7th ANNUAL TELEVISION NUMBER

JANUARY 1954

RADIO-ELECTRONICS

TELEVISION · SERVICING · HIGH FIDELITY

HUGO GERNSBACK, Editor

The screen of a color TV receiver showing a Faye Emerson broadcast

50¢
U. S. and CANADA

Decide on DuMont

on the basis of...

Product Superiority

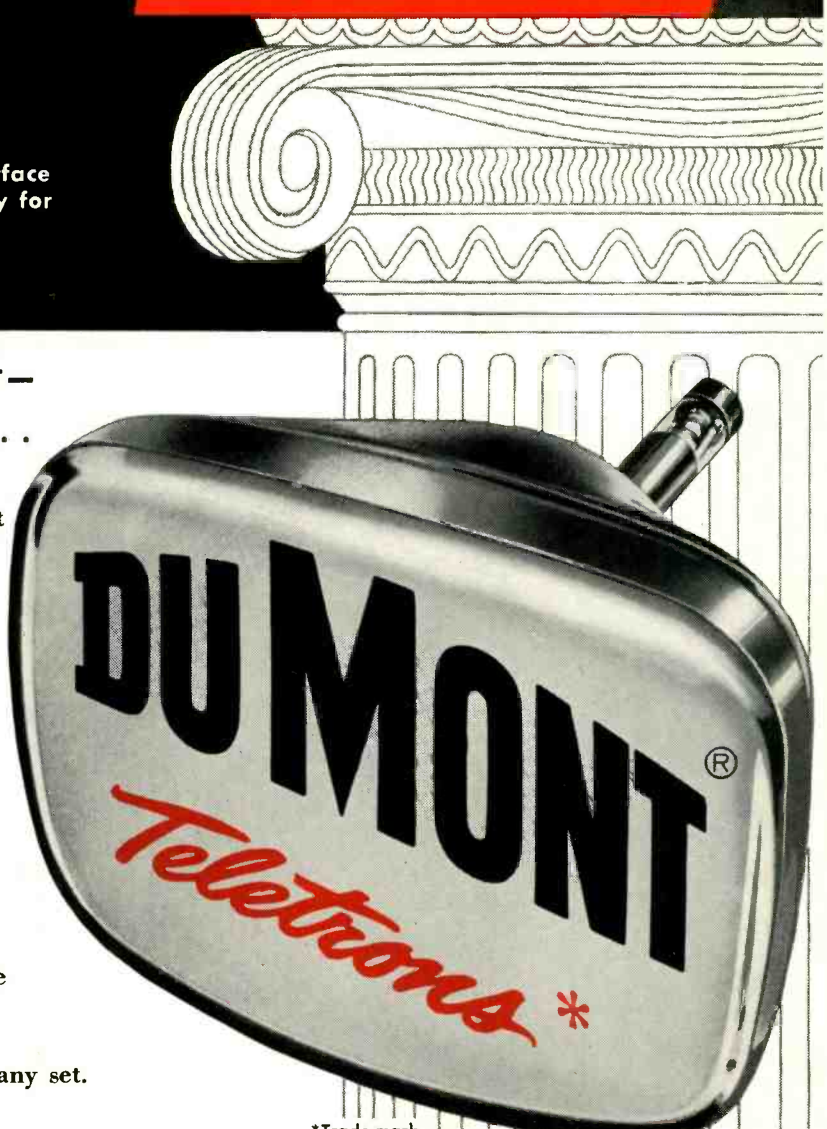
Microscopic look at the cathode surface reveals soft, even texture, necessary for efficient tube performance

not too wet, not too dry—
not too light or heavy...

THE CATHODE plays an important role as source of electron energy in the picture tube. Moisture content and texture of the cathode coating must meet rigid standards to insure maximum picture tube life.

At Du Mont, exclusive processes are used for applying the cathode substance. The soft even texture achieved (see illustration) packs the effective emitting area (in circle) with extra electron power.

The resulting brighter performance over maximum tube life tells you why Du Mont is the right replacement for any set.



*Trade-mark

REPLACEMENT SALES, CATHODE-RAY TUBE DIVISION • ALLEN B. DU MONT LABORATORIES, INC., CLIFTON, N.J.

RADIO-ELECTRONICS

Formerly RADIO-CRAFT • Incorporating SHORT WAVE CRAFT • TELEVISION NEWS • RADIO & TELEVISION*

ON THE COVER:
Unique study of Faye Emerson, as photographed directly in color from the screen of an RCA color-mask TV tube. It was taken during one of the first of the recent experimental transmissions with NTSC compatible standards.

Color original courtesy NBC.

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JANUARY, 1954

7th ANNUAL TV ISSUE

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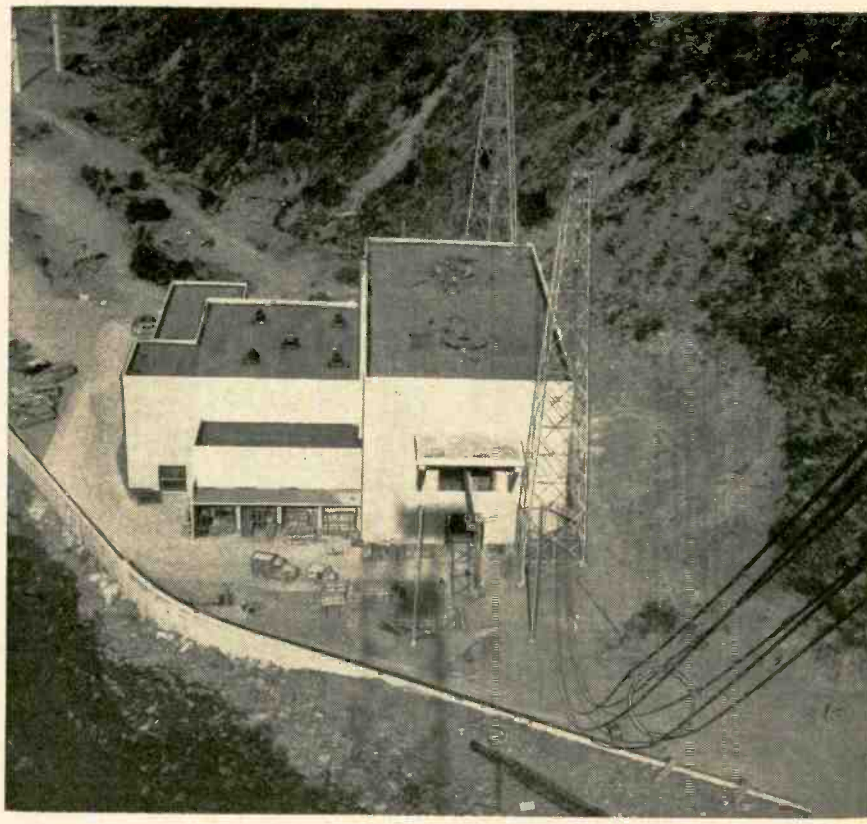


Courtesy U.S. Navy

The Jim Creek Valley installation as seen from one of the 200-foot towers above.

BIGGEST TRANSMITTER in the world went into operation at Jim Creek Valley, Washington on November 17. Constructed for the U.S. Navy by RCA, it has a power of 1,200,000 watts (1200 kw). With it, the Navy can communicate instantly with any of its units at any point on the globe using c.w. on any frequency from 14.5 to 35 kc.

The transmitter itself is composed of two identical units operated in parallel. Either can be used independently if the other should be put out of service.

The antenna—stated to be the largest ever erected—is strung between twelve 200-foot towers erected along the crests of two 3,000-foot mountains which enclose the valley on the north and south. The ten antenna spans zig-zag back and forth between the towers, covering an area of 435 acres with active radiating elements. Because the mountain crests are not exactly parallel, the spans vary in length from 5,640 to 8,700 feet. Like the transmitter, the antenna is divided in two, either half of which could be used independently.

DR. HERBERT EUGENE IVES, TV pioneer, whose research resulted in the first American public demonstration of television in 1927, and who also developed three-dimensional pictures, died on November 13. He was 71 years old.

At the end of World War I, Dr. Ives joined the technical staff of Bell Telephone Laboratories. His first work was in the field of photoelectric cells and their applications to the communication industry. He was in charge of the general development of picture transmission over telephone lines which was first used in 1924.

Dr. Herbert Eugene Ives

Following this, Dr. Ives had charge of the investigation of television which resulted in the first demonstration in April, 1927. Two months later television images in color were demonstrated, using three transmission lines, one for each primary color. He remained a member of the technical and research staff at Bell Telephone Laboratories until his retirement in 1947.

COLOR TV PICTURE TUBES will soon represent the entire picture tube production of Crosley's Batavia, Ill., tube plant. Crosley has announced they will discontinue the production of black-and-white picture tubes at that plant by February.

Production of the Lawrence tube, called the Chromatron, has been started at the plant in very small quantities, and is expected to reach 100 color tubes a day by February. From then on, Crosley will buy all its black-and-white picture tubes from other tube makers.

It was way back in 1945 that Raytheon, the first tube manufacturer to recognize the Service Dealers' need for help in combating public mistrust, provided that help through the *Raytheon Bonded Electronic Technician Program.* For the past nine years this Raytheon support has helped many thousands of Service Dealers gain customer confidence and good will — substantially increase their volume and profit.

Today, with the addition of television, the Raytheon Bond is more important than ever. And today, as always, if you can qualify for it, your status as a Raytheon Bonded Electronic Technician *costs you not one cent.* It is *Raytheon's* investment in *your* future.

If you're interested in making more money, ask your Raytheon Tube Distributor to tell you about the Raytheon Bonded Program. He'll be pleased to tell you how this powerful sales stimulator can help you.

RAYTHEON

RAYTHEON MANUFACTURING COMPANY

Receiving Tube Division

Newton, Mass., Chicago, Ill., Atlanta, Ga., Los Angeles, Cal.

Excellence in Electronics

RAYTHEON MAKES ALL THESE:

RECEIVING AND PICTURE TUBES • RELIABLE SUBMINIATURE AND MINIATURE TUBES • GERMANIUM DIODES AND TRANSISTORS • NUCLEONIC TUBES • MICROWAVE TUBES


TRIO proudly announces
The New ZIG-ZAG
"TWIN-SIX"
(A significant addition to the Zig-Zag line)

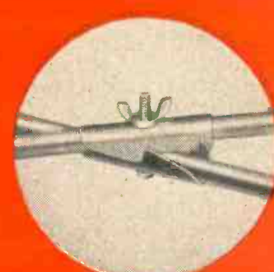
... the greatest advance ever made in ALL-CHANNEL antenna design!

Not content to bring out just another all-channel antenna, TRIO studied and tested every other model available. Months of research produced the "Twin-Six", a Zig-Zag that provides all of the desirable features indicated above. Quantitative ratings for antennas are practically meaningless because of some exaggerated claims. For this reason, the "Twin-Six" is announced without the usual gain charts. The new "Twin-Six", however, equals and, in most cases, greatly exceeds the gains of these antennas on *every* channel. For instance, the "Twin-Six" showed a 2 to 6 db higher gain than a competitive antenna which is advertised as having a 12 db gain.

MINUTE-UP ASSEMBLY

There's no antenna easier to assemble. Shipped with all hardware mounted on the boom. Complete assembly consists of matching elements to color coded insulators and snapping on spring clips. Improper assembly impossible.

Insulators come mounted on boom and are so designed that "shorting-out" is impossible. Antenna elements mounted merely by snapping on the spring clips.



Pre-assembled high channel elements are swung into position and quickly locked by mating brackets.

Team the new Zig-Zag "Twin-Six" with the dependable TRIO rotator for the maximum in TV enjoyment!

NEW ZIG-ZAG "TWIN-SIX" OFFERS:

Measurable Higher Gain On All VHF Channels Than Any Other Single Bay All-Channel Antenna

PLUS

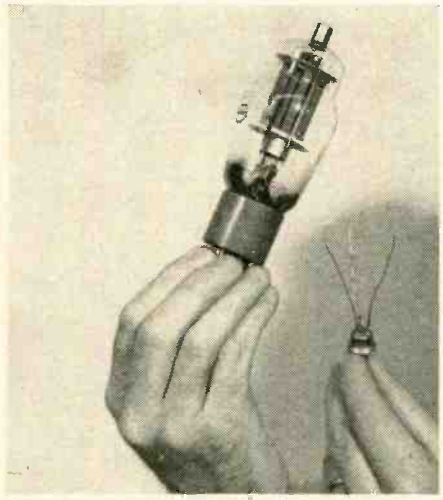
1. One Horizontal Bay Does It All!
2. Single Lead-In Operation!
3. Easy-Up, One Minute Assembly!
4. Rugged Construction Throughout — No Droop, No Sag! Light Weight — Attractive Appearance!
5. UHF Reception For All Primary Areas!
6. Low Standing Wave Ratio!
7. Built and Backed by TRIO — A Name You Can Trust!
8. Competitively Priced!

TRIO

MANUFACTURING CO., GRIGGSVILLE, ILL.

THIMBLE SIZE TRANSISTOR 100 times as powerful as present commercially available types has been developed by the Minneapolis Honeywell Regulator Co.

Dr. Finn J. Larsen, research director, said the new power unit, which has an output of 20 watts, would do work not possible with the low-output types, and should greatly expand the range of transistor uses.



Thimble-size power-type transistor.

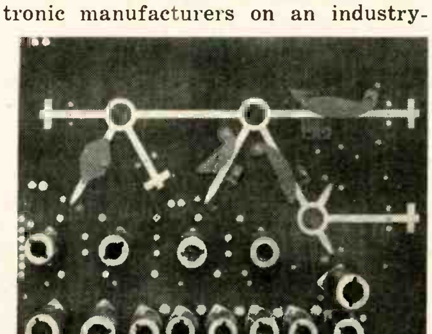
A prototype aircraft electronic fuel gauge making use of the new transistor has already been built by the company, though the transistor is not yet in commercial production, being built on a pilot-line basis.

The new transistor's power output of 20 watts contrasts with that of 20 hundredths of a watt for present commercial types. This greater power enables it to do things heretofore impossible with transistors, such as the operation of motors, valves, relays and other equipment.

Dr. Larsen said the inability of transistors to handle sizable amounts of current has been a major drawback, and one that many researchers in the electronic industry have been trying to overcome. The big stumbling block has been the problem of heat.

The key to Honeywell's development of a power-type unit was the discovery of an effective means of removing heat from the germanium-alloy junction.

MICROWAVE WIRING method that may revolutionize the production of television links and aircraft radar devices will be made available to electronic manufacturers on an industry-wide basis.



Microstrip receiver weighs 5 pounds.

The technique, called *Microstrip*, was developed by Federal Telecommunication Laboratories, Nutley, N. J., a division of IT&T, and is being offered to prospective users under a special licensing agreement.

As described in RADIO-ELECTRONICS, May, 1952, the equipment differs radically in design from conventional microwave circuitry. In conventional circuits, radio waves travel inside a highly polished tube, while in their Microstrip equivalent they are carried by metal strips etched on a thin sheet of metal. With the new device, costly wave guides may virtually be eliminated.

The Microstrip components can be produced directly from diagrams by etching the circuits on a dielectrically coated base plate, as in photo engraving, or by the use of stamping and embossing techniques. The units resemble oversized calling cards, and can be turned out almost as rapidly as sheets from a printing press. They can be produced at a fraction of the cost of their conventional counterparts.

TV INTERFERENCE was the subject of a stern warning delivered by FCC Commissioner Sterling to TV, radio, and broadcast equipment makers. The occasion for this warning was the Fall meeting of the combined RETMA, RTMA of Canada and IRE in Toronto.

Commissioner Sterling stressed that the industry must do much more about reducing radiation from TV receivers and transmitters which interfere with reception on government, aircraft, amateur and TV-radio bands.

Sterling said that the FCC received 22,264 interference complaints in fiscal 1953. More than 12,600 resulted from spurious responses of broadcast receivers—6,000 from TV sets. Some 9,600 were the result of spurious radiations from transmitters.

At one point, the commissioner departed from his prepared text, reminding manufacturer's of FCC's new power to issue "cease and desist" orders, which in some cases could have the effect of putting an offending company out of business.

The Commission has been making extensive field measurements in Portland, Oregon, site of the first commercial u.h.f. station, on radiation from u.h.f. TV receivers and converters. The results gave great cause for concern. In the instance of strips and separate converters, excessive radiation was observed in the region between 200 and 500 mc. The radiation from u.h.f. oscillators was in the order of thousands of microvolts per meter, and in one instance a field of 10,000 microvolts-per-meter was obtained at 100 feet from a set of one of our major manufacturers.

In reply, Crosley's Lewis M. Clement, chairman of RETMA engineering department's executive council reported that the vast majority of manufacturers have now reduced spurious v.h.f. oscillator radiation below RETMA's "interim" maximums (50 microvolts-per-meter at 100 feet for channels 2-6 and 150 microvolts-per-meter for 7-13). END

NEW *Certified* Quality Service Business Builders

SIGNS...POSTALS ...AD MATS

GET THIS CATALOG

TIE IN even stronger with your *Certified* Quality Service campaign in LIFE and POST. Tell your customer again and again. *You* offer him the quality service and fair charges that spell C...Q...S. Win his confidence and you win his business. Along with your CQS tags and displays, use your new CQS illuminated indoor sign . . . flange sign . . . postals . . . and ad mats. You'll be proud of them. They are modern, dignified, economical . . . and their CQS message sells *hard*. See them at your CBS-Hytron distributor's. Or write for CQS-10 catalog. But act now!

NEED MORE CQS TAGS?

With your 3-line imprint, they are priced low: 250 for $2.25, 500 for $3.50, 1000 for $6.00. Order from your distributor . . . or direct.

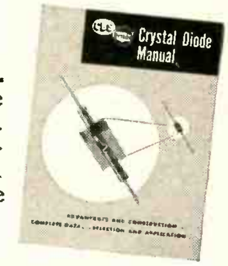
CQS-10 Catalog also features 3 direct-mail postals . . . 9 ad mats.

60-DAY OFFER! 10 SOCKET LOCATORS with 20 miniature tubes

During January and February. Order 20 CBS-Hytron miniature tubes. Your distributor will *give* you this package of 10 new CBS-Hytron Socket Locators. With them, plugging miniatures into hard-to-locate sockets is easy. Socket Locator slips over pins of tube (7-pin or 9-pin). Key of Locator finds socket . . . guides tube into it, quickly. Save time and temper . . . take advantage of this limited offer. See your CBS-Hytron distributor.

NEW...FREE CBS-HYTRON CRYSTAL DIODE MANUAL

Complete, down-to-earth, 8-page manual on crystal diodes. Three parts: 1. Advantages and construction. 2. Complete data, 38 types. 3. Selection and application. Profusely illustrated. Ten basic circuits. Gives you *all* the crystal-diode information you have been seeking. FREE . . . from your CBS-Hytron distributor . . . or write direct.



CBS HYTRON

Manufacturers of Receiving Tubes Since 1921

CBS-HYTRON Main Office: Danvers, Massachusetts

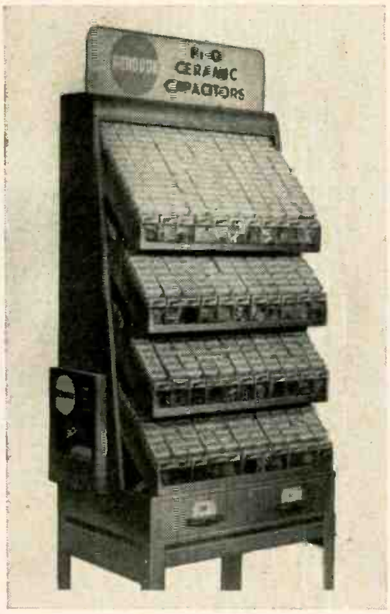
A Division of Columbia Broadcasting System, Inc.

A member of the CBS family . . . CBS Radio • CBS Television
Columbia Records, Inc. • CBS Laboratories • CBS-Columbia • and CBS-Hytron

RECEIVING . . . TRANSMITTING . . . SPECIAL-PURPOSE AND TV PICTURE TUBES • GERMANIUM DIODES AND TRANSISTORS

Merchandising and Promotion

Aerovox Corporation, New Bedford, Mass. designed a new *Ceramic Center*



display and dispenser cabinet which holds 700 window cartons of the company's ceramic capacitors.

Raytheon Manufacturing Co., Waltham, Mass., in co-operation with its

Boston area distributors, held a lecture for service technicians in Boston. Bill Ashby, staff lecturer of Raytheon, outlined the company's new *Service Saver* plan which tells the service technician how to save time on service calls and how to build good will and extra business with his customers.

Finney Co., Cleveland antenna manufacturer, set up an exhibition of its

antennas in a Fort Wayne, Ind. department store in conjunction with the opening of WKJG-TV, new Fort Wayne TV station. The company followed up with an advertising campaign over the new station.

Alliance Manufacturing Co., Alliance, O., reported considerable success with the fall advertising campaign on its Tenna-Rotor and other TV accessories, according to John Bentia, Alliance vice-president. An independent survey reported that the company ranked 16th among national TV spot advertisers. Mr. Bentia also announced that the company's tie-in promotion with the Milwaukee Braves on the Alliance u.h.f. converter last fall in the Milwaukee area was highly successful.

Simpson Electric Co., Chicago, recently sponsored a series of lectures for service technicians in Northwestern cities. Lloyd Austin, assistant chief engineer for Simpson, demonstrated the use of Simpson equipment in TV alignment.

Javex, Redlands, Calif., designed a new plastic promotional package for

distributors who carry its line of wall plates and other products.

Cornell-Dubilier, South Plainfield, N. J., developed a new compartment type, plastic, hinged-cover case for an assortment of 76 of its most popular *Cub* capacitors.

Ram Electronics, Irvington-on-Hudson, N. Y., held another in its series of forums for service technicians in the St. Louis area under the joint sponsorship of its distributors in that territory.

Jensen Industries, Chicago, issued a new pocket-size booklet for service technicians telling how they can add $240 a year to their income by selling just one Jensen needle per day.

Production and Sales

RETMA reported the sale of 7,522,862 cathode-ray tubes and 347,152,450 receiving tubes for the first 9 months of 1953. This compares with 3,908,745 cathode-ray tubes and 245,689,629 receiving tubes for the 1952 period. RETMA announced that 5,524,370 TV sets and 10,149,163 radios had been produced in the first 9 months of 1953. This compares with 3,670,590 TV sets and 7,528,412 radios produced in the 1952 period. The association also noted that 4,300,360 TV receivers and 4,526,186 radios (excluding car radios) were sold at retail during the first 9 months of 1953.

Shows and Conferences

The Second International Sight and Sound Exposition will be held in the Palmer House, Chicago, September 30 through October 2, 1954, a month later than the 1953 show. The show management announced there would be a 75% increase in display space.

The 1954 Audio Fair—Los Angeles, sponsored by the Los Angeles section of the Audio Engineering Society, has been scheduled for February 4-6 in the Alexandria Hotel.

New Plants and Expansions

Sylvania Electric Products broke ground on a new 20-acre site in Fullerton, Calif., for a new TV picture-tube factory. The company is also nearing completion on a 200,000-square-foot extension to its TV picture-tube plant in Seneca Falls, N. Y. It will be used for the manufacture of large picture tubes and for pilot production of color tubes.

Allen B. Du Mont Laboratories moved the Teletron Service Department of its Cathode-Ray Tube Division to new and larger quarters at 760 Bloomfield Ave., Clifton, N. J.

Waldom Electronics broke ground for the construction of a modern new plant in Chicago. The new plant is expected to double the company's production capacity for its electronic components and *Croname* products.

Business Briefs

. . . **RCA** announced that it will begin deliveries of its compatible color TV broadcast equipment before the beginning of 1954.

. . . **Channel Master Corp.,** Ellenville, N. Y. is sponsoring an educational program for its employees under which they may study any course related to their jobs at any school in the country. Channel Master will foot the bill for tuition, books, and any necessary laboratory fees.

. . . **JFD Manufacturing Co.,** Brooklyn, N. Y., protected the design and construction of its lightning arresters which have sawtooth contact washers with U. S. patents.

. . . **The Gaslight Club,** a private club in Chicago, was opened by the *Secret 16,* a group of prominent men in the electronics industry headed by Burton Browne, owner of the Chicago advertising agency bearing his name.

. . . **United Catalog Publishers, Inc.,** New York City, introduced its File-O-Matic perpetual counter catalog service for distributors.

. . . **NEDA** announced more definite plans for its series of regional educational conferences for distributors, at a committee meeting in Pittsburgh. The first meeting will be held in New York City, in the Hotel New Yorker, on either February 8th or March 1st.

. . . **Sarkes Tarzian Rectifier Div.,** Bloomington, Ind., recently conducted a survey among consumers (predominantly women) in an effort to determine their reaction to color TV. According to George Eannarino, director of the Rectifier Division, $500 was the

price set as the limit most of those questioned would pay. However, an overwhelming majority would be satisfied to wait two years if the price could be brought down to $300.

. . . **The General Electric Tube Dept.**, Schenectady, N. Y., has launched a new program of controlled field testing of its TV receiving tubes, according to John T. Thompson, manager of replacement tube sales for the Tube Department. The program is being conducted by Howard W. Sams & Co., Indianapolis, Ind.

. . . **Superex Electronics Corp.**, Yonkers, N. Y., is now operating Rayburne Corp. and will market the combined lines of electronic components and equipment under the Superex name. Superex is headed by engineers Daniel Schulman and Marvin Buchalter.

. . . **The Finney Company**, 4612 St. Clair Avenue, Cleveland 3, Ohio, manufacturers of the FINCO 400-A fringe area antenna, have obtained a court judgment for damages and a permanent injunction against a Canton, Ohio service company that had been selling an antenna much inferior to the FINCO as a genuine FINCO antenna.

The following quotation is reproduced from a decision of the Court of Common Pleas, Stark County, Ohio, November 6, 1953: "Being fully advised in the premises and by agreement of the parties hereto, the Court finds that the defendant has engaged in unfair competition, as in said petition complained of, by passing off unto its customers, as "FINCO" antenna, other antennas of similar appearance which were not genuine "FINCO" antennas and which were not products of the plaintiff, and that plaintiff is entitled to an award of damages and a final and permanent order restraining defendant from further unfair competition with the plaintiff."

Within a week after the decision was rendered, The Finney Company ran a large ad in the Canton newspaper reproducing a paragraph from the court decision and warning the Canton public against the possibility of being victimized in the future by the few and isolated service companies who engage in unscrupulous substitution practices.

. . . **1954 Electronic Parts Show** manager, Kenneth C. Prince, announced that contracts for more than one half the Exhibition Hall space at the Conrad Hilton Hotel for the May show had been received within ten days of the original mailing. Drawings for space were held in New York City, December 9th.

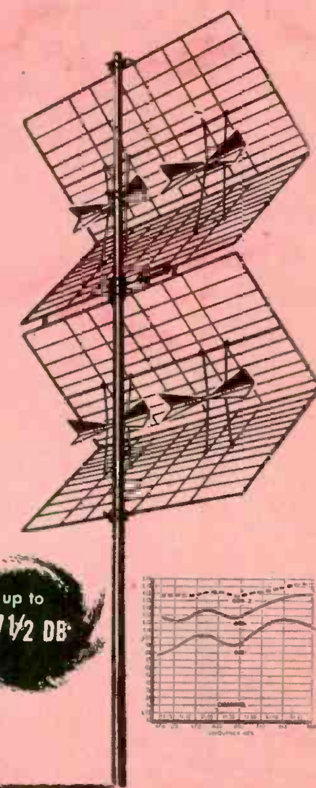
. . . **National Union Radio Corp.**, Hatboro, Pa., has begun pilot production on RCA color tubes and it announced plans to begin similar production on the CBS color tube as well, at a later date.

