilohms, the current through it will be 0.2 μa. At the input it will appear as though 1 volt has produced 0.2 μa current, so the apparent input impedance will be 5 megohms. We can use this very high resistance as the load for a pentode amplifier stage and obtain a correspondingly high increase in its voltage gain. This will make up the loss of gain in the triode phase splitter, because the two stages together would hardly have shown such a high gain normally, anyway.

A more refined circuit

Fig. 7 shows the way in which the circuit is arranged. The supply to tube 1 passes through R_7, R_2 and R_1 in series, with R_1 as the useful part of the load. The load on tube 1 is R_1 in parallel with R_3 multiplied by the feedback effect in tube 2. The impedance in shunt across X and Y is of the order of megohms, so that tube 1 has a very high gain; so high indeed that we can use the simple gmR_L expression for the gain of a pentode (R_L=R1). R_2 is needed to prevent Y from being grounded by the decoupling capacitor C_3, and R_2 is, for a.c., in parallel with R_1, the cathode load resistor of tube 2. Since R_1 settles the voltage at which the cathode is set, and the steady current conditions in tube 2, it cannot be made too large. We must therefore reduce the value of the plate load of tube 2, R_3, and tube 2 will not be operating under ideal conditions. The values shown in Fig. 7 represent a reasonable compromise, however. (The values are all even numbers—the nearest preferred values will work in a practical circuit.)

Perhaps the most serious disadvantage of this circuit is the fact that the gain depends on the amplification factor of a pentode, a number which you never see in the books. Just how constant this quantity is I do not know.

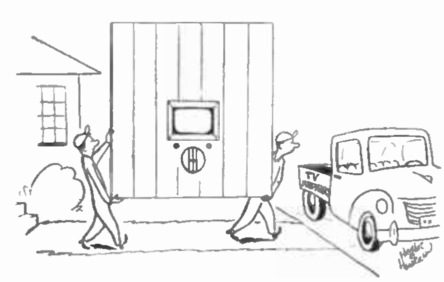
We can, of course, stabilize the gain of the complete amplifier by using negative feedback. but here we meet another difficulty. The plate capacitance of tube 1, together with the capacitance of the unit to ground, will be in parallel with the very high pentode plate load. Perhaps with care these can be kept down to 20 μμf but with a 5-megohm effective load the characteristic frequency is 1,600 cycles. This means that the response will be 6 db down at 3,000 cycles, so that the feedback will only have half the expected effect on the third harmonic of 1,000 cycles, while as this stage alone is 18 db down at 12,000 cycles we shall need a relatively large feedback just to flatten the response.

This last analysis is over-developed, if you examine it critically. The average small pentode has a plate impedance of about 1 megohm, which is in parallel with the load, so that this alone shifts the characteristics frequency up to about 9 kc. Furthermore, there is no gain to be obtained by pushing up the load from say 2 megohms to 5 megohms. We shall probably do better, indeed, to drop R_1 to 33,000, get more current through our tube and thus increase its amplification factor, at the same time widening the response slightly. We shall still get about 60 db from our two tubes, so that if the final stages need 20 volts drive we can operate with 20 mv input. But this is neglecting the gain reduction caused by the negative feedback which I hope *all* my readers use lavishly.

The circuits shown in Figs. 6 and 7 are two of the most important phase-splitter circuits. They provide a very well balanced output, are almost independent of the characteristics of the phase-splitter tube over the range of commercial tolerances, and involve no trick circuitry. The only disadvantages are that the tube must have good heater-cathode insulation (both to prevent breakdown under the voltage stress and to prevent the leakage of 60-cycle hum into the cathode resistor) and that one tube must provide sufficient swing to drive both the push-pull grids.

Thus if each grid requires 20 volts, the tube must be capable of giving 40 volts under normal amplifier conditions. When driving class-B amplifiers, such as the EL34 stage I described some time ago, which needs 40 volts peak for each grid, this demand for 80 volts peak is too much for a small tube. Some designers have therefore followed a phase-splitter of this type with a push-pull intermediate driver. I am not enamored of this solution, which puts in an additional double triode to do work which could be done better by a single tube elsewhere in the circuit.

In the article which will follow this I propose to discuss the other main type of phase-splitter. As I said in the first article, this obtains its balance by using very large amounts of negative feedback. It must not be confused with the circuit discussed above. in which the negative feedback is an unwanted result of our desire to ground one side of the input. In the circuits which follow, the negative feedback is deliberately introduced to force the two outputs to balance. But that will be another story. END



ELECTRONIC MUSIC---the easiest way

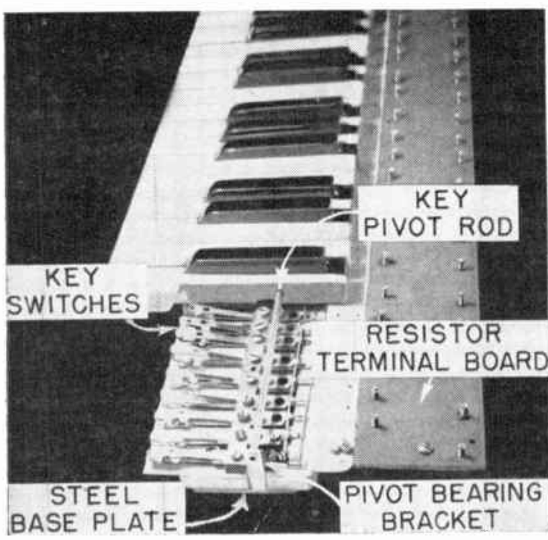
PART II

By V. FASTENAEKELS

NOW FOR some of the constructional features of the *Ondiovox*. The parts most likely to be unfamiliar are the keyboard and the metal-tubing base pedestal, but neither of these should present any great difficulty if you can use simple woodworking tools and an electricians' "hickey".

Taking the keyboard assembly first, you can get a general idea of the layout from Photo A. Details are shown in Fig. 1-a and 1-b. The entire assembly was mounted on a steel foundation plate 17 inches long, 3 inches wide, and ¼ inch thick. This slab just happened to be available, and a shallow metal radio chassis could be used as well. The base plate is just long enough to accommodate the 21 hand-made keys. These were cut from oak strips, but there is no reason why you can't use a section of an old piano or organ keyboard. The base plate or chassis is simply made long enough to accommodate the over-all width of the 21 keys.

The key switch contacts are mounted side by side on a full-length bakelite insulating plate, with the same center-to-center spacing as the keys. The contacts can be assembled from old phone jacks, or from Guardian type 200-3 contact assembly kits. The stack assembly screws must be countersunk in the bakelite, or kept short enough to clear the metal base. Adjust the contacts so that a slight pressure on the key closes the top pair first and energizes the keying relay; additional pressure bends the closed pair down far enough to meet the bottom contact, which grounds the appropriate resist-



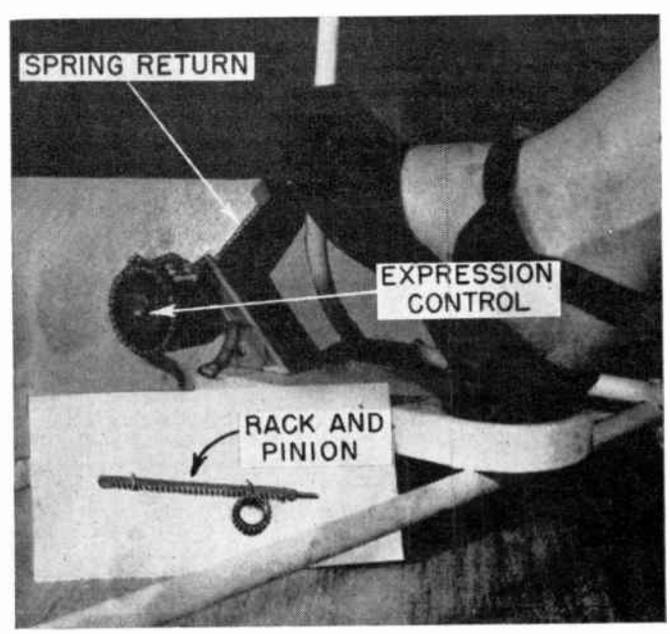


Photo A (upper left)—Keyboard construction. Photo B (upper right)—Keyboard and chassis assembly. Large bulb is European neon lamp. Photo C (lower left)—Completed *Ondiovox*. Photo D (lower right)—Expression control.

CRYSTAL MARKERS for SWEEP GENERATOR

By BRUCE MORRISSETTE

This simple marker generator converts an inexpensive sweep generator into a precision instrument.

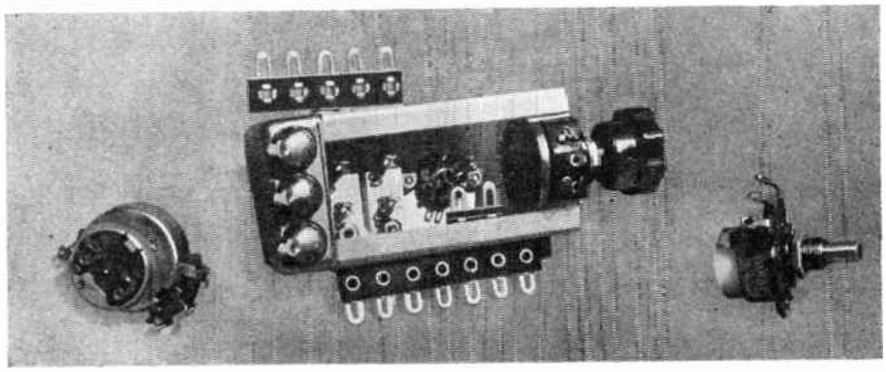


Photo A—The calibrator before wiring.

SWEEP generators for aligning wide-band i.f. amplifiers in television and FM sets usually need highly accurate marker signals or pips for identifying frequency points along the response curve. Accurate markers are especially important for peaking individual coils and setting sound and adjacent-channel traps. Intercarrier receivers also require an accurate 4.5-mc unmodulated signal for aligning sound-take-off windings and discriminators.

The two most common sources of marker signals for sweep alignment are the *built-in* marker (either a calibrated tunable oscillator, or a passive, absorption-type network), and the *external* marker oscillator or signal generator. The absorption-type marker is useful for locating points along the response curve but cannot serve as a single-frequency r.f. source for aligning individual stages. A variable marker oscillator, internal or external, not only will mark points on the curve but may be used to tune individual coils and traps.

Both types leave much to be desired with respect to accuracy of calibration. Most modern i.f. systems are stagger-tuned at various fractional frequencies like 25.3 mc, 23.1 mc, and 21.7 mc. Even the best tunable marker oscillators and signal generators may be off calibration by as much as 0.5 mc, making it practically impossible to align a set exactly at the specified frequencies. A few of the more expensive TV generators are equipped with crystal calibrators which give accurate marker pips every 2.5 mc or 5 mc along the curve.

The low-cost, easy-to-construct unit described here not only gives accurate markers at 0.5-mc intervals, but provides a 4.5-mc, crystal-controlled, pure r.f. signal for intercarrier alignment. The wide range of marker pips is adequate for almost any servicing or design need, and all have the high accuracy and stability associated with a well-designed crystal oscillator.

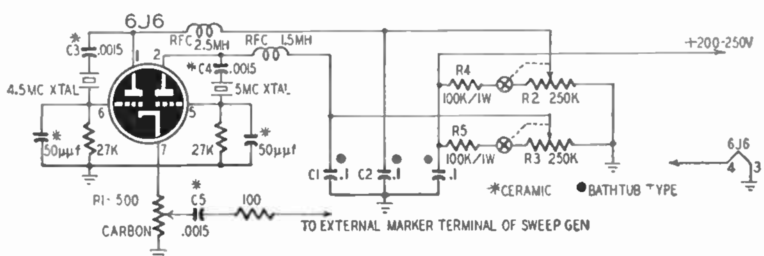
Although this marker oscillator-mixer was constructed to fit a *Heathkit* model TS-2 sweep generator, it can be installed in almost any other make or model, or built as an independent unit. The choice of crystal frequencies and the use of either separate or mixed outputs gives the unit unusual versatility. It consists of separate 4.5-mc and 5-mc crystal oscillators. Either crystal or both may be disabled by switching off the B supply to the appropriate oscillator, and each section has its own output-control potentiometer. A mixer-amplitude control adjusts the combined outputs of the two crystals to any desired level, and a simple mixing network added to the sweep-generator combines the sweep signal and the crystal-marker frequencies at the sweep output terminals.

Circuit details

Fig. 1 is the schematic diagram of the dual-marker unit. Each section of the 6J6 is connected as a Pierce crystal oscillator. Using r.f. chokes rather than resistors in the plate circuits increases the output on the higher harmonics essential in this application. Amplitude of oscillation is controlled by individual potentiometers which vary the B plus voltage to each plate. Switches on these controls turn the individual oscillators off and on, by opening or closing the B plus line. With a single crystal switched on, the cathode potentiometer (R1) functions as the load resistor of a conventional cathode follower, providing the correct low-impedance match for connecting the marker in parallel with the output of the sweep generator.

When both crystals are operating, the 6J6 functions as a mixer, since the two triodes have a common cathode resistor. The output contains the frequency difference between the two crystals (0.5 mc) and harmonics of 0.5 mc extending to 50 mc and even higher. Sum frequencies also appear in th combined output (9.5 mc and its harmonics), but they are superimposed on 0.5-mc pips. The 0.5-mc pips are given uniform amplitude by adjusting the relative outputs of the two crystal oscillators with potentiometers R2 and R3.

The height of the pips on the alignment curve itself is controlled by



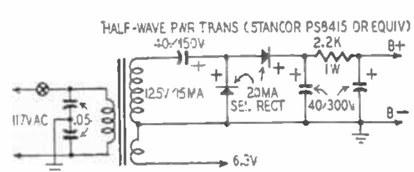
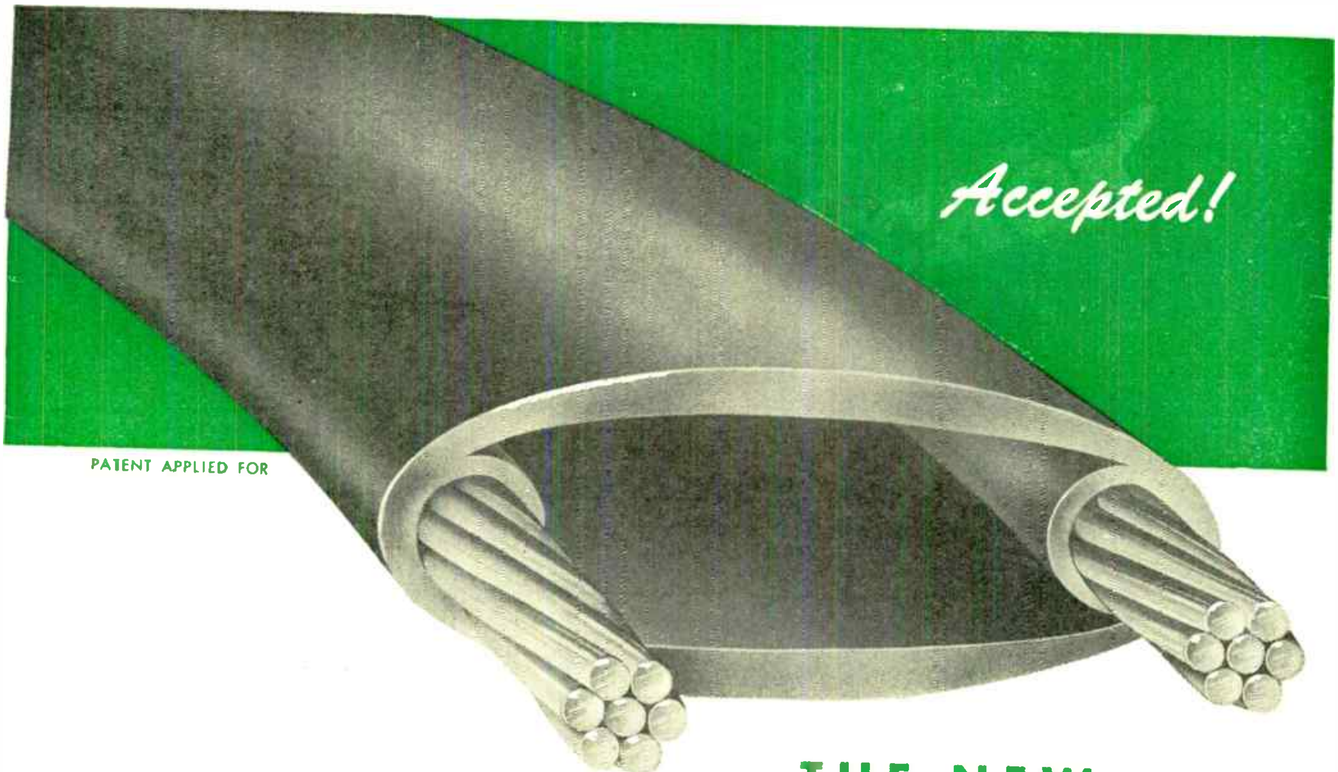


Fig. 1 (left)—Schematic of the dual-frequency calibrator. Operating power may be obtained from the sweep generator or from the power supply in Fig. 2. Fig. 2 (right)—Power-supply schematic.



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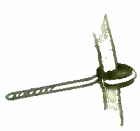

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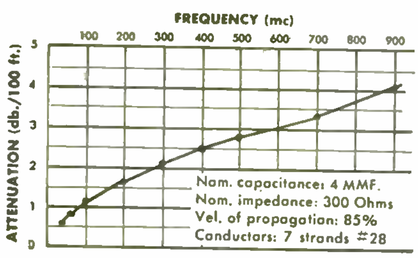

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cathode-potentiometer R1. (Like all marker signals, they should be kept at the lowest possible level to avoid distorting the response curve. About one-eighth to one-quarter inch is right for the average pattern on a 3-inch or 5-inch oscilloscope.)

The 50-μμf ceramic capacitors across the grid resistors give added reliability of operation in the Pierce circuit. Plate-supply decoupling is accomplished by resistors R4 and R5 and capacitors C1 and C2. Capacitors C3 and C4 isolate the crystals from the d.c. on the oscillator plates. C5 couples the output from R1 through a 100-ohm isolating resistor, which reduces interaction between the marker circuit and the sweep generator. The supply voltages for the marker unit are taken from the sweep generator, or the small power supply shown in Fig. 2 may be added. The total drain with both crystals functioning is less than 5 ma.

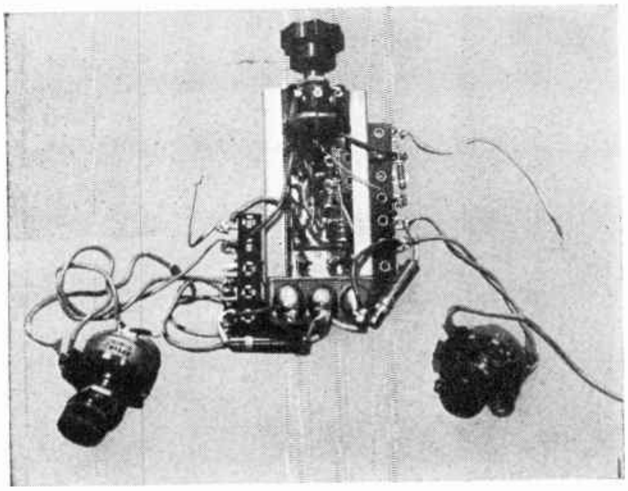


Photo B — Under-chassis view of the completed unit. Miniature capacitors and tube reduce the overall dimensions.