. . . **The 1954 Western Electronic Show and Convention** to be held in Los Angeles will have Mal Mobley, Jr. as business manager. Heckert Parker, business manager of the 1953 show, will act as management consultant. END

3 great, new **UHF** antennas

by *CHANNEL MASTER*

STACKED TWIN CORNER REFLECTOR model no. 406-2



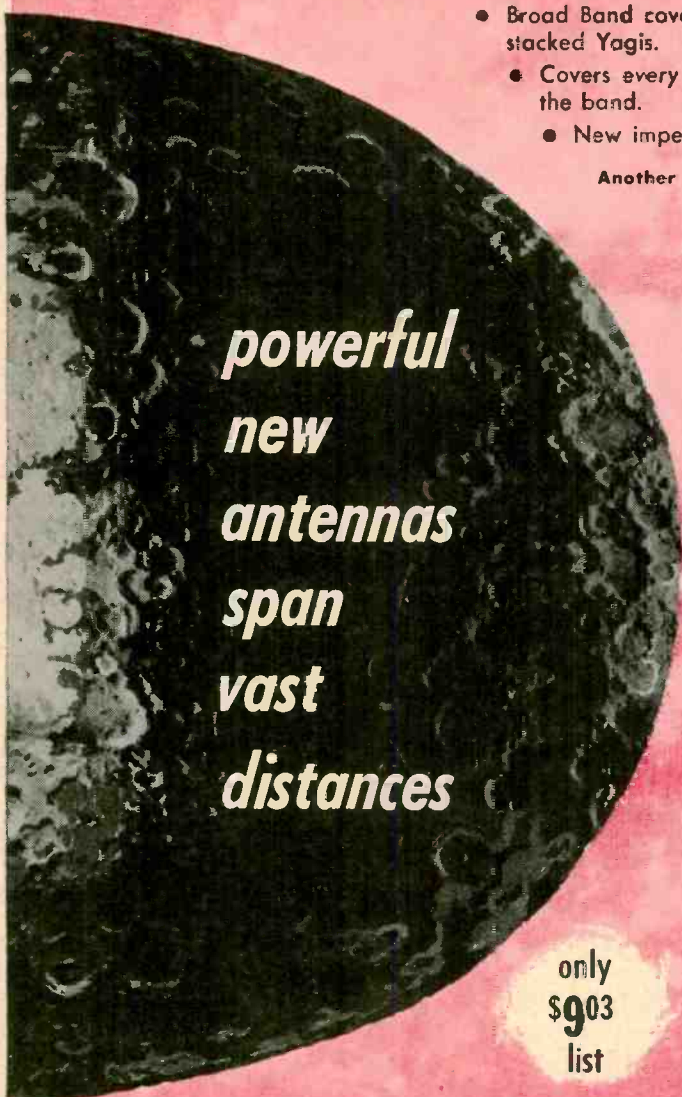
The most powerful UHF fringe area installation you can make today!

- Broad Band coverage — yet out-performs most stacked Yagis.
- Covers every UHF channel, *not* just segments of the band.
- New impedance-matching, two-stage stacking system.

Another original Channel Master development!

Model No.	Description	List Price
406	Twin Corner Reflector	$18.06
406-2	2-Bay Twin Corner Reflector. Stacking harness furnished free.	36.10
406-3	Stacking harness only, furnished separately.	2.08

up to 17½ DB



only $9.03 list

the first UHF CORNER REFLECTOR

with optional "2-way" mounting!

mounts this way . . . or this way

model no. 409

Only CHANNEL MASTER'S CORNER REFLECTOR can be adapted to any kind of UHF installation — with or without VHF — at no extra cost. Every antenna contains all necessary hardware and braces for BOTH popular types of mounting. Sharp directivity and unusually high gain across entire UHF band.

Installs instantly! Original Channel Master assembly feature. Screen swings open like a book — dipole assembly snaps into place.

"SWEET 16" The World's First 16-Element UHF Yagi!

- Custom-designed for your particular area.
- Super-power! Sensational fringe area reception.
- Delta-Weld design. Elements WELDED to crossarm. Delta-matched dipole gives uniform impedance.
- Wide band coverage, up to 21 channels.
- Average gain: 13 DB single
  16 DB stacked

model no. 420

$8.20 list

Send for complete technical literature.

CHANNEL MASTER CORP.
ELLENVILLE, N. Y.

You can't do without...

SYLVANIA'S SEE-WELL TOOL KIT

A NEW, TIME-SAVING TOOL-SENSATION!

YOUR 3 MOST NEEDED TOOLS IN 1 KIT–MAGNETIC PHILIPS AND FLATHEAD SCREWDRIVERS, NYLON ALIGNMENT TOOL–**PLUS** POWERFUL FLASHLIGHT!

This $7.95 VALUE for only 15 Sylvania Premium Tokens.

NO MORE FUMBLING inside dark radio and TV cabinets. At the flick of a switch, a bright light automatically focuses right at the spot you're seeking. Saves your time . . . improves your work.

3 Handy Tools in 1. Magnetized Phillips and Flathead screwdrivers, nylon alignment tool – all 3 built into break-resistant lucite shafts perfectly fitted to flashlight handle.

Without doubt, this SEE-WELL Tool Kit is one of the slickest, quickest service tools ever built!

See your Sylvania Distributor Today! He has this remarkable tool kit for you now – you need only 15 Sylvania Premium Tokens. The time to get this valuable Sylvania See-Well Tool Kit is NOW – so don't delay, order high quality Sylvania tubes TODAY.

Remember, you get 1 token with every 25 Sylvania Receiving Tubes or every Sylvania TV Picture Tube you buy.

SYLVANIA

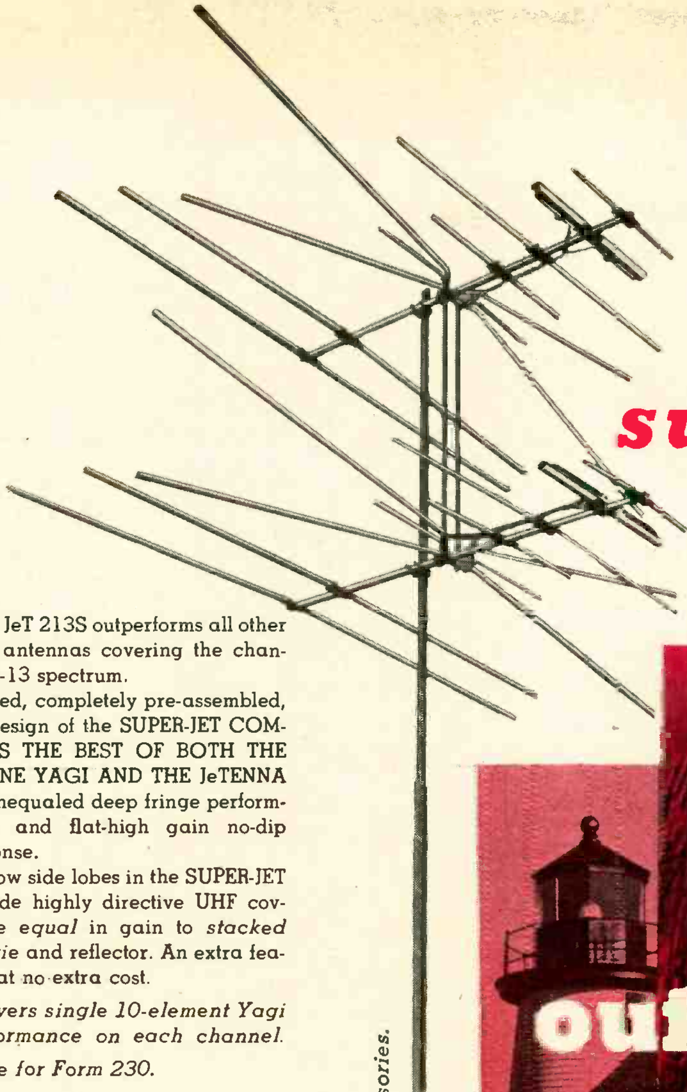
Sylvania Electric Products Inc. Dept. 4R-3801, 1740 Broadway, New York 19, N. Y.

In Canada: Sylvania Electric (Canada) Ltd.
University Tower Bldg., St. Catherine Street, Montreal, P. Q.

LIGHTING • RADIO • ELECTRONICS • TELEVISION

THE JFD

super-jet



JFD's JeT 213S outperforms all other VHF antennas covering the channel 2-13 spectrum.

Rugged, completely pre-assembled, the design of the SUPER-JET COMBINES THE BEST OF BOTH THE BALINE YAGI AND THE JeTENNA for unequaled deep fringe performance and flat-high gain no-dip response.

Narrow side lobes in the SUPER-JET provide highly directive UHF coverage *equal* in gain to *stacked bowtie* and reflector. An extra feature at no extra cost.

Delivers single 10-element Yagi performance on each channel.

Write for Form 230.

HERE ARE THE FACTS—COMPARE FOR YOURSELF.

JFD JeT 213 S	Competitor D CHS 2-13 YAGI	Competitor C RADAR SCREEN TYPE B	Competitor B RADAR SCREEN TYPE A	Competitor A MATTRESS (4 STACK)	CHANNELS
6.5	4.50	0.75	0.0	4.0	2
7.5	5.00	3.25	3.0	5.0	3
9.5	5.75	4.5	4.0	7.0	4
8.5	3.00	3.5	3.25	6.25	5
8.5	2.50	3.5	3.0	5.0	6
11.0	3.50	6.0	4.5	5.25	7
11.0	1.00	7.0	7.0	6.0	8
12.0	0.0	6.5	7.0	5.25	9
12.0	.875	7.75	8.0	7.25	10
11.25	.875	8.0	10.0	9.25	11
12.75	.50	7.5	10.0	6.5	12
12.0	7.5	6.0	9.0	7.0	13
DB GAIN					
YES	NO	NO	NO	NO	1" Square Cross Arm
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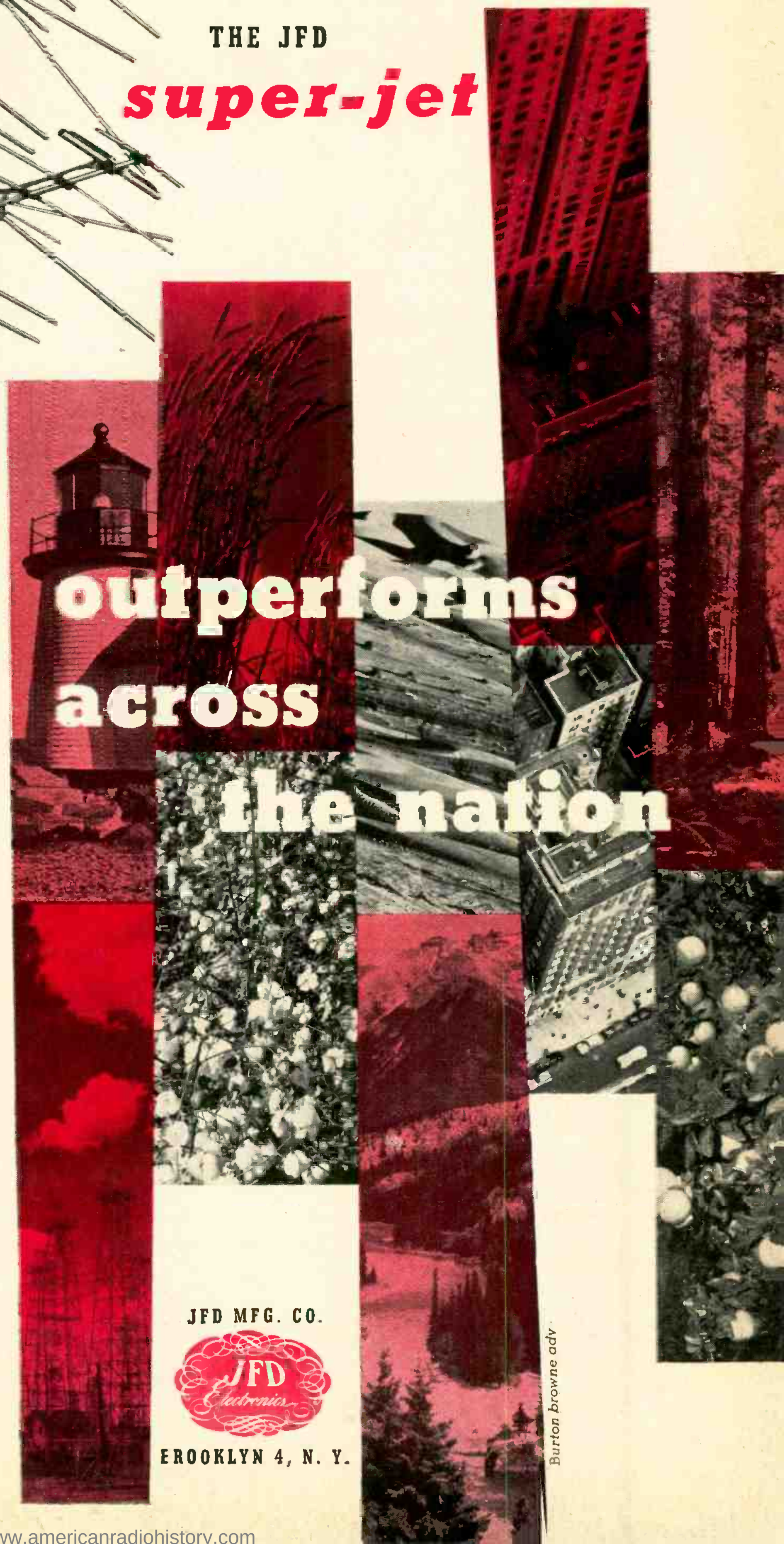

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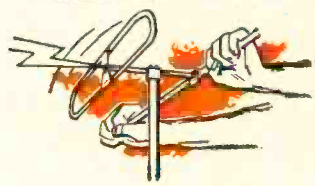

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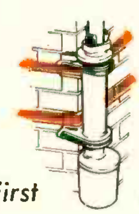

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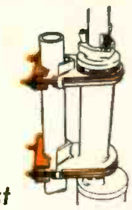

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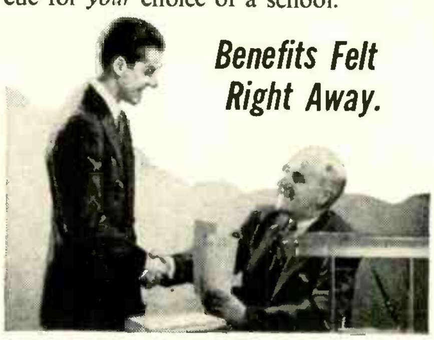

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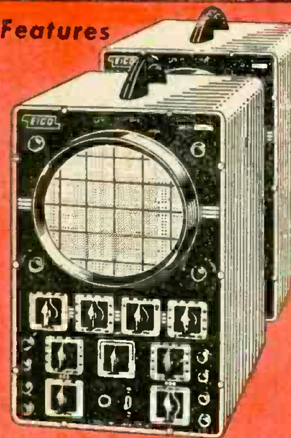

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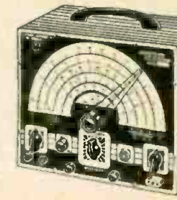

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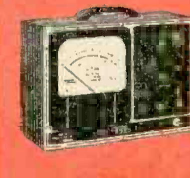

- Large 7½" meter, can't-burn-out circuit.
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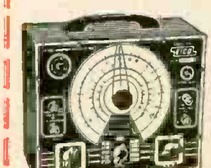

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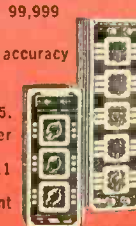

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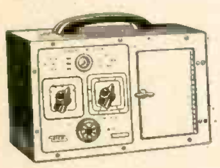

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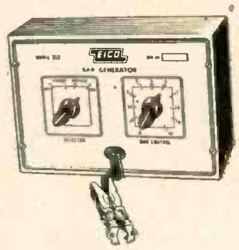

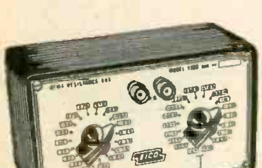

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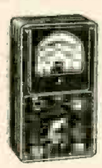

- 1000 Ω/V; 31 ranges
- DC/AC volts: Zero to 1, 5, 10, 50, 100, 500, 5000.
- DC/AC Current: 0-1, 10 ma; 0.1, 1 A.
- Ohms: 0-500, 100 K, 1 meg.

320K SIG. GEN. KIT $19.95. WIRED $29.95.
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COLOR TV PROBLEMS

. . . . The new multichrome sets will make TV history . . . .

By HUGO GERNSBACK

THE year 1954 is certain to go down in history as the official beginning of Color Television in the U. S. *In a technical sense, color TV is here.* In the economic, business, production, and servicing sense, color TV is just beginning.

A comparatively small number of color TV sets will be manufactured and sold in 1954. All will be expensive—four or five times as costly as monochrome receivers today. It will be difficult to get any type of color TV set—nor can one be choosy—customers will have little choice in style or finish. The screens will be mostly small—15 inch average. It will also be difficult to get satisfactory TV color servicing in 1954.

Nevertheless, color TV is here with a bang and the uproar it is causing is only second in comparison to the excitement created when television started a few short years ago. And it is quite true that once you have seen color television in all its often incredible splendor, you can no longer doubt that this is the REAL beginning of the Television Era.

Unfortunately, as so often in the past, under parallel circumstances, the set industry, as a whole, failed to alert the public that color TV is definitely *not* around the corner, and that the few thousand color TV sets manufactured in 1954 will only be a token production. For every thousand anxious customers, there will be only one or two color TV sets in 1954.

Multichrome TV sets are far more complex than monochrome receivers. They have several times as many parts and components, thus are more difficult and consequently slower to assemble. This is true for the complex tricolor TV tube—only more so. Small wonder then that we cannot reasonably expect mass production of color TV sets running in the millions in 1954.

Let us also not forget that it took us seven years to produce the 27 million present black-and-white sets. If *all* these receivers were to be replaced or duplicated with color TV sets, it is probable that it would take us into 1960 to achieve this output. But, in our opinion, this reasoning is not sound. Past history in our industry teaches us that, contrary to early opinions, television never replaced radio. It did not even make a dent in radio. To the contrary—and much to the surprise of the industry—there are many more radio receivers in active use today than in 1947. Incidentally, we predicted that too, in no uncertain language on this page in our June 1949 issue. This history is certain to repeat itself in TV. Just as not everybody owns a Cadillac or a Rolls Royce, yet even people not considered wealthy in the United States own more than one medium-priced car.

For several years to come and until color TV sets are really mass produced, *prices will be high*—not everyone will rush to buy one. Many people who *can* afford it will certainly not buy the present small screen, 15 inch sets—they will prefer to wait for larger screen types. And most of those who do buy color TV sets will probably keep their monochrome sets for the children, or as a spare to be used in other quarters in the house—particularly where members of the same household routinely want to watch different programs. Yes, even the kitchen—if there is sufficient room—is now a popular spot, often a must, for TV.

But that only scratches the surface. Not everyone likes color TV. Many older people prefer black-and-white. *There will always be a big demand for monochrome receivers which will increase as the prices come down.* Mass production, new techniques, transistors, cheaper cabinets, all will make it possible to sell good 21 inch black and white sets for around $100—perhaps for less—in the future.

Add to all this the tens of millions of utility sets, in offices, banks, factories, jails (for supervision), two-way communication, etc., and it becomes plain that the monochrome set will be in the ascendency for many years to come.

Indeed, we think that it is a safe prediction that in 1960 there will be more monochrome than multichrome TV sets in use.

As the present trend consistently has been towards larger and larger pictures, we have even now reached the practical limit in our direct view television tubes. It is almost certain that future TV sets—monochrome as well as multichrome—will be equipped with projection type TV tubes. This will give us life-size (and larger) faces and people, projected against a wall or screen. With projection TV it is no longer necessary to have a heroic size console, as projection tubes are far smaller than our present day direct view tubes.

The great trouble with projection TV in the past was poor definition, dim pictures, focus difficulties and high voltage servicing trouble. Many of these have now been overcome. Then, most important, there was the public's indifference to the projection idea itself. The reason for this is simple. Most walls in homes are not white or sufficiently light in color. Roll-up screens make a poor appearance and are psychologically wrong—they always look like makeshifts. Never—if left hanging—do they blend with the surroundings. And people just refuse to put up a wall screen every time they want to turn on the TV.

We therefore advance the thought that the industry must develop new means to sell projection TV to the public. The answer is: *do away entirely with the present-day make-shift screen.* Develop something both esthetic and utilitarian.

We can imagine a 3 by 4 foot (or larger) "mirror" permanently installed on a wall. When not used as a television projection screen, it looks like an art mirror, but during TV projection the rear of the "mirror" becomes white and serves as a screen. The trick mirror can be like a "one way" mirror or a special dichroic type of mirror, or a combination of both. We can also imagine a beautiful painting in a frame. But the painting has no canvas—the scene is painted on a number of closely fitting narrow wooden, metal, plastic—or other material—slats. By moving a small lever at the side of the picture frame, the slats rotate through 180°. *The reverse side of the slats are painted white*—making an excellent screen. Move the lever once more and in a second you restore the original picture.

There are many other optical, chemical and mechanical ways to accomplish the same result for TV projection screens.

Let us now consider color TV servicing. Perhaps it is a blessing in disguise that there will not be millions of multichrome TV sets in 1954. Who would service them? True, in a few of our larger cities TV set manufacturers probably are even now training a small body of service technicians to take care of a few thousand sets. But as there are over 110,000 TV technicians in the U. S., the great majority at the present time naturally has had no chance to even see a color TV set, much less become sufficiently acquainted with one to learn its intricacies. All this will take time, just as it took time and study for the former radio technicians to evolve into TV service technicians.

The servicing of color TV sets is complex and the service technicians are in for many new and interesting experiences. But by the end of 1954 most of these difficulties will have been resolved. By then color TV will be on its triumphal rainbow carpeted march.

COLOR TELEVISION

PAST PRESENT FUTURE

Lee de Forest

RADIO and television technicians, scientists, the general public, are today focusing attention on the absorbing topic of color television. When can we see it; place it in our homes; how good and reliable will "color" be; at what price, or range of prices?

Today's color television is the outcome of many years of careful thought, persistent ingenuity, and thousands of experimental hours. That sterling British TV pioneer inventor, John Logie Baird, made interesting experiments and gave the art some highly valuable suggestions as to how his crude television images could be combined with natural colors. There has been scarcely a television inventor since Baird who has not conceived some method or apparatus for mingling natural colors with the present monochrome image.

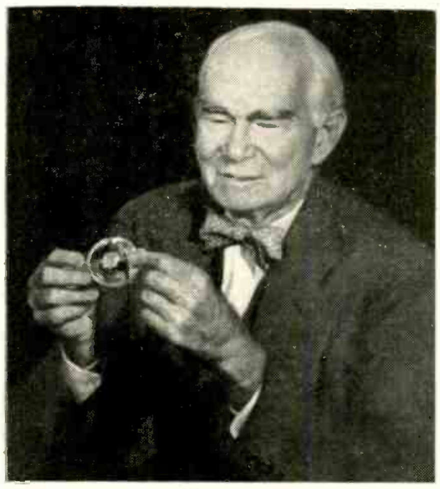
To actually accomplish this, one must begin with the television pickup device or camera. The simplest way to do so is —quite obviously—to employ three cameras, exactly like the present black-and-white type, typified by the RCA orthicon camera. Most researchers have been content to use the amazingly faithful and instantaneous qualities of the orthicon—three of these focused upon the color image to be transmitted: live object, wide scene, or Technicolor film. Each camera is synchronized with the TV transmitter; each views the scene through one of three primary color filters—red, green, and blue—of the exact shade found by practice to produce the most nearly correct color or tint on the final projected image tube, or screen. The three colored images are separated by a dichroic mirror into three images, each in its own color, and directed upon the lens of its own orthicon. Thus each color image is translated into a electron image. The three-electron images are scanned simultaneously by the cathode beam in each pickup camera. The combined electron output, now in the form of electric, high-frequency images, is caused to modulate—at a subcarrier frequency—the common television carrier as it is delivered to the transmitter antenna.

If the color filters were removed from the front end of each orthicon, these would see and translate the same all-color image, and the resultant would be that from three identical camera images—black and white or monochrome, all in perfect synchronism.

The old CBS field sequential color television system employed only one camera, located behind a rapidly rotating tricolor disc. The color segments transmitted only those picture elements from the scene which were of the same color as that of the segment then in the line of sight. A similar arrangement of a tricolor segmented disc rotating before the kinescope of the receiver and synchronized with the disc at the transmitter camera caused the picture to be seen in a semblance of its true colors. The practical limitations of the sizes of the disc in front of the kinescope so limited the size of the latter as to be disappointing to the viewer who had become accustomed to kinescopes of 15 or more inches in diameter. Moreover, the large, rapidly whirling disc in the room constituted a serious disadvantage to this method, quite aside from the fact that the CBS color system was incompatible and required special frequency standards.

With the casting into limbo of the rotating disc type of television, and the rapid development of large cathode-beam viewing tubes, (10 or 12 inches at first, then rapidly expanding after the war to our present 21-inch and 27- to 30-inch tubes), the combined active zeal of a hundred inventors and technicians in a half-dozen laboratories gradually resulted in an intelligent aggregation of ideas from which developed our present official National Television Systems Committee (NTSC) color TV standards, covering first the optimum use of the 6-megacycle band which the Federal Communications Commission had allotted for monochrome picture transmission, the prescribed synchronizing signal wave form, the number of horizontal lines permitted in the picture, the aspect ratio, the intensity and duration of the blanking signal, the burst frequency, etc. Such co-operative spirit had never before been witnessed, though it had been foreshadowed by the work of that earlier committee which—before the monochrome dawn of television—made to the FCC the recommendations which integrated finally to today's highly practical, well-proven national black-and-white standards, now universally adopted in the United States. The results of their foresight are evidenced today by more than 27 million television receivers in use; the highly profitable employment of thousands of so-styled, "artists," mostly unknown otherwise; a systematic process of implanting terror, fright, and rough manners into the impressive generation of younger ones; the frantic resurrection of millions of feet for opportune gain, of long-forgotten "Western" murder and mayhem films—plus the most gigantic travesty —advertisement conspiracy—in the history of modern civilization.

Scientific and engineering brains and their standards apparently are no match against the impropriety and lack of moral obligation of the group comprising program producers and advertising business managers, whose wholesale profanations of God's and mankind's ether in the name of beer, cigarettes, laxatives and cosmetics may mean millions of dollars to a few hundred private interests, but only impatient dis-



The Father of Radio and the Audion. From a painting by George Camarero.

gust to millions of other persons.

Television is a great and marvelous institution toward which science has been steadily working through decades. The dignity of its future will not be limited by commercial exploiters.

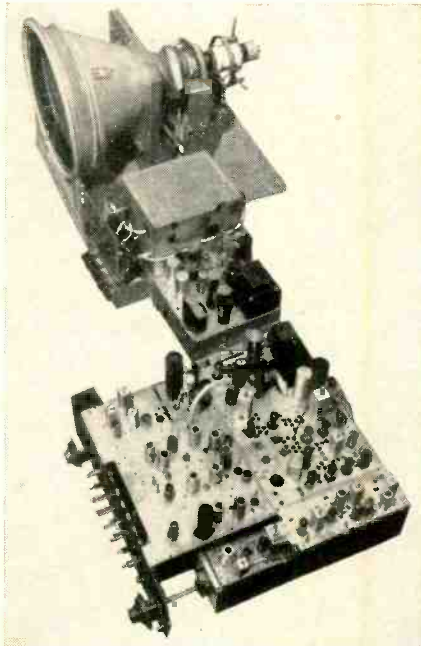
There are today, over three hundred television transmitters in operation. The number is increasing at an average of nearly three dozen per month. Within two years, scarcely a household in the United States will be out of range of at least one TV station, v.h.f. or u.h.f. This great increase in station erection, following the prolonged "freeze" by the FCC, exceeds the forecasts of its most enthusiastic proponents.

Unquestionably, the present state of compatible color television is chiefly due to the determined, long pursued, and ingenious labors of the research engineers of the Radio Corporation of America in its laboratories in Camden and Princeton, N. J. Spurred on by the zeal of RCA chairman, General David Sarnoff, the advent of compatible color TV has been advanced by years, so that today daily demonstrations of live and color-film pictures may be seen in New York, and will be available soon in Hollywood, Washington, and elsewhere.

To make this rapid progress possible it was necessary that the technical leaders of the TV industry should jointly and harmoniously agree upon a national set of standards, to avoid prolonged and manifold working at cross purposes throughout the industry. Last March the previously agreed upon standards were somewhat altered and improved. Patent licences were generously exchanged so that the various technical leaders can now work harmoniously in the common aim to bring to the public, as quickly as possible, (following FCC formal approval of the NTSC standards), color television receivers at the lowest possible prices.

Today there are at least three types of color kinescopes in "laboratory" production, the tridot perforated masking screen kinescope of RCA, using at present three guns; the horizontal tricolor narrow horizontal strip (or wire), so-called Lawrence tube; and the new CBS-Hytron tube to be described later.