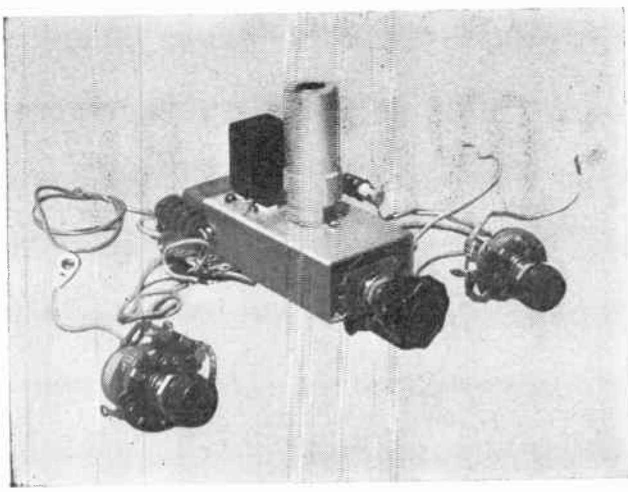
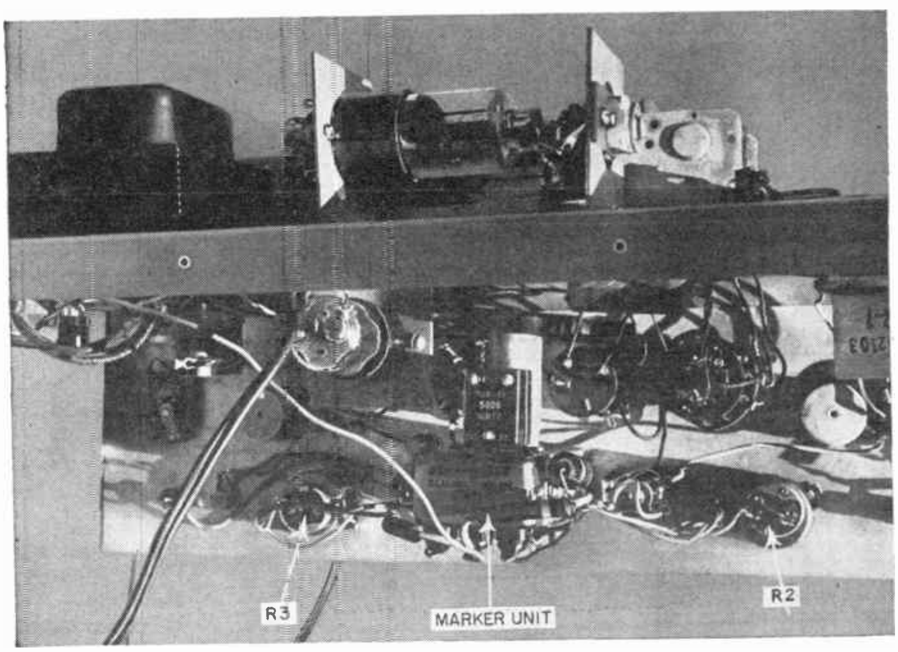


Photo C—A top view of the finished calibrator. The output controls and on-off switches are at the ends of flexible leads.

Photo D (below)—The marker unit installed below the chassis on the panel of a *Heathkit* model TS-2 sweep generator.



Construction

The photographs (A, B, and C) show the unit during and after construction, and D and E show the unit mounted on the front panel of the *Heathkit* TS-2. The small aluminum chassis (1¾ x 3⅛ x 1 inch) is a standard commercial type and is supported firmly by the shaft bushing of control potentiometer R1. An aluminum bracket may be added if desired.

The photos show the layout of the tube socket, crystal holders, "outboard" tie-points for the r.f. chokes, and the triple-0.1-μf bathtub capacitor. Potentiometers R2 and R3 are mounted on the sweep-generator front panel, the 4.5-mc control at the left and the 5-mc control at the right. The parts values in the *output circuit* should be followed closely, since they were chosen to reduce interaction between the crystal markers and the sweep generator to a minimum. The only moderately expensive items are the crystals. A well-known mail-order house (Allied Radio) offers Bliley 5-mc crystals at $2.80 and 4.5-mc crystals for $3.25, bringing the total cost of the unit to about $10.00.

Using the marker unit

Testing and using the complete unit involves straightforward procedures. It is assumed that the reader is already familiar with the technique of applying the sweep generator to the mixer or first i.f. grid; with connecting the oscilloscope across the video-detector load resistor (preferably through an isolating resistor of about 25,000 ohms); and with supplying the scope sweep with synchronized horizontal input from the sweep generator.

First, connect the sweep generator with the built-in marker unit to a television or other wide-band-i.f. amplifier known to be approximately in alignment, or at least capable of passing the i.f. signal. Phase the sweep response curve on the scope screen or throw the blanking control—if one is provided—to the ON position for single-trace operation.

Adjust the curve to normal height with the sweep-generator attenuator, and switch on the 5-mc crystal. With cathode control R1 well advanced, rotate output control R3 until a 5-mc harmonic pip in the pass band of the i.f. strip appears on the curve. Most television-i.f. amplifiers include 25 mc somewhere near the flat top of the curve (see Fig. 3). Keep the pip ampli-

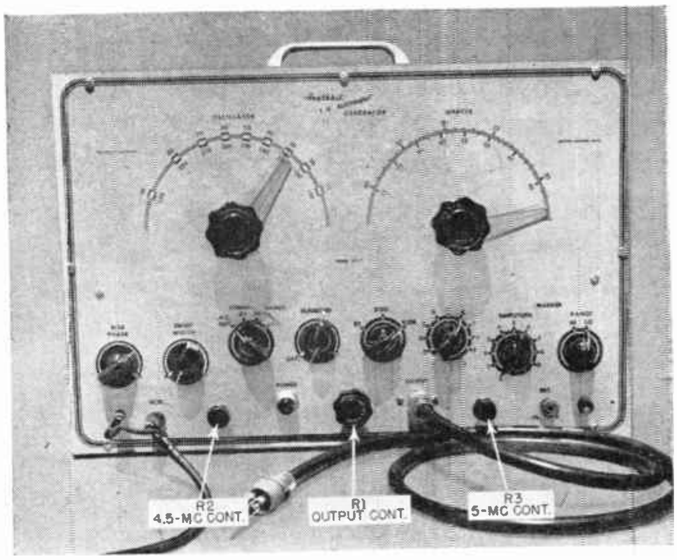


Photo E—Panel of the modified sweep generator showing the added marker oscillator controls.

tude at a minimum; too much signal from the marker will distort the curve.

Now turn off the 5-mc crystal and switch on the 4.5-mc section. The same amplitude-regulating procedure (this time with R2) will give a pip at any harmonic of 4.5 mc which lies in the i.f. pass band. In ordinary TV receivers, the 22.5-mc pip will be prominent on the curve. Well-designed wide-band i.f. amplifiers will also show the next harmonic pip at 27 mc (see Fig. 4).

If both harmonic pips of the 4.5-mc crystal are visible, the bandwidth characteristics of the amplifier can be seen at a glance, since the separation of the two markers is the 4.5-mc difference that separates video and sound carriers, and which is fundamental to the design of ideal i.f. circuits.

When each crystal is oscillating satisfactorily, as indicated by its harmonic pips, switch them *both on.* Adjust controls R2 and R3, and the cathode control R1, to produce a line of uniform markers of convenient height, each of which is separated from the next by the crystal difference frequency of exactly 0.5 mc. The response pattern should then have the appearance of Fig. 5. Output control R1 should be used to adjust the amplitude of the 0.5-mc pips with respect to the alignment curve.

The 0.5-mc pips may be identified by noting the nearest reference pip from *either* the 5-mc or the 4.5-mc crystal, and counting the order of the 0.5-mc pip in question from that point. For example, the first pip *above* 25 mc would be 25.5 mc, the second, 26 mc; the first pip *below* 25 mc is 24.5 mc, the second, 24 mc, and so on.

Some of the newer i.f. systems will need a 45-mc pip as a reference point. Since any television-i.f. response curve must have a bandwidth of about 4.5 mc, there will always be a 4.5- or 5-mc reference point on the curve.

In the *Heathkit* and similar instruments the built-in absorption marker can be checked against the 4.5- and 5-mc pips and then used to identify the value of a 0.5-mc pip, although its accuracy without the crystal-marker guide is insufficient for precise work. Of course, an external signal generator or other *active* marker device may also be included in the setup, especially when it is desired to set such a device to some fractional frequency, as discussed earlier. Since there are no tuned circuits to adjust in the crystal-marker unit, its accuracy is limited only by the precision of the crystals used (in this case ± .02%).

In testing or aligning an i.f. amplifier, turn on the 0.5-mc pip series as soon as the response curve appears. Bandwidth between any two critical points can be determined almost instantly. The point at which the picture-carrier should appear, as shown in the service information for the set, is located by counting pips or running the tunable marker along the pips. If the picture carrier is not at its proper position (usually exactly halfway up on one side of the response curve) the i.f. stages must be adjusted to correct the misalignment. The vestigial-side-band transmission employed in television requires that modulating frequencies extending approximately 1 mc above and below the video carrier be amplified by the same amount as the higher-frequency video components for which only one side band is transmitted.

The sound i.f. carrier point, on the other hand, must be almost at the bottom at the opposite end of the curve to avoid sound interference in the picture, and to minimize 60-cycle sync buzz in intercarrier receivers. Many of the better intercarrier sets have a "sound shelf" or flat portion near the bottom of the curve for the sound i.f. carrier. Ordinary marker systems cannot be relied on to identify this point without significant error, but the marker pips from the crystal unit will locate it exactly.

With the sweep generator on standby, the output of the 4.5-mc crystal can be used for intercarrier sound alignment. (The 5-mc crystal is turned off during this operation.) Service manuals explain the manner in which the

sound-take-off coil and the FM-detector-transformer primary and secondary are to be peaked with the 4.5-mc signal. The precision required in this operation is shown in the following statement from an Admiral service manual (19A1): "Before proceeding, be sure to check the signal generator used in alignment against a *crystal calibrator* or other frequency standard for absolute frequency calibration at the 4.5-mc point. *Accuracy required within one kilocycle.*" The 4.5-mc signal from this dual-crystal unit has the required accuracy (.02% of 4.5 mc = .0002 × 4,500,000 = 0.9 kc) and eliminates all need for additional equipment or special frequency checking in this important operation.

Finding fractional frequencies

For extreme precision in tuning individual i.f. coils and traps, or in experimental design work with wideband television- or radar-i.f. amplifiers, this

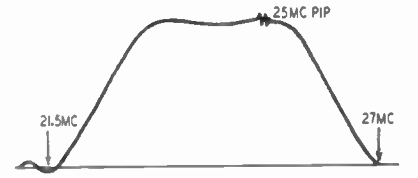


Fig. 3—Typical i.f. response curve with 25-mc marker pip from crystal calibrator.

unit allows the technician or experimenter to set an ordinary tunable marker generator to hair-line fractional-megacycle values. Suppose a certain i.f. stage must be peaked at exactly 22.3 mc. An ordinary signal generator set at this frequency may be putting out a signal anywhere be-

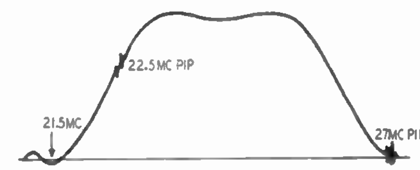


Fig. 4—Two marker pips from the 4.5-mc crystal show i.f.-amplifier bandwidth.

tween 22 and 23 mc. But if the output of this external generator is applied to the circuit under test along with the sweep and the 0.5-mc pips from the crystal oscillator-mixer, the *tunable marker pip* may be set visually at a point between the 22.0- and the 22.5-mc crystal pips corresponding in frequency to 22.3 mc. This can generally be done with very great accuracy.

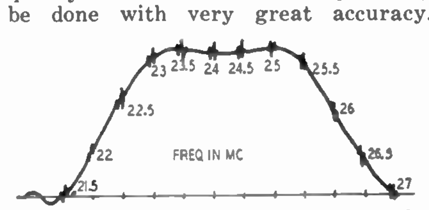
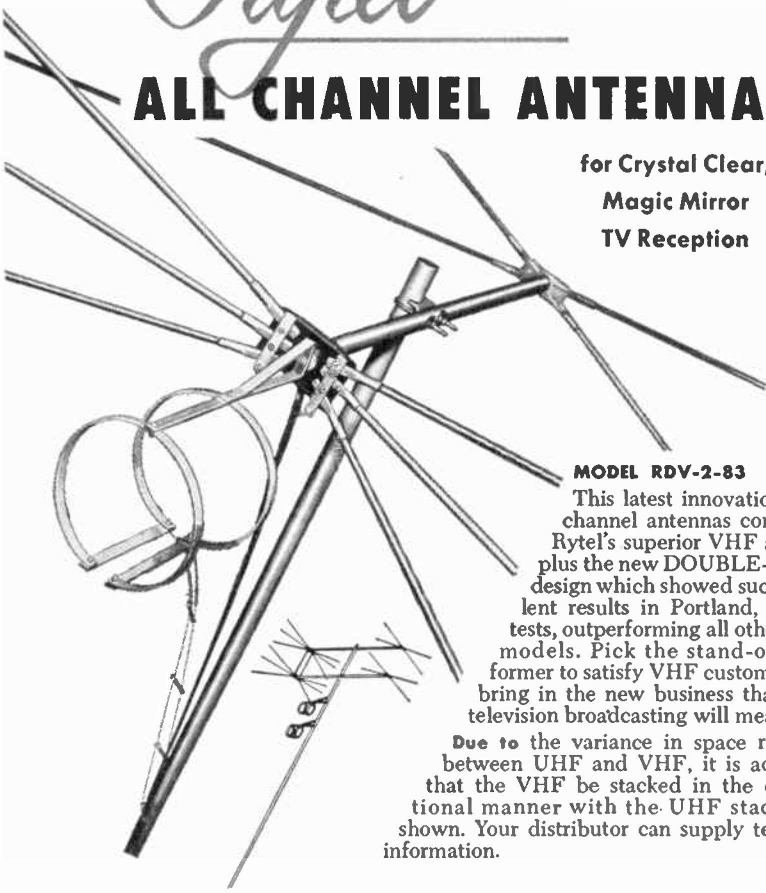
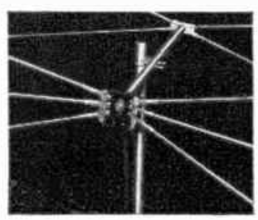


Fig. 5—With both crystals in operation the over-all response curve shows accurate marker pips every half-megacycle.

This dual crystal marker unit installed in your sweep generator will convert it into an instrument of laboratory precision at the cost of about ten dollars and a few hours construction time. END



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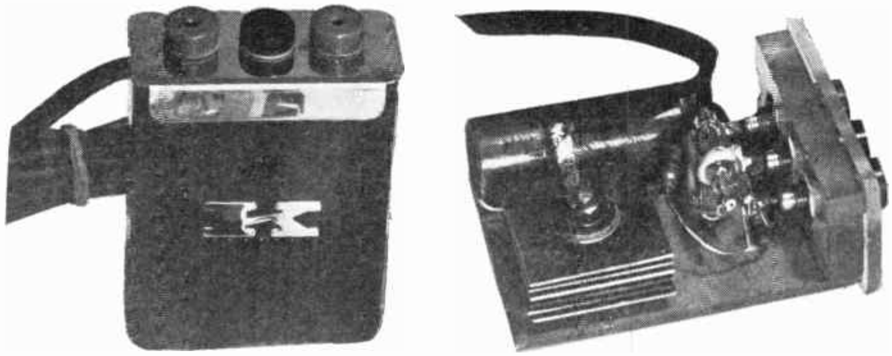


Two views of the capacitor checker. It is built into a plastic cigarette case.

QUICK CAPACITOR CHECKER

By GEORGE KELLY*

SPEED is one of the first essentials in profitable servicing. Here is a pocket-sized checker that not only speeds your work but makes many tests that cannot be made with an ordinary meter. It shows open, shorted, or intermittent capacitors, leaky electrolytics, and circuit continuity. In addition it indicates whether voltage in a circuit is a.c. or d.c.

Fig. 1 shows the extremely simple circuit. The checker can be built breadboard style, or can be fitted into a plastic cigarette case (as above). If the case has a metal top the pin jacks can be mounted as shown, with the insulating shoulder washers usually supplied. If you like, a plastic top may be substituted. Mount the rectifier, capacitor, and tie lug on a small piece of bakelite or plastic, then wire in the neon lamp, resistors, and line cord. Make a small notch in the side of the case to pass the line cord.

The circuit can be checked after wiring by connecting a jumper between the *red* and *black* pin jacks, and plugging the unit into the line. The neon lamp should glow brightly. Slip the unit into the case and it is ready for use. Make two suitable test leads with *insulated* phone tips for the checker pin jacks at one end, and alligator clips at the other.

Using the checker

To check paper, mica, or ceramic capacitors, disconnect one side of the capacitor completely from the circuit, connect the test leads to the *red* and *black* pin jacks, and plug the checker into the line. Good capacitors will show a single flash on the initial charge. (With small capacitance values the flash will be faint.) Intermittent or repeated flashing indicates leakage. If the neon lamp glows steadily the capacitor is shorted. There will be no flash or glow at all if the capacitor is open.

The output of the power supply is approximately 155 volts d.c. with 117-volt a.c. input. Do not use the checker on any capacitor rated at less than 150 volts *or on any equipment that is grounded or connected to the power line.*

When checking electrolytic capacitors, polarity as well as working voltage must be observed. The red jack is connected to the *positive* side of the capacitor. The bulb will glow brightly at first, and as the capacitor charges this glow will grow dimmer until the bulb goes out. If the lamp flashes more than once per second, the electrolytic is too leaky to trust in a circuit. Flashes at the rate of one per second or longer are normal, as all electrolytics have a small leakage current.

This unit can indicate a leakage of over 300 megohms, and can be used for many types of continuity checks where an accurate resistance measurement is not required.

When using the instrument for continuity checks on resistors, appliances, or ignition systems, the lamp should

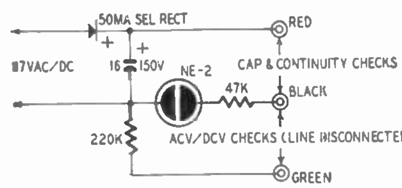
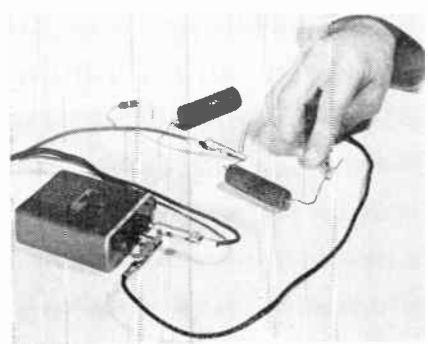


Fig. 1—The checker uses few parts.

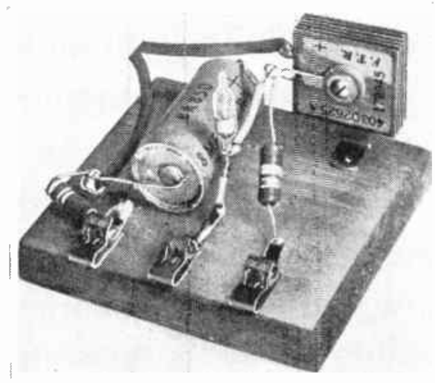


How it is set up to check a capacitor.

*Supervisor, de Forest's Training, Inc., Chicago, Ill.

show a steady glow. The glow will be less bright with high circuit resistances. This provides an excellent test for the quality of the capacitor in auto ignition systems.

The checker also will test the electrical continuity of photoflash bulbs without discharging them. This will often save good flash bulbs which did not fire because of low battery voltage or defects in the flash-gun or shutter switch. A good flash bulb produces a steady glow.



The checker set up in breadboard form.

The green and black pin are used for voltage checks. *The unit should not be plugged into the line for these checks.* When the glow surrounds both electrodes in the neon bulb, the circuit voltage is a.c. The lamp will ignite on 65 volts and operate up to 500 volts. Only one electrode glows on d.c., igniting at 90 volts and operating up to 500 volts.

The unit also will indicate the presence of r.f. voltage around a transmitter circuit by merely bringing a single lead near the circuit while holding the other lead in the hand. *Caution:* Do not make an actual connection to the circuit or to the a.c. line in this case.

(This little gadget was tried out by one of the editors of RADIO-ELECTRONICS and shown to students at one of the largest radio and TV schools in New York. It made such a hit that over 500 were turned out in less than a month, and each new enrollee insists on building one as soon as he learns the difference between a resistor and a capacitor.

Some handy modifications were worked out by the more ingenious students. One was to add a compact d.p.d.t. slide switch with one section in series with the a.c. line, and the other section across the red and black output terminals. With the line switch open, the other section shorts the output terminals and discharges both the internal filter capacitor and the capacitor being tested. This eliminates the danger of a shock from the test leads even with the line disconnected, since the electrolytic filter capacitor will retain its charge of 150 volts or more for a considerable time.

Another refinement was the addition of a detachable line cord. A standard television "cheater" receptacle fits neatly in the side of the case, and allows the cord to do double duty.) END

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POLARIZED POWER PLUGS FOR THE EXPERIMENTER

By L. B. HEDGE

"A POLARIZED plug makes certain that the chassis is always grounded through the a.c. supply," I told a friend, recently, while explaining a new gadget in my shop. I was surprised to have him reply: "But who wants to buy polarized a.c. receptacles for all the places he may want to plug the thing in?"

I say his reply surprised me—it would not surprise me now, because, after questioning many friends and acquaintances and reading through a variety of electrical engineers' and electricians' handbooks, practical wiring manuals, fixture and appliance catalogs, and all manner of related publications, I find that few people seem to know, and few publications mention the fact, that *virtually all power receptacles and convenience outlets used on ordinary a.c. installations are polarized.* If you're as skeptical of this statement as most of my friends were, look at the receptacles in the room you're in—they're polarized if one slot is longer than the other. The opening which gives access to the white metal (grounded) contact should be not less than 0.045 inch (about 3/64 inch) longer than the slot to the dark metal (hot) contact. (Fig. 1.)

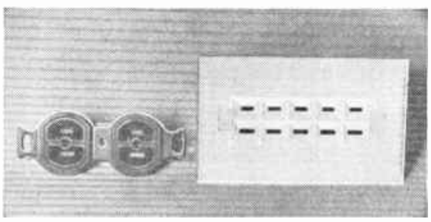

Fig. 1—Practically all modern outlets are polarized with the wider blade tied to the grounded side of the line.