The three guns of the RCA tube are located within a nickel cylinder converging at a narrow angle which brings the three narrow cathode beams together in the plane of the perforated plate. Magnetic deflection means similar to those used with the conventional black-and-white single gun cause the three beams to be swept across the perforated masking plate, horizontally and vertically, exactly as in the monochrome kinescope. The three beams are controlled in time and intensity by the arriving "red," "green," and "blue" signals from the distant transmitter, so that any one, two, or all three beams pass through a single hole in the masking plate simultaneously. Upon passing through any aperture in the masking plate, the three beams diverge, each beam falling upon a tiny red, green, or blue fluorescent spot on the parallel flat glass plate which is mounted approximately one inch in front of the perforated masking plate. By this arrangement the viewer in front of the tube sees true color reproduction, because the intensity of the three primary color dots varies in accordance with the three colors picked up by the three closely grouped cameras at the distant transmitter, and are commingled so as to reproduce all color tints and shades with their proper intensities.

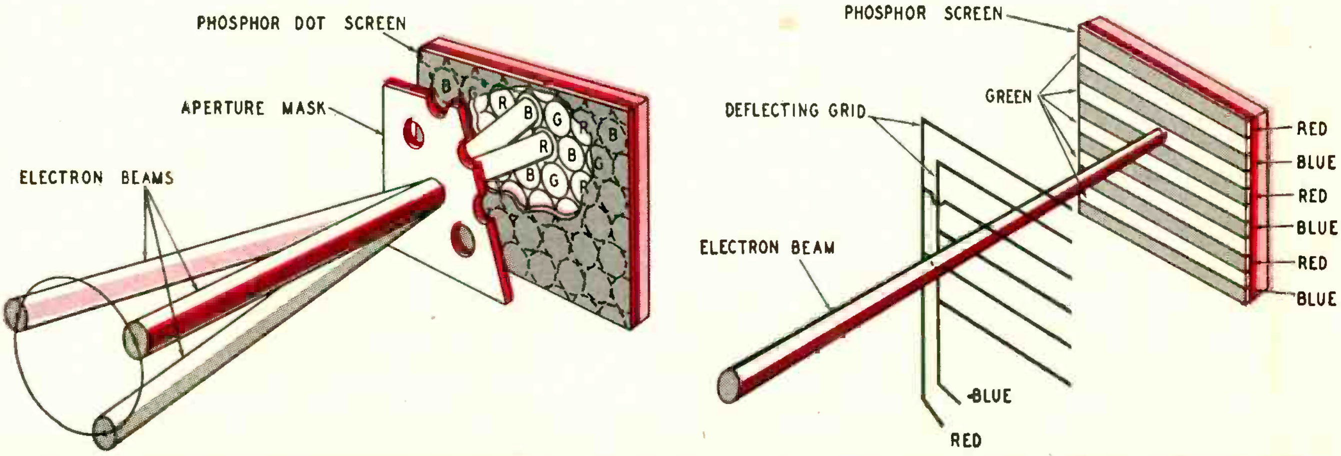


Courtesy General Electric Review
Experimental G-E color TV receiver.

The basic idea of a perforated masking plate, located before a transparent plate carrying on its face a vast number of tricolor phosphor dots, symmetrically located, is attributed jointly to TV engineer Levering, and Dr. Alfred Goldsmith. To date this arrangement, using three guns, or only one, is generally accepted as the most practical and promising of a multiplicity of more or less practical suggestions.*

The so-called Lawrence color tube employs a flat viewing plate carrying a series of fine tricolor stripes, preferably horizontal. Behind this plate is a parallel array of fine wires. Every third wire is connected to a common terminal. These three terminals are connected—each to a high-voltage source controlled by the incoming color signal, so that one set of wires divert the horizontally swept beam so that it falls upon the desired color stripe—red, green or blue—as it travels along. Thus the other-

* *Included is a patent application recently filed by the writer.*



Section of two types of color screens. Left is the RCA shadow-mask; right the Lawrence tube with its deflecting grid.

wise "black and white" beam is made to appear in the proper sequential color picture elements. Inasmuch as the cathode beam at the plane of the control grid wires is at high voltage, high velocity, the rapid control of the beam requires correspondingly high voltages. This may be a distinct disadvantage. Furthermore, there is a considerable loss of beam energy in transversing the wire grid, resulting in a loss in brilliance of the picture. To obtain a sufficiency of picture detail, the color modulation of the beam must occur at high frequency, a disadvantage considering the high voltages which must be applied to the beam-shifting wires.

The most recently developed type of color tube is that of the CBS-owned Hytron engineering staff. It differs from the above-described RCA in that, instead of using a flat glass plate to carry the three-color dot pattern, the tricolor dots are implanted directly upon the inner face of the kinescope. A perforated screen plate, or shadow mask, is employed as with RCA, but this is curved as is the tube face, the shadow mask plate being rigidly fastened at the correct distance behind the tube face. The tube carries three guns, as does RCA's.

This arrangement weighs much less than do the two flat plates, and the necessary heavy metal frame and screen—stretching means in the RCA tube. The exhaustion problem is thereby simplified and the tube cost is claimed to be substantially less. Further, the curved surfaces of the *Colortron* tube should avoid the size limitations presently inherent in the use of the two flat parallel plates of RCA. The anode voltage in both tubes is the same, 20 kv. Both screens are aluminized. The CBS receiver employs 40 tubes, including 2 rectifier tubes.

CBS uses the NTSC signal standards. Its newly demonstrated color system employs at the transmitter a single orthicon camera (instead of three with dichroic mirror color separators of RCA), with the familiar color-segment wheel, quite like what was used in the original CBS color system. Recent public demonstrations of this system show future promise, but as yet it is comparatively unimpressive in its performance. Doubtless Dr. Peter Goldmark is well capable of solving the problems yet remaining.

The present NTSC color signal consists of a wide-band "luminance" signal transmitted according to FCC standards for black-and-white TV, to which has been added a narrow-band color subcarrier having a video frequency of 3.58 mc. This combination of the two carriers, a color carrier of high frequency relative to that of the horizontal line frequency, makes the pattern of the subcarrier virtually invisible in monochrome receivers, so that the color signal may be received by present black-and-white receivers, an outstandingly clever solution. Hence the new color standards result in complete compatibility, an absolute essential for successful color television today. The color subcarrier sidebands extend to 1 mc below and 0.4 mc above the color subcarrier frequency, as measured to the 6 db down point.

The well-known standard horizontal synchronizing pulse is followed by a burst of 3.58 mc frequency which is delivered during the "backporch" of the horizontal blanking period. This burst, of exceedingly brief duration, is used in the standard color system to lock the oscillating system of the receiver. For black-and-white reception the burst signal is omitted. For a burst of eight cycles, the pulse duration would be 2.2 microseconds. The color subcarrier frequency is chosen to be an odd multiple of one-half the horizontal deflection frequency. Therefore the unit generating the 3.58-mc signal and the synchronizing generator must be locked together.

The various types of compatible color TV systems must all conform to the present NTSC standards, but as regards the receiver, a wide variety of design of the picture tube, including the color screen (dot or linear type), is permissible and a number of inventors are still very active in efforts to obtain better results and to permit use of much larger viewing tubes than the present RCA type (approximately 15-inch) screen.

A vast amount of research to determine the most efficient types of red, green, and blue phosphors has resulted in the following: Red (zinc phosphate; manganese), green (zinc silicate; manganese), blue (zinc sulfide; silver and calcium-magnesium silicate; titanium). The relative luminosity of these three phosphors is 25.3, 100 and 26.6 respectively, that of the green being taken as 100 or standard. Doubtless, further research may result in yet greater color efficiencies. The chemists continue their researches.

Disturbance of the color picture due to outside interference is found to be no greater than with the monochrome receiver; although the present color receiver employs from 30 to 50 electron tubes, of a large variety of types. Servicing of commercial color TV receiver is certain to be a far more complicated and tricky job than for black-and-white receivers. *The good service technician will require long and meticulous training. No ordinary slap-dash "tube shifter" can be expected to qualify or give customer satisfaction. Alignment techniques and general know-how must be developed to a high degree.* (The italics are ours.—*Editor*)

As far as sound in color TV is concerned, nothing novel is introduced. The old standard sound circuitry and the spectrum space reserved for sound are the same as for present standard monochrome transmission and reception. It is to be hoped that the larger color receiver cabinets will involve needed improvements in sound emitters, such as two or three good loudspeakers distributed in the cabinet, with selective circuits and controls. *Improved video should demand correspondingly better acoustic reproduction facilities.*

The estimated initial cost of color receivers varies from $800 to $1,400. These costs are certain to come down as quantity production proceeds, but it is clear that color will always be relatively costly, even for screen sizes small compared with our present 21- to 27-, or 30-inch kinescopes. Furthermore, much will depend on the quality of color programs. Color commercials will, of course, be much more attractive than are today's dull displays of beer-bottles and cigarette packages; but to justify the high cost of receivers, and their proper maintenance, the viewer must be given a superior quality of program along with a minimum of commercial commands.

Color television will not be all beer and skittles—we hope. The new program director will have many new problems, but also he will have a magnificent new medium for the public's delectation—not dejection.

What does the future of color TV present? A most enticing and challenging question that will stimulate ingenuity and imagination unlimited. Why, for example, must color TV be necessarily confined to a vacuum chamber? Why not use a dazzling needle of light instead of the cathode ray? Assume a brilliant gas tube which can be modulated millions of times per second, focused with tiny concave mirrors mounted in spiraled formation upon a small, light, rapidly revolving cylinder, or disc, which throws the beam across the face of a large screen, from left to right, and from top to bottom of the screen. The mechanism may be small, cabinet enclosed, and noiseless. This is a flareback to the old neon-light television ideas of C. Francis Jenkins, John Baird, and Mihaly. But it can be resurrected and refined, provided only that we can find the gas tube combining sufficient brilliancy with no inertia lag or hangover, one whose light output can be quantitively modulated at 6,000,000 times per second!

Or, let our synthetic chemists provide a new type of light-modulating liquid cell, (resembling the Kerr cell); or, better yet, a new type of refracting crystal which deflects a transmitted light beam quantitively in response to the received modulated television signal. This beam could then be spread sequentially over the viewing screen by a mirror drum, or two drums, as above described, traversing first a focusing lens or system of lenses.

Let's imagine further: Insert in the light path a *color cell* whose chameleon-like fluid changes its hue from red to green to blue instantly, in response to the incoming color signals, by voltage or high-frequency changes—a tricky problem for future chemists!

Given such inertialess voltage response cells, it will not take our TV engineers long to chuck the huge, bulky, implosion-liable, highly evacuated kinescopes into the trash can—an outcome devoutly to be wished. END

TRANSMISSION LINE LEAD-IN for U.H.F.

Dielectrics take on great importance in u.h.f. transmission lines

By BRUCE RICHARDS

TRANSMISSION line lead-in is a necessary evil. The service technician should not regard it lightly. The best antenna and the best receiver in the country may not give satisfactory reception unless serious attention is paid to the connection between them.

There are no certain tests by which the service technician can determine which is the best type transmission line lead-in. Any transmission line attenuates the signal. Theoretically, the *best* transmission line is the one that couples the antenna to the receiver with the smallest attenuation loss. The problems involved are different for u.h.f. than for v.h.f. At ultra-high frequencies the losses are greater. A typical attenuation curve is shown in Fig. 1.

We are going to present some of the fundamental principles of transmission line cable for u.h.f. lead-in and will make comparisons between cables now on the market. The attenuation losses for several types of line will be indicated. The effect of weather on the lines will be indicated where data are available. See Fig. 2.

Nothing will be said about the effects of mismatch. Obviously, the more closely matched the antenna, line, and receiver, the less will be the attenuation and other mismatch losses.

Let's confine ourselves to three basic types of u.h.f. lead-in line: open wire, ribbon, and tubular twin-lead cable.

Open-wire line

The open-wire line has a lower attenuation figure than other types. This attenuation is approximately 1 db per 100 feet at the center of the u.h.f. spectrum. See Table I.

Where it is necessary to run an exceptionally long lead from antenna to receiver this wire will hold to the low attenuation limit necessary for such an application. Or, if it is possible to run a lead-in completely indoors so that it will be shielded from weather, this is an ideal lead-in.

There are some disadvantages which make this wire a headache to the service technician. It is difficult to mount, and it requires special care to avoid changing the spacing of the wires between the insulators. Matching to a 300-ohm impedance is a serious problem, because the characteristic impedance of open-wire line is 225-250, 375, or 450 ohms.

A desirable characteristic of this type of line is that there is practically no difference in its attenuation under wet or dry conditions. This is the only type of line for which it can be said that if the picture is good under dry conditions, the picture will be good under wet conditions.

Punched-ribbon line

Tests made under all types of weather conditions along seacoast sections have shown that the average flat or round 300-ohm lead-in will give only a short period of satisfactory service. The quality of the picture then deteriorates rapidly and remains at a low level, as a result of the salt-spray deposits which encrust the lead-in. Similar problems exist in areas where there is a hot, humid climate, where much alternate rainfall and strong sunlight prevail, or where the lead-in is subject to frost, snow, and ice.

One solution to this problem, which permits use of ribbon line for some locations, is to punch out rectangles about an inch long and use short ribs to support the wire at these inch intervals. This line has certain outstanding features. Eighty percent of the loss-producing dielectric web is eliminated; the nominal 300-ohm impedance is correct for a large number of receivers and antennas; it is lower in cost than other lead-lines; and by insuring correct spacing of the flexible stranded conductors, less than 1% of the operating wavelength is radiation loss.

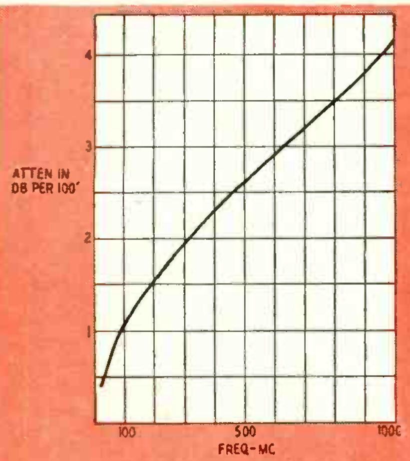
Ordinarily, attenuation losses of unpunched twin-ribbon type lead are greater than that of the punched-ribbon lead, except when water droplets accumulate in the punched-out areas. The losses of punched lead are then very high; but this condition disappears when the line dries out.

This punched type of line is good for an inside installation where it can be kept clean and dry and would not be subject to the lossy effects of weathering. Attenuation losses are moderate; it is flexible, easy to install; it fits into standard insulators; and it does not present any impedance-matching problem.

Tubular cable

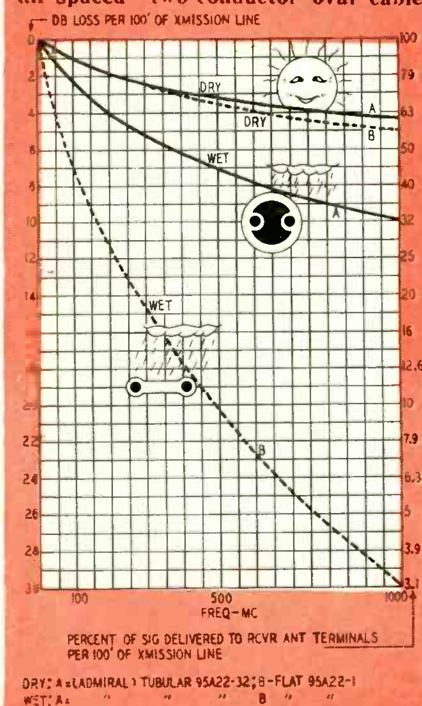
Each new advance in television brings along a number of accompanying advances in associated products. The u.h.f. boom has encouraged the development of a large variety of tubular-type twin lead-in cables. This is the type that is likely to win general acceptance because it seems to provide the best overall characteristics for good u.h.f. reception under all conditions of installation, as well as with aging and weathering. See Fig. 3. In tubular 300-ohm lead-in, the extremely important field of energy is concentrated on the inside and is virtually unaffected by weather conditions. In flat 300-ohm lead-in, the field of energy is largely outside, exposed to all weather conditions and subject to signal loss.

The basic patents on putting two or



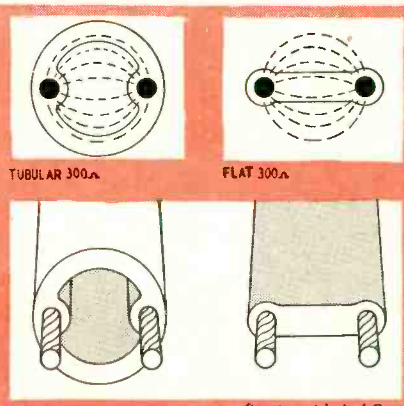
Courtesy Fenton Co.

Fig. 1 — Attenuation curve for an "air-spaced" two-conductor oval cable.



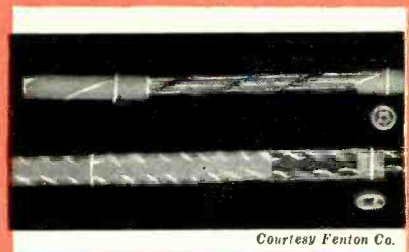
Courtesy Admiral Corp.

Fig. 2—Comparison of transmission lines under wet and dry conditions.



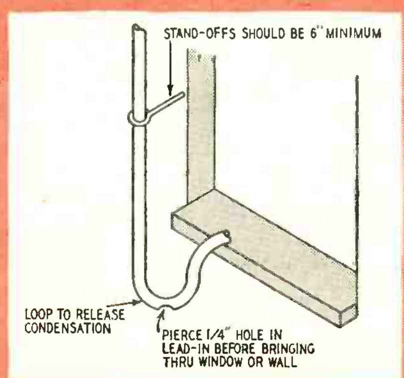
Courtesy Admiral Corp.

Fig. 3—Tubular and flat type lead-in.



Courtesy Fenton Co.

Fig. 4—Fentube Airspace cable below; the Fenton Twistube is shown above.



Courtesy Admiral Corp.

Fig. 5—Diagram shows tubular transmission line lead-in at point of entry.

more conductors inside a cable are over 50 years old. This means there is little room for invention in this field beyond minor improvements. Hence manufacturers have been concerned with producing as good a wire as possible with the lowest possible attenuation losses.

The published attenuation figures for a variety of these tubular twin cables are in Table I. Some data were not available. For the most part these are laboratory experimental data; what the data would be with respect to actual reception of a u.h.f. station is not known for the most part. This would be desirable information, but it is not available.

All the u.h.f. receiver manufacturers usually purchase a number of competing types of cable and set up some experimental procedures to determine the performance of the lead-in under ideal conditions, under wet conditions, and to determine results of aging. These data become a company report and unless the information is released the service technician, who would profit much from such information, is not likely to see it.

The data on the Rego *Spiraline* given in this table were obtained under actual test conditions of a u.h.f. station operating in the 700-mc region. Incidentally this was the best performing tubular cable out of a group tested under dynamic conditions in the metropolitan New York City area. This is a novel design twin-lead wire, using a solid conductor. Let's look at it more closely.

Air is the most desirable dielectric for the twin-conductor cable now commonly used for v.h.f. and for the tubular type cable being used for u.h.f. An ideal cable would be a pair of air-supported twin conductors properly spaced inside a tubular cable. However, this can exist in theory only.

It is common to support the cables and to maintain them in their proper spacing by means of a thin film of dielectric, sufficiently thick to serve the purpose of maintaining uniform spacing. See Fig. 3, "tubular 300 ohm." The dielectric, by surrounding the cable throughout its entire length, contributes markedly to attenuation losses, since the highest energy field is in the straight-line path between the two conductors.

Rego *Spiraline* has adopted a design featuring a thin wall of dielectric material supporting the twin conductors at points such that the ratio of bare conductor to dielectric-covered conductors is sufficient to permit maintaining uniform wire spacing throughout the cable length and at the same time permitting most of the twin conductors to be free of dielectric covering. The points at which the dielectric holds the twin conductor to the wall of the tubular cable do not have to be opposite each other; they may be staggered along the cable at alternate spots. The bottom cable in Fig. 4 illustrates the design used by *Spiraline*.

This cable has low dielectric losses and superior characteristics under wet conditions. This wire must be handled carefully during installation. Rough handling or sharp bends will change the spacing of the bare conductors and affect the impedance characteristics and attenuation losses of the wire. For the service technician who is very careful in his workmanship, this is an ideal tubular type lead. The manufacturers have not been pushing this wire because they don't know whether the service technician will give it the installation care it requires.

Characteristic impedance

The characteristic impedance of a transmission line is important—more important at u.h.f. than at v.h.f. because there is a relationship between the impedance of a line and its attenuation losses. Both the size of the conductor and the spacing of conductors affect the impedance of a transmission line. Standard tables of attenuation losses show that losses are greater for lines with impedances less than 300 ohms. For lines comparable in all other respects there would be greater losses for a 280-ohm line as compared to a 300-ohm line. Again, there is little the service technician can do about this as the difference in spacing of conductors for 280 or 320 ohms is negligible. Comparatively little wire is sold with a guaranteed impedance.

The spacing of the conductors varies from manufacturer to manufacturer for a variety of reasons. Here are typical comments:

A. The spacing of the conductors was determined more by economic reasons than any other It was felt that it was best to keep the conductor spacing at the minimum and so decrease the over-all size of the line, rather than get somewhat higher impedance with a wider separation and therefore larger over-all dimensions.

B. The characteristic impedance of the flat and tubular line is 300 ohms nominally with a production tolerance of ± 20 ohms. For this reason it is possible that the impedance could be 280 ohms and still be within tolerance.

Dielectric material

Most manufacturers advertise that their tubular cable is made with virgin polyethylene. This may not always be true. Polyethylene is not available in the quantities necessary to supply all demands by the wire and cable plants. Some of them are maintaining production with a percentage of reused polyethylene. The Bakelite Company, manufacturer of polyethylene, suggests, "The dielectric constant of reprocessed polyethylene, we believe, is greater than that of new polyethylene due to the impurities which are introduced either prior to or during the reprocessing operation. While we have no data to substantiate our belief we do believe that reprocessed polyethylene attenuation losses would increase more quickly with age due to impurities, as mentioned above, which might be introduced either prior to or during the reprocessing operation."

Unfortunately there is little the service technician can do about such manufacturing substitutions, as it is practically impossible to determine the difference between virgin and reprocessed polyethylene. There is one clue which will help the service technician get a good polyethylene wire. The smoothness of the finish on the tubular twin-lead u.h.f. cable does influence the losses of the cable. If there is any roughness on the outer surface of the polyethylene this rough portion would tend to catch and be a collecting spot for dust, dirt, soot, and other foreign particles. Under wet conditions this would tend to increase the losses for the cable involved.

Notes on tubular cable

Amphenol makes two types of tubular *Twin-Lead* cable: 14-076 and 14-271. The 14-076 is superior because of the following design and construction features:

1. The tubular design of the insulation reduces dirt and moisture concentration in the field between the conductors. This means the impedance is constant for wet or dry conditions.

2. 14-076 has seven strands of No. 26 wire as conductors rather than seven strands of No. 28 wire as used in the 14-271 cable which has higher attenuation losses.

3. The design of the cable is such that there is a thin wall of dielectric covering the wires and most of the field between the conductors is air. This is illustrated in Figure 3.

The Fentube Airspaced tubular u.h.f. cable is illustrated in Fig. 4. This figure also shows the Twistube. Both are made by the Fenton Company, New York City. For most of the Fentube conductor length there is very little between the bare conductors to interfere with the concentrated energy field. The No. 20 AWG conductors are solid wires supported by means of the helical polyethylene wire-like cords.

The lines least affected by moisture and contamination are the new ATV-270 lines. There are two types: the ATV-270 and the ATV-270 Foam. The Foam line is superior at the high end of the u.h.f. band, because the attenuation losses are small. This line uses two single solid conductors accurately spaced and firmly fixed in place in foamed polyethylene. This line is so new there are no reports on it from field tests as yet. These data are based upon the manufacturer's literature. The manufacturer, Anaconda Wire and Cable Co., claims that attenuation characteristics for both types of line are practically unaffected by moisture.

Installation

For new installations, 300-ohm flat line should be avoided for u.h.f., particularly when long lengths must be used. There should be a minimum separation of 6 inches from surrounding objects to prevent signal absorption losses. The standoffs should keep the wire at least 6 inches from the building. Make a drainage loop in the line just before it enters the house. Punch a hole at the bottom of the loop to remove moisture condensation in the line (see Fig. 5). Avoid coils or kinks anywhere between the antenna and the receiver. Cut the line to the proper size to reach the receiver and do not leave any extra line which might be coiled up or kinked, causing impedance changes. END

TABLE I—TRANSMISSION LINE ATTENUATION

	Attenuation in decibels per 100 feet Frequency in megacycles		
Type	100	500	1,000
225-250 ohm open	0.4	0.8	1.8
450-ohm open	0.4	0.8	1.1
300-ohm tubular	1.2	3.2	5.0
ATV 270 (Anaconda)	1.5	3.6	5.1
ATV 270 Foam (Anaconda)	1.5	3.6	5.0
Rego Spiraline	1.1	2.4	4.0
Fentube Airspaced	1.1	2.6	4.2
Fentube Twistube	1.2	2.6	4.7
Amphenol 14-076	1.0		
Amphenol 14-271	1.3		
Admiral 95A22-32	1.0	3.2	4.3
Goodline 733 GA	0.7	2.5	
Goodline 823 GS	0.7	2.1	
Belden Ultra Weldohm	1.1	3.2	5.0
Federal Pipeline	1.2	3.0	4.5

TV CHANNELS TABLE

Channel No.	Freq. Range (mc)	1/4 λ Electric (inches)	1/4 λ Physical (inches)
V.H.F.			
2	54–60	51 13/16	42 13/32
3	60–66	46 29/32	38 15/16
4	66–72	42 13/16	35 3/32
5	76–82	37 13/32	30 21/32
6	82–88	34 3/4	28 1/2
7	174–180	16 21/32	13 21/32
8	180–186	16 3/32	13 3/16
9	186–192	15 19/32	12 13/16
10	192–198	15 3/32	12 13/32
11	198–204	14 23/32	12 1/16
12	204–210	14 1/4	11 23/32
13	210–216	13 27/32	11 11/32
U.H.F.			
14	470–476	6 1/4	5 1/8
15	476–482	6 3/16	5 1/16
16	482–488	6 1/8	5 1/32
17	488–494	6 1/32	4 31/32
18	494–500	5 31/32	4 29/32
19	500–506	5 7/8	4 13/16
20	506–512	5 13/16	4 25/32
21	512–518	5 3/4	4 23/32
22	518–524	5 11/16	4 21/32
23	524–530	5 5/8	4 19/32
24	530–536	5 9/16	4 9/16
25	536–542	5 1/2	4 1/2
26	542–548	5 7/16	4 7/16
27	548–554	5 3/8	4 13/32
28	554–560	5 5/16	4 3/8
29	560–566	5 1/4	4 5/16
30	566–572	5 3/16	4 1/4
31	572–578	5 5/32	4 7/32
32	578–584	5 3/32	4 3/16
33	584–590	5 1/32	4 1/8
34	590–596	5	4 3/32
35	596–602	4 15/16	4 1/16
36	602–608	4 29/32	4
37	608–614	4 27/32	3 31/32
38	614–620	4 13/16	3 15/16
39	620–626	4 3/4	3 29/32
40	626–632	4 11/16	3 7/8
41	632–638	4 21/32	3 13/16
42	638–644	4 5/8	3 25/32
43	644–650	4 19/32	3 3/4
44	650–656	4 17/32	3 23/32
45	656–662	4 1/2	3 11/16
46	662–668	4 15/32	3 21/32
47	668–674	4 13/32	3 5/8
48	674–680	4 3/8	3 19/32
49	680–686	4 5/16	3 17/32
50	686–692	4 9/32	3 17/32
51	692–698	4 1/4	3 1/2
52	698–704	4 7/32	3 15/32
53	704–710	4 3/16	3 7/16
54	710–716	4 5/32	3 13/32
55	716–722	4 3/32	3 3/8
56	722–728	4 3/32	3 11/32
57	728–734	4 1/16	3 5/16
58	734–740	4 1/32	3 9/32
59	740–746	3 31/32	3 1/4
60	746–752	3 15/16	3 1/4
61	752–758	3 29/32	3 7/32
62	758–764	3 29/32	3 3/16
63	764–770	3 7/8	3 5/32
64	770–776	3 27/32	3 1/8
65	776–782	3 13/16	3 1/8
66	782–788	3 25/32	3 3/32
67	788–794	3 3/4	3 1/16
68	794–800	3 23/32	3 1/32
69	800–806	3 11/16	3 1/32
70	806–812	3 21/32	3
71	812–818	3 5/8	2 31/32
72	818–824	3 19/32	2 31/32
73	824–830	3 9/16	2 15/16
74	830–836	3 9/16	2 29/32
75	836–842	3 17/32	2 7/8
76	842–848	3 1/2	2 7/8
77	848–854	3 15/32	2 27/32
78	854–860	3 7/16	2 27/32
79	860–866	3 7/16	2 13/16
80	866–872	3 13/32	2 25/32
81	872–878	3 3/8	2 25/32
82	878–884	3 3/8	2 3/4
83	884–890	3 11/32	2 23/32

From the October, 1953, issue of Sylvania News

A listing of all TV channels and frequencies with useful dimensional data for constructing antennas and making impedance-matching sections and rejection traps from 300-ohm ribbon line. Use the electrical-length data in the third column for antenna elements and spacings. The fourth column gives the physical length of a quarter-wavelength section of 300-ohm ribbon line with a propagation factor of 82%. Use these when constructing matching sections and traps. When using other types of transmission lines, multiply the electrical length by propagation factor.