Polarized plugs—plugs which will enter these receptacles only when correctly oriented—are obtainable from most electrical supply houses on special order, and a few of the larger ones will have them in stock. An ordinary (non-polarized) plug can be easily polarized, however, by soldering a U-shaped piece of wire around one of its blades to increase its width. The large loop of an ordinary paper clip (Fig. 2) serves well

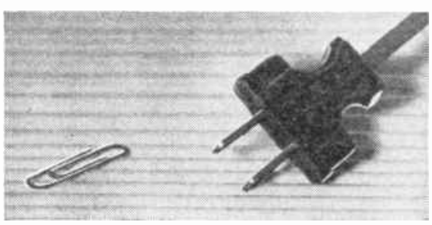

Fig. 2—Paper clip soldered around the edge of one prong polarizes the plug.

for this purpose. Cut it to length; fit it around the edge of one blade of your plug; back the blade with an asbestos

sheet (Fig. 3) and solder it on. Clean off the extra solder and open up the hole in the blade and you have a first-class polarized plug (Fig. 4)—it will not go wrong-way-to into the receptacle. You can convert a dozen plugs this way in half an hour and the whole conversion will only cost a few cents.

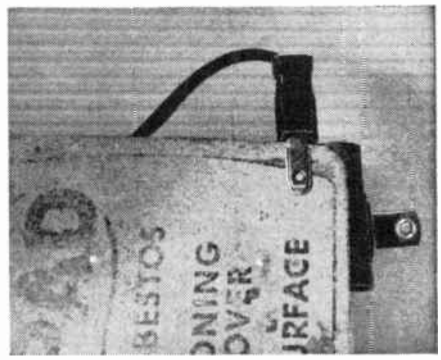

Fig. 3—How plug is held for soldering.

In view of the widespread ignorance of the polarization of receptacles, it will be wise for you to check the wiring on those with which you plan to use polarized plugs. A neon tester or an a.c. voltmeter—even a lamp with test leads attached—with one side grounded (to a water pipe if your outlet is not a metal conduit and box system, to one of the mounting screws into the box if the conduit and boxes are grounded) will identify the hot side. The short slot should

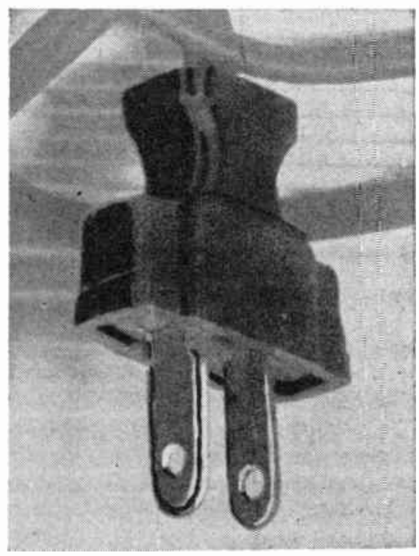

Fig. 4—The completed polarized plug.

be the hot one.

While you're doing this work it's not a bad idea to check all of the outlets in the house, reversing those you find improperly connected. With this done you can put polarized plugs on any hot frame or chassis devices you have and you'll be sure they're shockproof. This treatment will probably cure some of your humming audio gadgets—at least it will simplify the filtering necessary to eliminate the hum—and it will add stability to oscillators, v.t. voltmeters, and similar test gear that is not permanently wired into the 117-volt supply. END

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• Uses the new self-cleaning Lever Action Switches for individual element testing. Because all elements are numbered according to pin number in the RMA base numbering system, the user can instantly identify which element is under test. Tubes having tapped filaments and tubes with filaments terminating in more than one pin are truly tested with the Model TV-11 as any of the pins may be placed in the neutral position when necessary. • Uses no combination type sockets. Instead individual sockets are used for each type of tube. Thus it is impossible to damage a tube by inserting it in the wrong socket. • Free-moving built-in roll chart provides complete data for all tubes. • Phono jack on front panel for plugging in either phones or external amplifier detects microphonic tubes or noise due to faulty elements and loose external connections.

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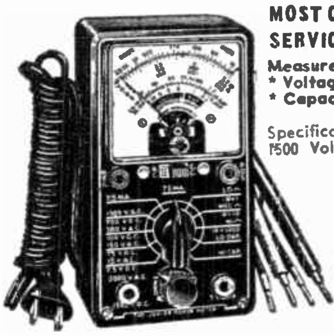

Measures:
* Voltage
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Specifications: D.C. Volts: 0-7.5/75/150/750/1500 Volts. A.C. Volts: 0-15/150/300/1500/3000 Volts. Resistance: 0-10,000/100,000 ohms. 0-10 Megohms. D.C. Current: 0-7.5/75 Ma. 0-7.5 amps. Capacity: .001 Mfd.—.2 Mfd. .1 Mfd.—20 Mfd. Electrolytic Leakage: Reads quality of electrolytics at 150 Volt test potential. Decibels: —10 Db to +18 Db. +10 Db to +38 Db. +38 Db. to +58 Db. Reactance: 15 ohms—25 K ohms 15 K ohms—2.5 Megohms. Inductance: .5 Henry—50 Henries 30 Henries—10 K Henries. Plus Good-Bad scale for checking the quality of electrolytic condensers.

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SUPER-METER

A combination volt-ohm milliammeter plus capacity reactance inductance and decibel measurements

SPECIFICATIONS:

D.C. VOLTS: 0 to 7.5/15/75/150/750/1,500/7,500 Volts
A.C. VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
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D.C. CURRENT: 0 to 1.5/15/150 Ma. 0 to 1.5/15 Amperes
RESISTANCE: 0 to 1,000/100,000 Ohms 0 to 10 Megohms
CAPACITY: .001 to 1 Mfd. 1 to 50 Mfd. (Quality test for electrolytics)
REACTANCE: 50 to 2,500 Ohms 2,500 Ohms to 2.5 Megohms
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Comes housed in rugged, crackle-finished steel cabinet complete with test leads and operating instructions. Size 6⅛" x 9½" x 4½".

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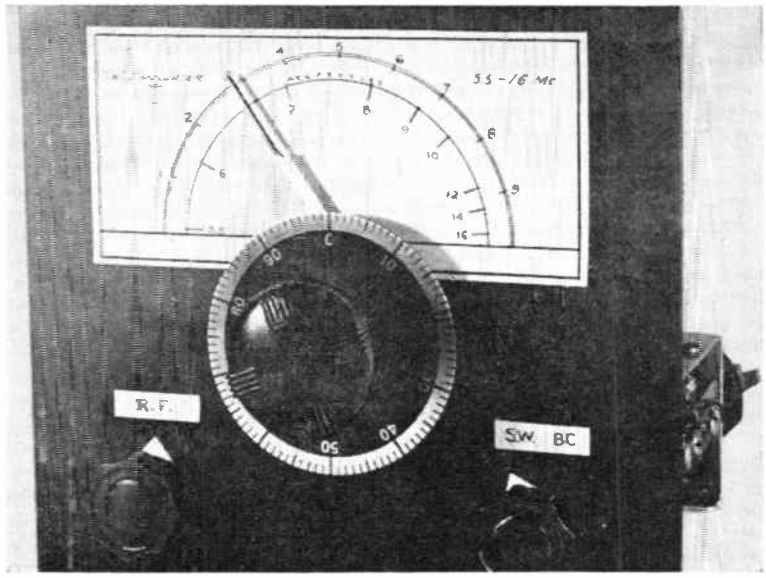


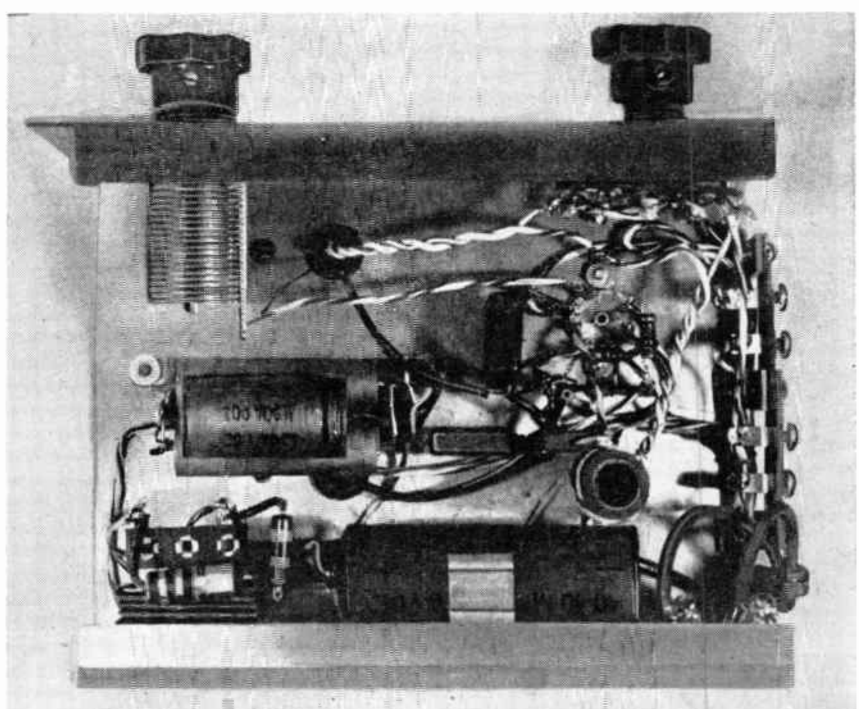
Front-panel view of shortwave converter.

SW CONVERTER

By RICHARD GRAHAM

THIS converter is a simple one-tube affair that will convert your present broadcast set to receive signals on the international short-wave broadcast bands, between 5.5 and 15 mc. With it you can break the chains that bind your set to the American broadcast band and multiply your listening enjoyment. Many fine educational, cultural, and musical programs can be heard daily. These originate in countries all over the world, including, of course, those from our own Voice of America stations. Many short-wave enthusiasts attempt to receive, identify, and verify as many of these foreign stations as they can, and this is a use to which this converter is well suited.

Although the converter uses only one tube, its performance far exceeds that of the simple one- or two-tube receivers. This is because it takes advantage of the selectivity and sensitivity of your present broadcast set. The result is plenty of "snap." Its performance will generally be equal to the lower-priced communications receivers. Even when the converter was used with a cheap a.c.-d.c. set and a 4-foot antenna, the results were surprising. English, Amer-



The r.f. tuning capacitor is mounted underneath the chassis.

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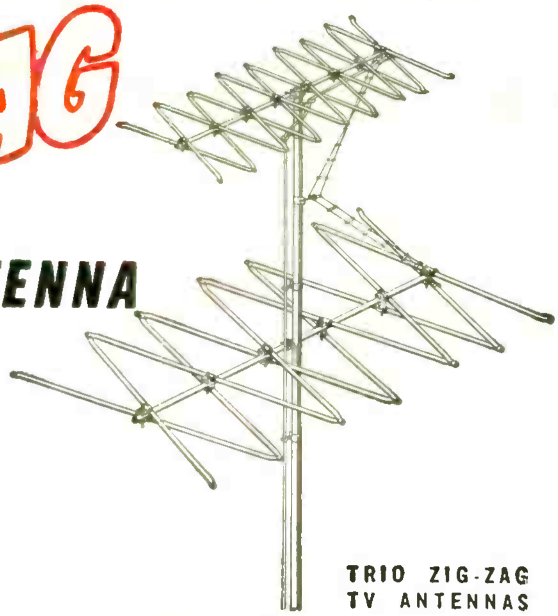


The sensational new TRIO ZIG-ZAG TV ANTENNA has already proven its superiority in the field. Thousands of installations have given a new high in TV reception, especially in ultra-fringe areas. Word of mouth has done the rest. TRIO'S plant capacity, taxed to the limit in an effort to supply the amazing demand for the ZIG-ZAG ANTENNA series, is being greatly expanded. Very soon now, your ZIG-ZAG ANTENNA will be supplied, and it's well worth waiting for.

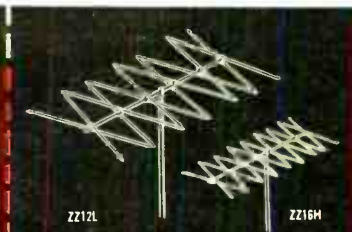
ZIG-ZAG ANTENNAS have replaced every known type of installation and TRIO is proud to report that in EVERY instance the ZIG-ZAG ANTENNA has out-performed them all, even the tried and true TRIO dual-channel yagi.

TV listeners are finding that with a ZIG-ZAG ANTENNA they are no longer tied down to just one or two channels, but are getting excellent reception on channels never seen before. ZIG-ZAG ANTENNA is truly HOT on all VHF channels.

TRIO ZIG-ZAG TV ANTENNAS available in 8 different models, provide a new high in all-channel performance for any area, from metropolitan to ultra-fringe. Tremendous gain, sharp directivity, excellent match to 300 ohm line, sturdy vibration-proof construction and fast, easy installation tells the rest of the TRIO ZIG-ZAG ANTENNA story.

SEE THEM at your JOBBERS. WRITE for CATALOG.

These ZIG-ZAG ANTENNAS provide the ultimate in extreme fringe area reception. ZZ12L provides 12-14 db. gain on Channels 2 thru 6. ZZ16H has a gain of 14 db. on Channels 7 thru 13. These antennas have very narrow forward lobe, high front to back ratio, provide high rejection in areas with co-channel interference.



Where maximum gain is not necessary these normal fringe model ZIG-ZAG ANTENNAS are ideal. Model ZZ8L has a gain of 9 db. average on Channels 2 thru 6. The ZZ8H provides an 11 db. gain on Channels 7 thru 13. Forward lobe patterns comparable to good multi-element single channel yagi.

For near fringe area reception these ZIG-ZAG ANTENNA models provide 8-9 db. gains on all Channels 2 thru 13. ZZ6L covers Channels 2 thru 6 and Model ZZ6H covers Channels 7 thru 13. Both models have patterns similar to those of cut to channel yagis.

These ZIG-ZAG ANTENNAS provide ALL CHANNEL reception with only ONE antenna bay. Model ZZ6A is designed for near fringe area reception of all Channels 2 thru 13, with an average gain of 9 db. Model ZZ4A is for use in suburban areas, providing an average gain of 6 db. on all Channels 2 thru 13.

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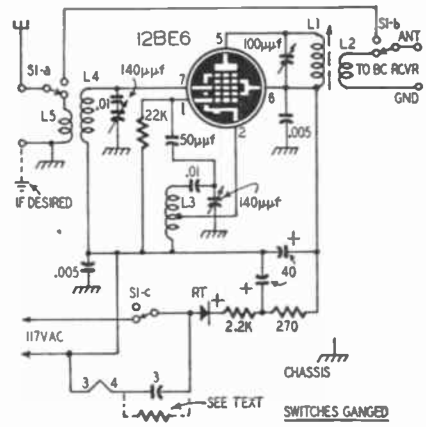
TRIO MANUFACTURING COMPANY • GRIGGSVILLE, ILLINOIS ican, and South American stations rolled in at full volume, actually overloading the speaker.

A superhet tuner

Circuitwise, the converter is very similar to the mixer circuit used in the front end of many superheterodyne receivers. It changes the short-wave signal to 1500 kc by beating it with another signal from an oscillator in the converter which is 1500 kc higher (or lower) than the received signal. Converting the short-wave signal to 1500 kc enables us to tune it in on any ordinary broadcast set.



Schematic of the 1-tube converter.

The broadcast receiver—which has been set to 1500 kc—then acts as the i.f., detector, and audio sections to complete the receiver. To avoid r.f. and oscillator tracking problems, which can be very nasty for a novice at these frequencies, the r.f. and oscillator capacitors are adjusted separately for best reception.

For economy reasons, the converter was made a.c.-d.c. To avoid serious shock, no connection is made to the chassis from the power line. But because the rotor of a variable capacitor is automatically grounded to the chassis when mounted on a panel and because of hand capacitance effects, it is necessary to ground the chassis to the line for r.f. The .005-μf capacitor between line and chassis and the .01-μf capacitors in series with the stators of the two variables isolate them from the line at 60 cycles while affecting them very little at frequencies between 5 and 15 mc. While it is still possible to get a "tickle" if the line plug is not polarized correctly, it will not be serious because of the high reactance of the capacitors at the power-line frequency of 60 cycles. The solution, of course, is simply to turn the plug over in the wall socket.

Another interesting feature is the use of a 3-μf capacitor in series with the filament to drop the line voltage to 12 volts for the 12BE6. This was actually made up of three 1-μf, 200-volt capacitors connected in parallel. These are seen in the left side of the photograph of the bottom wiring. If desired, a 697-ohm, 20-watt resistor can be substituted for the 3-μf capacitor. Since a capacitor does not dissipate power, the whole converter will consume about 2

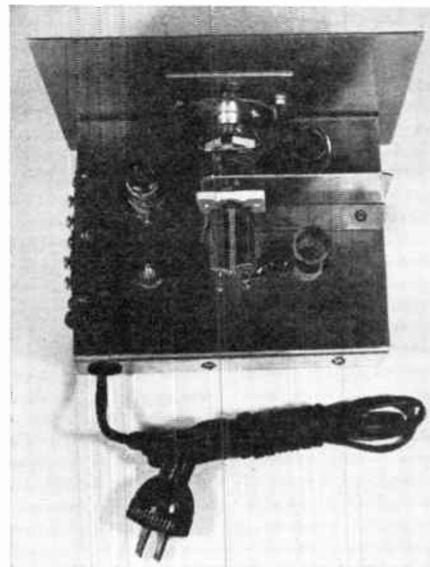
watts. With a resistor substituted for filament voltage dropping, the power consumption will be approximately 18 watts.

While there is nothing tricky or critical in the wiring of the unit, it is well to remember to keep all r.f. leads short and as direct as possible. Leads in this category would include those from the coils and variable capacitors. Other wiring such as the power supply circuit, filament, and other a.c. wiring may be conveniently wired and then cabled if desired. This is what was done in the unit shown.

Since the converter covers a rather wide band of frequencies, it is well for the constructor to invest in some sort of vernier dial. This will make tuning much easier and smoother. The dial shown in the unit constructed has been calibrated with both a 0—100 scale (for accurate logging) and a frequency scale. The dial can be calibrated by "on the air" observations and a radio log (available at most newsstands).

A word of caution concerning frequency calibration so the constructor may avoid a confusing pitfall. To make the unit simple, the r.f. and oscillator capacitors were tuned separately. Now, if an oscillator (for example) is set at 6 mc and the intermediate frequency is fixed at 1500 kc (1.5 mc), the incoming signal can be either on 6+1.5, which would be 7.5 mc, or 6-1.5, which would be 4.5 mc. The frequency that is selected is determined by the r.f. tuned circuit. In many instances the r.f. capacitor can be made to tune to either frequency, as in the example above. Thus you can tune in two different signals at one dial setting of the oscillator capacitor. With the r.f. capacitor plates in furthest, the frequency will be the *lower* of the two possible received frequencies. This is the best way of operating the converter, and should cause no confusion.

A switcn S1 has been provided to turn the a.c. to the converter on or off and, simultaneously, to switch the antenna from the converter to the broadcast set when the power to the converter is off,



Layout shows input-output coil shield.

and vice versa. This is the SW—BC switch shown on the front panel of the converter. It is shown in the "converter" position in the schematic.

Alignment and operation

After the unit is completed, it is necessary to align the converter by adjusting L1. All that is necessary is to hook up the unit to both the broadcast set and antenna as indicated in the schematic. Next turn the power on to both the converter and broadcast set. Then set the dial of the broadcast set to 1500 kc. If an interfering broadcast signal is heard, there is no harm in shifting the dial slightly either way to tune it out. Now adjust L1 for maximum background noise or—better yet—find a short-wave station and adjust L1 for maximum volume. A good point to remember is that when returning to short-wave from the broadcast band be sure to reset the broadcast set to exactly where it was when the converter was aligned. This setting determines the sensitivity as well as the accuracy of the frequency calibration.

There is little likelihood of image interference, since the 1500-kc i.f. separates stations that might cause this trouble by a full 3 mc. Harmonics of the receiver oscillator may give spurious reception at some points.

Materials for converter

Resistors: 1—270, 1—22,000 ohms, ½ watt; 1—2,200 ohms, 1 watt. If desired (see text). 1—697 ohms, 20 watts.
Capacitors: (Mica) 1—50 μμf; 2—.005 μf. (paper) 2—.01 μf; 1—3 μf (or three 1-μf units); (electrolytic) 2—40 μf, 150 volts; (variable) 2—140 μμf air variables.
Miscellaneous: 1—20-ma selenium rectifier; 1-12BE6 tube; 1—3-pole, 2-position switch.

Coil Data

L1	100	turns on ½-inch diameter slug form, No. 34 wire
L2	4	turns of hookup wire over L1
L3	23	turns, tapped at 5 turns from bottom, wound on ¾-inch form, ⅝-inch long, No. 22 wire
L4	17	turns, ¾-inch form, ⅝-inch, long, No. 22 wire
L5	4	turns of hookup wire over L4

L1, L3, L4 close-wound with enamel-covered wire.