NEW U.H.F. BOOSTER

By L. P. HAGEY*

As more and more u.h.f. television stations open, new problems peculiar to u.h.f. reception are beginning to be recognized. One of the most serious difficulties, of low signal strength, is not peculiar to u.h.f. It has been found that in many regions, particularly those in rough terrain, that *dead spots* may be large, and may occur fairly close to the transmitter.

The presence of these dead spots indicates that the term "fringe area," as applied to v.h.f. reception, must be changed to include all low-signal areas when applied to u.h.f. reception.

Because of the large u.h.f. fringe area, there is a great need for a sensitive preamplifier or booster. The signal strength required for an acceptable picture on u.h.f. is considered to be about 1,500 microvolts per meter, while a signal strength of only 200 microvolts per meter is required for a similar picture on v.h.f. This difference in sensitivity is due to the relatively high noise figure of the input circuits of present u.h.f. receivers. A crystal mixer is almost always used in the input circuit. In addition to high noise, the crystal also introduces a conversion loss of from 6 to 10 db. The problem of increasing the receiver sensitivity then becomes one of providing an input circuit with the lowest possible internal noise and the highest possible gain.

Types of input circuits

Vacuum tube mixers have conversion gains at u.h.f., but they too suffer from high noise, and require high oscillator drive, which magnifies radiation problems. New tubes and circuits are helping to overcome these difficulties, but the indications are that the crystal mixer will be here for some time.

Another approach to the problem of increasing sensitivity is to provide a stage of amplification ahead of the mixer. In this position, a low-noise stage is most effective in reducing the over-all noise of the system.

Circuit considerations

A triode stage is indicated because of its low noise. The triode, however, must be neutralized to eliminate electrostatic coupling between output and input circuits. The problems of neutralization are almost impossible to overcome at these frequencies. In addition, transit time and lead reactance effects operate to so lower the input impedance that the gain is seriously lowered at the higher frequencies.

The above remarks refer to the standard grounded-cathode triode amplifier. If a triode is employed in a grounded-grid circuit, no neutralization is required. The grounded grid acts as an electrostatic shield between the output and input circuits. See Fig. 1. Since the input signal is in series with the external plate-to-cathode circuit of the

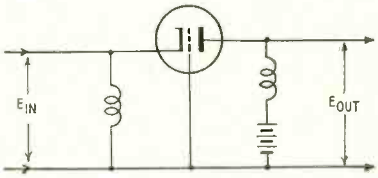


Fig. 1—Basic grounded-grid circuit.

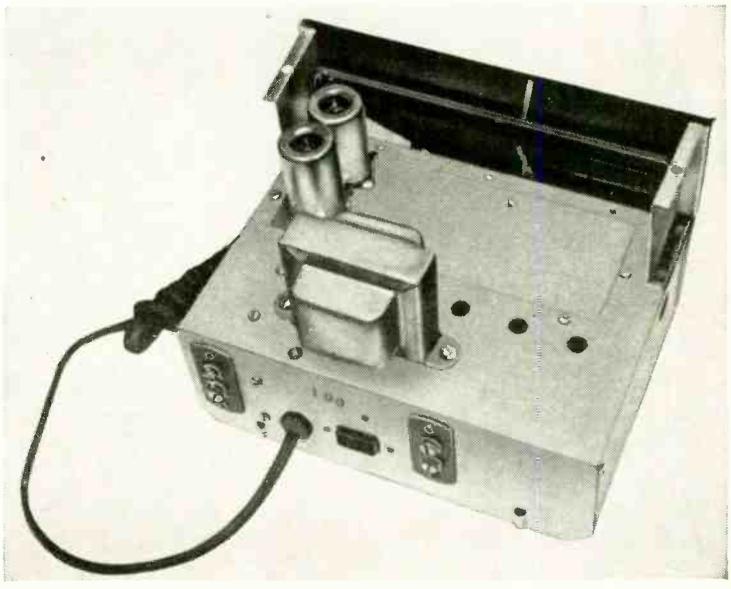


Photo shows rear and top view of u.h.f. booster. A push-pull grounded grid circuit is used.

*Electronic Engineer, Electro-Voice, Inc.

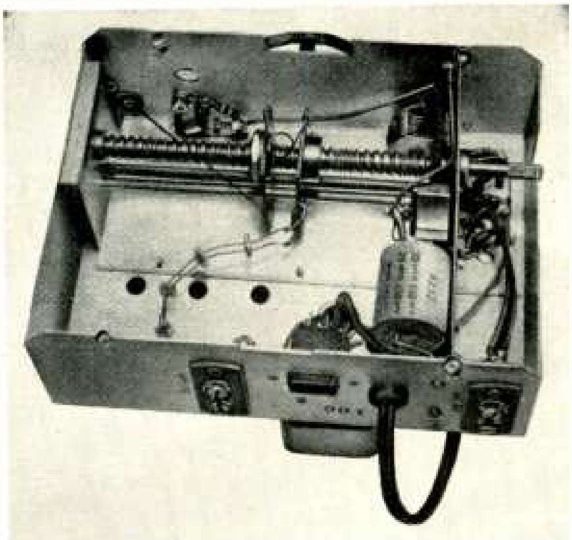


Photo shows under-chassis view of the u.h.f. TV booster. "Differential micrometer" tuning mechanism can be seen.

tube, a portion of the signal is transferred directly to the output circuit. This represents a load on the input and would seem to be more harmful than the transit time and lead reactance effects in the standard circuit. This is true at medium frequencies. But the loss of gain suffered by the grounded-grid stage increases much more slowly with frequency than that of the grounded-cathode stage. For a given tube, the grounded-grid circuit will still deliver useful amplification of frequencies where the grounded-cathode circuit is useless. In addition, the grounded-grid triode has less noise than the grounded cathode triode. The high degree of isolation between output and input provided by this circuit is also important, because it provides a higher attenuation of radiated energy from the local oscillator. This energy is kept from feeding back to the antenna where it could cause interference in neighboring receivers.

Lead reactance is a serious problem. Even a length of conductor such as the tube pin itself can have an inductance whose reactance is substantial at 900 megacycles. Obviously, if the grid pin of the tube offered inductive reactance, a signal voltage would appear on the grid. When this occurs, the conditions of grounded-grid operation no longer apply and the advantages of this type of operation are lost.

Tube capacitances are equal in value to the resonant circuit capacitances at these frequencies, and represent a serious obstacle to obtaining an external circuit which may be varied over a wide range of frequencies. A push-pull circuit effectively places the tube capacitances in series and reduces this effect to one-half that experienced with a single tube. Thus, a push-pull circuit places more of the resonant circuit outside of the tube.

Special tube types such as the lighthouse tubes and pencil triodes, which will operate satisfactorily at u.h.f., have been available for several years. However, due to high cost and difficult application, it is not worth while to use these tubes. New tubes with conventional bases, suitable for use in special circuits at the ultra-high frequencies, have now been developed.

The u.h.f. booster circuit

Due to the above considerations, a push-pull grounded-grid triode circuit was chosen for the design of the model 3400 u.h.f. booster (Fig. 2). The 6AJ4 tube is a new high-transconductance triode especially developed for grounded-grid operation at ultra-high frequencies. This tube features extremely short leads and excellent internal shielding between plate and cathode. The miniature noval base lends itself to standard circuits and to ease of tube replacement. It has five grid pins so that grid-lead inductance may be kept to a minimum. In the booster design these five grid pins are grounded directly at the tube socket. The tube sockets are of special low-loss design and have very short leads.

Electrostatic shielding is provided by the grounded grid and a vertical shield which divides the underside of the chassis into two compartments. The shield passes over the tube sockets, with all input contacts (cathode, heater, and three grid pins) on one side and all output contacts (plate and two grid pins) on the other.

The low input impedance of the grounded-grid stage makes it possible to connect it directly to 300-ohm transmission line. In addition, excellent balance to ground is maintained by the push-pull feature. The input impedance, due to the untuned input and the excellent isolation of input and output, is quite stable at about 120 ohms per tube. The total input impedance of 240 ohms presents very little mismatch to a 300-ohm line. The shunting effect of the cathode-to-heater capacitance is minimized by means of the series r.f. chokes (L1, L2, L3 and L4), which place the heaters above ground potential.

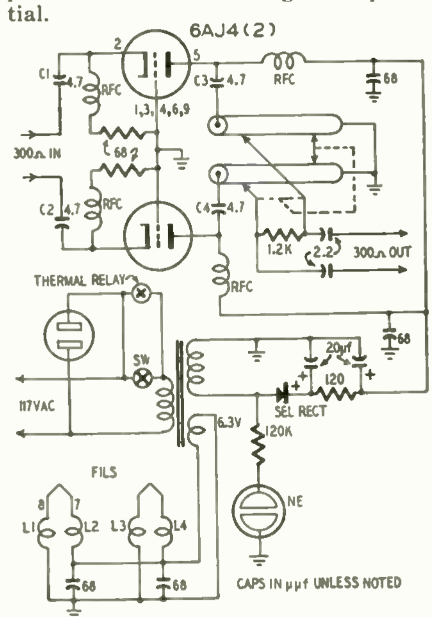


Fig. 2—Schematic diagram of the Electro-Voice model 3400 u.h.f. booster.

The output tuned circuit is a shorted quarter-wave resonant line. The 4.7-μμf series capacitors, C3 and C4, serve as d.c. isolation and also provide a small amount of decoupling to allow the external tuned circuit to reach the upper frequency limit of 900 megacycles. The resonant line is designed with a relatively low (115-ohm) characteristic impedance and is heavily silver-plated to keep losses at a minimum. A loaded Q of about 70 is reached with a bandwidth of 6 megacycles at a frequency of 470 megacycles and a gain of 12 db. The relatively high Q and narrow bandwidth keep the noise characteristic

Rear view of the booster, showing the v.h.f. bypass filter in place.

low, and also help reject many types of interference.

A resonant circuit of this type can be adjusted over a very wide range of frequencies by providing a short-circuit which can be moved along the line. Thus the effective length is varied, changing the resonant frequency. Fig. 3 shows how this is done. When the lead screw (9) is turned, the drive nut (7) and carriage (4) which carries the shorting contact move along the length

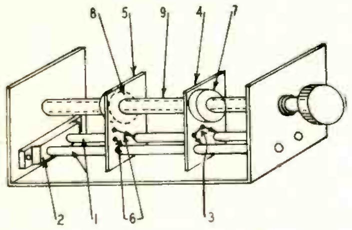


Fig. 3—Tuner mechanism. 1—Resonant line elements; 2—Low loss, low-capacitance line support insulator; 3—Silver shorting contact; 4—Insulating carriage; 5—Insulating carriage; 6—Silver 300-ohm output contacts; 7—Six-pitch drive nut; 8—Seven-pitch drive nut; 9—Lead screw with six- and seven-pitch threads superimposed.

of the line (1). The silver contact (3) forms a short-circuit between the two line elements, varying the length of line between it and the open end.

The problem of coupling energy from a resonant line section is easily solved by coupling a pickup loop inductively to the line, if only a narrow range of frequencies is involved. When a wide range must be covered the optimum position for the pickup loop moves along the line as the line length is varied. It was found practically impossible to maintain correct inductive coupling with a pickup loop over the entire frequency range of the booster. Therefore, another scheme is used.

Amateurs and many television technicians know that a resonant line section may be made to function as an efficient transformer simply by connecting to the proper points on the line. Thus, a shorted quarter-wave line presents a very high impedance at the open end (connected to the plates in our case) and zero impedance at the short-circuit. Any intermediate value of impedance may be obtained by connecting to the proper intermediate point on the line.

The high efficiency and excellent impedance match which may be obtained by this method of tapping the line makes it especially attractive. Of course, the mechanical problem arises of moving the tapping, or output, contacts in correct space relation to the shorting contact. This is not too difficult, since the distance between the tapped point and the short circuit for a constant output impedance varies with the wavelength.

The mechanical problem was one of causing the shorting contact and the output contacts to move down the line at different but constant speeds, when the tuning knob was turned at a constant speed. Flexible belt or cord drive methods were tried and discarded because they were unreliable. Instead, a positive drive was provided by a single lead screw. The lead screw has two threads of different pitch superimposed on each other. The drive nuts, (7) and (8), Fig. 3, follow only the thread of their own particular pitch. This "differential micrometer" tuning mechanism** can never slip or get out of adjustment. The high efficiency and constant impedance characteristic insure maximum transfer of energy to the 300-ohm output terminals. The entire range of u.h.f. television frequencies is covered in about 25 turns of the tuning knob.

U.h.f.—v.h.f. reception

When a single transmission line must be used for both v.h.f. and u.h.f. signals, there must be a way to shunt the v.h.f. signals around the booster. To avoid using a manual switch, filters are introduced. They provide high attenuation over the entire u.h.f. band and negligible attenuation at v.h.f. Discontinuities in the transmission line—introduced in part by the connecting leads—are responsible for much of the difficulty experienced with these matching units (filters).

To eliminate line discontinuities, small inductances are wound directly on special composition capacitor bodies to form parallel resonant or *band-stop* circuits of very small physical size. In the final filter design, (Fig. 4) these band-stop coils are connected by very short leads directly to the booster terminals. These short lead lengths are maintained by mounting the entire filter on a small low-loss phenolic base which mounts on the back of the booster and is supported directly on the booster terminals. See photo. The band-stop coils thus serve to isolate the longer leads in the filter from the u.h.f.

** Patent applied for.

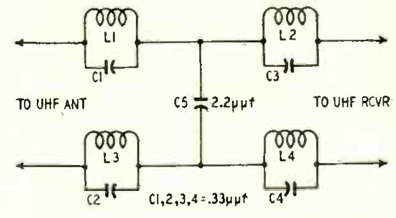


Fig. 4—Schematic of 3450 v.h.f. bypass.

lines and eliminate discontinuities. The series capacitors, C1, C2, C3 and C4 (Fig. 2), in the input and output circuits of the booster are electrically a part of this v.h.f. bypass network and prevent the v.h.f. signals from being shorted out by the u.h.f. circuits. The filter is called model 3450 v.h.f. bypass. Maximum attenuation of the filter to v.h.f. signals is 3 db, which is hardly noticeable.

Summary

In actual field tests the 3400 u.h.f. booster substantiates the theory that there is an appreciably lower noise figure through its use. Even where signal strength is adequate for acceptable picture contrast without the booster, a reduction of snow is noted when it is used. Extremely flexible in application, it may be used with any installation, providing increased sensitivity and a reduction in snow and back radiation. In the many areas where only one u.h.f. station can be received, completely automatic operation is possible. A thermal relay turns the assembly on and off automatically with the TV receiver. This allows the booster to be concealed if desired. END

FCC'S STERLING WARNS MANUFACTURERS ON TVI

TV interference was the subject of a stern warning delivered by FCC Commissioner Sterling to TV, radio, and broadcast equipment makers. The occasion for this warning was the Fall meeting of the combined RETMA, RTMA of Canada and IRE in Toronto.

Commissioner Sterling stressed that the industry must do much more about reducing radiation from TV receivers and transmitters which interfere with reception on government, aircraft, amateur and TV-radio bands.

Sterling said that the FCC received 22,264 interference complaints in fiscal 1953. More than 12,600 resulted from spurious responses of broadcast receivers—6,000 from TV sets. Some 9,600 were the result of spurious radiations from transmitters.

At one point, the commissioner departed from his prepared text, reminding manufacturers of FCC's new power to issue "cease and desist" orders, which in some cases could have the effect of putting an offending company out of business.

The Commission has been making extensive field measurements in Portland, Oregon, site of the first commercial u.h.f. station, on radiation from u.h.f. TV receivers and converters. The results gave great cause for concern. In the instance of strips and separate converters, excessive radiation was observed in the region between 200 and 500 mc. The radiation from u.h.f. oscillators was in the order of thousands of microvolts per meter, and in one instance a field of 10,000 microvolts-per-meter was obtained at 100 feet from a set of one of our major manufacturers.

In reply, Crosley's Lewis M. Clement, chairman of RETMA engineering department's executive council reported that the vast majority of manufacturers have now reduced spurious v.h.f. oscillator radiation below RETMA's "interim" maximums (50 microvolts-per-meter at 100 feet for channels 2-6 and 150 microvolts-per-meter for 7-13).

Fig. 1—A three-quarter view of the new v.h.f.-u.h.f. TV tuner.

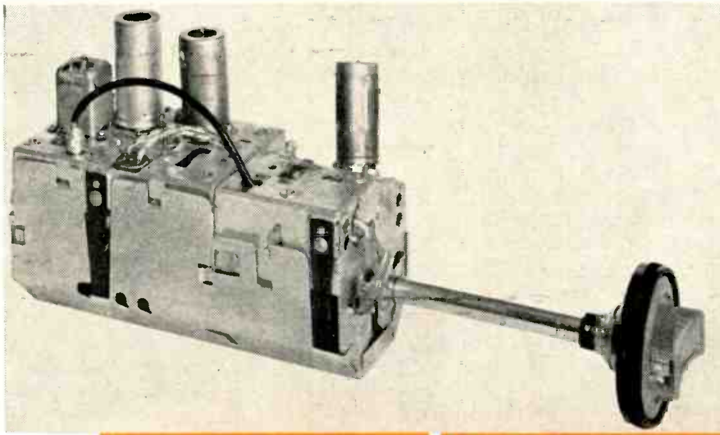
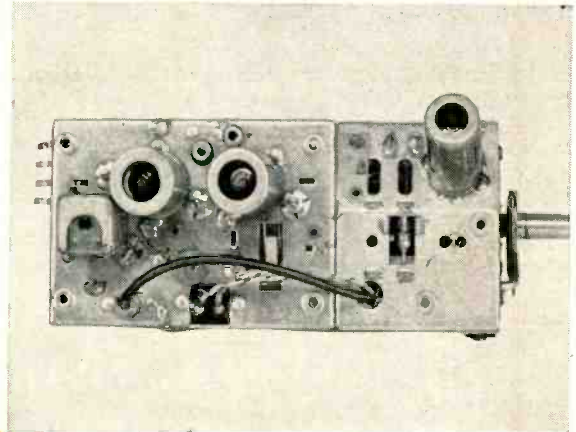


Fig. 2—Top view. The i.f. traps are in can at left.



Courtesy Tech-Master Products Co., Inc.

U.H.F. V.H.F. 82-CHANNEL CASCODE TUNER

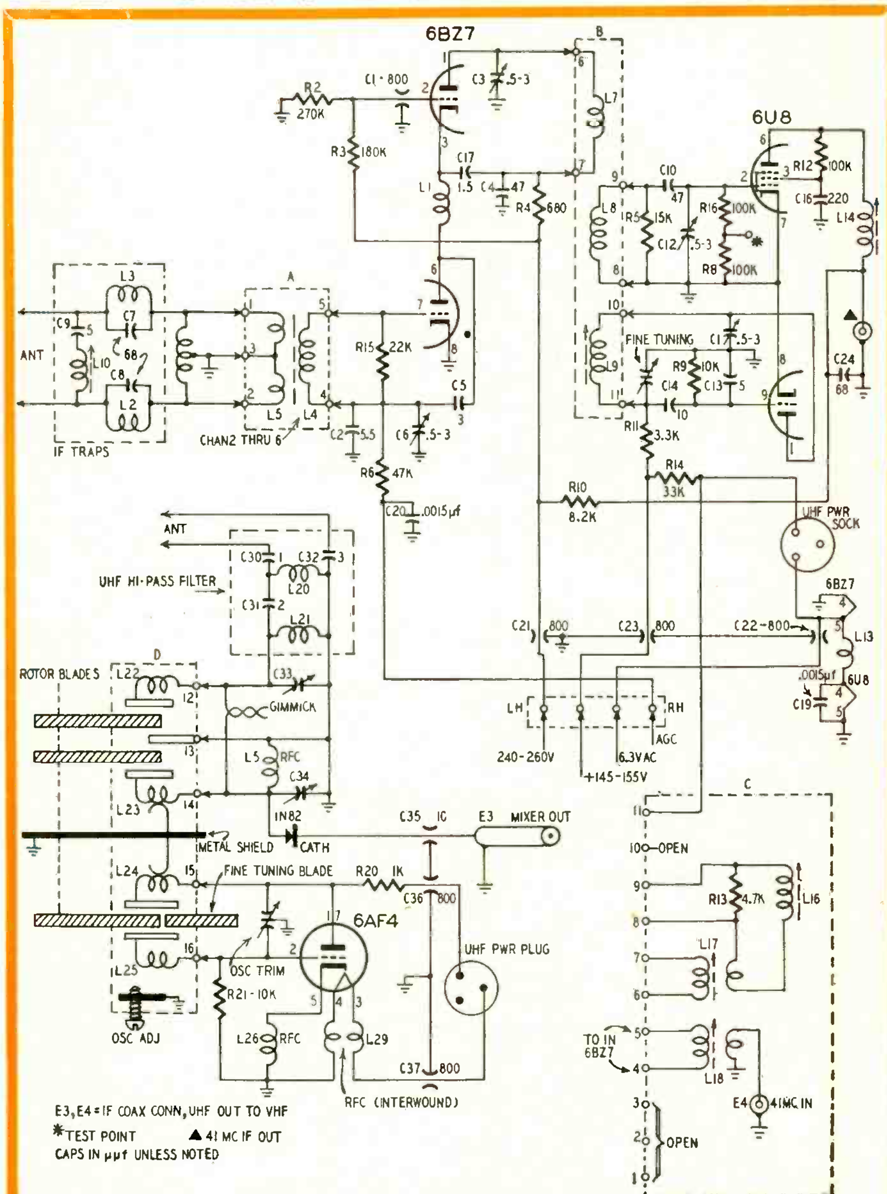


Fig. 3—Schematic diagram of the all-channel turret-type television tuner.

By E. D. LUCAS, JR.

THE new Standard Coil v.h.f.-u.h.f. television tuner is a detent—or step-type instrument designed for exceptionally high gain and low noise reception of channels 2 through 83. It was developed primarily for use with 41-mc i.f.'s, but is available in a modified form for 21-mc i.f. strips.

Using only three tubes, this tuner provides a gain of more than 34 db on all v.h.f. and u.h.f. channels. A high-pass filter and fixed and tunable i.f. traps in the antenna input circuits provide good i.f. and image rejection. On v.h.f., image rejection is better than 50 db and i.f. rejection is at least 60 db at the interfering frequency. The maximum noise figure is 7 db on channels 2 to 6 and 9 db on 7 to 13.

In the u.h.f. range, v.h.f signal rejection is greater than 50 db and i.f. rejection exceeds 60 db. The noise figure is less than 19 db on any channel between 14 and 83. The tuner's r.f. response is flat within 0.25 db per mc for any desired pass-band in the u.h.f. TV spectrum and within 3 db over the v.h.f. bands.

The tuner is small considering its performance and all the parts it contains. Its length (exclusive of shaft) is 7.34 inches, width is 3.5 inches, and maximum height (including tube shields) is 5.6 inches. The shaft length is specified by individual receiver manufacturers to meet their requirements for various chassis and cabinet styles. The tuner requires 6.3 volts a.c. at 1.07 amp, 1.5 volts of negative bias, 250 volts d.c. at 20 ma, and 150 volts d.c. at 12 ma for v.h.f. and 17.5 ma for u.h.f. reception.

Figs. 1 and 2 show that the new tuner is literally a combination of separate v.h.f. and u.h.f. tuners. The larger section contains the v.h.f. section and the smaller chassis contains most of the u.h.f. circuitry. By constructing the tuner in two distinct sections, production is simplified and the sections can be tested separately, reducing the number of rejected finished units. The technician's service problems are simplified when the v.h.f. section is used alone in areas where the number of u.h.f. channels is small.

The tuning control consists of three concentric control knobs or rings mounted on concentric shafts. The outer ring and shaft control the fine tuning for the v.h.f. and u.h.f. oscillators. The central shaft is a decade selector—a sort of band-switch with nine decade positions. One is for v.h.f. channels 2 through 13, one for channels 10 through 19, and the other seven for channels 20 through 83. The innermost of the three shafts controls the selection of the individual channels, both v.h.f. and u.h.f. To tune to channel 4, for example, the central ring is turned to the v.h.f. position (channels 2 through 13) and the innermost ring is then turned until the number 4 appears in the clear plastic window. Now, the outer ring controls the fine tuning. U.h.f. channels are selected the same way.

The v.h.f. section

A major addition to the v.h.f. circuit appears at the extreme left of the v.h.f. chassis in Fig. 1 and schematically in Fig. 3. This feature consists of i.f. traps to reject interfering signals within the 41-mc i.f. pass-band. Tuned circuit C9-L10 is tunable over a range from 35 to 48 mc. Traps C7-L3 and C8-L2 are fixed-tuned for maximum rejection of i.f. interference. The entire trap section is shielded.

The signal passes from the i.f. traps to L5 and L4 mounted on coil board A, shown in Fig. 3. These coils are separate windings, which represents a departure from the antenna coils of the previous Standard Coil 21-mc tuner, since the latter are bifilar-wound. In the new design, the primary L5 is a reversed helix. L4, the secondary, includes an iron core for tuning channels 2 through 6 on the coil boards for those channels. These newly designed windings help isolate the v.h.f. antenna input from the input of the 6BZ7 cascode amplifier. The single-tuned input to this first grid also incorporates a physical shield for further isolation of the v.h.f. antenna and grid circuit.

To compensate for tube input-capacitance variations, the variable steatite capacitor C6 is paralleled with C2. This adjustment is useful when replacing 6BZ7's.

C5 is a neutralizing capacitor. It reduces noise by compensating for the plate-to-grid capacitance of the first triode and minimizes the change in response with changes in the a.g.c. voltage applied to the grid. Thus a flat characteristic is maintained in the first r.f. amplifier stage, and input noise is kept at a minimum. R15 is a damping resistor which improves the VSWR (voltage-standing-wave ratio) on the low-band v.h.f. channels. On the high-band v.h.f. channels, the tube loading takes care of the required damping.

Design of the cascode amplifier is similar to that of the corresponding circuit in the 1952 v.h.f. tuner. At the grid (pin 2) of the second stage, resistors R2 and R3 act as a bias network. The values of these two resistors are selected to provide delayed a.g.c. action on the cascode amplifier. This maintains a high signal-to-noise ratio when a.g.c. is applied to the first triode, until the signal overrides tube noise. Value of the delayed a.g.c. is about 1.5 volts. Feedthrough capacitor C1, in the grid circuit of the 6BZ7 (pin 2), minimizes oscillator radiation.

C17 provides feedback for neutralizing the second triode to improve the tilt of the frequency response *vs.* a.g.c bias curve. This action of C17 and the similar action of C5 in the first triode's plate circuit help to maintain a reasonably flat frequency response despite considerable change in a.g.c. voltage. Output of the cascode amplifier is fed from the second plate (pin 1) of the 6BZ7 through an overcoupled double-tuned circuit, variable trimmer C3, L7, and L8 on oscillator coil board B, to the grid of the 6U8 mixer.

The 6U8 pentode-triode was chosen as the mixer-amplifier (pentode) for v.h.f. and second i.f. amplifier stage for u.h.f., as well as the local oscillator (triode) for v.h.f., for two principal reasons. One is to isolate the plate and grid circuits at intermediate frequencies and thus eliminate the need for neutralization, which was required with the 6J6 mixer-oscillator in the previous Standard tuner. Another reason for choosing the 6U8 is the considerably greater gain (an average of 3 db on v.h.f. channels) possible with the pentode amplifier stage as compared with a triode. It also helps to account for the high gain of the tuner when used for u.h.f. reception.

R5 is a damping resistor used to flatten the response of the overcoupled circuit (L7 and L8) to a maximum variation of 3 db. Trimmer C12 tunes out the variations in internal capacitance between individual 6U8 tubes.

R12 is a screen-dropping resistor to maintain the voltage at a sufficiently low level to prevent excessive dissipation or overloading of the pentode. An interesting feature of C16 is that its leads are relatively long, to increase the screen grid's input impedance—by adding inductance—for the high-band v.h.f. channels. At intermediate frequencies C16 provides adequate isolation.

The combination of L14 and C24 provides a low-side capacitance-output circuit which, with the first i.f. stage of the television receiver, can be tuned to provide any desired bandpass and to minimize oscillator radiation.

All voltages are fed to the oscillator-mixer section through feed-through capacitors C21, C22, and C23, mounted in the center shield, to isolate the r.f. section from oscillator voltage which might appear on the supply leads.

The v.h.f. oscillator, or triode section of the 6U8, is a fairly conventional Colpitts circuit. The negative-temperature-coefficient capacitors C13 and C14 reduce short-term oscillator warmup drift to a minimum. After a minute or so of warmup, drift is negligible.

Fine tuning is achieved by moving a nylon dielectric blade between two electrically-hot plates connected to the oscillator grid and plate circuits. The same fine-tuning control operates similar blades for the v.h.f. and u.h.f. oscillators, with both blades on the same shaft but about three inches apart physically in carefully shielded sections. R9 is a conventional grid-leak resistor, and C1 is a trimmer inserted to compensate for variations in capacity between 6U8 tubes. Oscillator injection voltage is applied to the mixer by the coupling between L8 and L9 on coil board B. L9, like the oscillator coils in previous Standard tuners, is slug-tuned and is accessible from the front of the tuner through a slot in the movable fine-tuning sector. In the new combination tuner, the plastic-tipped tuning tool must be inserted through the u.h.f. section at the front of the tuner to reach the v.h.f. slug core in L9.

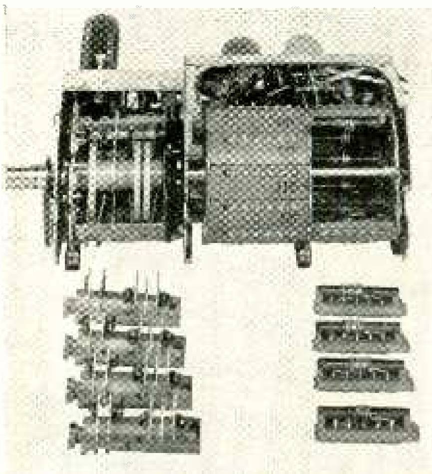
The u.h.f. section

The u.h.f. antenna terminals connect to capacitors C30, C31, and C32 and coils L20 and L21 which form a u.h.f.-band high-pass filter with cutoff below 470 mc. Physically, C30 and C31 are small metal-and-dielectric blades held with nylon screws. This high-pass filter at the antenna input prevents i.f., v.h.f., and other interfering frequencies from entering the u.h.f. section of the tuner.

The remainder of the antenna circuit consists of the portion of coil board D shown above the metal shield (Fig. 3), together with the trimmers C33 and C34, choke L5, and an r.f. coupling gimmick to the 1N82 crystal mixer. There are eight different D type coil boards mounted on the u.h.f. drum. Each of these eight boards covers one of the eight decade bands in the u.h.f. spectrum. A typical coil board D covers the 60-mc range of 10 u.h.f. channels. Channels within this range are tuned by moving dielectric vanes or rotor blades between capacitive plates mounted on the board. This construction is shown in Fig. 4.

The three capacitive blades, attached respectively to L22 and terminal 12, to terminal 13, and to L23 and terminal 14, vary in size and spacing depending upon the decade range to be covered. The tuned circuit of these three blades and associated coils L22 and L23 is prealigned at the factory. Trimmers C33 and C34 are adjusted to tune in any specific u.h.f. channel, an alignment procedure to obtain the correct r.f. bandpass.

The dielectric vanes for tuning individual u.h.f. channels within the decade range covered by each coil board D are so connected to the u.h.f. drum that they are turned by the same inner



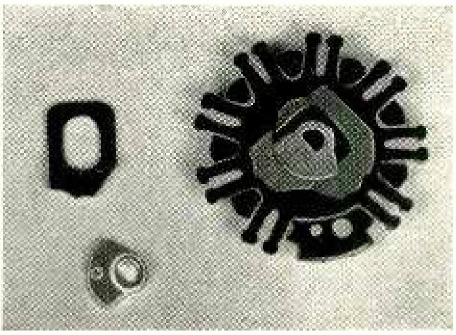


Fig. 4 (Left)—The v.h.f.-u.h.f. tuner with cover and several u.h.f. and v.h.f. strips removed to show the construction. Note the dielectric tuning vanes and the metal blades in the u.h.f. tuner section. Fig. 5 (Right)—The spider disc contains two small cams like those shown to control movement of coil strip C.

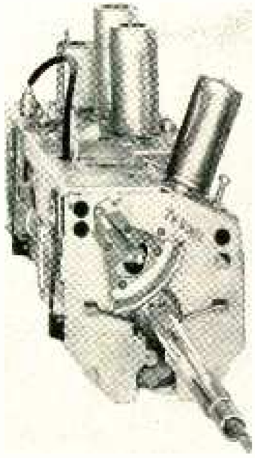


Fig. 6—Front view. The u.h.f. and v.h.f. oscillators are adjusted with plastic tool through the fine-tuning sector.

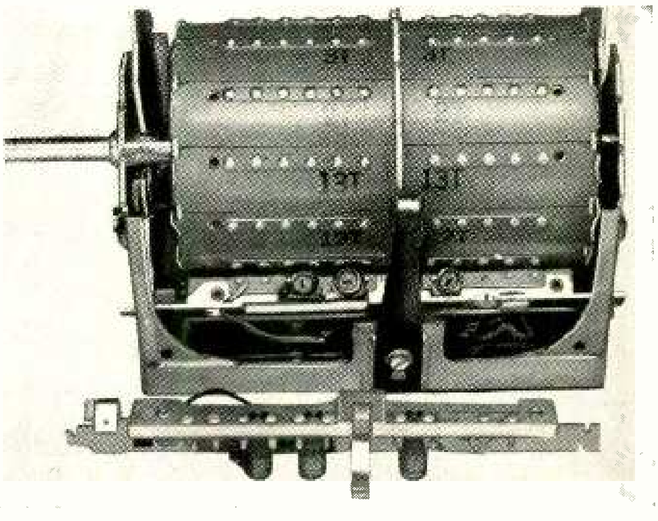


Fig. 7—The "rocking horse" (coil board C is shown below the v.h.f. drum and in the foreground outside of the tuner.

Figs. 4 and 6 courtesy Tech-Master Products Co., Inc.; Figs. 5 and 7 courtesy Standard Coil Products Co., Inc.

tuner-dial ring and shaft that turns the drum for v.h.f. stations. The same control makes the transition between v.h.f. and u.h.f., with the one exception of the decade, channels 14 to 19. Here, because of the action of the small cam shown in Fig. 5, which fits into the larger cam for other u.h.f. decade positions, the unit goes along as a v.h.f. tuner for channels 10, 11, 12, and 13. Then at 14, the small cam operates to switch the tuner to u.h.f. reception for channels 14, 15, 16, 17, 18, and 19. In the normal v.h.f. operation, it is also possible to tune in channels 2 through 13 at the v.h.f. decade position. Thus channels 10 through 13 can be tuned in at two positions of the decade dial's ring.

The u.h.f. oscillator is a 6AF4 operated 41.25 mc above the sound carrier of each TV channel. The oscillator section of each coil board D consists of L24 and L25 connected with fixed metal blades as indicated in Fig 3, the schematic, and shown in Fig. 4. Individual u.h.f. channels within the decade range covered by any coil board D are tuned in by moving a dielectric vane between these two blades.

An adjustment for each board D's oscillator section—corresponding to the slug-tuning of the v.h.f. oscillator coils—is provided by means of the screw indicated on Fig. 3 and shown in the hole in the middle of the fine-tuning sector in Fig. 6. This screw can be turned closer to, or away from, the blade attached to L25 to change the capacitance of the circuit sufficiently to provide an oscillator tuning adjustment. The screw can be reached through the same hole at the front of the tuner that is used for v.h.f. oscillator-slug tuning.

In the circuit of the u.h.f. oscillator, the oscillator trimmer is a split-stator ceramic padder used to compensate for variations in internal capacitance of 6AF4's. The oscillator and incoming signals are heterodyned in the mixer to produce a 41-mc i.f. The 41-mc signal is amplified by the cascoded 6BZ7 and the pentode section of the 6U8 to compensate for the 9-db conversion loss in the mixer.

From the 1N82 mixer, the 41-mc signal is applied through connectors E3 and E4 to coil board C which contains coils for the 41-mc i.f. preamplifier. Coil board C is mounted in the v.h.f. section of the tuner and is used only during u.h.f. reception. It is shown in Fig. 7. Standard Coil engineers call it the "rocking horse" because it rocks from one position depending on whether the tuner is set for v.h.f. or u.h.f. On v.h.f., the spider cams shown in Fig. 5 disengage board C from the springs which make contact with terminals on the exterior of coil boards mounted on the v.h.f. tuner drum.

In all u.h.f. positions, strip C contacts the springs and the v.h.f. drum is disengaged. Board C rocks to and fro so contacts are automatically wiped clean each time the tuner is switched from one of the u.h.f. channels to another.

L16, L17, and L18 form a band-pass circuit which is loaded by R13 to provide flat response over a range of 6 mc. Signals from the mixer are fed over shielded cable to the primary of L18. L16, L17, and the secondary of L18 connect to numbered terminals in the 6BZ7 and 6U8 circuits. The 41-mc signal at the plate of the 6U8 pentode section appears across L14 and is fed from there to the receiver's 41-mc i.f. circuits.

This writer is indebted to Edward F. Theis, vice-president in charge of engineering and research, and Robert Eland, chief engineer of Standard Coil Products Co., for major assistance in the preparation of this article. END

UNDERSTANDING VIDEO I. F.'s

A study of i.f. bandwidth and coupling clarifies the subject

By H. L. MATSINGER

OUR problem with the intermediate frequency stages of AM radio receivers was to get 10-kc selectivity with as much suppression of signals outside that band as we possibly could. In TV we are faced with a harder problem. Our i.f.'s now have to have a passband of 4 *megacycles*, with a sharp cutoff at the upper limit to keep sound modulation out of the picture.

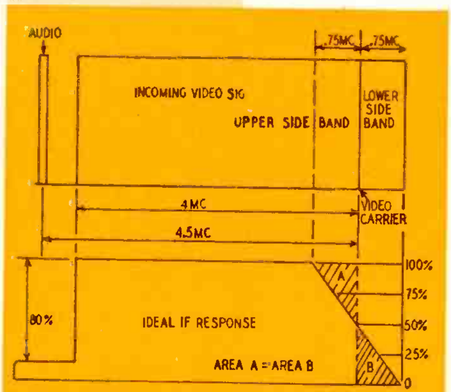


Fig. 1—Relationship between the signal and ideal response of i.f. transformer.

Fig. 1 shows the relationship between the TV signal and the response of an ideal i.f. transformer. For the low modulation frequencies which extend 0.75 mc on either side of the carrier frequency, we have a sloping response. This is so the combined strength of the two sidebands over this region will not add up to more than the single sideband at the higher frequencies.

The ideal curve will have a sharp cutoff at 4 mc, so the sound signal does not interfere with the picture. This type of curve—up to 4 mc—is desirable whether we use split sound or the intercarrier system. With intercarrier sound we must provide for a passband of 4.5 mc, the strength of which should be at least 80% below that of the picture signal.

There are many types of coupling used in i.f. stages: single-tuned, double-tuned, and overcoupled, to mention the most common. In every case there is a good reason for using some particular type. Some sets are designed with low cost as the most important factor; others with best performance; and still others represent a compromise of the two. As a rule of thumb, it is safe to say that the more aligned circuits a set has, the better will be the picture. It does not make a great deal of difference whether the i.f. is 24 or 44 mc; it is the i.f. band-width and shape which determines picture quality.

When we use an i.f. amplifier consisting of only three stages of single coil, single tuned transformers (Fig. 2), it is hard to get good results. The single-tuned coil gives a sharply peaked response, and it is necessary to place a resistor (4,000 to 10,000 ohms) across the coil to broaden its response. In such an amplifier, the adjustments are so few and the circuits so sharply peaked, that

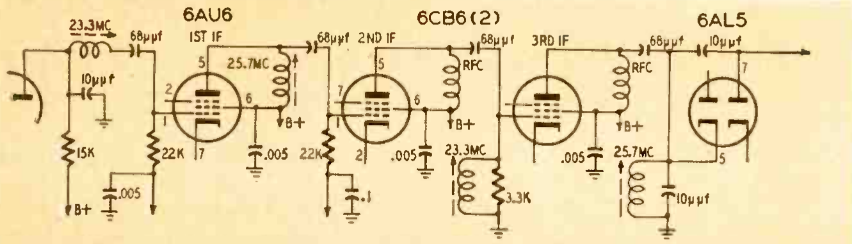


Fig. 2—Typical single tuned i.f. coils. Circuit is similar to Mirrortone 17MC.

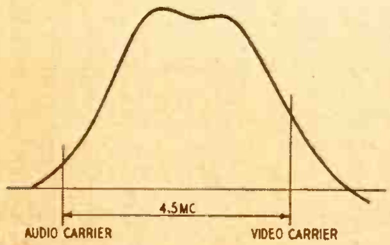


Fig. 3—Overall response of Fig. 2.

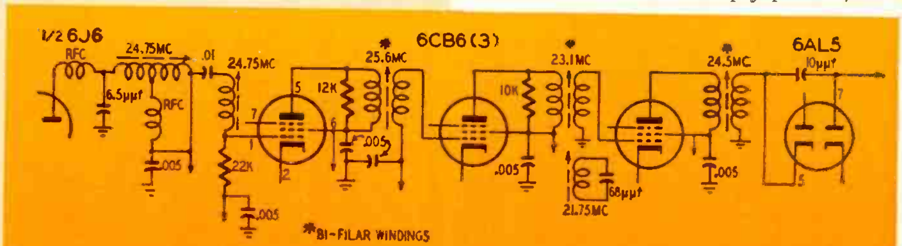
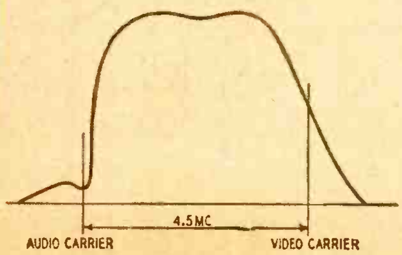
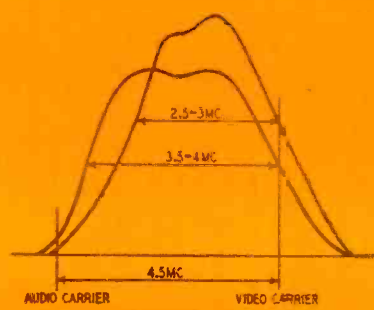


Fig. 4—I.f. circuit with overcoupling, similar to the Hallicrafters A1100D.

Fig. 5—Right, diagram shows overall response of Fig. 4.

Fig. 6—Far right, i.f. gain greatly increased by peaking.





no amount of tuning will give us a really good response curve. To get good low-frequency response, and still retain about 85% of the picture components, we have to sacrifice some of the higher picture frequencies.

When a tuned circuit is loaded, as when plate current flows through it, there is a tendency for the resonance peak to be reduced. On the other hand, a grid circuit will tune sharply. Many design engineers, to take advantage of this, alternate the tuned circuits in the i.f. stages.

Mirrortone model 17MC is a good example of this. The mixer plate is shunt fed through a resistor, and the first i.f. coil is in series with the first i.f. grid. The unloaded coil tunes sharply. A broadening effect is introduced because the next tuned circuit is in the plate of the first i.f. tube. The second i.f. is untuned, in both the plate and grid, giving some amplification, but having little effect upon the response curve. The third i.f. stage is grid tuned, but the response is broadened by the use of the parallel 3,300-ohm resistor. There is also another tuned circuit before the video detector. This design is not flexible, and Fig. 3 represents about the best that can be done. The 4-mc upper limit of video modulation comes down about 50% on the response slope. This is not too bad, since it is possible to regain much of this by peaking in the video amplifier.

Fada uses a similar circuit in their model 7T32; except for the addition of a 21.6-mc trap in the grid circuit of the third video i.f. This trap, in addition to removing adjacent-channel video signals, also permits the proper positioning of the sound channel on the flat portion of the response curve.

Although stagger-tuned 3-stage i.f. amplifiers are often used in less expensive sets, full 4-mc bandwidth is easily attained through use of an additional stagger-tuned stage. A wise choice of peaking frequencies and adequate traps can result in response and gain that meet all standards of performance. The 630, Radio Craftsmen, Hoffman, and other makes and models provide high-gain 4-mc-wide i.f. response with 4-stage stagger-tuned systems.

We obtain better control over the response and gain of 3-stage stagger-tuned amplifiers when the tuned chokes and R-C coupling networks are replaced by dual-winding transformers with a single tuning adjustment. Bandwidth and gain are controlled by varying the turns ratio and spacing between the windings and by shunting a resistance across one or both windings. The response and alignment procedures of a single-tuned transformer are about the same as when a tuned choke is used.

The basic i.f. circuit of the Hallicrafters chassis A1100D is shown in Fig. 4. The total effect of tuning the circuit is shown in Fig. 5. The output of the mixer is a tapped coil tuned to 24.75 mc. Plate current flows through this coil, and it is capacitively coupled to a second coil, also tuned to 24.75 mc. A bifilar i.f. coil, with single slug tuning, is used between the first and second i.f. tubes. The same type coil is used between the second and third i.f. tubes, which has, in addition, an absorption trap tuned to 21.75 mc. This trap is used to remove any adjacent-channel picture signal, and can be used as an aid in the proper positioning of the sound channel. Another single-slug-tuned bifilar coil is used in the input to the detector. To help broaden the response of the i.f. in the first and second stages, two resistors of 12,000 and 10,000 ohms respectively are used across the primaries.

The foregoing arrangement is very flexible. You have ample control of the bandpass. Ample bandpass means good detail. With the larger tubes, and good bandpass, you can see flies buzzing around the studio.

Some sets use double-tuned i.f. transformers to obtain the desired bandpass. The windings are placed close together (overcoupled) so a double-humped response curve is obtained when both are tuned to the same frequency. Schematically, the circuit of an overcoupled i.f. stage is essentially the same as the single-tuned transformer-coupled circuit in Fig. 4. You can usually identify overcoupled transformers by the dual tuning slugs or trimmer capacitors. However, the mere fact that a transformer can has two tuning adjustments does not necessarily mean that it is an overcoupled unit. It may be a tuned choke or a single-tuned transformer with a built-in adjustable trap. Check the schematic to be sure. Some overcoupled transformers may have a small capacitor connected between the grid and plate terminals to prevent a droop at the high end of the passband.

Alignment

In fringe areas, where the basic picture is more important than the fine detail, it is possible to get more energy by narrowing the passband. Truetone suggests that this trick be used with their model 2D2149A. In normal reception areas, a passband of 3.5 to 4.0 mc is used; while in fringe areas, a passband of 2.5 to 3.0 mc is recommended. As indicated in Fig. 6, you do get a worthwhile increase in gain. Of course, picture detail and sound output will be less. To compensate for the loss in sound signal, Truetone has available a plug-in adapter which incorporates two stages of sound i.f. This adapter plugs into the socket provided for the regular sound i.f. tube, and gets its power from the chassis. Almost any service technician can make up this type of an adapter if he wishes to take advantage of the gain from a narrowed i.f. bandpass.

The most common method of aligning overcoupled i.f. amplifiers is to use a scope and sweep generator. The scope is connected across the video detector load or across the output of the video amplifier. A single frequency—usually set at about the center of the i.f. passband—is used for alignment of all stages. The generator is set for a sweep of about 10 mc and its output is fed to the grid of the last i.f. stage. The i.f. output transformer and traps, if any, are adjusted for the desired response at this point. The sweep generator is then moved in steps from the grid of one i.f. stage to the next until the mixer grid is reached. At each point, the circuits are adjusted for the specified over-all response curve at that point. Be sure to check the set manufacturer's data for alignment procedure and response curves.

Alignment of the sound i.f. in an intercarrier sound receiver is quite simple; almost like the older AM sets. We have two signals in the output of the video detector, one containing the picture elements which extends up to 4 mc beyond the zero frequency, and the other is the 4.5-mc beat (plus or minus 25 kc for 100% modulation) which can be likened to the squeal which we sometimes get on an AM receiver. In AM jobs, the squeal comes from adjacent station interference, in TV it is an intentional co-channel beat, the beat of the FM audio.

The sound take-off is from the output of the detector or video amplifier, through a coupling capacitor or transformer which acts as a wave-trap, but the amplifier is always tuned for 4.5 mc. There are no tricks in the audio i.f., just straight peaking.

With most signal generators, exclusive of those which are crystal controlled, there is a degree of error. If you are not certain of your signal generator, you can always fall back on the crystal used by the transmitter. Tune in the test pattern signal with constant tone modulation, connect your output indicator, and align for maximum signal. You can also align the ratio detector with the same signal, since with constant tone modulation the deviation on either side of the center frequency is the same, and the exact center will be zero. If you use a voltmeter, the correct setting is halfway between minimum and maximum. Alignment of split carrier sets is identical except for center frequency used (it must be accurate, too). Whenever possible, consult manufacturer's data before aligning.

If there are any 4.5-mc traps in the circuit, align these with care, for they can destroy picture quality when tuned too low. The best way to be certain is to shoot a strong 4.5-mc signal through the detector output, hook the terminals of your oscilloscope across the trap, and align for maximum indication. You can also align for least herringbones on the picture, but sometimes the signal is so strong that you have to go way below 4.5 mc to remove them, and you end up taking away picture detail. The resonance method is the best.

Before you call any i.f. alignment job complete, always make an over-all check through the input of the set. No matter how well you align the i.f.'s, an improperly aligned oscillator will gum up the works. If there is any doubt, check and recheck. It might even be a good thing to zero heat the signal generator against the transmitter's carrier on each channel to be received. END

VERTICAL SWEEP TROUBLES

The vertical sweep circuit is not too complex: by turning a few controls you can usually localize the trouble

By CYRUS GLICKSTEIN

VERTICAL sweep circuit troubles are among the most common in TV. In fringe areas especially, vertical roll is a frequent complaint. As a background for trouble-shooting, let us look at the basic circuit operation.

A typical vertical sweep circuit is shown in Fig. 1, with a blocking oscillator as the sawtooth generator. A multivibrator oscillator for generating the sawtooth is shown in Fig. 2. Both types of oscillators are in common use. The same symbols in the two diagrams refer to components having the same function.

For proper operation, the vertical circuit output waveform must have the correct *frequency*, *amplitude*, and *linearity*. The free-running frequency of the sawtooth sweep depends mainly on the time-constant of the R-C network in the grid circuit, C4, R4, and R5 (Fig. 1). C4 acts as the grid leak capacitor in the oscillator circuit. R4 and R5 in series act as the grid-leak resistor across which C4 discharges. A negative voltage, which keeps the oscillator tube cut off most of the time, is developed from grid to ground. Varying R5 changes the time-constant of the discharge circuit—that is, the speed with which C4 can discharge—thereby varying the frequency of oscillation. R5 is the vertical hold control.

For proper operation, the vertical hold control must be set so the free-running frequency is somewhat *below* 60 cycles. Then the vertical synchronizing pulses will trigger the oscillator and keep it in sync with the transmitted signal.

Troubles in the oscillator circuit, the sync circuit, or the video strip may account for a loss of vertical sync. Vertical roll occurs more often in fringe areas because of the low signal-to-noise ratio. Horizontal synchronization is less affected by the low signal level because of a.f.c. (automatic frequency control) commonly used in horizontal sweep circuits.

R1, R2, R3, C1, C2, and C3 make up the integrating network. This network builds up the vertical sync pulses, which come in at the end of each field, to the point where they can trigger the vertical oscillator and start the retrace, sending the beam back to the top of the picture tube to start the next field.

The *amplitude* of the vertical output waveform determines the height of the picture or raster, and is controlled by the following factors:

1. The time constant of the R-C charge circuit which generates the modified sawtooth waveform (C5, R6, R7, and R8).
2. The amount of B plus applied to this charge circuit.
3. The amount of amplification in the output stage (including the yoke).

In the charge circuit of the sawtooth generator, C5 is the sawtooth charging capacitor and R6 is the peaking resistor. The charge and discharge of C5 through R6 produces the modified (trapezoidal) waveform (from the top of C5 to ground) which is required to deflect the beam vertically (Fig. 3-a).

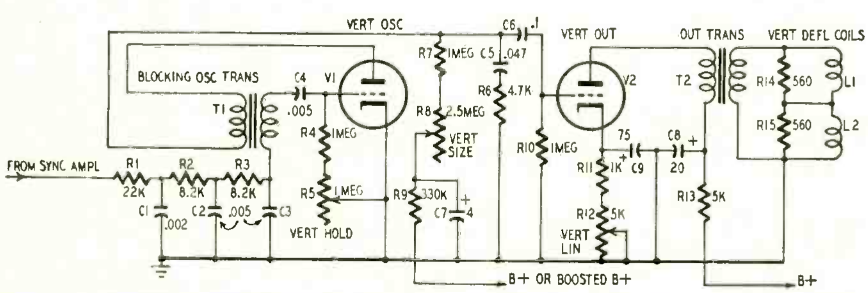


Fig. 1—Vertical sweep circuit. Blocking oscillator generates sawtooth wave.

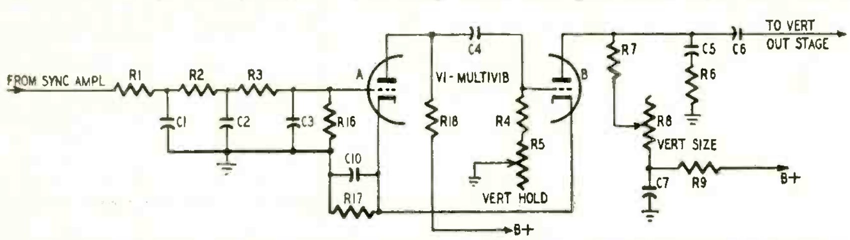


Fig. 2—Schematic of a multivibrator generator for vertical sawtooth waves.

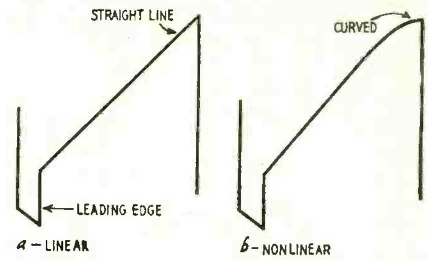


Fig. 3—Modified sawtooth waveforms.

The charge path of C5 is through R6, R7, and R8 to B plus. The discharge path is through R6, V1, and the primary of T1 (Fig. 1). The value of B plus and the time-constant of C5, R7, and R8 are the main factors determining the voltage amplitude to which C5 will charge before the sync pulse causes V1 to fire. The peaking resistor R6 is for wave shaping. R6 determines the amplitude of the leading edge of the wave only (Fig. 3-a), and this affects the linearity of the output. Varying R8, the vertical size control, varies the time-constant of the charge path and so varies the height.

R9 and C7 act as a decoupling circuit to prevent any B plus ripple from getting into the vertical sawtooth generator. At the same time, they prevent any sawtooth voltage from being applied to the B plus line and fed into other circuits. (C7 charges up to the value of B plus, therefore R9 is not part of the charge circuit for C5.) In many receivers, the voltage applied to the vertical oscillator plate is the boosted B plus from the horizontal damper circuit.

The *linearity* of the sawtooth is responsible for the even distribution of the picture, with no vertical stretching, crowding, or foldover at the top or bottom. A linear modified sawtooth waveform is shown in Fig. 3-a; Fig. 3-b shows a nonlinear one, which will produce a nonlinear picture, possibly with foldover at the bottom (Fig. 4). R12 (Fig. 1), the vertical linearity control, is part of the cathode resistance in the vertical output stage. Varying this control changes the amount of cathode bias, shifting the operating point of V2 to compensate for any nonlinearity in the sawtooth. Since changing the bias also changes the amplification, it is usually necessary to vary the vertical size control when the vertical linearity control is varied. Nonlinearity in the vertical output which cannot be corrected by the linearity control may be caused by a fault either in the sawtooth generator (oscillator stage) or in the output stage.