The actual frequency range of the converter is 5.5 megacycles to 16 megacycles. This covers all the important international short-wave broadcast bands as well as the 40- and 20-meter ham bands and a host of other commercial services. END

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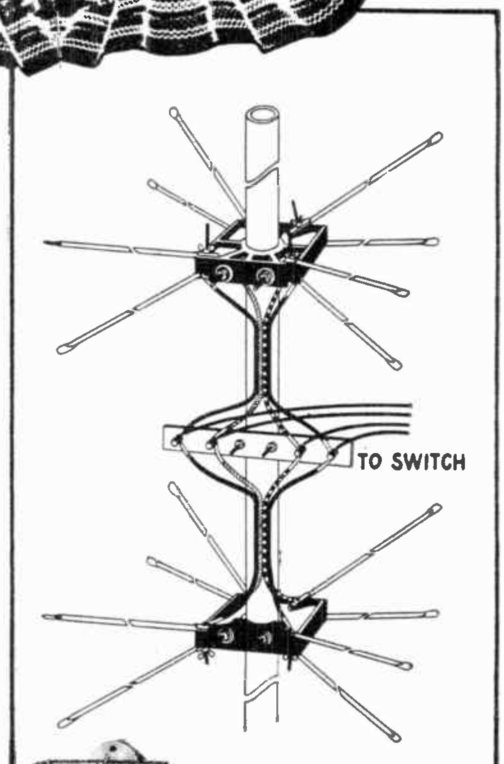

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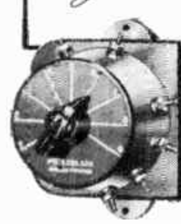

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Includes Stacked Antenna Array. 9 Position Switch. Completely Wired Stacking Harness. A.I.M.— Automatic. Impedance Matching Coupler.

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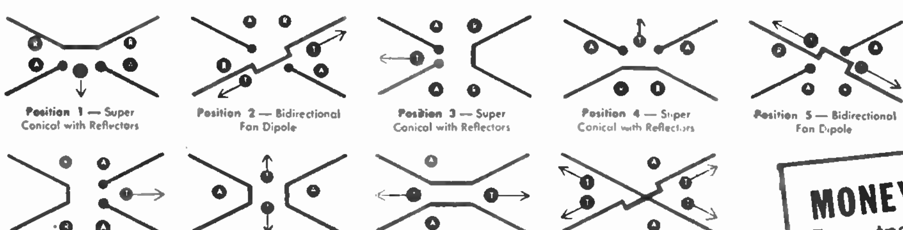

Position 1 — Super Conical with Reflectors

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Position 4 — Super Conical with Reflectors

Position 5 — Bidirectional Fan Dipole

Position 6 — Super Conical with Reflectors

Position 7 — Bidirectional Inverse Triple Double V

Position 8 — Bidirectional Inverse Triple Double V

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IMPROVING OSCILLATOR AND A.V.C. OPERATION

By JAMES SAREDA

WHILE experimenting with all types of receivers over a period of years, I have worked out several ways of improving the performance of the local oscillator and a.v.c. circuits in small superhets of the commercial and home-grown types.

Oscillator-pulling is one of the major problems in the design and construction of shortwave superhets. Any change in the tuning of the r.f. circuit affects the oscillator frequency whenever there is the slightest coupling between the two circuits. It is particularly bad with pentode mixers where the oscillator grid is coupled to the mixer grid through a small capacitor, but it is also noticeable in pentagrid mixers with separate oscillators when the oscillator grid and injector grid are tied together. Pulling can be reduced by taking the oscillator output from the plate, but this causes a serious reduction in the injection voltage fed to the mixer circuit from the oscillators.

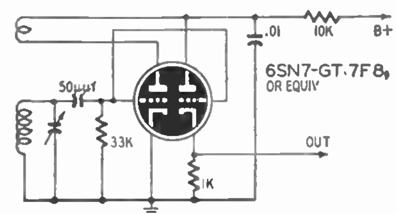


Fig. 1—Oscillator-buffer arrangement.

My solution to the problem of oscillator pulling is to use the oscillator circuit shown in Fig. 1 as a replacement for the existing oscillator circuit. I use a double triode with one section connected as the oscillator and the other as a cathode follower which acts as a buffer coupling the oscillator signal to the mixer. Since the tube is a dual triode, no extra holes, sockets, or mounting brackets are required. Simply wire in the circuit and connect the point which formerly went to the oscillator plate or grid to the cathode of the cathode follower.

The circuit shown uses tickler feedback but any other type of oscillator may be used. Simply tie the grids of the oscillator and cathode follower together. You can use any double triode as long as it has separate cathode connections. The 6SN7-GT is good for broadcast and slightly higher frequencies. A 7F8 is recommended for use above about 14 megacycles.

Another advantage of this circuit is that it makes approximately 90% of the oscillator voltage available at the mixer. Since the cathode follower has a low-impedance output, the lead between it and the mixer can be made long without the ill effects encountered when using plate-output circuits.

One trouble frequently encountered

in superhet circuits is caused by high harmonic output from the local oscillator. Oscillator harmonics beat with harmonics of strong local signals to produce spurious beats in the i.f. range. These beats cause a series of whistles which can be distinguished from images by the fact that they tune in and out very sharply.

I find that the harmonic output of such oscillators can be markedly reduced by rewiring the circuit to use plate-circuit tuning instead of the usual tuned-grid circuit. The circuits in Fig. 2 show tuned-plate oscillators. The circuit at *a* is used with two-winding coils and the circuit at *b* uses tapped coils. The triode shown may be the oscillator section of a converter tube or a separate oscillator.

A.v.c. circuits

The circuit in Fig. 3-a shows the detector-a.v.c. arrangement used in most simple superhets. This system is satisfactory in most respects but it pro-

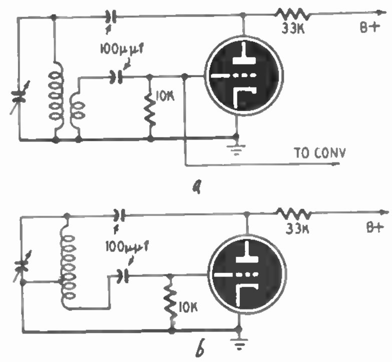


Fig. 2—Two methods of reducing oscillator harmonics by plate-circuit tuning.

duces a lot of distortion with high percentages of modulation on the signal. The villain is the 1-megohm a.v.c. filter resistor which shunts the 500,000-ohm diode load resistor. With the values shown, the presence of the a.v.c. circuit can produce distortion as high as 23% on a 100% modulated signal.

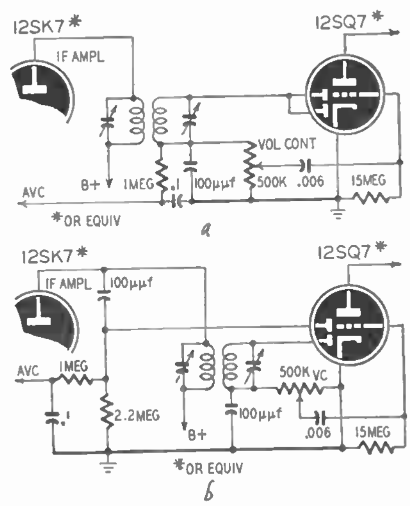


Fig. 3—(a) Standard a.v.c. circuit. (b) Modification for less distortion.

The remedy is to use one of the diodes of the usual duo-diode-triode used as a separate a.v.c. rectifier connected as shown in Fig. 3-b. The change is easy to make. The 100-μμf capacitor and the

2.2-megohm resistor are the only components which must be added. In this circuit, the a.v.c. has little effect on the detector and distortion is reduced.

Novel a.v.c. circuit

In almost all modern sets, a.v.c. voltage is applied to the control grids of remote-cutoff tubes in the r.f. or i.f. sections of the set. The circuit in Fig. 4 shows a system of applying the a.v.c. voltage to the screen grids of the controlled tubes. This circuit eliminates the elaborate a.v.c. network. Also, since the control-grid voltage does not change

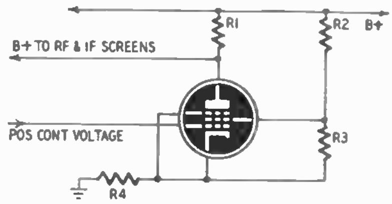


Fig. 4—Circuit for supplying a.v.c. voltage to r.f.- and i.f.-amplifier screen grids for improved control action.

nearly so much as it does when the a.v.c. voltage is applied to it, the amplifiers are being operated at all times over the most linear portions of the characteristic. This reduces distortion often caused by operating remote-cutoff tubes over the curved portions of the characteristic on strong signals. In the later i.f. stages where cross-modulation is not a problem, sharp-cutoff tubes can be used.

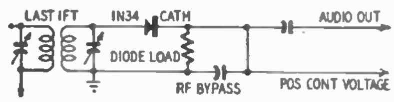


Fig. 5—Suggested detector circuit for developing positive control voltage.

The control tube in Fig. 4 is a high-transconductance, sharp-cutoff pentode. R2, R3, and R4 make up a voltage divider which supplies proper operating voltages to the screen and cathode of the control tube. The resistors are proportioned so the screen operates with maximum permissible voltage and the cathode is 3–4 volts positive with respect to the grid. R1 is the dropping resistor supplying the screen grids of the r.f. and i.f. amplifiers controlled by a.v.c. It should be adjusted so the screen voltages are normal with no signal.

The grid of the control tube connects to a point which goes positive with increasing signal. The positive control voltage can be obtained by modifying the detector to conform with that in Fig. 5. However, if the set has a plate or infinite-impedance detector, take the control voltage from the detector cathode. In this case, bias the cathode of the control tube 3–4 volts higher than the no-signal cathode bias of the detector.

When a signal is received, the grid of the control tube goes increasingly positive and the drop across R1 increases. This lowers the screen voltage and reduces the gain of the r.f. and i.f. stages. Do not connect the circuit to the screen of a converter tube unless a separate oscillator tube is used because the changes in screen voltage cause frequency shift. END

LINEAR SWEEP GENERATOR

A bootstrap type sawtooth generator produces an output waveform which is more linear and has a wider voltage range than any other type of sawtooth generator. Its principal disadvantage is the relatively long time which must elapse between sweep cycles. The basic bootstrap generator is shown in Fig. 1.

V1 is the control tube which must be triggered by a negative pulse each time a sweep stroke is desired. This tube is normally conducting heavily, drawing its current through diode V3 and resistor R1. Because of the large voltage drop across R1, C2 charges to a voltage approximately equal to E_1. C1 is substantially discharged while V1 is conducting.

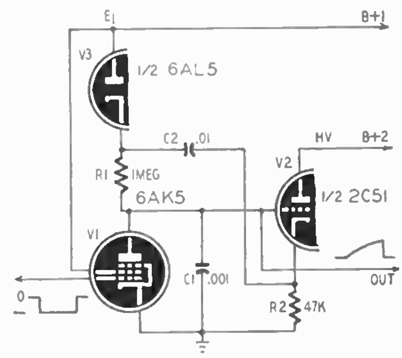


Fig. 1—The basic bootstrap generator.

A negative trigger pulse on the grid of V1 cuts it off and C1 begins to charge through V3. If the cathode of V3 remained at a fixed voltage level, the charge on C1 would increase exponentially to produce a nonlinear sawtooth. In this circuit, the grid of V2 becomes more positive and the voltage drop across R2 increases in proportion to the charge on C1. The rising voltage across R2 is applied to the cathode of V3 so the voltage drop across R1 and the charging current of C1 are substantially constant so the output voltage is a linear sawtooth.

At the end of the sweep stroke, the trigger voltage drops to zero. V1 conducts and C1 discharges rapidly through it. C2 recharges through the resistance

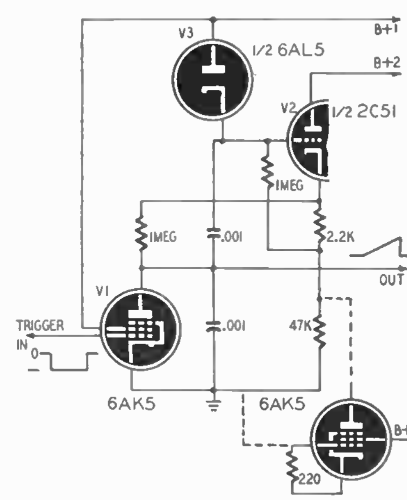


Fig. 2—Modification for higher rates.

of V3 in series with R2. Since C2 is usually about 10 times as large as C1, its recharging time will be considerably longer than the discharge time of C1. A new sweep stroke cannot be initiated until C2 has recharged to its original state. It is this recharging time that limits the repetitive rate of the trigger.

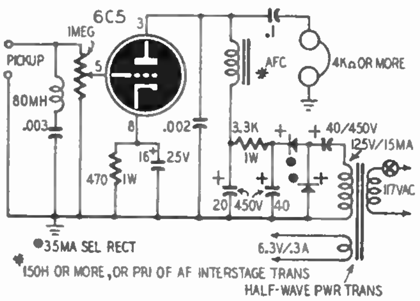
The circuit in Fig. 2 is a modified version of the bootstrap generator designed to provide a much higher repetition rate than the circuit in Fig. 1. The circuit is described in patent No. 2,606,287 issued to David O. McCoy. In this circuit, the grid of the cathode follower V2 connects directly to the cathode of V3 and to the plate of V1 through a .001-μf capacitor. Another .001-μf capacitor is connected between the plate of V1 and ground.

Now, during the recovery or flyback period, the *lower* capacitor discharges rapidly through the resistance of V1 while the *upper* capacitor recharges through V3 and V1 in series. Since the two capacitor values are equal and the resistances in series with them are approximately equal, the recovery time of this circuit is nearly equal to the flyback time so the trigger repetition rate is increased.

Linearity can be improved by replacing the 47,000-ohm resistor with a constant-current pentode connected as shown by dashed lines.

INDIVIDUAL PHONOGRAPH

Habitual playing of code or language-training records on the home phonograph is one sure way of making the family unhappy, particularly if the phonograph is a part of the family radio or TV combination. You will probably want to listen to your records when others in the family would rather listen to a soap opera or watch TV.



Materials for amplifier

Miscellaneous: 1—470, 1—3,300 ohm, 1-watt resistors; 1—1-megohm volume control with switch; 1—a.f. choke, 150 henries or more (Thordarson T20C50, Stancor C-2300, or equivalent); 1—16-μf, 25-volt, 1—20-, 2—40-μf, 450-volt electrolytic capacitors; 1—0.1, 1—.003, 1—.002-μf, 400-volt paper capacitors; 1—r.f. choke, 80 mh; 1—half-wave power transformer, 125 volts, 15 ma, and 6.3 volts, 0.6-amp secondaries (Stancor PS-8415 or equivalent); 1—6C5 tube. Socket, chassis, input and output connectors.

You can keep the family happy by constructing the one-tube phono amplifier shown in the diagram and allowing the others the exclusive use of the radio combination.

The amplification of the single 6C5 is sufficient to provide good headphone volume when used with a crystal pickup. The L-C network across the input terminals reduces scratch and needle hiss.—*A. Iwaniwsky* END

B. C. ABANDONS *BULLETIN*

The *Bulletin*, long the official organ of the service technicians of Vancouver, and more recently, of the British Columbia Council of the Radio Electronic Technicians Association, has been discontinued. Abandonment of the paper was decided upon at the provincial council meeting at Nanaimo last September. The reason was the lack of an editor with journalistic training.

It was not learned whether the Vancouver association intends to continue carrying on a local paper of its own.

NEW PHILADELPHIA GROUP

A new organization to be known as the Television Servicing Dealers Association has been formed in Philadelphia. President of the new group is Dave Krantz, chairman of the Federation of Radio Servicemen's Associations of Pennsylvania, and its secretary is Edward J. Strychowski. Louis J. Smith is vice-president, and Sam Brown treasurer.

Reasons for a new organization in Philadelphia, which already has the Philadelphia Radio Service Men's Association (PRSMA) and the Television Contractors Association (TCA), were not given.

FRSAP TO HEAR EDITOR

The Pennsylvania Federation of Radio Servicemen's Associations (FRSAP) has tentatively arranged a series of lectures at Pittsburgh, York, Williamsport, Harrisburg, Wilkes Barre, Scranton, Reading, and Altoona. The proposed schedule at time of writing was:

January 6	Pittsburgh
January 7	York
January 8	Williamsport
January 19	Harrisburg
January 20	Wilkes Barre
January 21	Scranton

Schedules for Reading and Altoona were not fixed when this issue was made up.

The lectures are to be delivered by Mort Bernstein, Associate Editor of RADIO-ELECTRONICS, a radio engineer and professional television instructor as well as a radio-television editor.

CHICAGO MOVES TO LICENSE

The Chicago City Council has requested the Illinois State Legislature to amend the Cities and Villages Act to permit the city of Chicago to license radio and television service technicians. The request, made at the end of October, cannot be acted upon until the Legislature meets this month (January), and could not be enacted into law until July 1.

If approved, the city will then hold the necessary hearings to determine what type of licensing, if any, is desirable, and how a license law should be enacted and enforced.

Sponsors of municipal licensing in Chicago include Frank Moch, president of the Television Installation Service Association, and E. T. Wood, business manager of Local 1639, International Brotherhood of Electrical Workers, a local of 700 television repairmen. Opposing it was Norman Brahmstedt, of the National Appliance and Radio-TV Dealers Association, who reported that his association would make a formal statement of its views at a later date, probably before the State Legislature.

BBB KNOCKS $1 CALLS

The Better Business Bureau of New York City—in a special bulletin issued late last October—urged that advertising of specific prices for TV service be discontinued. The bulletin stated that the Bureau has been increasingly concerned with "apparently flat-rate low-price offers, such as '$1 per call plus parts'" and that complaints about such service are increasing.

The Bureau recommended that in advertisements of television service:

1. No prices should be mentioned.
2. "Free estimate" offers should not be used.
3. "Guarantees" should be specific as to duration and actual terms.

FRSAP TO PRESENT PLAQUE

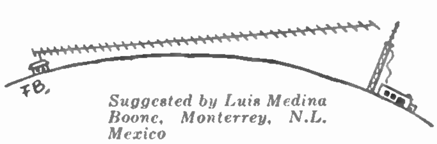
The Pennsylvania Federation will present its plaque—awarded annually to the person or organization who has done most for the benefit of radio service technicians during the year—at Harrisburg on January 18.

Last year's plaque was awarded to John Rider, long-time champion of the service technician and publisher of servicing aids.

TV GYP CHARGE HOLDS TWO

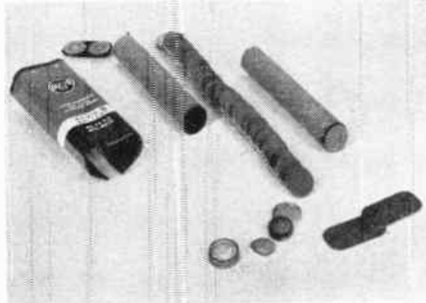
Charges of larceny have been preferred against two television service technicians whose firm levied a charge of $34.13 for "repairing" a set whose only fault was a bad tube. The men were employed by Sibko Television Service Corporations, of Queens, one of the boroughs of New York City. It is said to be one of the largest "$1.00 plus parts" concerns in that area.

The set was a "planted" one, with all parts marked invisibly, and one dead tube. The receiver was removed to the shop because "the high-voltage circuit was out" and allegedly returned later with a bill for $34.13, which itemized a new flyback transformer, a capacitor, and two resistors. All the supposedly replaced parts still had their original code markings, however. A warrant was issued for the man who removed the set from the house and for the bench man who gave the estimate for replacing the non-replaced parts. END



Suggested by Luis Medina Boone, Monterrey, N.L. Mexico

"The Best Yagi"



A can opener gave us this excellent interior view of the 67½-volt "B" battery. The plastic cup, felt pad, and metal end cap are all visible.

New Long-Life Cell Boon to Portables

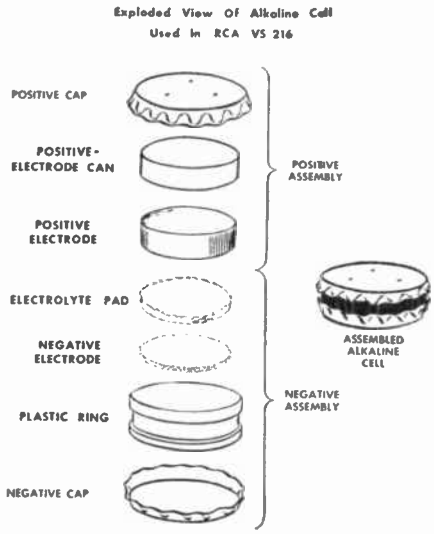
The newly developed 1½-volt *alkaline type* dry cell is now being used in new long-life A and B batteries for personal portable receivers. The new 67½-volt B battery is 22% smaller than ordinary 67½-volt dry batteries yet increases playing time up to 100% in personal type portables. The companion 1½-volt A battery (size G) is 75% longer than conventional size D batteries but it provides up to five times the playing life.

Two of these new-type 1½-volt alkaline dry cells connected in parallel balances the life of one 67½-volt type and enables a personal portable to play up to ten times longer without battery change. One alkaline type 67½-volt battery and two alkaline type 1½-volt batteries in parallel have the equivalent playing life of two standard 67½-volt batteries and 10 to 12 1½-volt A batteries.

The crown type alkaline cell used

How the new battery compares in size with the popular RCA VS 016 model.

in these new batteries measures only 0.9 inch in diameter and 0.23 inch high. The positive electrode can, the positive and negative electrodes, and the electrolyte pad are sandwiched together inside a protective plastic ring between two "bottle caps" which serve as positive and negative terminals.



Schematic view of the new B-battery.

The cells, which use zinc for the negative pole and manganese dioxide for the positive pole, and an alkaline electrolyte, are stacked together in paper tubes. The number of cells which go into a

Battery complement of a new portable. Playing time is enormously increased.

battery depends on its voltage and current ratings. The completed battery is enclosed in a steel shell which resists swelling and prevents it from wedging in the radio. END

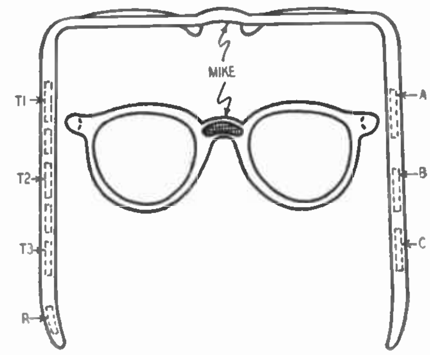
ELECTRONIC POSTMAN?

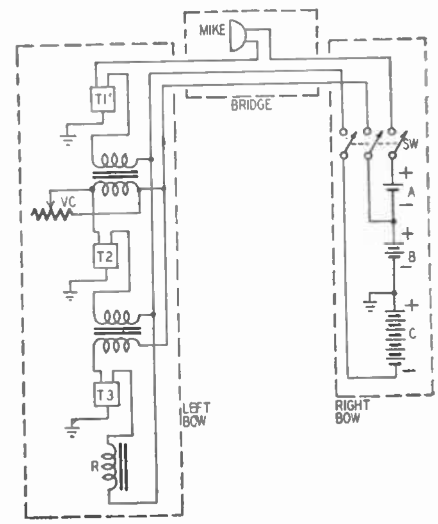
Electronic mail-sorting devices and supervisory TV systems are to be installed in Canadian Post Offices. The average human handler can reach only about 60 pigeonholes in sorting mail. Pushbutton electronic selectors will enable each man to reach 300 slots and eliminate multiple handling. Closed circuit TV installations will permit postal inspectors to watch operations anywhere from a central point, instead of from the peephole galleries now used.

SPECTACLE-TYPE HEARING AID

Patent No. 2,613,282
Alan M. Scaife, Pittsburgh, Pa.

Some hard-of-hearing persons object to wearing a hearing aid because it is conspicuous. This invention hides the hearing aid within a pair of spectacles. All components are located within the frames or the bridge. No external wiring is needed. The microphone is located in the bridge, so that maximum sound is picked up when the person turns his head toward the speaker. The device and its circuit are shown below.





Assembly and circuit of hearing aid.

The amplifier is built into the left-hand bow of the spectacles as shown. It uses 3 transistors, transformer coupled. Reproducer R may be of the bone conduction type. It presses against the bone just back of the ear. A tiny volume control is also included in this frame, together with a ring type switch which is operated by the fingers. The right-hand frame carries three batteries. A supplies 1.5 volts to energize the carbon microphone M. It also biases the emitter of the first transistor, T1. The battery B provides a voltage of 3 volts to bias the emitters of the other transistors, T2, T3. C is a 30-volt battery for the collectors.

TV MARKER GENERATOR

Patent No. 2,610,228
George F. Devine, Marcellus, N. Y.
(assigned to General Electric Co.)

This invention reduces the number of crystals needed for correct TV alignment. It uses one crystal to mark the desired picture carrier (i.f. or r.f.). A second crystal provides markers at 1.5-mc intervals on either side of the pix carrier. Thus it automatically indicates the *adjacent sound carrier* and the *accompanying sound carrier*. Also, the third harmonic of the 1.5-mc crystal may be used to align intercarrier sound stages.

A sweep generator is connected as usual to the TV under test and to the sync terminal of an oscilloscope. The 1.5-mc oscillator provides a fundamental and harmonic frequencies which mix with the desired picture carrier signal. The latter may be i.f. or any r.f. channel. Due to modulation, the detector output contains a large pip which indicates the picture carrier and smaller pips at intervals of 1.5 mc.

These pips identify picture and sound carriers for correct alignment. The third harmonic of the 1.5-mc crystal is used to align intercarrier sound.

VOLTAGE LEVEL SELECTOR

Patent No. 2,612,550

George T. Jacobi, Schenectady, N. Y.

(assigned to General Electric Co.)

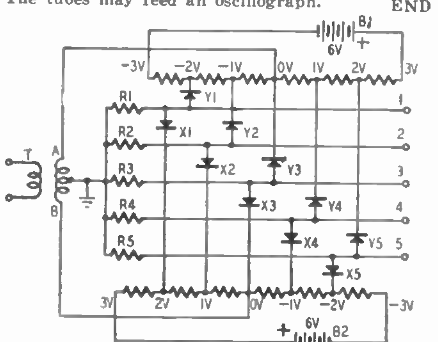
This is a high-speed switch useful in quantizers and oscillograph recorders. It indicates signal amplitude by steps. For example, when the amplitude lies between 0-1 unit, it energizes the "No. 1" circuit. For a level between 1-2 units, "No. 2" circuit is energized, and so on. This indication by steps is called *quantizing*.

See Fig. *a*. B1 and B2, are 6-v. supplies. All divider resistors are equal, to provide the voltages shown. The upper values are given with respect to point A, the lower ones relative to B. With zero signal at T, these values are also correct with respect to ground.

Note the 5 pairs of rectifiers, X1Y1, X2Y2. . . . If a rectifier passes current, it feeds one of the load resistors R1, R2. . . . Current through any load can flow in only one direction. In this circuit only one rectifier pair can remain non-conducting at any time. For example, assume zero signal at T. Then X3Y3 is the only non-conducting pair since these have no voltage across them. Line 3 is grounded but all others are negative.

Now assume an input signal. Let A be 2 volts positive and B 2 volts negative. Now the original voltages (marked on the diagram) are changed. The upper values are *increased* 2 volts, the lower values *decreased* 2 volts. Therefore X1Y1, with no voltage across them, are non-conducting. All other Y rectifiers are blocked, but the other X rectifiers have negative cathodes so they conduct. Now Line 1 is at ground potential, but all others are negative. In this way, only one line is at ground potential at any time.

Fig. *b* shows how the level selector may be connected to a bank of triodes. At any time, only one tube has its grid grounded. All other tubes are blocked by the negative bias on their grids. The tubes may feed an oscillograph. END



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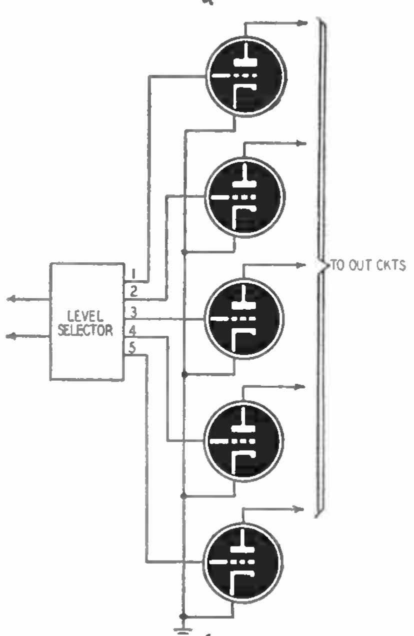


b

teamed together for Better TV Picture Quality

The combination of the famous Amphenol Inline Antenna with the extremely low-loss Amphenol Tubular Twin-Lead permits any TV set to present the best picture it possibly can.

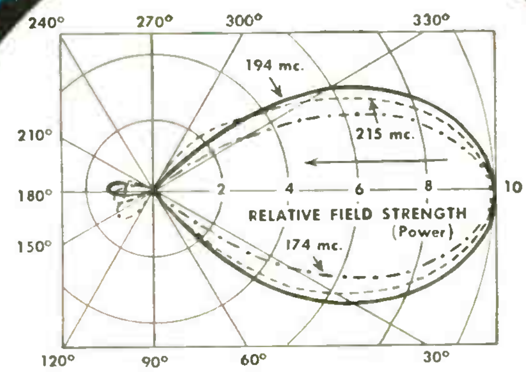
In addition to a strong forward reception lobe, the Inline has uniform gain over the entire range of VHF channels—less variation than the 3 decibel change which causes "fuzziness." The Inline is also available in stacked array for those fringe or trouble areas which require additional signal strength.

The Amphenol Tubular Twin-Lead provides very low-loss and constant impedance. The tubular construction minimizes the effect of moisture and dirt deposits on the concentrated field of energy and ends weather interference. Because of these characteristics, Amphenol Tubular Twin-Lead has been recommended by leading TV manufacturers and authorities for any installation where UHF is, or will be available.

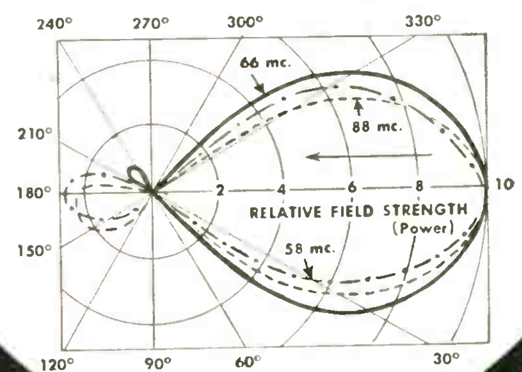
This illustration clearly shows that the concentrated field of energy between the two conductors, which are 7 strands of #28 copper weld wire, is contained by the tubular construction. This important field of energy is unaffected by any exterior conditions.

Your free copy of this book is available from your Authorized Amphenol Distributor. It contains complete factual and test data on the factors which determine Better TV Picture Quality.

AMPHENOL



consider the evidence...



The test patterns on *both* high and low bands reveal the Amphenol Inline Antenna's superior uni-directional reception lobe. This single forward lobe intercepts the TV signal at its maximum available strength. It also rejects unwanted reflected signals or side interference that cause "ghosts" and unsteady pictures.

No other broadbanded antenna can present as favorable a reception pattern on *all* the VHF channels as does the Amphenol Inline Antenna.

TAPE RECORDER

Allied Radio Corp., 833 W. Jackson Blvd., Chicago, Ill., has announced a low-priced tape recorder, the *Knight*. Two speeds and dual-track recording head provide four recording times.

At 3.75 inches per second a 7-inch reel with 1,200-foot tape capacity records continuously for one hour (two hours using second half of tape width). At the fast speed of 7.5 inches per second the recording time is one-half hour continuously and one hour overall.

Frequency response is flat from 70–8500 c.p.s. at 7.5 inches speed and 90–6000 c.p.s. at 3.75 inches speed. Recordings may be made either from the microphone supplied, or direct from radio, FM tuner, or phonograph. Playback is through the built-in amplifier and 5 x 7-inch oval speaker.

The unit weighs less than 22 pounds and operates on any 105-120-volt, 60-cycle a.c. outlet.

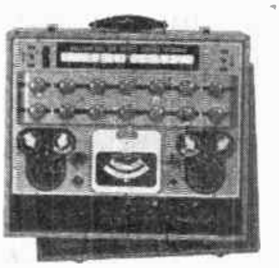
DYNAMIC MIKE

Astatic Corp., Conneaut, Ohio, has announced the *Dynabar* unidirectional dynamic microphone featuring a multi-impedance transformer and impedance selector switch.

The front-to-back pickup differential is approximately 15 db. Impedances provided: 50, 200, 500 ohms and high impedance. Output level of the mike is —54 db (1 volt per microbar); range is 40 to 10,000 cycles. Standard equipment includes Amphenol cable connector and 18 feet of two-conductor shielded cable.

C-R TUBE ANALYZER

Jackson Electrical Instrument Co., 16 18 Patterson Blvd., Dayton 2, Ohio, is producing a new cathode-ray tube analyzer, model 707. It tests all TV picture tubes, both magnetic and electrostatic deflected types. It also will analyze oscilloscope, radar, and other special-purpose C-R tubes without removal from chassis or carton. The instrument weighs 22 pounds.



PORTABLE RECORDER

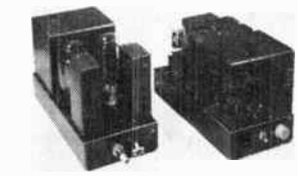
Amplifier Corp. of America, 398 Broadway, New York 13 N. Y., is manufacturing a battery-powered portable tape recorder with spring-wound motor, the Broadcaster model 610-SD.

The unit is 11½ inches wide x 10 inches deep x 7½-inches high, and weighs 15 pounds. The flutter content is within ± 0.1% over the full winding cycle of 6 minutes. It operates at a tape speed of 7½ inches per second, furnishing 15 minutes of playing time on a standard 5-inch diameter 600-foot reel of sound recording tape. Recordings may be played back on any a.c.-operated studio equipment of equivalent tape speed. A supplementary speed control provides ± 5% tape speed adjustment.

Recordings can be made while the instrument is in motion or being carried. Headphone monitoring while recording and immediate playback through phones, or into an auxiliary amplifier, speaker, or telephone transmission lines are two features of the unit. Standard phone jacks are used for the high-impedance microphone input and output terminals.

WILLIAMSON AMPLIFIER

British Radio Electronics, 1 Thomas Circle, Washington 5, D.C., has announced that it is importing the first production version of the Williamson amplifier to be endorsed by the designer.



The amplifier is supplied with specially wound transformers and chokes and with capacitors of approved British Government type. It consists of two units, and weighs 47 pounds.

Metering and balancing arrangements are provided. Jacks and plugs have been supplied from the U.S. to conform to American standards, and replacement parts are available in this country.

TV CALCULATOR

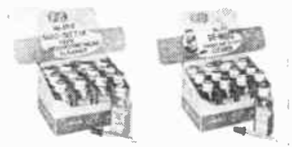
Pioneer Electronic Supply Co., 2117 Prospect Ave., Cleveland 15, Ohio, has announced a television signal-range

calculator. Designed as a slide rule it shows the approximate Grade A, Grade B, and City coverage for all v.h.f. and u.h.f. television channels.

SERVICE AIDS

General Cement Mfg. Co., Rockford, Ill. has announced two new service chemicals, one for TV and radio receivers, the other for magnetic recorders.

De-Noiz, for radio and TV controls such as volume controls, detents, tuners, switches, relays and contacts, dissolves



corrosion and oxidation and stops noise.

Mag-netic Head Cleaner, applied to recording heads of tape and wire recorders where it aids in preventing the accumulation of scum, oxides and other residue.

Both products come in 2-ounce sealed bottles, complete with applicator.

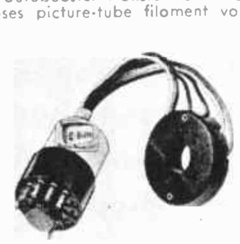
NEW TRANSFORMER

Blonder-Tongue Labs, 526 North Ave., Westfield, N. J., announce a 75–300 ohm matching transformer, model MT-1. The unit provides a 2-times increase in signal voltage and signal-

to-noise ratio when transforming from 75 to 300 ohms. It is built into a small metal case, which may be mounted at the antenna.

AUTOBOOSTER

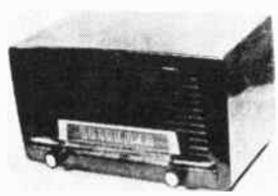
Perma-Power Co., 4721 North Damon Ave., Chicago 25, Ill., is producing a new autobooster transformer which increases picture-tube filament voltage



to 7.8 volts. The unit is designed for use in sets with parallel-wired filaments. The *C-Brite* is automatic and requires no switching or wiring.

RADIO KITS

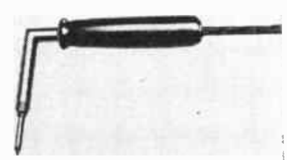
Radio Kits Inc., 120 Cedar Street, New York, N. Y. has announced the new "Q" line, available in kit or completely assembled form. Model QS is



a 1-band receiver or kit with a frequency range of 550–1600 kc; model Q5X is a 2-band receiver or kit with frequency ranges of 550–1600 kc and 6–18 mc.

SOLDERING IRON

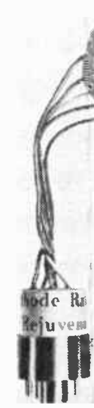
American Electrical Heater Co., 6110 Cass Avenue, Detroit 2, Mich., is pro-



ducing an angle type electric soldering iron for light-duty soldering. The iron weighs 10 ounces, has a ¼-inch plug-type tip, an input of 60 watts, and is available in standard voltages and for 32 volts. A separate heat-insulating stand is supplied with each iron.

TUBE REJUVENATOR

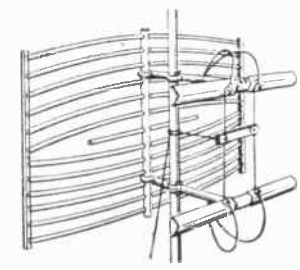
Crest Laboratories, Whitehall Bldg., Far Rockaway, N. Y., has introduced a



new picture-tube rejuvenator, the model D, designed to operate with all series-filament type television receivers.

V.H.F. ANTENNA

Davis Electronics, 4313 W. Magnolia Blvd., Burbank, Calif., has announced an all channel (2–13) high-gain v.h.f. antenna, the *Super-Vision*. Manufacturer claims such features as minimum ghosts, 10 db or more gain on high



channels, good front-to back ratio on all channels. The antenna can be tipped to shift the vertical pattern without tilting mast and can be used with antenna rotator. It is 6 feet, 2 inches high (less mast), 8 feet wide, and 4 feet deep.

MULTIPLIER PROBE

Insuline Corporation of America, 3602 35th Ave., Long Island City 1, N. Y., has announced a multiplier probe that extends the d.c. voltage ranges of standard vacuum-tube voltmeters 100 times. The device, known as the "100x" has the catalog listing No. 6222.

If the meter has a normal top range of 300 volts, it reads up to 30,000 volts with the probe; if it has a range of 500 volts, it reads up to 50,000 volts.

The insulated handle has a finger guard. The probe is 8½ inches long and has a 5 foot flexible cord and accompanying grounding wire. The meter end of the cord has a microphone type screw-on connector. An adapter plug (No. 33) permits the use of the probe with meters having phone plug connection.

MOBILE CONVERTERS

Radio Manufacturing Engineers, Division of Electro-Voice, Peoria 6, Ill., has announced three mobile converters for amateurs. Model MC-55 is a five-band

MC-55

MC-53 & MC-57

model giving full coverage of bands of 10–11, 15, 20, 40, and 75 meters. Model MC-53, designed for v.h.f., is a three-band converter for 2, 6, and 10–11 meters. Model MC 57 is another 3 band converter for full coverage of the 10–11, 20 and 75 meter bands.

PICTURE-TUBE BRIGHTENER

Standard Transformer Corp., 3580 Elston Ave. Chicago 18, Ill., is producing the *Stancor* P-8192 C-R tube booster, a compact, self contained device designed to add months to the useful life of a television picture tube. The unit can be used with all electromagnetic picture tubes, regardless of size, where dimming is due to low cathode emission.

Easy to install, the new booster measures only 3½ inches high and 1½ inches in diameter. It does not require a.c. line connection, and is equipped with high-low switch providing two levels of brilliance. Of autoformer construction, it has 18-inch leads between the booster and the connector plug, allowing the unit to be placed anywhere in the set, and is supplied with bracket and screws for chassis or cabinet mounting. To install, it is necessary only to remove the tube connector and attach it to the booster, then attach the connector plug of the booster to the tube. If there is insufficient brilliance at "low" it is necessary only to flip the switch to "high."

U.H.F. ANTENNAS

Technical Appliance Corp., Sherburne, N. Y. has two new antennas. The u.h.f. antenna Catalogue No. 3008, known as the *Bow-Tie*, is a stacked 4-element antenna for maximum gain. The four elements are preassembled to a 4-foot mast section complete with Q-bars, standoff insulators, and fitting an additional 4-foot section of mast included to provide clearance above the roof.

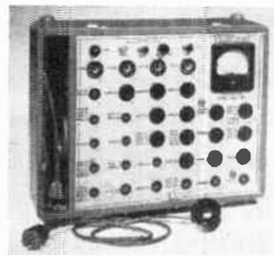
The *Bow-Low* consists of a Bow-Tie antenna with an ultra-efficient all-channel antenna designed for mounting on an 8-foot mast.