T2 (Fig. 1) is the vertical output transformer feeding the stepped-down sawtooth voltage (and stepped-up sawtooth current) to the yoke. In many receivers, T2 is an autotransformer (one winding), with the output taken off the lower part of the winding. R13 and C8 are a decoupling circuit. L1 and L2 are the vertical deflection coils which deflect the C-R tube beam vertically. R14 and R15 are damping resistors which load down the deflection coils and damp out any oscillations that might be caused by the sharp polarity changes in the sawtooth wave.

Troubleshooting

Methods for finding troubles in the vertical sweep system are:

1. Analyzing indications on the screen and checking the effect of varying the controls; especially the vertical controls—hold, size, and linearity.
2. Tube changes.
3. Waveworm analysis on the oscilloscope.
4. Resistance and voltage measurements.

The first step in localizing vertical faults is careful observation of the information on the screen and of how the picture or raster is affected as the controls are rotated.

For example, the picture which was previously normal, rolls vertically, and cannot be stopped by the vertical hold control. If this happens on each active channel at a normal contrast control setting, there is obviously a loss of vertical sync. The fault may originate in the vertical oscillator or in the preceding sync or video circuits.

A simple check can indicate the probable location of the trouble. Rotate the vertical hold control through its range. (When the picture rolls upward, the vertical oscillator frequency is too low; when rolling downward, the frequency is too high.) If the picture rolls upward at one extreme of the control rotation and downward at the other extreme, this indicates the oscillator is capable of reaching the frequency needed for correct operation but is not being synchronized properly. Therefore the fault must be in the video or synchronizing circuits. If the vertical hold control cannot make the picture roll in both directions (when there is a loss of sync), the fault is usually in the vertical oscillator stage. In either case, the next step is to change the tube or tubes.

When, as a result of the above test, trouble is indicated in the video or synchronizing circuits, the fault may be a weak r.f. amplifier tube, video amplifier tube, or sync separator or clipper tube. These tubes should be changed before looking for further trouble. As a check, before changing these tubes, rotate the horizontal hold control. Trouble in the video or sync circuits affects both vertical and horizontal pulses, but the fault may show up as a loss of vertical sync only because of the greater stability of the horizontal sweep circuit. If the horizontal hold has a smaller than normal range, this indicates weaker than normal sync pulses —both horizontal and vertical—and the trouble is in the video or sync circuits. To narrow down the source of trouble further, a defect in the video circuit usually shows up in the picture quality—as an overcontrasted, weak, or noisy picture. Where the picture quality is normal, and the horizontal hold has the normal range of control and the vertical hold makes the picture roll in both directions, the fault is most likely to be in the integrating circuit.

If tube changes do not eliminate the trouble, signal tracing with an oscilloscope can be used to localize the fault. By noting the peak-to-peak amplitude of the wave and the shape, and comparing these to the information provided in the manufacturer's service notes, it is possible to find the approximate location of the fault quickly. D.c. voltage and resistance checks, compared to the correct readings in the service notes, usually tell the rest of the story immediately.

The main troubles in the vertical sweep system are:

1. Vertical roll.
2. Poor linearity, or foldover at top or bottom or both.
3. Inadequate height.
4. Loss of vertical sweep—horizontal line.

Other less common troubles are:

5. Poor interlace.
6. Intermittents.
7. Vertical buzz.
8. Keystoning.

Circuit defects

The basic trouble-shooting procedures described above should be used in each case of vertical trouble. To serve as a handy reference guide, the most common causes for each of these troubles will be noted.

Frequently, the manufacturer's field service bulletins will list certain troubles that might be anticipated, and troubleshooting procedure. These of course should always be referred to. The following are general in nature.

1. Poor vertical sync (including vertical roll, jitter, and instability). Vertical jitter may be caused by incorrect control settings: excessive contrast setting or a vertical hold setting too near the lock-in point. The common causes

Courtesy Allen DuMont Labs.

Fig. 4—Vertical foldover; caused by excessive nonlinearity of sawtooth.

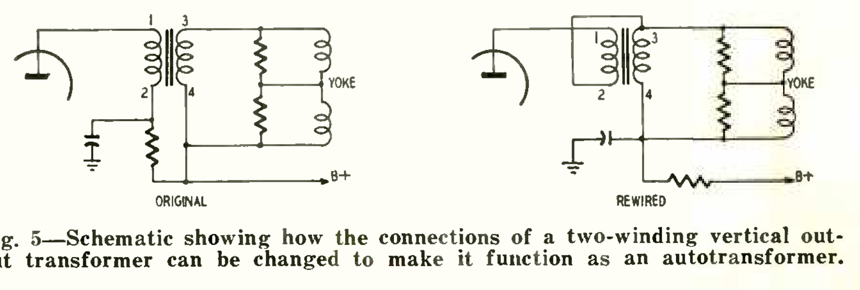


Fig. 5—Schematic showing how the connections of a two-winding vertical output transformer can be changed to make it function as an autotransformer.

for poor vertical sync include: poor signal-to-noise ratio or fault in the video, sync, integrating, or vertical oscillator circuits. The methods for isolating the cause to a given circuit were outlined above in the discussion of trouble-shooting methods.

When the instability originates in the vertical circuit, the most common causes include:

Defective tubes. Change the oscillator tube (and output tube if there is any feedback from the output to the oscillator stage). In receivers using a 6BL7-GT tube, try a 6BX7-GT. The pin numbers are the same. If insufficient vertical size and compression at the bottom results, make certain the vertical oscillator plate circuit is returned to the boosted B plus point. If foldover at the top of the picture occurs after the tube is changed, increase the value of peaking resistance (R6, Figs. 1, 2) by about 2,000 ohms.

Change of value of grid capacitor (C4, Figs. 1, 2) or grid leak resistor (R4, R5).

Insufficient decoupling in the vertical circuits. If there is no decoupling circuit in the output stage, insert one between the bottom of the output transformer primary and the B plus supply —a 5,000-ohm, 5-watt resistor and a 20-μf, 450-volt capacitor (R13, C8, Fig. 1). This prevents feeding a ripple into the B plus supply from the vertical output stage, which may in turn be fed to the sync circuits to trigger the vertical oscillator out of phase. In sets where the vertical oscillator plate circuit is connected to low-voltage B plus, decoupling is sometimes insufficient and an additional decoupling circuit may be needed.

A slight ringing in the blocking oscillator transformer may be responsible for unstable sync. A 10,000-ohm, 0.5-watt resistor across the primary (plate) winding of the blocking oscillator transformer dampens ringing which might interfere with sync.

Pickup from leads which are not correctly dressed may be responsible for poor sync. Some possibilities are: damper filament leads too close to the vertical oscillator; hot horizontal deflection coil lead too close to the vertical oscillator.

Vertical sync pulses which are too small in amplitude can be the cause of unstable vertical sync, especially in fringe areas. In such cases, it may be necessary to modify the sync circuit to obtain a larger output.

2. Poor linearity or foldover. The most important reasons for nonlinearity are:

Incorrect adjustment of the vertical linearity control. In some receivers, misadjustment can cause foldover.

Bad vertical oscillator or output tube.

Leaky coupling capacitor to the vertical output stage or a leaky charge capacitor (C5, Figs. 1, 2).

Low line voltage or low B plus. If the line voltage falls below 105, vertical foldover may result. In homes where this is likely to occur, as one of the first steps check the line voltage. If the line voltage is O.K., change the low-voltage rectifier tube.

Other possible troubles include: defective blocking oscillator or output transformer; defective cathode resistor or bypass capacitor in the vertical output stage; leaky decoupling capacitor in the plate circuit of the vertical oscillator or output stage.

When there has been poor linearity from the beginning, that could not be corrected by the vertical linearity control, a small change in value of peaking resistor (R6, Figs. 1, 2) may correct it. Increasing the value of this resistor (25 to 50%), causes stretching at the top of the picture; decreasing the value causes compression.

3. Inadequate height. If the inadequate height is due to foldover, then the basic fault is foldover rather than inadequate height. The most important reasons for insufficient height are:

Low emission of the vertical oscillator or output tube. Change tube or tubes. In many receivers, a dual tube is used for both stages.

Low line voltage or low B plus. If the line voltage is normal, change the rectifier tube. Low line voltage or low B plus usually results in insufficient width also. When width and height are both affected, look for trouble in the common supply—either B plus or boosted B plus. In many sets, the vertical oscillator is fed from the boosted B plus point.

Other possible defects include: change of resistor values in the charge circuit, or change in the value of charging capacitor; defective vertical output transformer; open capacitor in the decoupling circuit of the output stage (C8, Fig. 1); change of resistor value in either decoupling circuit (R9 or R13, Fig. 1); defective yoke (ferrite core cracked.)

If the fault has been present from the beginning, check the manufacturer's field modifications for the particular model. Some common methods for increasing height include: Boosting B plus with new (or a more efficient type of) low-voltage rectifier tube; using a 6Y6-G instead of a 6K6-GT as the vertical output tube in converted 630 type sets where the filament supply permits this (the 6Y6-G filament takes 1.25 ampere, about three times the current of the 6K6-GT); lowering the value of the fixed resistor in the charge path (R7, Figs. 1, 2) to two-thirds or one-half the original value; changing the two-winding vertical output transformer connections to make it function as an autotransformer (Fig. 5).

4. Loss of vertical sweep. The most common cause is a defective vertical oscillator or output tube. Other common causes are: shorted charge capacitor; shorted decoupling capacitor to B plus in the oscillator or output stage; open blocking oscillator transformer; open vertical output transformer; open yoke. In some receivers, a circuit is used where the vertical output stage feeds back a signal to keep the vertical oscillator operating. In these models, a defect in the output stage may be responsible for no output at the plate of the vertical oscillator.

5. Poor interlace. Poor interlace shows up as the pairing of lines with black space between. This fault is particularly annoying on large screens since it shows up to a much greater degree. The most common defect causing this is a defective capacitor in the integrating circuit. However, in some receivers, interlace is not optimum and circuit changes are recommended by the manufacturer to improve the condition. These changes may include one or both of the following: reducing the value of peaking resistance to about half or shorting it out altogether; reducing the value of cathode resistance in the vertical output stage about 25%. Other causes for poor interlace include: misadjustment of the vertical hold control; horizontal leads in the high-voltage compartment dressed too close to the vertical oscillator stage.

6. Intermittents. The most common causes for intermittent operation in the vertical circuit as in other circuits are defective tubes or capacitors. But this fault can be caused also by almost any other defective component—including resistors and transformers.

Intermittent operation of the vertical circuit usually shows up as intermittent collapse of the picture to a horizontal line, or as intermittent foldover. An additional reason for intermittent collapse to a horizontal line is momentary oscillation of the vertical output tube. Remedies for this condition include: a new tube; a 330-ohm resistor from the grid to the grid return; a 100-ohm resistor between the plate and screen when the output tube is a pentode connected as a triode.

7. Vertical buzz. A 60-cycle buzz may be caused by pickup from the vertical circuit, hum in the audio, loose laminations in the power transformer, and sync buzz in the audio in intercarrier sets. To check whether the buzz is originating in the vertical circuit, vary the vertical hold control. If this varies the pitch of the buzz, the buzz is being picked up from the vertical sweep circuit. Possible causes for this are: audio cable is (even if shielded) too close to the vertical output tube; loose laminations in one of the vertical transformers; an insulation breakdown in the vertical ouput transformer. If a vertical transformer has defective windings, this shows up as a defect in the vertical sweep also.

8. Keystoning. (Picture becomes narrow at the right or the left side.) Keystoning is caused by a short or partial short in one section of the vertical deflection coil (yoke) or a defective damping resistor (R14, R15, Fig. 1).

While not covering every possible defect, this should facilitate vertical sweep servicing in general. END

SERVICING HORIZONTAL SWEEPS

By ROBERT B. SMITH*

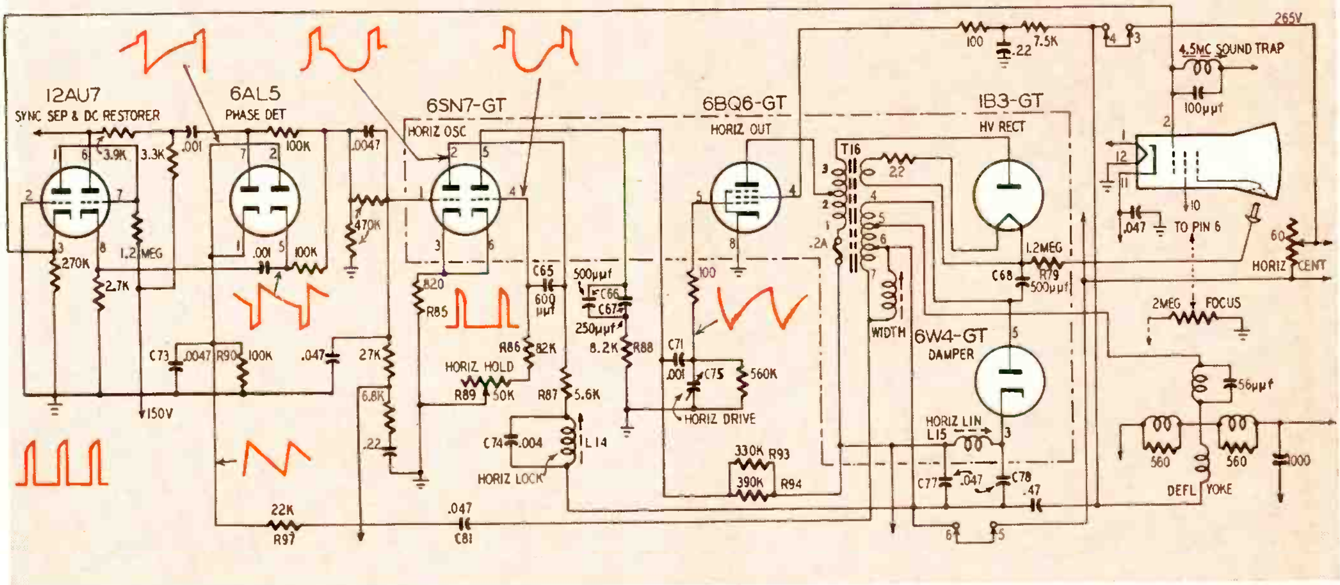


Fig. 1—Schematic diagram of the horizontal section of Sentinel model 438 XD chassis. Waveforms are shown throughout.

THE functions of the horizontal circuit in TV receivers are: 1. To provide horizontal sweep. 2. To supply high voltage. 3. To closely control horizontal frequency. 4. To provide a power boost.

Starting with the horizontal phase detector circuit, let us examine the high points of the horizontal section (Fig. 1). Two voltages are fed into the 6AL5 balanced phase detector. They are the incoming signals' horizontal sync pulses and the horizontal reference feedback voltage. These two voltages are compared in phase, and the d.c. voltage developed is applied to the control grid, pin 1 of the 6SN7-GT horizontal oscillator. The d.c. voltage varies the plate resistance of the tube, keeping the oscillator from going out of synchronization.

The horizontal sync pulses are applied to the 6AL5 phase detector through two .001-μf capacitors to pins 7 and 5 respectively. The horizontal reference voltage is appled simultaneously tc pins 1 and 2 of the phase detector through the .047-μf capacitor (C81) and the wave-shaping network consisting of R97, R90, and C73.

The phase detector functions as a close-tolerance automatic frequency control. It is called a phase detector because it must prevent any shift in horizontal oscillator frequency, and any change in phase of the oscillator with respect to the synchronizing signal. Any tendency of the horizontal oscillator frequency or phase to change is automatically offset by the counteracting d.c. voltage from the phase detector.

The circuit action can be observed by connecting a v.t.v.m. to pin 1 of the 6SN7-GT horizontal oscillator and noting the positive-to-negative voltage change as the horizontal hold control is varied. *Never use anything but a v.t.v.m. on this pin.* (A 1,000-ohm-per-volt meter would start a pulse 10 times normal amplitude throughout the horizontal circuit. This will break down parts unable to stand the abnormal voltage.)

The 6AL5 phase detector creates a d.c. voltage proportional to the phase relationship of the signals' horizontal sync and the receiver's horizontal reference voltage. This d.c. voltage is used for automatic control of the horizontal oscillator.

The horizontal oscillator is a cathode-coupled multivibrator, with parallel sawtooth-forming capacitors (C67 and C66) and a platform-forming resistor (R88) connected in series from the plate (pin 5) to ground. The fundamental frequency determining components are the 600-μμf capacitor (C65) from plate (pin 2) to grid (pin 4) and the resistors R86 and R89 in the horizontal hold circuit from grid to ground. The other factor controlling frequency is the d.c. voltage on the grid (pin 1).

Horizontal lock coil

The ability of the circuit to maintain synchronization is stabilized by the horizontal lock coil connected between the 5,600-ohm 5%-tolerance plate-load resistor (R87) and B plus. The value of this plate-load resistor is critical, and is a frequent source of horizontal instability when either the 6SN7-GT or the .047-μf feedback capacitor (C81) shorts and causes excessive current flow through it. It is not uncommon for this 5,600-ohm resistor to change in value, several thousand ohms. When it does it is impossible to adjust the horizontal lock and properly stabilize the picture.

The horizontal lock coil (L14) has a .004-μf silver mica capacitor (C74) in parallel, making a parallel-resonant circuit. As the inductance is varied its resonant frequency is changed. This resonant circuit introduces a 15,750-cycle ripple into the plate voltage applied to the left triode section of the horizontal oscillator. In operation, just as the grid voltage is decaying from its negative peak, this positive-going ripple in the plate triggers the tube into conduction. For the balance of the cycle, the ripple voltage lowers the plate voltage in a negative direction.

This reduced plate voltage makes the oscillator less sensitive to transient noise pulses which might start a cycle at the wrong time. At the time for the next cycle, the ripple is positive-going and helps trigger the oscillator into action at the proper time. The energy to maintain the lock circuit in oscillation is derived from the pulses of current through it.

The sawtooth voltage waveshape produced in this circuit is coupled to the grid of the 6BQ6-GT horizontal output tube through a .001-μf capacitor (C71). This .001-μf capacitor and the drive

*Service Manager Sentinel Radio Corp.

capacitor (C75) form a capacitance voltage divider which determines the amount of signal or drive that is applied to the 6BQ6. Grid-to-cathode rectification provides the bias voltage for the horizontal output stage. The larger the signal applied, the higher the negative bias or drive voltage.

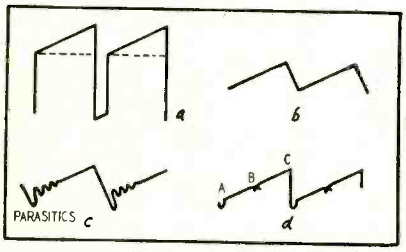


Fig. 2—Waveforms used in analysis of horizontal sweep circuit operation.

A versatile signal

The amplified signal in the plate circuit does quite a number of things. It supplies a pulse for the high voltage applied to the 1B3 rectifier. It supplies the filament voltage for this high-voltage rectifier. A voltage is applied in the yoke circuit which enables the spot to be moved in the horizontal sweep. And last but not least, part of the signal is used as a horizontal feedback reference voltage.

The very rapid cutting off of current in the 6BQ6 plate circuit causes a high-voltage pulse to be created in the primary of the horizontal output transformer (T16). This pulse is stepped up by the autotransformer action and applied to the 1B3-GT plate. Its rectification provides the high voltage for the picture-tube second anode, through the R-C π filter formed by the 1.2-megohm resistor (R79) and the 500-μμf 20,000-volt capacitor (C68), and the capacitance of the picture tube anode to the aquadag coating and ground.

One of the lesser known difficulties that arise in the high-voltage section is an arc that is audible only when the brightness is advanced far enough to bring the picture tube above cutoff. The arc frequency increases as the brightness control is advanced. This is usually due to an arc inside the 1.2-megohm high-voltage filter resistor (R79). Many service technicians inadvertently contribute to the failure of this resistor by excessive arcing of the picture tube anode connector to ground as a check for high voltage. A shorted picture tube also will cause this trouble. Resistors have a voltage rating that is just as important as those used for capacitors. A ½-watt resistor should never have more than 400 volts placed across it, or arcing from granule to granule will occur. This "eats" out the center and increases the resistance beyond tolerance, and at times may open the resistor.

Evolution of the circuit

Before examining the process of producing the sweep current in the yoke, it would be a good idea to consider some history of the design of horizontal circuits. The first electromagnetic-deflection sweep circuits had to have a perfect trapezoidal voltage wave (Fig. 2-a) to apply to an inductive circuit like the yoke to obtain a sawtooth current wave (Fig. 2-b) through it.

When this trapezoidal wave was applied to the horizontal section of the yoke it was found to produce parasitic oscillation which resulted in a very nonlinear sweep at the left side of the raster (Fig. 2-c). The damper tube was installed to suppress this parasitic oscillation by absorbing energy from it and quickly damping it. It was then found that the damper continued to conduct, interfering with the sweep. It was quite a problem to design a circuit in which the damper would stop conducting soon enough to allow linear sweep.

The final decision was to design the circuit of the horizontal output transformer and yoke to resonate at about 70 kc. A half cycle of this parasitic oscillation could then be used to provide a very rapid retrace. This was the first negative half-cycle of the parasitic oscillation. The positive half-cycle made the 6W4 damper tube conduct, and due to the time-constant of the damper circuit it continues to conduct for approximately one-half line of the horizontal trace A-B (Fig. 2-d). Just as the 6W4 current starts to drop off, the grid of the 6BQ6 is brought up above cutoff and the horizontal output tube current provides the energy through the output transformer which gives the last half of the horizontal sweep B-C for that line (Fig. 2-d). Thus, the 6W4 is active in the first half, and the 6BQ6 is active for the last half of the horizontal line. This can be seen by setting the drive too high. There will appear in the center or the left of the raster a tendency to squeeze, and several bright vertical lines show that the 6W4 and the 6BQ6 are not able to transfer the horizontal sweep action as smoothly as they should. Also, the sawtooth fed into the horizontal output tube is a far cry from a trapezoidal waveshape.

We see that the diode called the "damper" is not just loafing along on one job at all. As a matter of fact, the engineers had another bright idea. As long as the damper was rectifying the parasitic oscillation, why not throw in a filter circuit and use the rectified voltage to give us a higher positive voltage than we could normally get from the power supply? Thus power boost was born. This higher positive voltage is used for the plate of the horizontal output tube, the horizontal oscillator, and the vertical oscillator. It is sometimes used for the first-anode supply on the picture tube.

Summary

The damper tube dampens parasitic oscillation, provides the first half of our horizontal sweep, and gives us power-boost voltage to be applied wherever needed. This may make you think of the large meat-packing firms that have succeeded in finding use for everything in a pig except the squeal and are still looking for some way to sell the squeal. We have a case not too far from that in Sentinel television sets. The filter circuit in the power boost contains a variable inductance L15, the horizontal linearity control. Adjusting this inductance varies the phase of the ripple applied to the plate of the 6BQ6 horizontal output tube. Varying the phase of this ripple in the 6BQ6 plate circuit affects the tube's conduction and the last half of the horizontal sweep. Many service technicians concentrate on the left half of the raster when adjusting the horizontal linearity, and they say that the control has no effect on the picture.

Servicing tips

A few trouble-shooting hints for *Sentinel* television horizontal section follow.

1. No high voltage until 6AL5 horizontal phase-detector tube is removed from its socket: The .047-μf feedback capacitor (C81) is shorted. This applies a high positive voltage through cathode to plate of the 6AL5 (pins 2 and 5) and on to the control grid (pin 1) of the 6SN7 horizontal oscillator, which kills the oscillator and the high voltage. When this capacitor shorts it frequently affects R97, R90, R86, R85, and C73. Even if no obvious horizontal instability develops after the capacitor has shorted, it is a good idea to check the above parts. If the set was on long enough with the capacitor shorted you can be sure that some or all were affected.

2. Insufficient high voltage: The cathode and plate of the 6W4 have the same d.c. potential. Shorted power boost capacitor C77 or C78. In many sets, no voltage appears at cathode terminal of the 6W4 damper tube when the tube is removed from its socket unless the boost capacitors are leaky.

3. Inability to lock horizontally: Usually due to changed value of the 5,600-ohm, 5% resistor, R87.

4. Horizontal squeal and double image on the horizontal: It is sometimes possible to synchronize the set to one picture, but changing stations or interrupting the sync momentarily produces the double image again. Open .0047-μf capacitor (C73).

5. Drive voltage down to about 5 volts, insufficient high voltage: An open resistor in 6SN7-GT parallel plate load, R93 or R94.

6. Drive voltage very high (40 volts and up) and decided foldover: An open platform-forming resistor, 8,200-ohm (R88).

7. High voltage arc audible only when the brightness control is advanced far enough to produce a raster: Due to internal arc in the 1.2-megohm high-voltage filter resistor R79.

8. Horizontal instability: Due to leaky .047-μf feedback capacitor C81, changed value of R97, R90, R85, or R87.

END

VIDEO AMPLIFIER PROBLEMS

Reflected troubles and great number of components complicate the life of the service technician

By WALLACE WANER

THE video amplifier in present-day receivers has many tasks to perform. Besides boosting the video signal level for application to large-screen picture tubes, it must provide for intercarrier sound take-off and furnish signals for the sync separator and noise-reducing circuits. Thus, the current video amplifiers are more complex than earlier types; there are more components which can give trouble.

Besides this, any trouble in the various circuits which are fed by the video amplifier can reflect the defect back into the video amplifier and seriously disturb its normal operation. Thus, leaky or shorted capacitors, defective tubes, or other troubles in a.g.c. systems, noise circuits, or sound i.f. stages can place a heavy load on the video amplifier and lower picture quality.

A defect in the noise circuit may influence the sound take-off signals or reduce the sync levels to the separator stages. Because of this, knowledge of modern circuit arrangements will help considerably when it is necessary to trouble-shoot the video amplifier.

Typical circuits

The video amplifier in 1954 Zenith television receivers is shown in Fig. 1 (19L25 and 19L27 chassis). It uses the efficient 12BY7, the video amplifier which produces high output signals for low values of load resistance and voltage. It provides sufficient signal strength for the picture tube without an additional amplifier between it and the video detector.

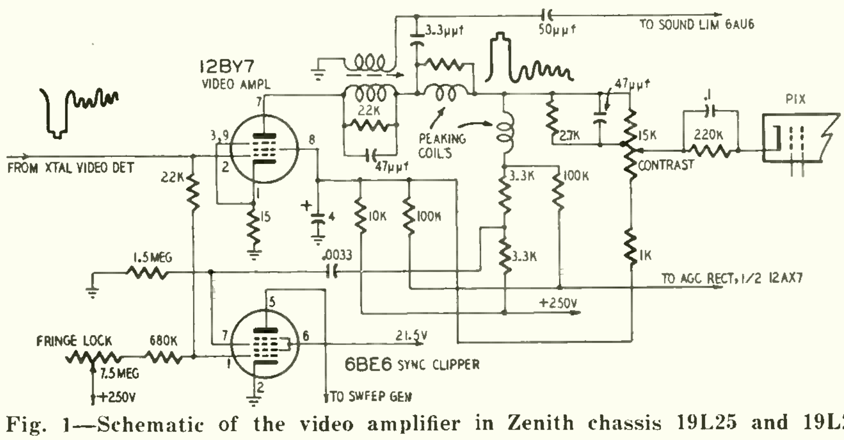


Fig. 1—Schematic of the video amplifier in Zenith chassis 19L25 and 19L27.

The 6BE6 sync clipper prevents noise pulses from triggering the sweep oscillators, besides performing the usual function of sync separation. Two signals must be fed to the 6BE6 from the video amplifier. The first is from the grid circuit (the output of the video detector), which applies the composite video signal to the first grid of the sync clipper. The second signal, the amplified video signal, is taken from the junction of the two 3,300-ohm resistors in the plate circuit of the video amplifier and is applied to the third grid of the 6BE6. The third grid acts as the control grid of a standard sync separator, and only the sync pulses appear at the output (plate) of the clipper tube. Whether or not any output is produced in the plate circuit depends on the voltage of grid 1. Thus, the fringe lock control is adjusted so the bias on the first grid permits normal sync separation. If a noise pulse rides in with the video signal and appears at the first grid, it will drive the grid negative enough to cause complete plate current cutoff. Thus, noise pulses cannot get through to upset the normal synchronization of the vertical and horizontal sweep generators. The manual fringe-lock control can be adjusted to give good sync stability in fringe or local areas for a wide variety of signal and noise levels.