NEW CARTRIDGES

General Electric, Electronics Park, Syracuse, New York, have added three new 15,000-cycle variable reluctance phonograph cartridges to their *Golden Treasure* line. These are dual-stylus RPX 053, RPX 061 and RPX 063, the latter two single-stylus cartridges. All three feature retractable diamond styli.

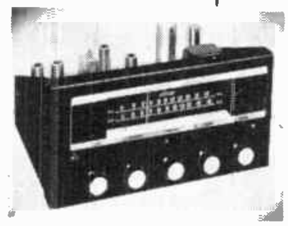
TUBE TESTER

Anko Manufacturing Co., 7311 West Burleigh St., Milwaukee 10, Wis., has announced a new tube tester, the *Teletest*, which reduces testing time on most receivers by eliminating switching and set-ups. One meter, with a single scale, indicates "good" and "bad" tube conditions. Picture tubes can be tested through a single adapter cord and plug while in the receiver chassis.



HI-FI FM-AM TUNER

The Radio Craftsmen, Inc., 4401 N. Ravenswood, Chicago, Ill., have announced production of the new model C800 high fidelity FM-AM tuner for custom installations. Front-panel controls include equalization for AES, LP, or European recording characteristics, a.f.c. on-off switch for FM tuning, and continuously variable bass and treble controls from 15 db boost through 15 db attenuation with flat position clearly marked. Also featured is a double shadow tuning eye.



The C800 has a total complement of 15 tubes and can be mounted in the same panel formerly cut for an RC10 or C10 tuner.

TUBULAR CAPACITORS

Industrial Condenser Corp., 3243 N. California Ave., Chicago 18, Ill., has announced a complete line of single-stud tubular oil-filled capacitors. Added to the line are an 8-µf and a dual 4-µf, 600-volt d.c. capacitor, a 4-µf 1000-volt d.c. unit, and similar units of the same case size.

Known as the G and H types, they are oil-impregnated and filled with Indco oil "A". Pyroteen-filled capacitors are also available. Standard capacitance tolerance: +20% to −10%. Temperature range: Indco oil, −40 degrees to +70 degrees C.; Pyroteen, −70 degrees to +90 degrees C. Power factor: Indco oil, 0.4%; Pyroteen, 0.2%.

Catalog and further information available from manufacturer. END

All specifications given on these pages are from manufacturers' data.

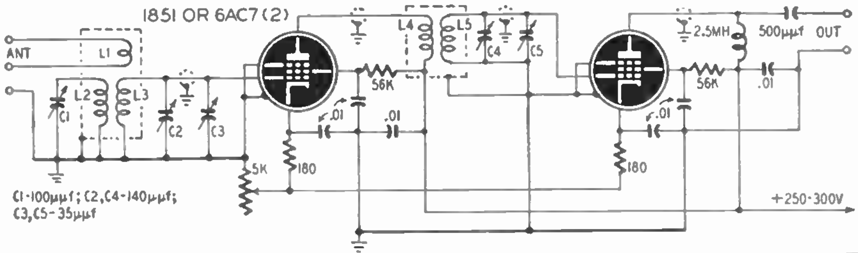
SHORT-WAVE PRESELECTOR

A good r.f. preselector can be used with any type of receiver from the simplest blooper to the deluxe superhet to pull those weak dx signals up out of the noise. A two-stage preselector covering from 200 to 10 meters was described by I1AHR in *Rassegna di Radiotecnica* (Ravenna, Italy).

A pair of 1851 pentodes were used in the original model, but you will probably get better results with a 6AC7. The latter is electrically identical to the 1851 with a redesigned grid structure for improved high-frequency performance. Gain is controlled by varying the 5,000-ohm resistor in series with the cathodes of the tubes. Selectivity is varied by tuning the 100-μμf capacitor across L2.

The coils are wound on standard 1¼-inch plug-in forms. The antenna coils are on 6-prong forms. Four-prong forms are recommended for the r.f. (interstage) coils to insure that the coils are plugged in to the correct sockets.

Winding data is given in the table. On the antenna coils, L2 is interwound with L3, and L1 is spaced below the ground end of L3. Spacing between L1 and L3 is 5/32 inch for 200-80 meters, ⅛ inch for 80-40 meters, ¼ inch for 40-20 meters, and 1.8 inches for 20-10



COIL TABLE

Band (Meters)	Coil	Turns	Wire
200-80	L1	15	22
	L2	32	22
	L3-L5	50	20
	L4	20	22
80-40	L1	7	22
	L2	14	22
	L3-L5	24	18
	L4	10	22
40-20	L1	6	22
	L2	8	22
	L3-L5	11	18
	L4	8	22
20-10	L1	4	22
	L2	4	22
	L3-L5	5	16
	L4	3	22

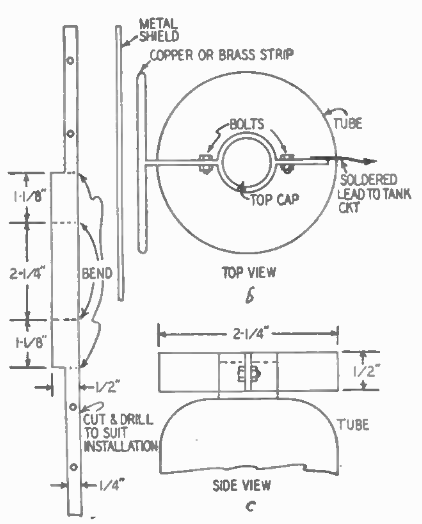
meters. L4 is interwound with the ground end of L5. If the 140-μμf tuning capacitors are ganged (they should be for easy tuning), L3 and L5 should have exactly the same number of turns and the same winding length. The antenna and r.f. coils should be shielded, and the sections of the 140-μμf bandset and 35-μμf bandspread capacitors should be separated by a partition shield to prevent oscillations.

TVI REDUCTION KINK

Most articles on amateur TVI elimination stress the need for very low harmonic output and the elimination of v.h.f. parasitics in the transmitter. Various types of high-pass filters, harmonic traps, and parasitic suppressors have been described. Writing in *The Radio Amateur*, G5JU, a British ham, described a simple device for reducing harmonic output, eliminating parasitics, and increasing the radiation for heat from transmitting tubes.

The device consists of a length of ½-inch wide copper or brass strip cut to the approximate shape shown at *a*, and then bent to shape and bolted to the cap of the tube as shown in drawings *b* and *c*. The 2¼ x ½-inch "plate" is located close to and parallel with the metal shield separating the power amplifier from the driver and other portions of the transmitter. The plate and interstage shield form a small capacitor between the tube plate (anode) and ground. This capacitor bypasses high-order harmonics which may be generated in the tank circuit or fed into the tube via the grid. The inductance of the capacitor lead is exceptionally small, thus minimizing the possibility that the inductance and capacitance of the unit may form a resonant circuit which will accentuate harmonics rather than suppress them.

The effectiveness of the capacitor depends on the area of its plate and the distance between the plate and the grounded shield. When constructed as shown, its capacitance is large enough to bypass harmonics and suppress parasitics without causing any appreciable reduction in the L-C ratio of the plate tank circuit at frequencies be-



tween 10 and 20 meters. At 40 meters or lower frequencies, the size of the plate should be increased accordingly.

With an 813 or similar tube running at 2,000 volts or so, the spacing between capacitor plate and shield should be about ¼ inch. Reduce the spacing proportionately at lower voltages.

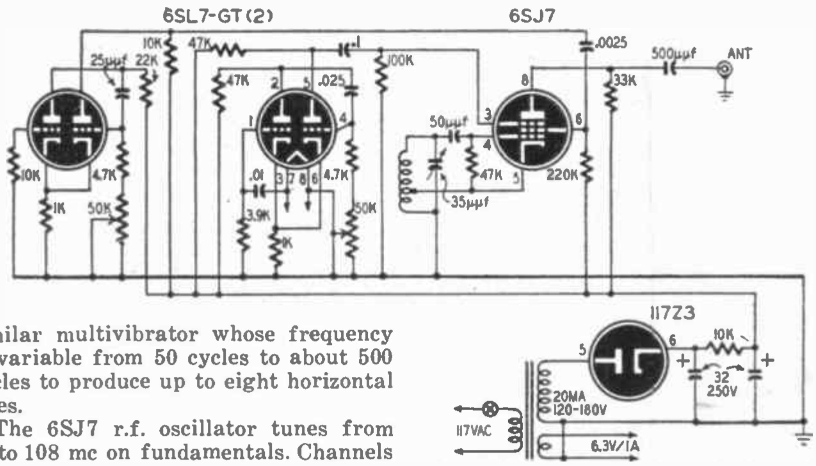
TV LINEARITY CHECKER

Now that many TV stations are televising program material from early morning until late at night, it is becoming increasingly difficult to tune in a test pattern for checking the linearity of TV receiver sweep circuits. A simple circuit for generating a grid of vertical and horizontal bars on a TV screen is described in *La Radio-TV Revue* (Antwerp, Belgium).

The instrument uses two 6SL7-GT's as multivibrators, a 6SJ7 r.f. oscillator, and a 117Z3-GT rectifier. V1 is the multivibrator which generates the vertical lines. Varying the setting of the 50,000-ohm potentiometer in the grid circuit varies the frequency from approximately 20 to 200 kc to produce a maximum of approximately 18 bars. V2 is a similar multivibrator whose frequency is variable from 50 cycles to about 500 cycles to produce up to eight horizontal lines.

The 6SJ7 r.f. oscillator tunes from 45 to 108 mc on fundamentals. Channels 7 through 13 are covered by second harmonics. The suppressor grid is modulated by the signal from the vertical oscillator and the screen grid is modulated by the rectangular-wave output of the horizontal oscillator. The signal is radiated into the input of the receiver by a telescopic whip type antenna or a piece of bus bar 12–20 inches long.

The original r.f. oscillator coil consisted of 8 turns of 10/12 Litz wire spacewound on a ¼-inch form. Litz wire being difficult to obtain in this country, we recommend a National AR-5 or equivalent coil.



BAND-EDGE CRYSTAL MARKER

A novel and exceptionally useful circuit for checking the calibration of the tuning dial is built into the ARC-5 and SCR-274-N command transmitters. It consists of a quartz crystal and a tuning eye which closes when the v.f.o. is tuned to the same frequency as the crystal.

The band-edge marker or calibrator shown in the diagram is an adaption of this circuit designed to be added to

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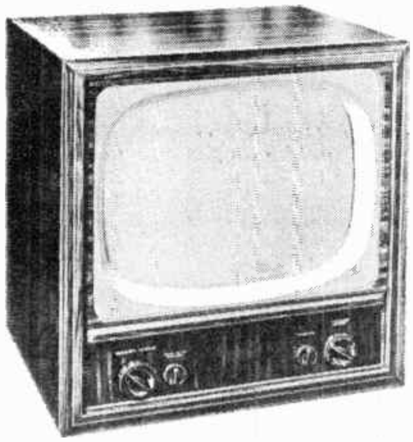

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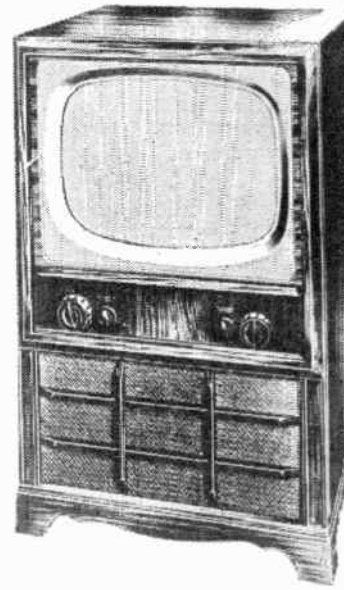

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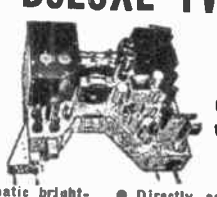

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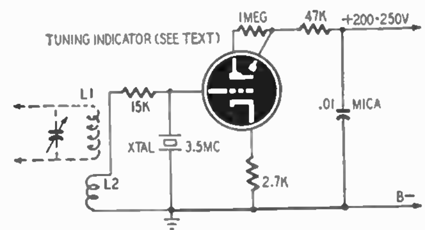
existing v.f.o.'s. It was developed by GI3EVU and was described in *Short Wave Magazine* (London, England). The original circuit uses a Y63 electron-ray indicator tube. A 6E5, 1629, 6G5, or any similar type may be substituted without changing the values of the components, as the tubes are very similar.

L1 is the oscillator, buffer, or doubler plate coil. L2 is a 2-5-turn link coupled fairly closely to the cold end of L1. Adjust the coupling between L1 and L2 so the eye is almost fully closed when the signal source is tuned to the crystal frequency. Mount the tube so it projects through a hole in the panel close to the v.f.o. tuning dial, and in a position where it will not be obscured by the operator's hand while tuning.



The crystal frequency is not critical as long as it is within the frequency range of the circuit to which it is coupled. A 3.5-mc crystal is perhaps the most useful because it marks the low-frequency end of the 80-, 40-, 20-, and 10-meter bands. If the v.f.o. operates in the 40-meter band, a 7.0-mc crystal should be substituted.

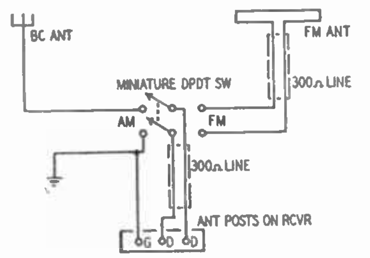
(If you are accustomed to operating close to both edges of any band, you can add suitable crystals to mark the upper edges. The crystal should be connected in parallel with the one shown in the circuit. We have used four 80-meter crystals in parallel to mark the edges of the band and two net frequencies. The crystals do not oscillate continuously, so there is no danger of interaction between them.

Be sure you know the exact frequencies of the crystals you use. It is highly advisable to borrow a good frequency meter and check the crystals in the marker circuit before you begin operating within a few kc of the band edges. Otherwise the system will have greater dangers than advantages.—*Editor*) END

"There! That's the kind of topcoat I want!"

AM-FM ANTENNA SWITCHING

When using an AM-FM broadcast and shortwave receiver such as the Hallicrafters SX-62, a miniature d.p.-d.t. knife switch will enable you to switch quickly from a long-wire shortwave or broadcast antenna to a 300-ohm FM dipole without introducing mismatch between the 300-ohm lead-in and receiver. When the switch is wired as shown in the diagram, throwing it to the AM position automatically connects the G (ground) terminal to one

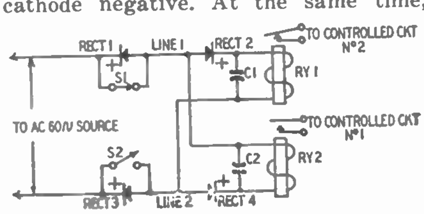


of the D (dipole) terminals. The short is removed and the 300-ohm lead-in connected when the switch is thrown to FM. I used a switch mounted on an insulated block measuring only 1 x 1¼ inches. The spacing between its blades is only ½ inch. This preserves the symmetry of the 300-ohm ribbon and minimizes reflections and mismatch. The switch is mounted on a polystyrene angle bracket at the rear of the receiver.—*Arthur Trauffer*

NOVEL CONTROL CIRCUIT

Because of distance or other factors, it is often impractical to run more than two control leads to a remote electrical device. With the usual circuitry, the two leads would be required to control a single device. This circuit shows how this same pair of lines may be used to control two separate devices.

With S1 and S2 open, the rectifier polarities prevent current flow through either relay rectifiers. When S1 is closed, rectifier 1 is shorted out. Rectifier 3 conducts when the negative half-cycle of the line voltage makes its cathode negative. At the same time,



rectifier 2 conducts because its anode is positive. These two rectifiers pass current through relay 1 and cause its contacts to operate. Relay 2 operates when S2 is closed. Both relays operate when S1 and S2 are closed. C1 and C2 may be of any value large enough to keep the relays from chattering.

To avoid insulation problems and heavy lines, you may use low-voltage relays and supply the circuit from a step-down transformer.

D.c. may be used as the power source, thus eliminating rectifiers 1 and 3. Circuits are selected by reversing the polarity of the applied voltage. With d.c. operation, it is impossible to operate the relays simultaneously.—*Carleton Phillips*

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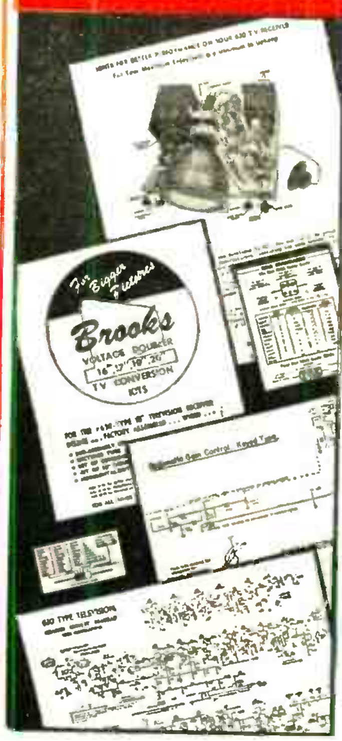

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CORONA DISCHARGE

Corona discharge in some TV sets and oscilloscopes is annoying because its effects are often mistaken for other faults and its source is sometimes hard to localize. In a TV receiver, this trouble is likely to cause breaks in the line structure of the raster, variations in brightness, and sometimes irregular black bars on the screen. In a scope, it causes variations in intensity and erratic breaks in the trace. You may hear clicks or frying sounds from the high-voltage compartment or the base of the C-R tube.

If corona discharge is suspected, sniff around the back of the set. If you smell ozone, turn out the lights and look over the power supply, the C-R tube and rectifier sockets, and the high-voltage leads. Watch for a bluish glow. Try blowing your breath on the high-voltage points. A soda straw or piece of spaghetti is handy for this.

When you locate the source of trouble, dress down all sharp corners and edges and smooth off rough solder joints with a hot iron.

If the discharge is on an insulator, replace it because it has probably broken down under the high potential. Discharge from a lead can be cured by replacing the lead with one designed for high-voltage operation. Keep the lead as much in the clear as possible. If this fails, try increasing the size of the offending conductor or connection. Keep everything as large and smooth as possible.—*R. A. Cunningham*

WELLER SOLDERING GUNS

If your Weller soldering gun is slow in heating, look at the nuts that hold the tip in place. If they are the least bit loose, they will introduce enough resistance into the circuit to seriously reduce the tip current. Try tightening these nuts with a wrench and note how quickly the gun heats up.—*Charles Erwin Cohn*

TV HIGH-VOLTAGE TROUBLES

Sometimes the 1B3-GT/8016 rectifiers fail to light under load in sets having flyback power supplies. This may be caused by a poorly soldered connection in one of the filament pins. The resistance of the connection may be high enough to prodnce a serious drop in filament voltage. A remedy for this condition is to reheat the filament pins with a hot soldering iron.—*Leonard Pfeiffer*

PRECISION RESISTORS

Replacement heating elements for electrical appliances such as small radiant heaters and hot plates can be used to make excellent high-wattage precision resistors for meter shunts and multipliers. When fully stretched out, the wire has a resistance of about 0.2 ohm per inch. The wire can be wound around a ceramic or bakelite tube. Screw-type terminals make the best connections.—*Richard J. Sandretto* END


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RHOMBIC ANTENNA QUERY

? I am about 200 miles from TV stations on channels 2 and 5 in Atlanta, Ga. The receiving antenna is a rhombic with 55-foot legs terminated with a 789-ohm resistor and fed with 300-ohm ribbon line. The antenna is 45 feet wide at the center. I seldom get a picture, but when I do, reception is fair on channels 2 and 5. Is there any way in which I can modify the antenna to improve reception on channel 2?—D. A. D., Knoxville, Tenn.

A. We assume that your rhombic is as large as you can conveniently make it, so we won't suggest making it larger. Its proportions are good and we would not suggest changing them. You may be able to improve reception by careful orientation of the antenna and by correctly matching the antenna to the transmission line.

A rhombic antenna for dx reception is very critical and must be oriented in the vertical and horizontal planes so the main lobe points directly at the transmitting station and lines up with the angle of arrival of the incoming signal.

Horizontal orientation or alignment of a rhombic is an exacting task when the installation is beyond the line of sight from the transmitter. Buy (from a local airport or aviation supply house) a regional airways navigation map showing the receiving and transmitting locations. Mark these points on the map and draw a straight line between them. Use a protractor to measure the angle that this line makes with *magnetic north*. Use the bearing of this line in laying out the base line of the rhombic. A surveyor will probably stake out the antenna base line for about the same fee as would be charged by a local TV technician for a standard antenna installation. If you do not care to hire a surveyor for the job, a surplus military marching compass can be used to lay out the antenna location. When laying out the base line, be sure that the compass is not thrown off by magnetic-metal tools, keys, belt buckles, and the like. Keep such material as far as possible from the compass. Make several sightings from the same point and lay out the base line midway between the two extremes.