The fringe lock must be adjusted together with the vertical and horizon-

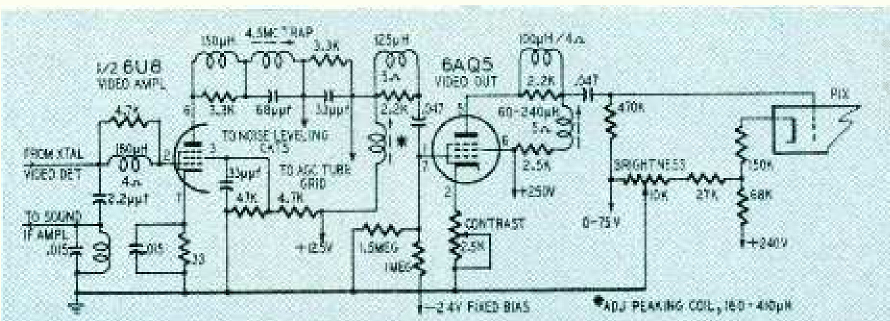


Fig. 2—Schematic of video-amplifier system used in the Philco model 2750.

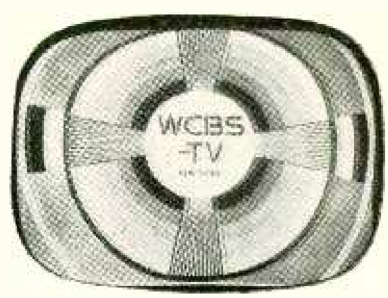


Fig. 3—Picture shows repeat lines.

tal hold controls. Turn it fully clockwise and back it off ¼ turn at a time while checking performance. At each setting the hold controls are adjusted and performance checked for each channel received in the area.

If the picture is unstable, back down the control more, readjust the hold controls, and check for performance on each channel, until good sync stability is obtained.

A defective component or tube in the sync clipper circuit can change the load on the video amplifier grid and plate circuit. Thus, when there is insufficient contrast or poor picture quality, video amplifier trouble-shooting would have to take in also the sync clipper circuit.

The sound take-off is in the plate circuit of the video amplifier, thereby assuring a high level of sound i.f. signal. Since the sound i.f. in intercarrier receivers is always 4.5 megacycles, the take-off transformer must be tuned to that frequency. When both primary and secondary slugs are adjusted for maximum sound output, the primary section will automatically act as a 4.5-mc trap, since it acts as a high-impedance parallel resonant circuit. The tweet interference which would result on the picture-tube face is thus minimized. Also adjust the sound take-off coils till intercarrier buzz is at a minimum.

The signal for the a.g.c. rectifier is taken from the other 3,300-ohm resistor in the plate circuit of the video amplifier. A voltage-divider network, with a tapped potentiometer, serves as the contrast control. The variable arm picks off the required amplitude of video signal.

Since the video signal is positive-going in the plate circuit of the amplifier, it is applied to the cathode of the picture tube rather than the grid. The d.c. has a direct path from the plate of the video amplifier to the picture-tube cathode, via the peaking coils and series resistors. Hence, the d.c. level is not disturbed and no d.c. restorer is necessary. With direct coupling, however, the voltage relationships between the cathode and grid of the picture tube are critical. A change in value of any of the resistors in the contrast control circuit (or the control grid of the picture tube) will upset bias relationships and can cause excessive or insufficient brilliancy. Thus, when either of these symptoms occur, check the voltages between cathode and grid while the brilliancy control is varied. The grid should always be minus with respect to the cathode and should vary with the control. Check the resistor values in both the contrast and brilliancy control circuits against those given in the service notes for the receiver. Make sure the capacitors in these circuits are not leaky or shorted when brilliancy troubles occur.

Another typical video amplifier system is shown in Fig. 2. It is used in the Philco model 2750 receiver which uses a 27LP4 picture tube. Two amplifier tubes are used. The first is one-half of a 6U8 triode-pentode tube. The video output amplifier uses the 6AQ5 beam-power tube which furnishes sufficient signal amplitude for good contrast in the 27-inch tube.

The sound take-off is in the grid circuit of the first video amplifier. The necessary signal is developed across an impedance composed of the inductance and capacitor shown. Since the arrangement does not trap the signal from the video amplifier, a 4.5 mc trap is inserted after the first peaking coil in the plate of the first video amplifier. This is followed by the noise leveling circuit take-off, and the a.g.c. signal take-off. This is followed by an adjustable peaking coil in series with the B plus, and a series peaking coil to the grid of the video output amplifier.

In the plate circuit of the video output stage, the series peaking coil (100 μh) is followed by a shunt peaking coil which is also adjustable. These two adjustable peaking coils are preset at the factory and normally do not require readjustment. If the coils are not adjusted properly, they may produce either smears or transients which will result in repeat lines on the screen (Fig. 3). Repeat lines indicate a slightly excessive high-frequency response, and as pointed out in the Philco service notes, a small amount of high-frequency overshoot may be desirable to produce a sharper picture.

At the same time, in weak-signal areas where a snowy picture is received, it might be better to have a slight amount of smear, to reduce the sharp outlines of the snow effect.

To make adjustments to the peaking coils: Tune in a station and adjust for best picture quality and contrast. Turn fine-tuning clockwise until a faint beat pattern shows on the screen. Repeat lines are produced by turning both peaking-coil slugs clockwise. Trailing smears are caused by turning both peaking-coil slugs counterclockwise. These adjustments should not be made to compensate for poor i.f. alignment or defective components. In Fig. 4, for instance, faint repeat lines are visible on the right side of the vertical wedge, indicating exceptional high-frequency response in the video amplifiers. Despite this, however, more than one-third of the vertical wedge is hazy and obscure, showing poor video i.f. alignment. While the over-peaking has helped the picture somewhat, a much sharper picture would be obtained if the tuner were tracked properly and the video i.f. alignment corrected.

The contrast control for the Philco video amplifier system is located in the cathode of the output tube as shown in Fig. 2. No cathode bypass is used, so the low-frequency response will not be affected. The lack of a bypass capacitor will cause degeneration and some decrease in amplification, but these shortcomings are tolerated in the interests of a wider frequency amplifier. Since a variation of the contrast control will affect bias, a fixed bias is applied to the control grid from the power supply (24 volts).

The brightness control varies the voltage between the grid and cathode in the cathode-ray tube as shown in Fig. 2.

Service hints

When poor contrast, lack of definition, or other troubles point to defects in the video amplifier system, the tubes should be checked first as a matter of routine. Since only one or two video amplifier tubes are involved, tube substitution can be tried. Frequently, a change in tube characteristics results in a sync level decrease and causes sweep instability. Such tubes will often check all right in a tube tester—particularly the emission type.

The tubes of the circuits fed by the video amplifiers, such as the noise clippers, a.g.c. rectifiers, first sound i.f. amplifier and d.c. restorer, also should be tested. After tubes have been eliminated as the source of trouble, voltage checks should be made at the grids, screens, and plates, of the video-amplifier tubes. The grid should always be negative with respect to the cathode. If it shows zero or a positive voltage, check the coupling capacitor for leakage. (A gassy tube could also cause a

Fig. 4—Left—Faint repeat lines are visible on the right-hand side of the vertical wedge.

Fig. 5—Right—Leaky coupling capacitors or open peaking coils are the cause of poor definition.

positive grid, but it is assumed the tubes have been checked prior to voltage readings.)

Voltages for the screens and plates, as well as those associated with the brilliancy-control section, should be compared with those given in the manufacturer's service notes for the receiver under test.

If tubes and voltages check out all right, the next logical step is a check of resistor values against those given in the schematic. The capacitors should be checked for leakage. To make sure tests are accurate, one side of the resistor or capacitor to be checked should be disconnected from the circuit. While the leakage of paper capacitors can be checked with the R×1 megohm scale of a v.t.v.m., many capacitors become intermittent or show defects only when operating under the normal voltages applied by the circuit. For this reason, a capacitor checker is advisable, for the actual working voltage can be applied and the power factor (leakage) determined.

Leaky coupling capacitors or open peaking coils will greatly affect picture quality. If a picture has been good and *suddenly* shows poor definition, trailing smears, or improper contrast levels (Fig. 5), the likely cause is some trouble in the video amplifier. An inspection at close range of the horizontal line trace on the screen helps the diagnosis.

If the horizontal line trace is fuzzy or no longer visible, the trouble would be in the focus control, or focus unit assembly on the picture-tube neck. However, if the line trace is clearly defined but the picture appears out of focus, the trouble is probably in the video-amplifier system. (Poor tuner tracking or video i.f. alignment could also cause such a condition, but the tuner and video i.f. alignment will not change *suddenly* and by a sufficient amount to cause the poor picture definition shown in Fig. 5.)

With peaking coils, the most common defect is an open circuit. On occasion, however, some turns will short together or the parallel resistor will change value or become otherwise defective. An open circuit in the shunt-peaking coils is easy to determine, because the plate voltage of the tube will be lost. With the series peaking coils, an ohmmeter will still give a reading when the coil is open because of the parallel resistor. Since the ohmic value of the peaking coils is only a few ohms as compared with several thousand for the shunting resistor, an open coil is indicated if the meter shows the value of the resistor. (With the coil in good condition, the meter of course would show a reading of only a few ohms.)

If the series peaking coil is shorted, the ohmmeter check would immediately indicate this because of the zero resistance reading. Shorted turns in the peaking coil can contribute to poor picture quality as well as can open peaking coils, but unless the actual ohmic value of the coils is shown, the shorted turns couldn't be detected if only a few were involved. In such an instance the only recourse is to try a new peaking coil. Of considerable help to the technician is the listing of the ohmic value of the peaking coils. In Fig. 2, for instance, the peaking coil in the grid of the 6U8 is listed at 4 ohms, while the one in the grid circuit of the 6AQ5 is 5 ohms. With an accurate low-range ohmmeter, shorted turns can be located quickly.

Meter accuracy and sensitivity is very important, as a few shorted turns may make very little change in resistance.

The series peaking coils help isolate the interelectrode and stray capacitances between the output circuit of one stage and the input of the next. The shunt peaking coils form high-impedance parallel resonant circuits with the circuit capacitances and prevent shunting of high-frequency signal components. Thus, their inductive values are critical and must be maintained if trailing smears, transients, and high-frequency losses are to be avoided. For this reason, an exact replacement must be made—that is, one having the same inductance and resistance.

Remember, when replacing peaking coils, to space them well away from the chassis. Normally in high-frequency work we are told to use short leads to reduce lead inductance or capacitance to other wires. With peaking coils, however, the leads *are not* cut short, but are left sufficiently long so the peaking coil can be mounted at right angles and away from the chassis. This prevents the capacitance effect between the peaking coil and the chassis from affecting the characteristics of the coil and affecting picture quality. Also dress the peaking coils away from other peaking coils and from all nearby circuit wiring.

Frequency response

The reader may feel that no discussion of video-amplifier servicing is complete without a description of frequency-response measurements. Testing the response by injecting a square wave into the video amplifier input and measuring the amount of distortion by checking the shape of the square wave at the output with a scope is often mentioned.

The writer has serviced hundreds of receivers and many video-amplifier circuits without once using this procedure. If the video amplifier is giving trouble, the picture-tube screen will give the clues. If the picture exhibits dark trailing smears, it indicates poor low-frequency response. If repeat lines show as in Fig. 3, the high-frequency response is excessive. Without enough high-frequency response, the fine detail will suffer. These symptoms are all the technician needs to know to get busy on the video amplifier circuit checking. His time is too limited to undertake redesign. He is concerned mainly with restoring the receiver to the level of performance which was built into it by the manufacturer. END

THE RCA COLOR TELEVISION DYNAMIC DEMONSTRATOR

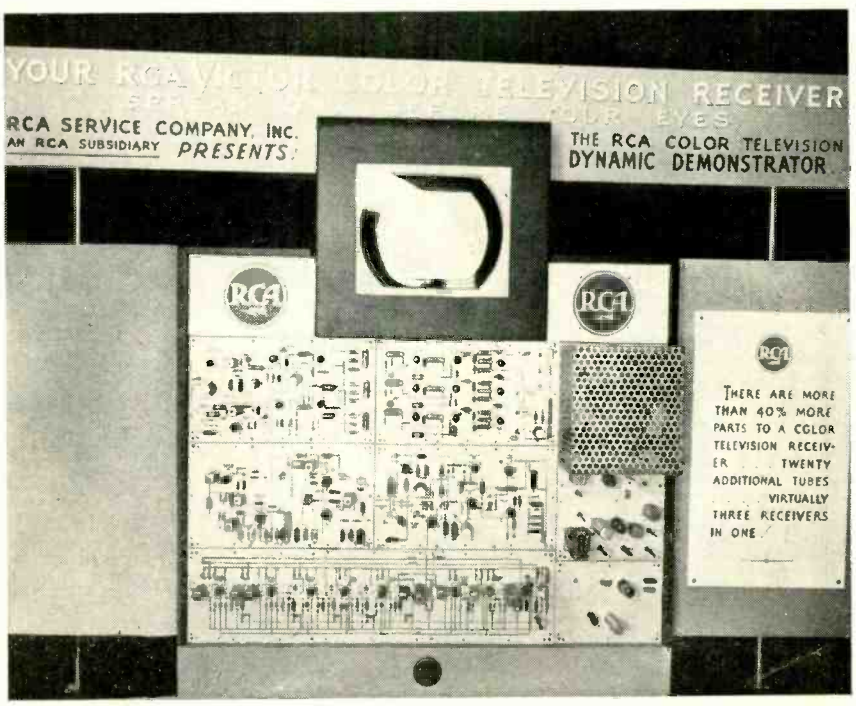
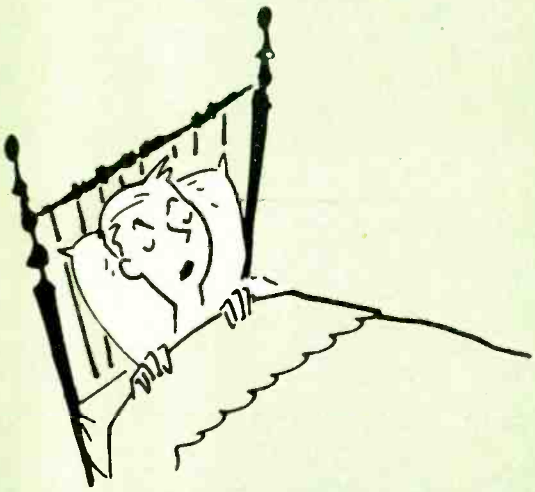


Photo shows latest in long line of RCA dynamic demonstrators. Similar in layout and operation to past dynamic demonstrators, this color TV receiver contains many more components. Using high-quality parts throughout, the demonstrator enables student and technician alike to closely examine the interrelation of the fixed and variable components at work in the various circuits. With all terminals accessible, voltage measurements and oscilloscope patterns can be obtained.

TELEVISION... it's a cinch!

By E. AISBERG

Eighth conversation, first half–Sawtooth action; an amplifier full of good points



Will—Last time, Ken, you promised that today we would have something better to talk about than sweep oscillators. I'm beginning to see them in my dreams! Right now, my trouble is that I don't just see *how* you get those sawtooth voltages onto the deflecting equipment—the deflection yokes, or—if you have an electrostatic set—plates.

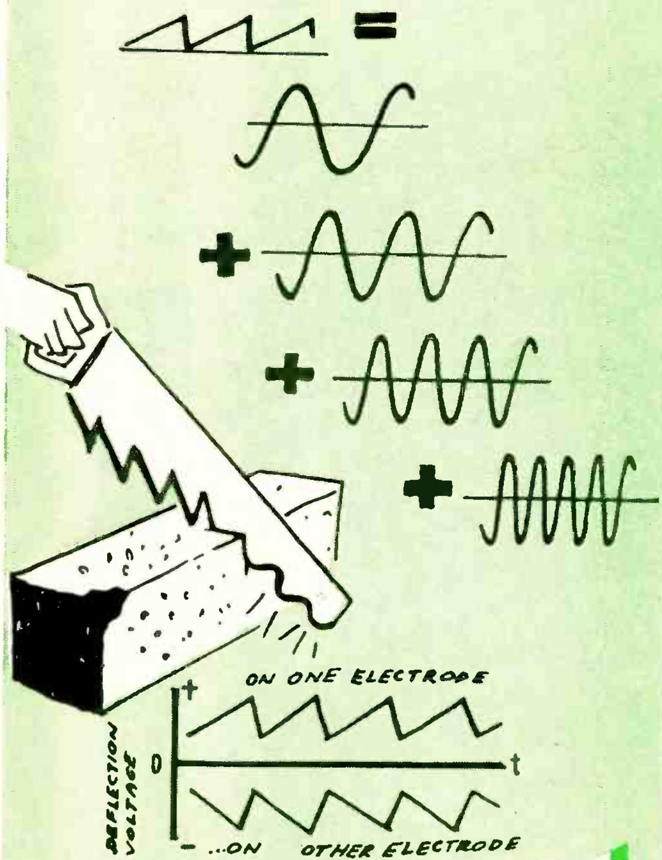
Ken—Good! It's fine to have those voltages, but even better to know how to use them. First, we have to put them through an amplifier; they usually don't have enough amplitude to swing the bright spot all the way across the fluorescent screen.

Will—That should be easy—the frequencies are fairly low.

Ken—Not so fast! The *fundamental* frequency of the time-bases is reasonably low. But they're not sinusoidal oscillations—far from it! So they're very rich in harmonics. You still remember what a harmonic is?

Will—Of course! Harmonics are oscillations at multiples of the fundamental frequency!

Ken—Roger! Now, our harmonic-rich sawteeth need an amplifier that can pass a very wide band of frequencies. Otherwise we'd eliminate some of the higher frequencies, and deform our waves.



Will—If I get you right, an amplifier that would cut off *all* the harmonics and leave only the fundamental would make sine waves out of our sawteeth?

Ken—Exactly—if you could get an amplifier that would cut off all the harmonics and still leave the fundamental! An amplifier usually attenuates only the higher frequencies, and just rounds the teeth off a little.

Will—Oh! A worn-out saw!

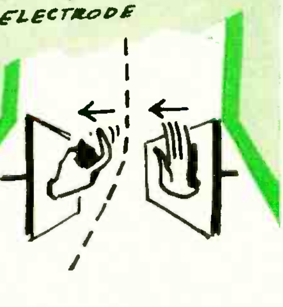
Ken—Remember, quite often we use an amplifier that changes the form of the sawteeth *intentionally!* We can use one to make sections of an exponential curve into straight lines, for instance.

Will—So I was in too much of a hurry when I decided that a time-base amplifier was simple!

Ken—At last you're right! It does a lot of jobs—it's an amplifier, it produces high-frequency harmonics, and it linearizes curved waveforms. But that's not all! In magnetic-deflection receivers, it has to deliver power . . .

Will—. . . like an ordinary radio output stage that supplies power to the speaker. But in electrostatic-deflection receivers the amplifier supplies only voltages. There isn't any current to speak of, and so, practically no power.

Port and starboard

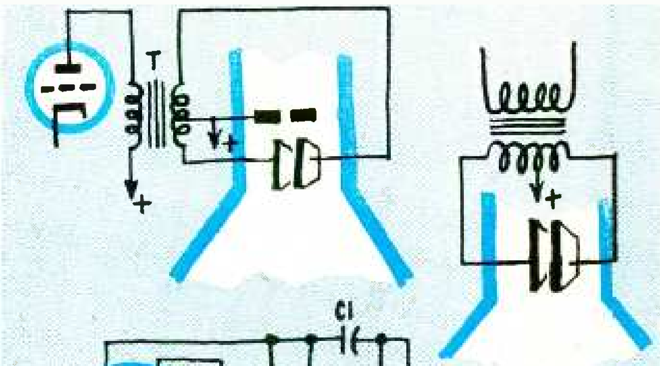


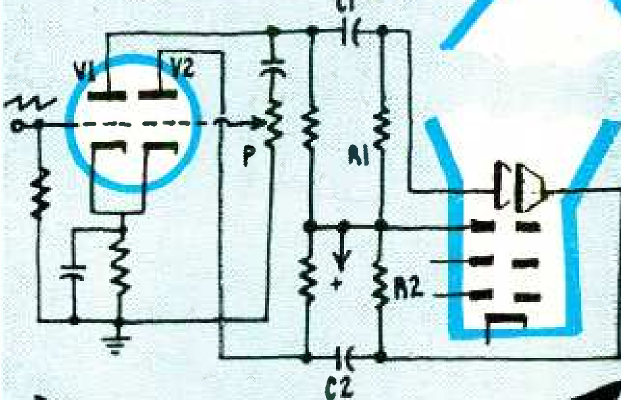
Ken—Yes, the electrostatic-deflection jobs are simpler—pity they don't use 'em in TV any more! But let's find out how they work first, then go on to the magnetic systems, which are a little harder. Even electrostatic deflection has its problems. We have to apply a pair of voltages phased oppositely to the two deflection plates. That is, while one plate becomes more positive, the other is becoming more negative. Then both plates have to drop back to zero simultaneously and practically instantly, so the whole thing can start over again.

Will—But how do we get these two oppositely phased voltages? Do we need a pair of sawtooth generators? What a mess!

Ken—Take it easy, Will! Remember when we were studying

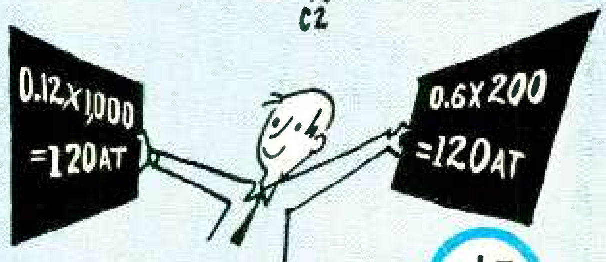
push-pull audio amplifiers? What did we find to be the easiest way to apply equal and opposite voltages to the output grids?
Will—A center-tapped transformer was the simplest way out.
Ken—And so it is here! Take a look at this sketch. You put the primary in the plate circuit of the horizontal sweep amplifier, connect the ends of the secondary to the deflection plates, and bring the center-tap back to the last anode, so that the deflection plates and it will be at the same voltage.
Will—And could you use a tube-type phase inverter with cathode-ray tubes?
Ken—Sure! Look at this. V1 is an amplifier; V2 a phase inverter. Potentiometer P controls V2 so its output is exactly the same as V1.



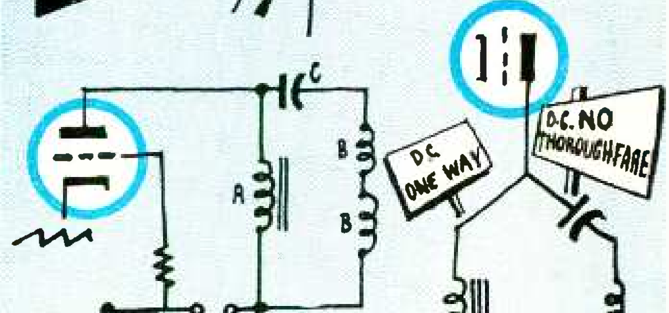


All seems simple

Will—None of this looks very tough. When you really know radio, you don't run up against many surprises in television!
Ken—You'll find that out when you look at magnetic-deflection circuits, where you have to get power out of your amplifier, just like an audio-output circuit. The power is used to set up magnetic fields around the deflection coil. The field strength depends on the number of turns in the coil *and* the amount of current going through it.
Will—I know, Ken! And you make me feel good by talking about ampere-turns that I can understand, instead of gausses, maxwells, or oersteds, that don't mean a thing to me!
Ken—You know then that a coil of 1,000 turns with 0.12 ampere passing through it. . . .
Will—. . . sets up a field of 0.12 × 1,000, or 120 ampere-turns.
Ken—And that you could get the same field from a coil of 200 turns . . .
Will—. . . and a current of 0.6 ampere.

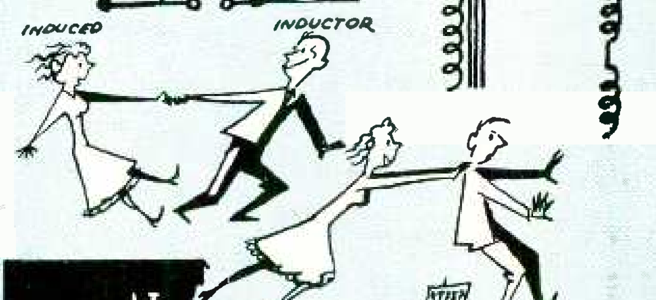


Ken—Yes, and that happens to be just about the power needed to sweep a 10-inch tube screen. The field must rise from zero to 120 ampere turns to sweep the spot once across the screen from left to right. That is, the current through our 1,000-turn coil must increase evenly to 0.12 ampere, then drop very rapidly to zero, and repeat.
Will—That sounds easy. All you need is a good big tube. Insert the deflection coils in its plate circuit . . .
Ken—. . . and the d.c. through the coil would set up a permanent field that would keep the spot somewhere right off the screen!
Will—So that won't work, eh? But how would this work? Connect the two deflection coils B through the capacitor C, with this inductance A to carry the current?
Ken—Fine, chum, fine! But what are you going to do about the well-known phenomenon of self-induction?
Will—What's self-induction got to do with it?

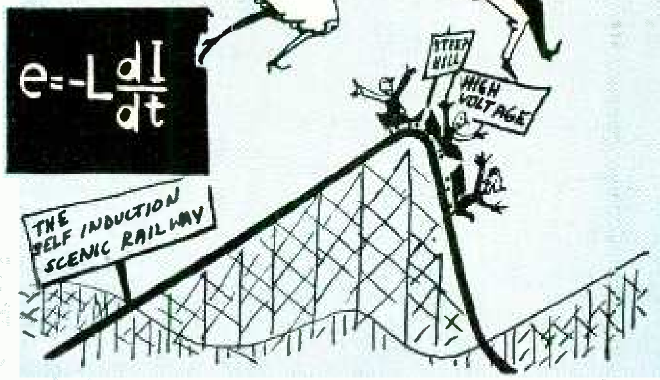


Deduction about induction

Ken—Well, now, we've quite a bit of wire in these coils—about 1,000 turns each. The inductance is about 0.15 henry. Won't the rapid current variations produce some effects we'll have to take notice of?
Will—Now I remember our old formula: "Induction equals contradiction." The induced current always opposes the current that produced it. If the current in a winding increases, it induces a current in the opposite direction. But if the current decreases, the induced current goes in the same direction, doing all it can to keep the inducing current up to its old value.



Ken—What a memory! All you need to add is that the induced current shows itself as a voltage at the ends of the winding. Can you guess what the value of that voltage depends on?
Will—I suppose it's proportional to the variation in the inducing current and the amount of inductance in the winding?
Ken—Right! But there's just one other thing—the variation speed of our current—the time it takes to change. If the sawtooth currents passing through our windings are quite linear, we can say that the voltage of self-induction increases as the duration t of the variation in current becomes shorter.
(TO BE CONTINUED)



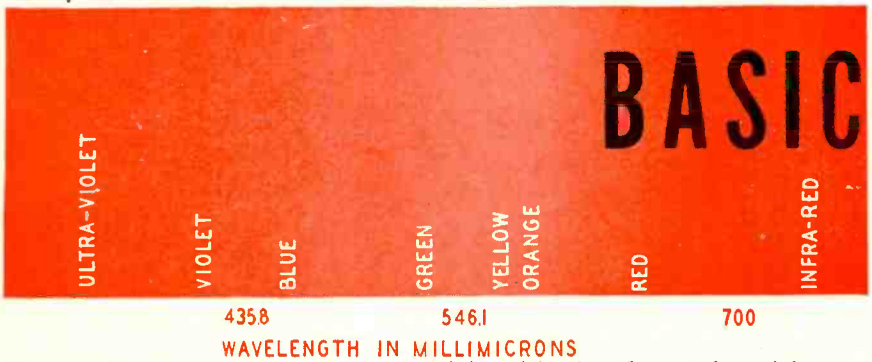


Fig. 1—The visible light spectrum, containing the colors from red to violet.