Since you do not know the angle of arrival (wave angle) of the incoming signal, you will have to adjust the antenna after it is erected. The supporting lines for the sides and the terminated end should run through pulleys fastened to the tops of the supporting masts. This enables you to tilt the plane of the antenna and adjust its wave angle to correspond with the angle of arrival of the TV signal. For your antenna, the terminated end should be about 18 feet lower than the end to which the lead-in is connected. You can adjust the plane of the antenna for best reception and least noise when receiving a signal. Keep the terminated end at least 10 feet above ground.

A 300-ohm transmission line does not provide a good match to a rhombic which has an impedance of approximately 800 ohms. Connect a 490-ohm quarter-wavelength matching section *between the antenna and lead-in.* Use No. 12 wire spaced 2½ inches center-to-center or standard open-wire TV lead-in. The length of the matching section in inches equals 2,880 divided by the center frequency of the TV channel in megacycles.

Since you are interested in reception on two channels, you should have a separate matching section and lead-in for each. Use 57 mc for channel 2 and 79 mc for channel 5 when calculating the lengths of the matching sections.

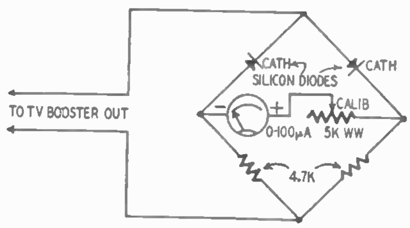
Use a d.p.d.t. antenna change-over relay at the antenna to connect the antenna to the matching section and lead-in being used.

FIELD-STRENGTH METER FOR TV MEASUREMENTS

? *I would like to construct an inexpensive TV field-strength meter for use in antenna orientation and experiments. I have heard that one can be constructed from a TV booster or front-end. Please tell me how this is done.— L. McC., Schenectady, N. Y.*

A. Such a meter usually resembles the video section of a TV receiver. The output of the tuner works into a conventional video i.f. strip. The output of the video detector is measured with a high-resistance voltmeter or the detector load current is read on a sensitive microammeter. A multiplier-resistor network is usually included to permit the unit to be used for a wide range of signal strengths. The i.f. strip is usually sharply tuned to the video carrier frequency for greater sensitivity. This calls for careful shielding and bypassing to prevent oscillations. Sensitivity may be controlled by varying the bias on one or more of the i.f. tubes.

The circuit of a tuned r.f. field-strength meter is shown here through courtesy of Cornell-Dubilier Electric Corporation. The output of the booster feeds a full-wave bridge detector circuit consisting of two resistors and two silicon diodes. A 100-μa meter and a 5,000-ohm wire-wound potentiometer



are connected in series across the output of the bridge. The reading of the meter is proportional to the strength of the signal fed into the booster. The 5,000-ohm calibration control permits the meter to be set to a predetermined reference point. Silicon diodes are more efficient at TV frequencies than most germanium types.

CONVERTING A G-E 260 PORTABLE FOR A.C. OPERATION

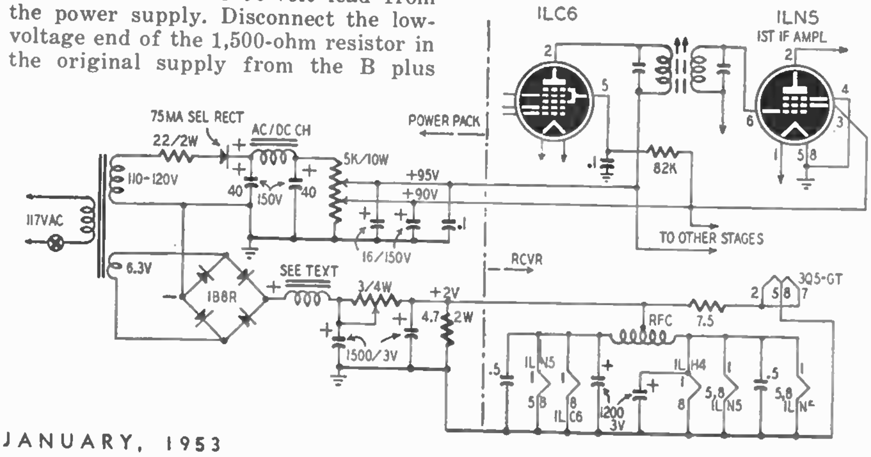
? *I have a G-E model 260 portable receiver which I would like to convert for a.c. operation only. I want to retain the original tubes and eliminate the 2-volt storage battery. Please print a diagram of a suitable power supply and show how it can be connected to the receiver.—R. W. O., Minneapolis, Minn.*

A. The diagram shows the circuit of an a.c. operated power supply (battery eliminator) and the method of connecting it to the receiver.

Disconnect the low-voltage end of the 10,000-ohm resistor in the original power supply from the lead going to pin 3 of the first i.f. amplifier and to the 82,000-ohm screen dropping resistor for the 1LC6. Connect the lead to pin 3 of the 1LN5 to the 90-volt lead from the power supply. Disconnect the low-voltage end of the 1,500-ohm resistor in the original supply from the B plus line supplying the 3Q5, 1LH4, 1LN5 second i.f., 1LC6 plate, and 1LN5 r.f. amplifier. Connect this B plus line to the 95-volt point on the 5,000-ohm voltage divider in the supply.

Connect a 5.6-ohm resistor across the low-voltage (filament) supply output and adjust the 3-ohm resistor for exactly 2 volts output. Remove the 5.6-ohm resistor and connect the 2-volt lead to the tap on the r.f. choke.

The low-voltage choke is made by winding as many turns of No. 22 enameled wire as possible on the core of an old a.c.-d.c. filter choke. The rectifier may be a Mallory 1B8R or equivalent, and the power transformer is a half-wave type designed for use with selenium rectifiers.



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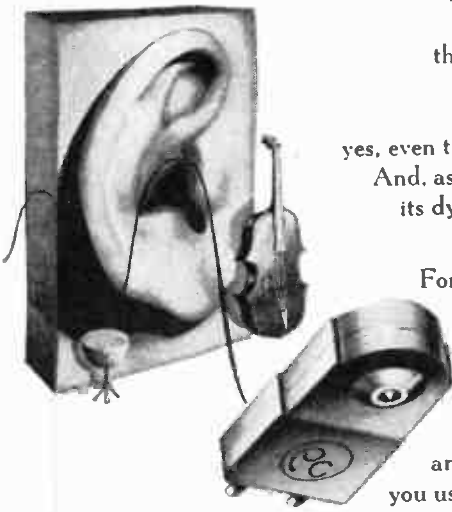

it comes to you in the subtle shading of a piano . . . in the clean brilliance of violins, the purity of a flute. Your ear detects the sweet mellowness of cellos, the roundness of a clarinet . . . yes, even the iridescense of clashing cymbals. And, as the symphony swells to crescendo, its dynamic energy adds a flood of color to your musical canvas.

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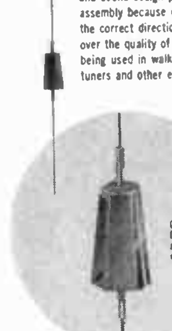
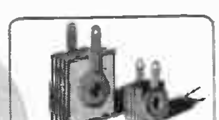
Radio Receptor's new Germanium Diodes feature polarity at a glance combined with simplicity of construction and sound design principles. The tapered shape speeds assembly because operators can see at a glance the correct direction of assembly. Users are enthusiastic over the quality of the product which is currently being used in walkie-talkies, computers, TV sets, tuners and other electronic applications.



Germanium Diode shown enlarged



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ADMIRAL AM-FM TUNERS

Oscillations which cause motorboating or whistles in the center of the AM band when the loop antenna is used are the result of excessive regeneration in the converter stage of the 4J1 and 4K1 chassis. The AM peaking coil L606 (between pin 6 of the 12AT7 and the plate lead of the first AM i.f. transformer) is used to provide positive feedback in the converter stage. This eliminates grid loading, inherent with a triode mixer, and provides greater conversion gain. If the resistor shunting the peaking coil increases beyond its specified tolerance, the set will oscillate in the middle of the band.

To verify this as the cause of the trouble, place your hand across the loop antenna. If oscillations stop, replace the damping resistor and the peaking coil—a 475-μh unit coded with a blue dot—with a new 120-μh coil (part No. 73A5-10) coded with a black dot.

If oscillations are present when the new peaking coil is used, look for trouble in the first AM i.f. transformer. In some cases, the silver mica capacitors in the transformer open up and cause the converter to oscillate. Replace the transformer.—*Admiral Service Bulletin*

BUZZ IN SENTINEL SETS

If station buzz is excessive and is not caused by the contrast control being advanced too far clockwise, adjust the discriminator secondary tuning slug for minimum buzz. Make sure that this position is between two maximum buzz peaks which will be noticed when the tuning slug is turned to the right and to the left of the minimum buzz position.

This adjustment screw is located on top of the discriminator coil shield and between the 6AL5 sound detector tube and the 6AU6 sound i.f. amplifier tube.—*Sentinel Service Notes*

MOTOROLA TS-174 CHASSIS

A vertical roll which cannot be stopped with the hold control may be caused by a change in the value of the fixed resistor in series with the vertical hold control. In one case, the value of the resistor had increased from 220,000 to 320,000 ohms.—*Stephen A. Quering*

(The vertical oscillator circuit varies with different production runs and versions of the chassis. In sets which use a 6J5-GT blocking-tube oscillator, the series resistance is 220,000 ohms. If the sweep generator is a 12AU7 multivibrator, the series resistance should be 330,000 ohms. When checking voltages and component values, be sure to refer to the manufacturer's service data and notes on production changes.—*Editor*)

RCA TV RECEIVERS

A light 2-3-inch horizontal band which drifts slowly across the face of the picture tube may be caused by oscillations in the 6BQ7 r.f. tube in the 17T150, 17T160, 17T170 (chassis KCS66) and 21T160 (chassis KCS68) models. In most cases, this trouble can be cured by replacing the tube.—*Gerald J. Macheak*

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1U5	.48	6CB6	.48	6W4	.44	12SQ7	.42
1X2	.68	6F6GT	.49	6W6	.52	19T8	.64
5W4GT	.46	6J6	.79	6X4	.34	25BQ6	.77
5Y3GT	.29	6L6G	.89	7X7	.62	25W4	.48
6A7	.62	6SA7	.52	12AT6	.48	25L6	.48
6AG5	.59	6SG7GT	.49	12AU6	.48	25Z6	.42
6AK5	1.14	6SK7	.49	12AU7	.56	35C5	.57
6BC5	.58	6SL7	.52	12AV6	.52	35L6	.48
6BE6	.48	6SN7	.54	12AZ7	.94	35Z5	.33
6BG6	1.21	6SQ7	.42	12BA6	.47	50L6	.48
6BH6	.62	6T8	.74	12SA7	.52	80	.38
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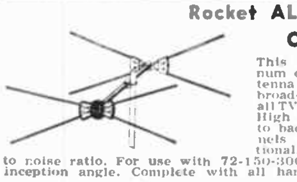

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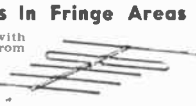

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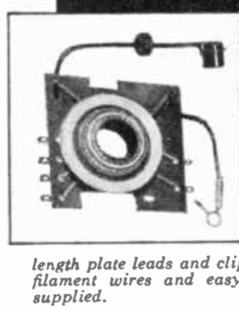

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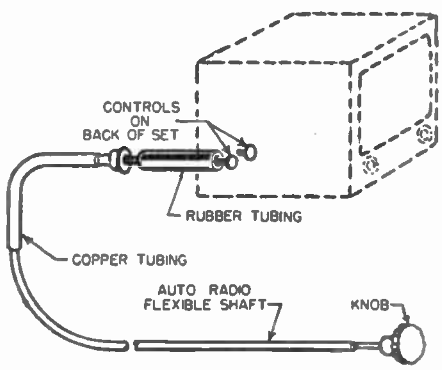
TV ANTENNA PRECAUTIONS

Always disconnect a TV or FM receiver from the line by pulling the plug before making any adjustments on the outside antenna. If the set must be turned on while orienting the antenna, be sure that you wear heavy gloves and that you do not permit any exposed part of the body to contact the antenna or mast. Failure to observe these precautions may cause serious injury. Don't rely on the switch. Pull the plug!

I have been shocked several times while reinstalling or orienting TV antennas. In most instances, the shock came when I touched the radiator connected to the lead-in. I don't believe that I got the full line voltage, but it was strong enough to be uncomfortable. In another case, I received a severe shock when I touched the mast while standing on a metal ladder. This time, the shock could have caused me to lose my balance and fall to the ground. Now, I pull the plug whenever possible and I wear heavy work gloves during antenna orientation.—*Alexander Kauders*

TV SERVICING TOOL

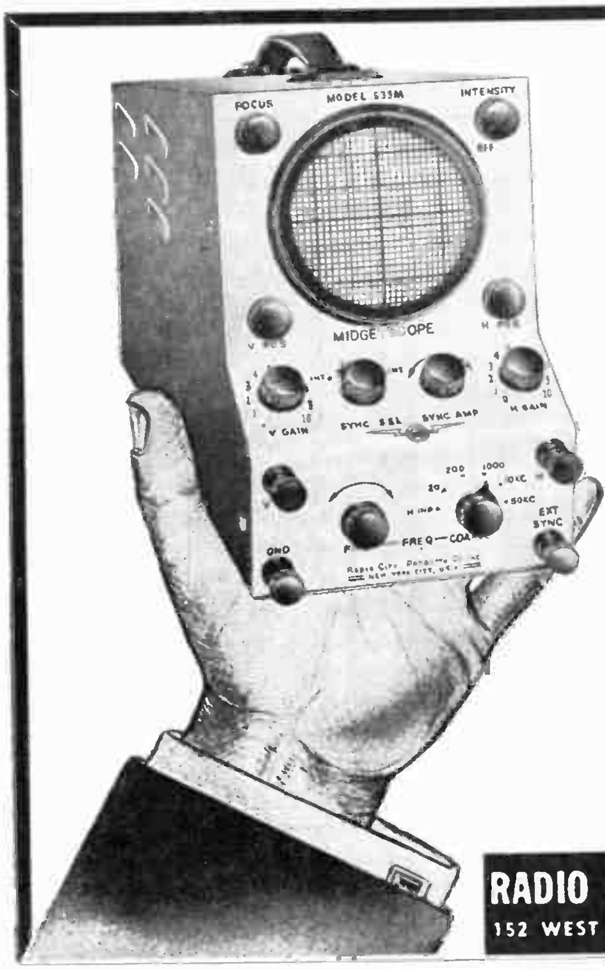
The gadget shown in the illustration is handy for adjusting the rear controls on large TV cabinets while watching the picture from the front. The tool is made from an auto radio flexible control shaft, a length of copper tubing, and a short piece of windshield-wiper hose. The copper tubing controls the degree of bend to prevent whipping and binding. The rubber hose slips over the shaft of the control to be adjusted.—*Motorola Service and Installation Bulletin*



CORONA TROUBLES

The cheaper fiberboard type high-voltage insulation materials tend to absorb moisture in coastal areas where humidity is high. This causes loss of high voltage and severe corona troubles. In one 16-inch set, a faint blue was observed all over the insulation and high-voltage leads when a blanket was thrown over the high-voltage cage to darken it. The condition was cleared up by replacing the fiberboard with plastic and the socket with a porcelain type.

Severe corona will often cause a horizontal output tube to fail within a few weeks. Metal shielding which is too close to the plate cap of the output tube will show a polished or bright circle opposite the cap if corona exists at this point.



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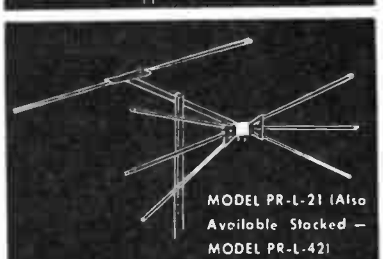

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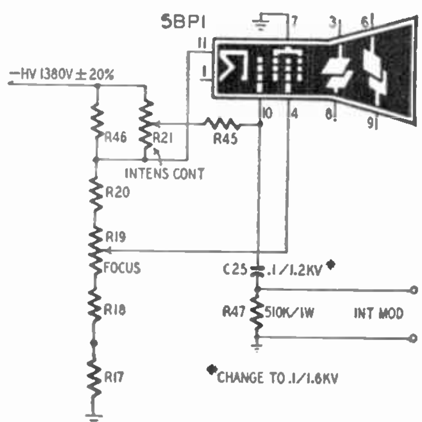
STROMBERG-CARLSON 421 SERIES

Repeated failure of the 6BL7-GT vertical oscillator and output tube (V18) in the 421 series chassis has been corrected in all chassis dated 52-20-1 by substituting a 6C4 for the vertical oscillator section of the 6BL7. A 6C4 tube was installed in an unused socket hole in the left front corner of the chassis. Grid, plate, and cathode leads (pins 4, 5, and 6) were disconnected from the 6BL7-GT (V18) and connected to pins 6, 5, and 7, respectively, of the 6C4. Pins 3 and 4 of the 6C4 were connected to the filament line and the unused pins (4, 5, and 6) of the 6BL7 were grounded.

If an earlier 421 receiver with a 6BL7 that causes vertical roll and which does not incorporate the 6C4 is encountered, it is suggested that the 6BL7 be replaced by one of the improved types. These can be identified by referring to the coding etched into the envelope beneath the 6BL7 tube designation. All Sylvania 6BL7-GT's are now of this improved version, so tubes coded E2E or later (F2E, G2E, H2E, etc.) are satisfactory replacements. If desired, the changeover to a 6C4 described in the first paragraph, can be made.—*Stromberg-Carlson Current Flashes*

EICO 425K OSCILLOSCOPE

Improper operation of the intensity control—indicated by excessive brightness at minimum setting—is usually caused by heavy leakage in capacitor C25 in the intensity modulation input circuit. The original capacitor is a 0.25-µf unit, rated at between 1,000 and 1,200 volts. However, the normal voltage at grid 1 of the 5BP1 is 1,380 volts ± 20%. This capacitor may check good under normal resistance checks but its



resistance drops when voltage is applied. This places an excessive drain on the high-voltage supply and causes a high negative voltage to appear across the INT MOD terminals.

Replace this capacitor with a unit rated at 1,600 volts or more, even if it has not shown the symptoms of leakage or breakdown. If it breaks down in use, operator may get a severe shock or equipment connected to the INT MOD terminals may be damaged.—*G. P. Oberto*

END

A *Federated* SPECIAL

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CHANNEL MASTER
CLAMP-ON
INDOOR-OUTDOOR TV ANTENNA

$1.39

MODEL #IN 852
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COMPARE THESE EXCLUSIVE FEATURES!

1. Special clamp for easy installation on rear of TV set, wall, or outside of window.
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1.99 For 7"—1200 foot Plastic reel. Save $3.51 on every reel.

Money cheerfully refunded if you do not find this tape cleanly erased and as good as new. (If you are skeptical and from Missouri send us 12c in stamps and we'll roll you a sample.) ● We buy commercial and government surplus plastic tape. Tape must be Irish (#211 RPA), Scotch, or Audio tape, or any tape that will meet government specifications and must not have more than one splice in any 1200 foot spool.

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4 Gang Variable Condenser . . 250 mmf. per sect. ¼" shaft. 7½"x3¼"x2¾" 1.29
2 Gang Variable . . Superhet or TRF. Either.. .69

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5" Scope Visor . . flex. vinyl.................. .89
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"JUMBO RADIO PARTS KIT"..17 FULL LBS. of: COILS, SWITCHES, CONTROLS, SOCKETS, RESISTORS, CONDENSERS, WIRE, HARDWARE—PLUS MUCH, MUCH MORE! (Shpg. wt. 20 lbs.)— **$3.95**

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1/17 H.P. G-E Motor (Type SD) . . 1725 RPM. .7 amp. Shunt wound. ⅜" shaft. 110V. DC. 4¾"x5½". Fully enclosed. Shpg. wt. 13 lbs.— ONLY 2.95
Hi-Fidelity Crystal Mike . . hi-imped. Rubber shock-mtd. Less housing—(1¼"x¼")......... 1.29
Aluminum Housing for crystal mike......... .15

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310 pages
170 illustrations

by Walter H. Buchsbaum

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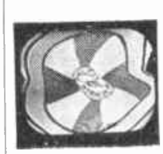

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Dr. John Ruze joined the GABRIEL LABORATORIES, Division of The Gabriel Co., Needham Heights, Mass., as director of research. The laboratories provide research and development facilities in


Dr. J. Ruze

the electronics field to other Gabriel divisions, including Ward Products and Workshop Associates. Dr. Ruze comes to Gabriel from the Air Force Cambridge Research Laboratories where he was assistant director of the Antenna Laboratory.

A. L. Champigny was promoted to supervisor of replacement sales promotion for GENERAL ELECTRIC'S Tube Department in Schenectady, N. Y. He will direct the promotion of G-E tube sales through distributors. He was formerly promotion service supervisor for the company's Large Motor and Generator Department.


A. L. Champigny

George Gemberling was named Western District manager for the ALLIANCE MANUFACTURING Co., Alliance, Ohio, maker of *Tenna-Rotors*, boosters and other electronic components. He has been with the company for the past two-and-a-half years.


G. Gemberling

Dr. James W. McRae, vice-president of Bell Telephone Laboratories, was elected president of the INSTITUTE OF RADIO ENGINEERS for 1953. He succeeds Dr. Donald B. Sinclair of the General Radio Co. S. R. Kantebet of the Government of India Overseas Communications succeeds Harold L. Kirke as vice-president of the I.R.E. Stuart L. Bailey, of Janskey and Bailey, and B. E. Shackelford of the RCA International Division were elected I.R.E. directors for 1953-1955.


Dr. J. W. McRae

Mike Meyers joined RMS (Radio Merchandise Sales) New York City, as chief field engineer. He will assist distributors and service technicians with antenna problems and help conduct the RMS technical forums now being given throughout the country. Meyers has had wide experience in the field


M. Meyers

SERVICE TECHNICIANS

What was your most unusual service case? Not necessarily the most difficult one, but the one you will remember longest, either because of the problem itself or because of other conditions surrounding the job. If the experience was interesting to you, it probably will be to other readers of RADIO-ELECTRONICS. We will pay $10 for each "My Most Unusual Service Job" item we consider outstanding enough to publish in this magazine. If the item is striking enough or carries sufficient technical information to be worth more than $10 in our opinion, it will be paid for at our regular space rates. Address your stories to

Unusual Service Job
RADIO-ELECTRONICS
25 West Broadway New York 7, N. Y.

of radar installation and television during the past 16 years.

Earl Kirk was promoted to distributor sales manager of the Regency Division of I.D.E.A., Indianapolis, Ind., manufacturer of boosters, converters, and other electronic equipment. He was formerly assistant sales manager. At the same time, Richard W. Mitchell, sales manager, announced that Edward M. Sheridan had joined the company as industrial sales manager. Sheridan was formerly with RCA.


E. Kirk

Personnel Notes

. . . Brigadier General David Sarnoff, Chairman of the Board of the Radio Corporation of America, was named by the U.S. Department of Defense to head the CITIZENS ADVISORY COMMISSION ON MANPOWER UTILIZATION IN THE ARMED SERVICES.

. . . Tom Cox, long associated with the electronics industry in sales and engineering positions, joined NATIONAL UNION RADIO CORP. as district manager for the Renewal Sales Division in the New Jersey and Eastern Pennsylvania territory.

. . . Harris D. Myers and Elmer G. Flood joined the Sound Equipment Division of STROMBERG-CARLSON, Rochester, N. Y., as field engineers. At the same time, A. L. Sebastian and Henry A. McMichael joined the company as sales engineers in the Sound Equipment Division. All have had wide experience in the field.

. . . Charles Maechling, Jr., was appointed government relations officer of the RTMA. He was formerly in the Office of the General Counsel of the Department of the Air Force. The association also named Stanley H. Manson of Stromberg-Carlson as vice-chairman of public relations on the RTMA Public Relations and Advertising Committee. He succeeds James M. Toney, who resigned after being assigned to a new position within RCA.

. . . Dr. Allen B. Du Mont was re-elected president of ALLEN B. DU MONT LABORATORIES. Other officers re-elected were Stanley F. Patten, vice-president; Paul Raibourn, treasurer; Bernard Goodwin, secretary, and Irving Singer, assistant treasurer.

. . . Edward Porter Robinson was promoted to plant manager of the ESPEY MANUFACTURING CO., New York City.

. . . Dr. Francis M. Wiener joined SPENCER-KENNEDY LABORATORIES, Cambridge, Mass., as section head in the Engineering Department. He was formerly with Bell Telephone Laboratories.

. . . Leon Marshall, who formerly operated his own art service, joined INSULINE CORP. OF AMERICA, Long Island City, N. Y., as assistant to Alfred S. Chambers, advertising manager.

. . . **Reinhold W. Schmidt** was promoted to manager of Equipment Engineering and Maintenance of the Cathode-Ray Tube Division of ALLEN B. DU MONT LABORATORIES.

. . . **F. Sumner Hall**, of Audio Equipment Sales Co., was installed as fifth president of the AUDIO ENGINEERING SOCIETY. Other officers include: Jerry B. Minter, Measurements Corp., Executive vice-president; Walter S. Pritchard, Ohio Bell Telephone, Central vice-president; Richard L. Burgess, Allied Record Manufacturing Corp., Western vice-president; C. J. LeBel, Audio Instrument Co., secretary; and Ralph A. Schlegel, WOR Recording Studios, treasurer.

. . . **Dan D. Halpin**, general sales manager of the Receiver Division, Allen B. Du Mont Laboratories, was elected an Honorary Life Member of the RADIO AND TELEVISION EXECUTIVES SOCIETY. He was so honored as a past president of the American Television Society which with the Radio Executives Club merged into the new organization.

. . . **Frank Toler** joined the HALLICRAFTERS Co., as district sales manager with headquarters in Nashville, Tenn. He was formerly with Tempco, Inc.

. . . **Abraham Hyman**, formerly the supervisory electronic engineer for the Civil Aeronautics Administration in New York, joined JFD MANUFACTURING CO., as an electronic consultant.

. . . **Donald N. Kirkpatrick** was appointed chief engineer of the NATIONAL Co., Malden and Melrose, Mass., manufacturer of communication radio receivers, electronic equipment and components. He formerly held a similar position with Boonton Radio Corp.

. . . **Edward A. Malling**, a former sales manager on the staff of the GENERAL ELECTRIC Receiver Department, was appointed manager of marketing for the Components Department.

. . . **R. Gordon Dougherty**, a veteran of the action in Korea, joined I.D.E.A., Indianapolis, as a field representative of the Regency Division. Before entering the service, Dougherty was a sales representative for I.D.E.A.

. . . **Marshall A. Williams** was appointed regional manager of the Government and Industrial Division of PHILCO CORP. with headquarters in the Beverly Hills office. He was formerly with Hughes Aircraft.

. . . **Eugene M. Keys** was elected executive vice-president and director of sales of EDWIN I. GUTHMAN & Co., INC., Chicago. He was also appointed a member of the Board of Directors. Keys was formerly vice-president in charge of sales. END

Radio-Electronics Annual Index

Volume XXIII **Oct. 1951 - Dec. 1952**

END

THE FUND TOPS $10,000

HELP-FREDDIE-WALK FUND

We continue to receive encouraging reports from Herschel Thomason, radio technician of Magnolia, Arkansas, on the progress of his four-year-old son, Freddie, who, as most of our readers know, was born without arms or legs. Freddie's courage and patience seem unending, and his father's latest letter tells us that he "is walking better every day, although he still needs a little help for his forward motion. We feel sure that when his legs are readjusted he will be able to walk over any level surface by himself."

And there, in the word "readjusted," we have the crux of the matter—the main concern of the Help-Freddie-Walk Fund. For not only will Freddie be always dependent upon mechanical devices for the simplest acts that we more fortunate ones take so for granted, but for many, many years these appliances will have to be constantly adjusted and readjusted to meet Freddie's growing needs.

Although the Fund has reached a grand total of over $10,000, many more thousands of dollars will be needed before we can consider our job well-done. We are most appreciative of the enthusiastic response from our readers during the past three years, and ask only that it be continued. At this time we would like to make special mention of a contribution of $2.00 received from the Signal Corps Inspection Office, Hi-Q Division, Aerovox Corp., Olean, New York.

We urge each and every reader to "start the New Year right" by sending in a contribution—large or small—to this worthy cause. *Make all checks, money orders, etc., payable to Herschel Thomason.* Address all letters to

HELP-FREDDIE-WALK FUND
c/o RADIO-ELECTRONICS Magazine
25 West Broadway
New York 7, New York

FAMILY CIRCLE CONTRIBUTIONS

Balance as of October 20, 1952	$ 571.50
FAMILY CIRCLE Contributions as of November 17, 1952	$ 571.50

RADIO-ELECTRONICS CONTRIBUTIONS

Balance as of October 20, 1952	$9,571.47
Anonymous, Cambridge, Mass.	1.00
Arthur Chretien, Methuen, Mass.	1.00
Joseph T. Corrigan, New York, N. Y.	5.00
Vernon C. DeWerff, Morrisonville, Illinois	5.00
Alvin J. Jacobson, Williston, N. Dakota	2.00
Mr. & Mrs. Thos. F. Maloney, Arlington, Virginia	3.00
Clodovaldo Rossetto, Sao Paulo, Brazil	1.00
Signal Corps Inspection Office, Hi-Q Division, Aerovox Corp., Olean, New York	2.00
RADIO-ELECTRONICS Contributions as of November 17, 1952	$9,591.47
FAMILY CIRCLE Contributions	571.50
TOTAL CONTRIBUTIONS as of November 17, 1952	$10,162.97

REMOTE-CONTROL PROBLEM

Dear Editor:

In reply to Mr. Waelder's switching problem in the October issue of RADIO-ELECTRONICS, one solution is to mount chassis type a.c. outlets on the back of the tuner or control amplifier, and add an extra deck to the input-selector switch to feed 117-volt a.c. to each unit in the corresponding switch position. The extra deck should be well separated or shielded from the audio-input deck to minimize 60-cycle hum pickup. (The switch contacts must be heavy enough to carry the required a.c. loads.—*Editor*)

I have used this system for a year and a half in a home-built radio-phono combination and it has given good results.

LEON CARTER

North Charleston, S. C.

(Mr. Waelder asked for suggestions on automatically turning on and off a.c. power to various units (such as a phono turntable and preamplifier, separate AM and FM tuners, or a tape recorder), from an audio-control unit that has only a signal-input selector switch.—*Editor*)

ELECTRICAL FUNDAMENTALS OF COMMUNICATION, Second Edition, by Arthur L. Albert. Published by McGraw-Hill Book Co., 330 W. 42nd St., New York 36, N. Y. 6 x 9 inches, 531 pages. Price $7.00.

This is a beginner's book in communication. It is clearly written and well illustrated. Interest is maintained by many numerical examples worked out in detail. Chapter summaries, review questions, and problems are provided at the end of each chapter.

The book starts with elementary principles of d.c. and a.c. Resistive, inductive, and capacitive circuits are analyzed and solved numerically. One chapter deals with measuring instruments of the d.c. and a.c. type.

More advanced material appears in the last half of the book. Impedance relationships, network theorems, transmission lines, and propagation are among the subjects discussed. One chapter is devoted to vectors and how to use them. This subject often proves difficult to nonmathematical readers, but it is clearly described here. Filter networks and bridge circuits are briefly covered.

The last few chapters discuss tube and crystal circuits, including oscil-

Radio School Directory

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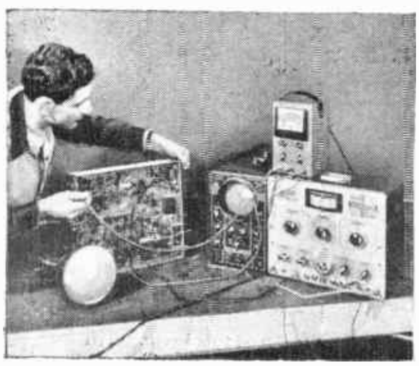

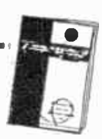

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ADVERTISING INDEX

RADIO SCHOOL DIRECTORY PAGE 177

Electronics Institute, Inc. — RCA Institutes
Indiana Technical College — Tri-State College
Martin School, Don — Valparaiso Tech. Inst.
Milwaukee School of Eng. — Western Television Inst.
YMCA Trade & Technical School

Radio-Electronics does not assume responsibility for any errors appearing in above Index.

lower frequencies. Then it proceeds with u.h.f. techniques and illustrates equipment.

One important chapter deals with transmission lines and how they are used as tuning elements, filters, and transformers. Waveguides are shown to be developed from lines. Other chapters deal with u.h.f. circuits and tubes. Butterfly circuits, travelling wave tubes, and others are included. An interesting chapter describes and illustrates several types of TV converters. Transmitters, test equipment, and h.f. measurements are also described in the book.—*IQ*

FUNDAMENTALS OF ENGINEERING ELECTRONICS, Second Edition, by William G. Dow. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. 5¾ x 9 inches, 627 pages. Price $8.50.

This book concentrates on tubes and semiconductors, rather than circuits. The level is suitable for college junior students. It is also well arranged for reference use. Physical explanations, and many illustrations and mathematical analyses are provided.

The first chapters establish basic principles of potential distribution, electron ballistics, and cathode rays. Then material is presented on fields within a tube, capacitance effects, tube characteristics, and thermionic cathodes. An important chapter describes electrons in metals and semiconductors to provide a good understanding of transistors, rectifiers, and photosensitive devices. There are also chapters on amplifiers, oscillators, and microwave tube types.

The remainder of the volume explains phenomena within gas tubes and photosensitive devices. Arcs, glow tubes, and gas rectifiers are illustrated and described in the final chapters.—*IQ*

ELECTROMAGNETICS by Robert M. Whitner, published by Prentice-Hall, Inc., New York, N. Y. 5½ x 8¼ inches, 270 pages. Price $6.65.

This is a book for engineering students. It emphasizes field theory and prepares the reader for a good understanding of fields and waves. A knowledge of calculus is required. It introduces the reader to vectors, after which this type of analysis is used freely. The mathematical treatment is effective and clear.

The first chapter describes charge, field and potential. Then electrostatics, d.c., magnetics, and a.c., are discussed in turn. The author shows the meaning and application of gradient, divergence, curl, and other concepts. Later chapters derive Maxwell's equations and other important laws. Advanced topics relating to fields and waves are covered in the final chapters.

Each chapter ends with a series of problems.—*IQ*

END

TV CONSULTANT, by Harry G. Cisin, was reviewed in the November issue under the erroneous title: "Rapid Trouble Shooting and Alignment." Our apologies to Mr. Cisin for the error.

SOLDERING IRON GUN

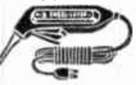

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Image-Converter Tube HiSensitivity simplified design 2" dia. Willemite screen—Resolution up to 350 line in. Complete data & tube, ea.........$4.98; 2 for $9.49

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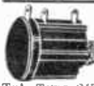

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800 Ohm, 10 Turn, 0.1% Tol. Type 800A1.$8.98
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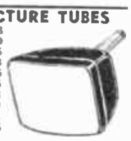

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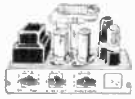

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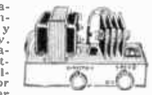

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Full-Wave Selen Rect & Trans. in Kit Form. All 115V/60 cy inputs
up to 14VDC at 12 amps.........$18.98
up to 28VDC at 12 amps......... 28.98
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DPST BKLT CSD 15A/125V.89¢; 3 for $2.50
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DPST BKLT CSD 20A/250V ....$1.25; 3 for $3.25
DPDT AHH-Laminated....69¢; 3 for $1.90

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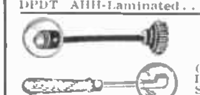

(Top) Ideal NO-LOSS Alignment Screwdriver—long Insulated Shaft. Sure Grip Knurled Knob.
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(Bottom) RELAY Spring Adjuster & Switch Bd Tool Slot takes up to .022".
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Precision feeler gauge TL147. Ideal for telephone & relay work, adj. Spark gaps. Removable gauges ....98¢; 6 for $5.00

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2.5V/2A .2 for 1.49; 7.5Vct/12A
24V/6a csd .. 4.98; 15Kvins 10.98
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770VCT/85MA, 5V/2A, 6.3V/3.5A.. 3.98
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700vCT/120MA. 2x6.3V/3A, 6.3V/1A..............$3.98; 2 for $7.25
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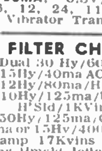

Dual 30 Hy/60ma Csd ...$ .98
15Hy/40ma AC/DC sets 3 for .98
12Hy/80ma/H'Sld/3KVins 2.25
10Hy/125ma/UTC/Csd/H'Sld/1KVins 1.69
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13.5Hy 1 amp 17Kvins Raytheon.. 39.95
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50 Draw Hvy Steel 34½"H/18"W/9"L/65 lbs Draws 3"W/2½"H/8"L.........$40.00
100 Draws as above 135 lbs $65.00
27 Draw Hvy Steel 37"H/30¾"W/14¼"L/120 lbs. Draws 3"H/9"W/12"L ..$39.95

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0A2	.95	6BQ7	2.15	12BH7	1.29	CK538DX	.98
0A3/VR75	1.04	6BY5G	1.45	12BY7	1.35	CK539DX	2.19
0B2	1.37	6CB6	.69	12BZ7	1.25	CK541DX	[illegible]
0B3/VR90	1.09	6CD6G	1.69	12SA7GT	.69	CK542DX	.99
0C3/VR105	1.15	6D4	2.70	12SC7	.80	CK543DX	[illegible]
0D3/VR150	.90	6J4	6.66	12SF5GT	.72	CK544DX	.99
1B3/8016	.81	6J5GT	.47	12SF7GT	.49	CK546DX	[illegible]
5R4GY	1.60	6J6	.63	12SG7	.83	CK547DX	1.98
5R4GYW	1.75	6K4A	6.45	12SH7	.63	CK571AX	2.49
5U4G	.69	6L6	2.09	12SJ7GT	.59	CK573AX	3.49
6AG5	.79	6L6G	1.35	12SK7	.72	CK1005	.85
6AG7	1.39	6L6GA	1.35	12SL7GT	.65	CK1027	[illegible]
6AH5G	1.49	6L6GAY	2.29	12SN7GT	.75	CK1028	[illegible]
6AH6	1.22	6SA7GT	.63	12SQ7GT	.63	CK1089	[illegible]
6AJ5	1.40	6SA7GTY	3.37	19T8	1.09	CK1090	2.98
6AK5	.74	6SB7Y	1.19	19V8	1.62	CK5672	1.29
6AK5W	2.98	6SC7	.90	25BQ6GT	1.19	CK5676	1.29
6AK6	1.05	6SD7GT	.80	25L6GT	.69	CK5678	1.89
6AL5	.54	6SF5	.77	25Z5	.79	5687	5.49
6AL7GT	1.29	6SF7	.73	25Z6GT	.99	CK5702	3.49
6AN5	2.90	6SG7	.72	28D7	1.95	CK5703	1.29
6AQ5	.55	6SH7	.61	35Z5GT	.59	Xtal Diodes	
6AQ5W	3.98	6SJ7	.70	50L6GT	.69	1N21A	1.55
6AQ6	.81	6SK7GT	.69	80	.69	1N21B	3.00
6AQ7GT	1.29	6SL7GT	.69	81	1.69	1N21C	21.50
6AR6	2.98	6SN7GT	.70	82	1.19	1N22	1.25
6AS5	.79	6SN7WGT	2.25	82V	1.39	1N23	1.35
6AS6	2.43	6SQ7GT	.63	83	1.45	1N23A	2.35
6AS7G	4.14	6SR7	.65	83V	1.79	1N23B	3.49
6AT6	.63	6SS7	.75	84/6Z4	.99	1N25	4.98
6AU5GT	1.10	6ST7	.98	117L M7GT	[illegible]	1N26	8.75
6AU6	.59	6SU7GTY	2.69	117N7GT	1.79	1N27	1.55
6AV5GT	1.29	6V6	1.39	117P7GT	1.79	1N29	3.50
6AV6	.49	6V6GT	.57	117Z6GT	1.19	1N32	23.75
6AW6	1.89	6W4GT	.57	117Z7GT	1.49	1N34	.64
6B4G	1.23	12AH7GT	1.45	CK501X	1.26	1N34A	.90
6BA6	.63	12AK5	1.98	CK501AX	2.20	1N35	1.65
6BA7	1.27	12AK5W	[illegible]	GL502A	1.79	1N38	1.43
6BC5	.63	12AL5	.75	CK502AX	1.49	1N39	4.15
6BC7	1.23	12AT6	.52	CK503AX	1.49	1N44	1.21
6BD5GT	1.65	12AT7	.81	CK505AX	1.79	1N45	1.39
6BD6	.83	12AU6	.72	CK506AX	1.49	1N47	5.49
6BE6	.59	12AU7	.63	CK509AX	[illegible]	1N48	.59
6BF5	.98	12AV6	.49	CK512AX	1.45	1N51	.45
6BF6	.65	12AV7	.98	CK522AX	1.29	1N52	1.62
6BF7	2.55	12AW6	1.79	CK525AX	1.29	1N54	.89
6BG6G	1.39	12AX4GT	1.20	CK526AX	1.49	1N56	.89
6BG7	1.98	12AX7	.79	CK528AX	1.49	1N57	.89
6BH6	.63	12AY7	2.95	CK529AX	1.79	1N58	1.19
6BJ6	.69	12AZ7	1.49	CK531DX	1.89	1N60	.60
6BK7	2.15	12BA6	[illegible]	CK532DX	1.89	1N61	2.10
6BL7GT	1.45	12BA7	.79	CK533AX	1.29	1N63/K63	2.49
6BN6	1.49	12BD6	1.23	CK534AX	.99	1N64	.69
6BN7	1.69	12BE6	.59	CK536AX	.99	1N67	1.95
6BQ6GT	1.20	12BF6	.85	CK537AX	3.04	1N69	1.98

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