BASIC COLOR TV

Part I—Some of the fundamental principles of color and vision

By D. NEWMAN* AND J. J. ROCHE*

MOST readers will recall that back in 1950 the FCC adopted a set of color television broadcasting standards based on the CBS color TV system. Soon after, it became apparent that this system would obsolete millions of black-and-white receivers already in use. This dampened the industry's enthusiasm for the CBS color system, and as a result, little effort was made to develop it into a practical reality.

The general feeling in the industry was that if a color television system was to be universally accepted, it could not afford to obsolete the millions of black-and-white sets already in use.

Fortunately, the FCC, in adopting the CBS color system, left the door open for consideration of a better color system should one ever be developed and demonstrated.

Prior to the war, the RETMA, then the RMA, established a committee composed of representatives of most of the major manufacturers, known as the National Television System Committee. The NTSC was given the job of formulating a set of black-and-white television broadcast standards for presentation to the FCC for its approval. These standards were subsequently adopted and are the ones in use today.

Taking a page from past experience, the RETMA again called on the NTSC in November, 1950, and assigned it the job of formulating a set of color television broadcast standards for presentation to the FCC.

As in 1941, the NTSC is composed of the best engineering brains in the country contributed by the members.

On July 23, 1953, the NTSC formally petitioned the FCC for adoption of a set of color television standards.

In studying the NTSC system, you will find it easier to understand if you realize that it is not necessarily the simplest, nor even the best, color system which could have been designed.

The NTSC system was developed to meet, on the one hand, a set of FCC requirements, and, on the other hand, the economic requirements which its originators felt were a necessity.

The FCC requirements were:

1. The system must operate within the present 6-mc channel allocations.
2. The quality of color reproduction had to be excellent. The pictures had to be well-defined and free from annoying defects such as line crawl, jitter, or prominent dot structure.
3. Pictures had to be sufficiently bright for adequate contrast under normal lighting conditions, and free from objectionable flicker.
4. Receivers had to be simple enough for the average person to operate, and cheap enough for the average person to buy.
5. The transmitting apparatus had to be reasonable in cost and simple enough to be operated by average station personnel.
6. The system could not be unduly susceptible to interference as compared to black-and-white.
7. The color signals had to be transmittable over existing and future relay facilities.

In addition to the above, the NTSC imposed upon itself other requirements, the most important of which was that the system had to be *compatible*.

A compatible color television signal is one that can be received by existing black-and-white receivers, in monochrome, without any changes or adjustments.

To accomplish these objectives, a

* *Allen B. DuMont Laboratories, Inc.*

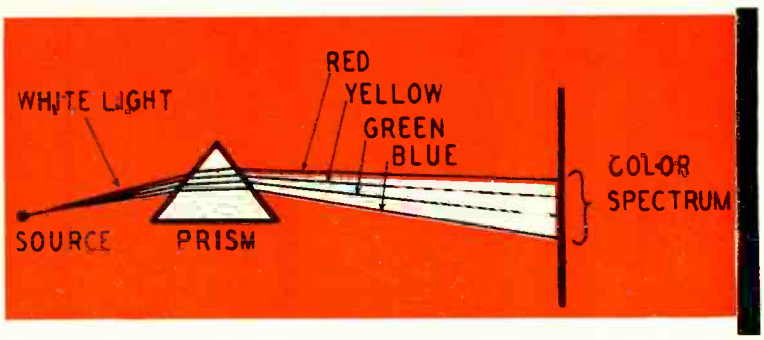


Fig. 2—A prism breaks white light up into the spectral colors.

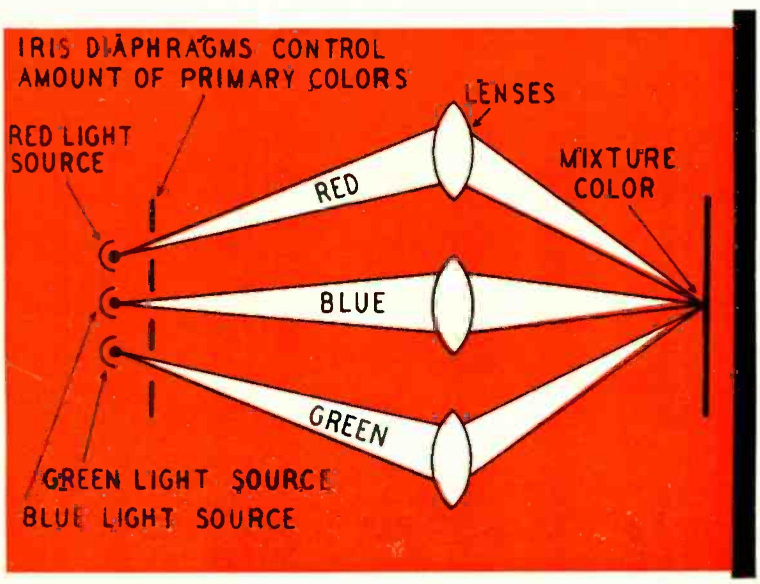


Fig. 3—Adding primaries to produce color (or white light).

number of new circuit techniques and electrical concepts were necessary. None of these new ideas are basically difficult, but at first they may appear strange and unfamiliar to the service technician.

To understand any color television system, some knowledge of color fundamentals is required:

What is color

Light is a form of radiant electromagnetic energy, just as is the familiar radio wave. Light waves are of much higher frequency than radio waves, and while radio-frequency energy is not perceptible to our senses, light produces sensation in the brain, via the eye.

Because the wavelengths of the visible frequencies are extremely short, it is not convenient to specify light wavelengths in meters. A much smaller unit, called the "millimicron," is commonly used. A millimicron is equal to one billionth of a meter and is written "mμ".

The frequency range, or spectrum, over which radiant energy is visible extends from 380 to 780 mμ. (See Fig. 1.)

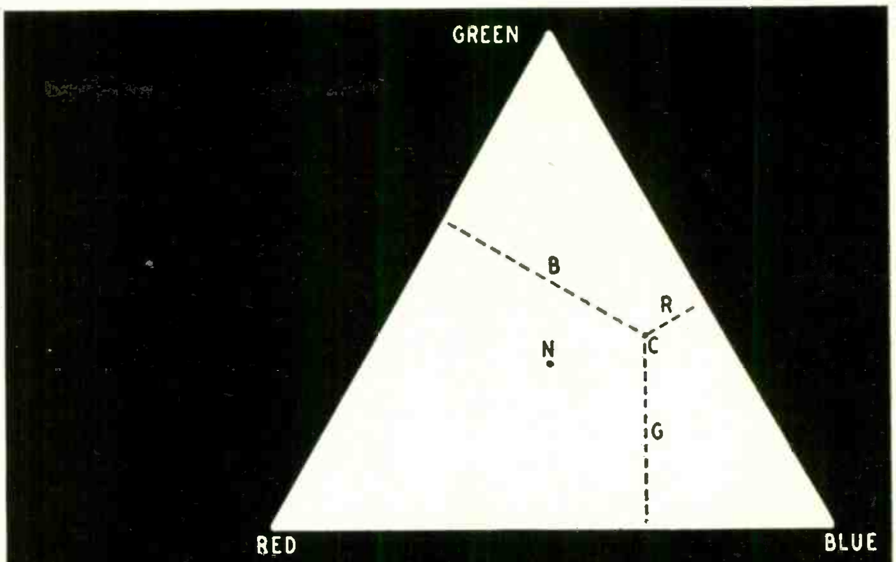
What does this have to do with color?

Well, when viewing light of a single frequency, located anywhere within the visible spectrum, we experience a sensation referred to as "color." The particular "color" we see is dependent upon the frequency of the light.

For example, light of a wavelength of approximately 700 mμ is called red; if the frequency is around 550 mμ, it is green; if about 450 mμ, it is blue.

When the light is made up of approximately equal portions of red, green, and blue energy, we see *white light*. This can be demonstrated by passing white light through a prism, as shown in Fig. 2. As the white light passes through the prism, its individual components separate and produce a series of colors known as the spectrum.

It is apparent from the above that it is quite incorrect to refer to white light as "colorless," since it is made up of all "colors."



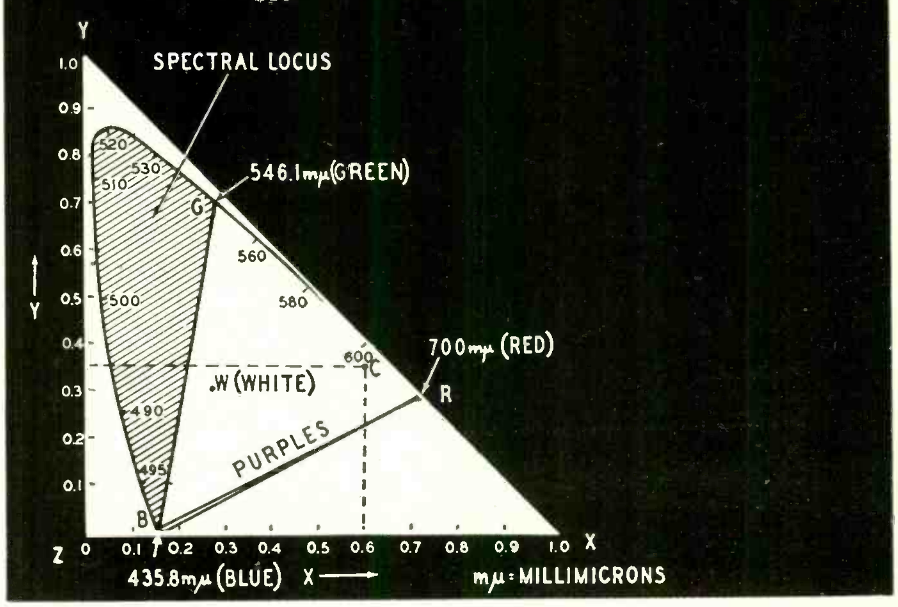


Fig. 4, above—The basic Maxwell triangle. N is the neutral or "white" point. Fig. 5, below—Diagram with artificial primaries, as used by color engineers.

Color properties

A pure color can be described by stating the frequency of its light and by stating its brightness or amplitude.

In nature, light of a pure color seldom occurs. In most cases, it is mixed with, or diluted by, white light. So, to describe the light which we commonly see, we must also state the extent to which the color is free from dilution by white light.

Therefore, a colored object should be described by stating three properties.

1. Brightness, or *luminance*
The total amount of light given off by the object determines its brightness. The term used in color television work for brightness is "luminance."

2. Frequency, or *hue*
A colored object is either reddish, bluish, greenish, yellowish, etc., depending upon which color predominates. This dominant color or frequency is called "hue."

3. Freedom from dilution by white light, or *saturation*
As stated, most colored objects have a principal or dominant "hue" which is diluted to some extent by white light. For example, if an object were pure red (that is, undiluted by white light), it would be 100% saturated, or have a *purity* of 1. A "pink" object would be specified as being red in "hue," but incompletely saturated, and its purity would be considerably less than 1.

Note: Purity is expressed as a number between 0 and 1, and is the ratio of the intensity of the "dominant color" light to the total light intensity.

Reproduction of color

You will recall that when using water colors it is possible to mix two colors together and produce a third color. Carrying this idea further, it is possible to mix three selected colors, known as *primary* colors, and produce a very wide variety of other colors.

In modern printing, the three primary colors are deposited alongside one another in dots of varying size. These dots are so small that the eye blends them together, creating the same effect as the mixed water colors.

In the familiar Kodachrome transparency, three layers of differently colored filters are placed on top of one another. As the transparency is viewed, white light passes through each filter in succession. The eye sees the net result in a wide variety of colors.

Both color printing and color photography achieve their results by using the *subtractive* method.

In the subtractive method a desired color is obtained by removing a predetermined amount of red, green, and blue from a source of white light. (You will recall that white light consists of equal amounts of the red, green, and blue primaries.)

By removing portions of the three primaries in varying degrees, we can obtain a wide variety of colors. (If you mix red and blue, for instance, the result is the mathematical *difference* between the red and blue primaries.)

In a color television receiver, the red, green, and blue light is produced on the face of the C-R tube. On the screen of the receiver the three primary colors are self-luminous—they create their own light and must be *added* together to produce the desired range of colors. The additive method of producing color is shown in Fig. 3. In this system, we start with the three primary colors (red, green, and blue) and by adding together the required amounts of each of the primaries, we can produce almost any desired color. In both the subtractive and additive systems, we vary the amounts of three primaries to produce the desired color.

You may wonder why red, green, and blue are always used. Actually, red, orange, and green or many other combinations of colors could be used. (Remember that red, yellow, and blue are the common subtractive primaries.) However, red and blue, located at opposite ends of the color spectrum, in combination with green, which is located at the center of the color spectrum (refer to Fig. 1) enable us to obtain the widest possible range of colors.

Color specification

Years ago, a need for exact color specification became apparent. What one person referred to as "red" might possibly mean any one of dozens of shades called "red", for example.

Because of these individual variations, tests were conducted with a large number of observers and the results were averaged out. Based on these tests, a set of color standards were adopted in 1931 by the International Commission on Illumination, to apply all over the world in all color activity.

These standards are known as the ICI system. after the commission which adopted them.

The standards specify that the red primary shall correspond to light of the wavelength 700 mμ, green as 546.1 mμ, and blue as 435.8 mμ.

We have seen that almost any desired color can be produced by mixing together appropriate portions of the three primary colors. Therefore, we can say that a particular color consists of so much red, so much green, and so much blue.

A convenient way of illustrating the exact amounts of the three primary colors which are present in a given color is by the triangle of Fig. 4.

Note that the center of gravity of the triangle is the neutral or white point (N) since this represents a "color" to which the three primaries are contributing equal amounts. As the described color departs from the neutral point, it takes on a definite, recognizable hue depending on whether the green, red, or blue frequencies predominate. Also the closer the described color point moves toward the sides of the triangle, the more saturated the color becomes. (Freer from dilution by white.)

When using this type of diagram (known as the Maxwell triangle), an exact color is specified by stating the proportion of each color to the total.

This is illustrated graphically in Fig. 4. Note that the proportion of red is indicated by the length of the line drawn perpendicularly from the side of the triangle opposite the red apex point. Similarly, the proportion of blue and green is specified by the perpendicular lines drawn from the sides of the sides of the triangle opposite the blue and green apex points.

Thus by knowing the numerical proportions of the three primaries to the total, we have sufficient information to reproduce any color. These proportions are always stated as a fraction of 1 to provide a standard method for color specification.

Since the total is always arbitrarily taken as 1, no information is furnished as to the real brightness of the colored object being described. If we were to reproduce a color using only the information given in the triangle, its color would be correct, but its brightness might be quite different from the original. Therefore, if we are to match the original colored object exactly, we must also be given information concerning the brightness. We see that we can specify the *color* of any object on the one hand, and its brightness as a *separate quantity* on the other. This principle is used in the NTSC color television system and will be described in the next article.

The triangle shown in Fig. 4 is seldom actually used. The basic reason for this is that it requires that three fractional proportions be specified while only two are necessary.

You will recall that the proportions are always stated as fractions of 1. If we know two of the proportions, the third can be found by simply adding the two and subtracting their sum from 1.

Since only two numerical quantities or proportions are required, it is more convenient to plot a color or "chromaticity" diagram in the form of a right triangle as shown in Fig. 5.

The three apex points of the triangle in Fig. 5, labeled X, Y, and Z, represent what can be considered imaginary primaries as compared to the real primary colors shown in Fig. 4. This is done for the sake of convenience in specifying all of the colors in the spectrum, including those which cannot be achieved by mixing the three standard ICI primaries.

Using the standard color diagram, a color is specified by stating its vertical (Y) and horizontal (X) co-ordinates. For example, the color *C*, corresponding to X = 0.6 and Y = 0.35, is seen to be a not quite fully saturated orange. In other words, color C consists of 60% imaginary red primary color X, 35% imaginary green primary color Y and 5% (1.0 minus 60% plus 35%) imaginary blue primary color Z.

Using these figures, plus information on brightness, the skilled colorimetrist is able to specify any given color. The method is not simple, and uses rather involved mathematics, therefore it would be unprofitable to attempt to go further into the details at this point.

The three ICI primaries which are used in color television are marked on the XYZ diagram. The area enclosed by the triangle connecting these points represents all of the colors which can be achieved with these primaries. Note that some of the highly saturated blues and greens, indicated by the shaded portion of the diagram, fall outside of this area and thus cannot be reproduced with the ICI primaries. These colors seldom occur in nature and very little is lost by not reproducing them in color television. The ICI primaries permit us to reproduce the saturated reds, yellows, and oranges, which are very common. With this compromise we can still obtain very pleasing color reproduction.

From the above, we see that it is possible to specify, or describe accurately the color of any object in terms of its *hue* (principal color) and *saturation* (freedom from dilution by white), by simply stating its X and Y coefficients on the color diagram. This information, plus brightness or "luminance" information, tells us all we need.

Peculiarities of vision

We are all familiar with that peculiar behavior of the human eye known as *persistence of vision*. The brain's ability to retain an image for a fraction of a second after it has actually disappeared forms the basis of motion pictures and television.

Less commonly known is the fact that people become progressively more color-blind as the size of the object they are looking at gets smaller. Another way of stating this is to say that the color of a large area looks different than the same color confined to a small area.

Most of us have had the experience of selecting paint of a certain color from a small sample and perhaps being disappointed in the results when the entire room was painted. We are sometimes inclined to question the skill of the painter and tend to blame him for improper mixing of the color. In many cases, the actual colors are identical—it is simply the fact that the difference in size has the effect of producing a mismatch.

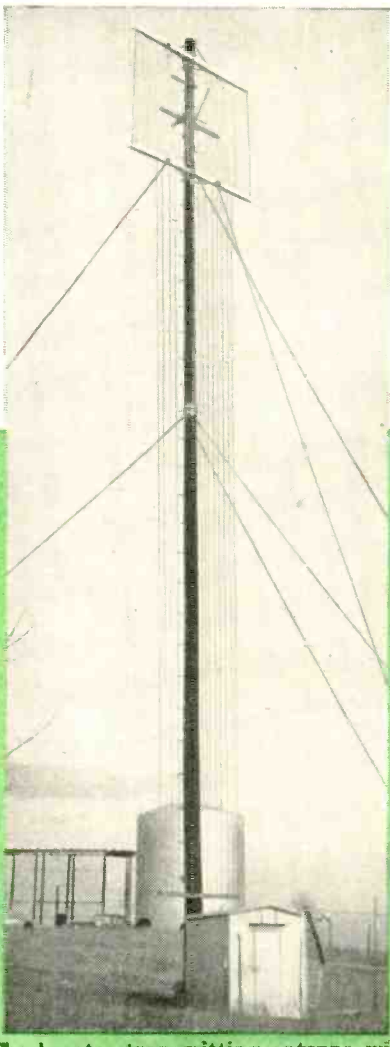
This color-blindness phenomenon follows a definite pattern which has been established as a result of extensive tests conducted with a great many people having normal color vision. The NTSC color television system takes advantage of this fact by transmitting only that amount of color information that can be appreciated by the eye. Full color information is transmitted for large-area portions of the picture; restricted color information is supplied for smaller areas of the picture, and only brightness information (no color at all) is furnished for the tiny areas (fine detail) of the picture.

This results in a substantial reduction in the bandwidth necessary to transmit a color television picture, and is one of the reasons it was possible to sandwich the color signal into the existing 6-mc channels. (TO BE CONTINUED)

In the next article we will discuss the basic requirements of a color television system, and how the peculiarities of color vision have been used to advantage in the design of a compatible system utilizing a 6-mc transmission channel.

BOOSTER TRANSMITTER INCREASES TV STATION RANGE

Co-channel booster brings TV to fringe areas, lowers antenna installation costs

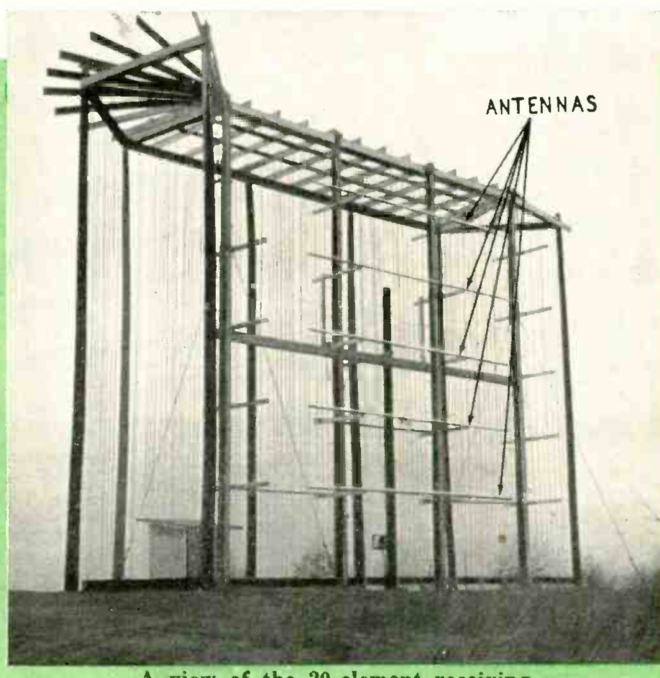


The booster transmitting antenna with the receiving array in the background.

HOW are we to bring television service to residents of fringe-area towns? Numerous methods have been proposed, including Stratovision, community antenna systems, satellites, and boosters. The co-channel booster described here was developed to meet this demand at the lowest possible cost. The experiment is being made at Lawrenceburg, Tennessee, a town of 70,000 people located 68 airline miles southwest of Nashville.

Lawrenceburg has 275 television sets with outside antennas which cost at least $100 each. This means that if every family in town had a TV set, there would be a total antenna investment of at least $175,000. Besides the initial cost, the life of these high antennas is short and the hazards involved in their use are great.

Wired systems—many of them very satisfactory—have been installed in many communities. To use them, the TV set owner must usually pay a fee of $100 or more, plus a monthly charge.



A view of the 20-element receiving array at the booster installation.

Here is a type of TV operation which may solve the problem of bringing television to many small communities. For the information in this article, we are indebted to a report by John H. DeWitt, Jr., president of WSM, Inc., and known to our readers (RADIO-CRAFT, April, 1946) as the man who first bounced radar signals off the moon. This latest achievement of his may be an even more important feat in the eyes of fringe-area television set owners!

Radio transmission to bring TV programs to people in fringe areas would seem to be more economical to the consumer. Such radio systems—of the type now being tested by Sylvania—are more attractive than wired systems, and (if the signal is strong enough) approach the service of a primary television station. But they require additional channels in the crowded u.h.f. band, and in some communities, might prevent or hinder the establishment of local TV stations.

The booster system has the great advantage of working on the same channel as the main transmitter, thus needing no extra channels. WSM-TV (Channel 4), of Nashville, proposed to the FCC in 1951 to experiment with an on-channel crossed polarization booster system, and after authorization on July 16, 1952, developed an experimental booster system.

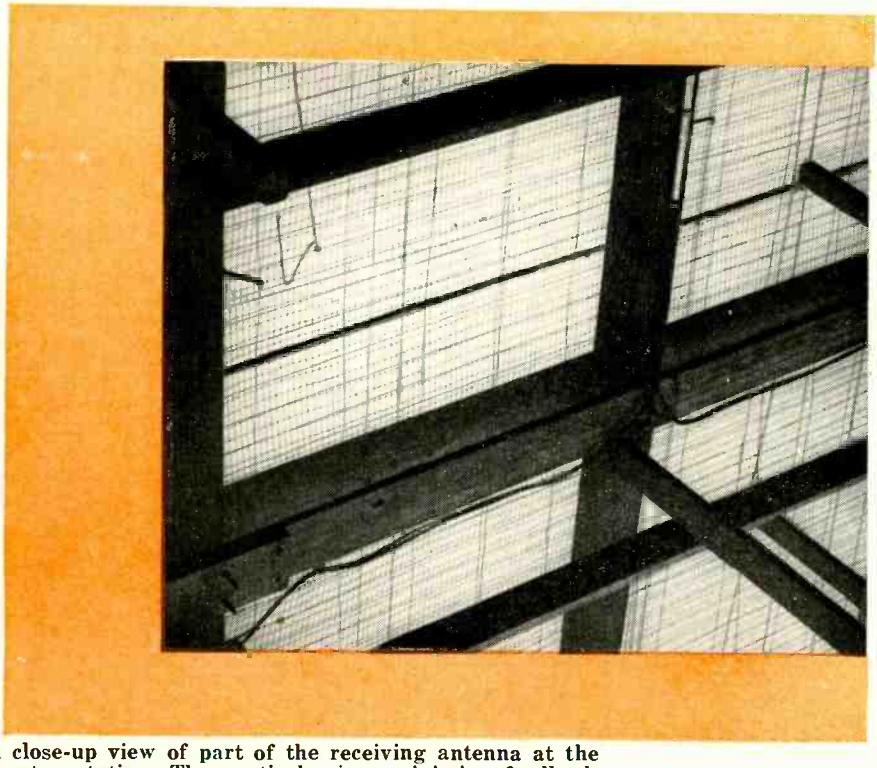
Such a system should have a number of advantages, besides that of requiring no additional channel space. Vertical polarization is used, and a strong signal is delivered over the town. This overrides the interference which troubles the users of tall antennas, and makes cheap—or even indoor—antennas possible. The cost of installation and operation is low, interference to other stations (and its own) is negligible, and the hazards of tall antenna towers are eliminated. The station licensee retains control of the booster, simplifying relationships with the FCC; and the system fits readily into existing allocations plans.

The basic booster system

Briefly, the system consists of a high-gain receiving antenna and a low-gain transmitting antenna placed back-to-back and connected through a low-power radio-frequency amplifier system with an over-all gain of about 100 db. The system is polarized *vertically* to maximize booster coverage for a given booster power and to minimize interference to the main TV station and other co-channel stations.

The transmitting antenna at Lawrenceburg is a vertical folded dipole mounted a quarter wave from a screen of one wavelength square consisting of No. 10 vertical wires. A transformer at the center of the radiator assures balance. It is mounted on a 100-foot pole, guyed with tarred rope. To prevent distortion of the vertical polarization, no horizontal metal was used in the construction. The crossarm bolts and the steps on the pole are made of nylon.

The receiving antenna is a broadside array of 20 half-wave elements in front of a screen of horizontal No. 10 wires spaced at 4-inch intervals. To this is added a maze of vertical wires which outline the walls of a theoretical waveguide operated beyond cutoff. To further attenuate pickup from the rear, a screen with rectangular openings 1 x 2 inches was applied to the backs of the poles which support the horizontal reflector wires (so that the reflector wires are between the screen and the antenna elements). This practically eliminates interference in a wide arc behind the antenna. Gain in forward direction is 17 db.



A close-up view of part of the receiving antenna at the booster station. The vertical wires minimize feedback between receiving and transmitting antenna systems.

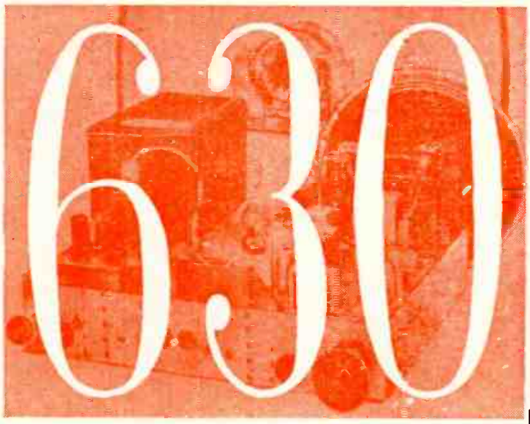
The station, with an effective radiated power of 10 watts, covers the city of Lawrenceburg and the adjacent urban area with a field intensity of 500 μv per meter, and a much wider area with a signal in excess of 100 μv.

Within the 100-μv area set owners with simple vertical antennas find reception from the booster more satisfactory than was reception from the station with the large high Yagi's that were necessary. But between the 100-μv and the 10-μv contours, there have been several cases of interference between booster and main station. This interference takes the form of a ghost which may be displaced halfway across the receiver screen. Elimination of the interference depends on the relative strength of the two signals. Where the booster signal is considerably stronger, the best approach is to erect a low vertical antenna and abandon reception from the main station. Where reception from the booster is only slightly stronger or weaker than that from the main station, a 5-element Yagi mounted vertically produces good signals from the booster in most cases. Where the relative strengths of the two signals are such that the owner prefers to retain his tall tower installation and receive direct, slight modifications of the antenna setup virtually eliminate the booster signals.

In a number of such cases, it was found that the long wire guys on the tall masts were reradiating the booster signal. Replacing the wire guys with nylon rope removed the trouble. In other cases it was necessary to replace the flat 300-ohm line lead-ins with shielded line.

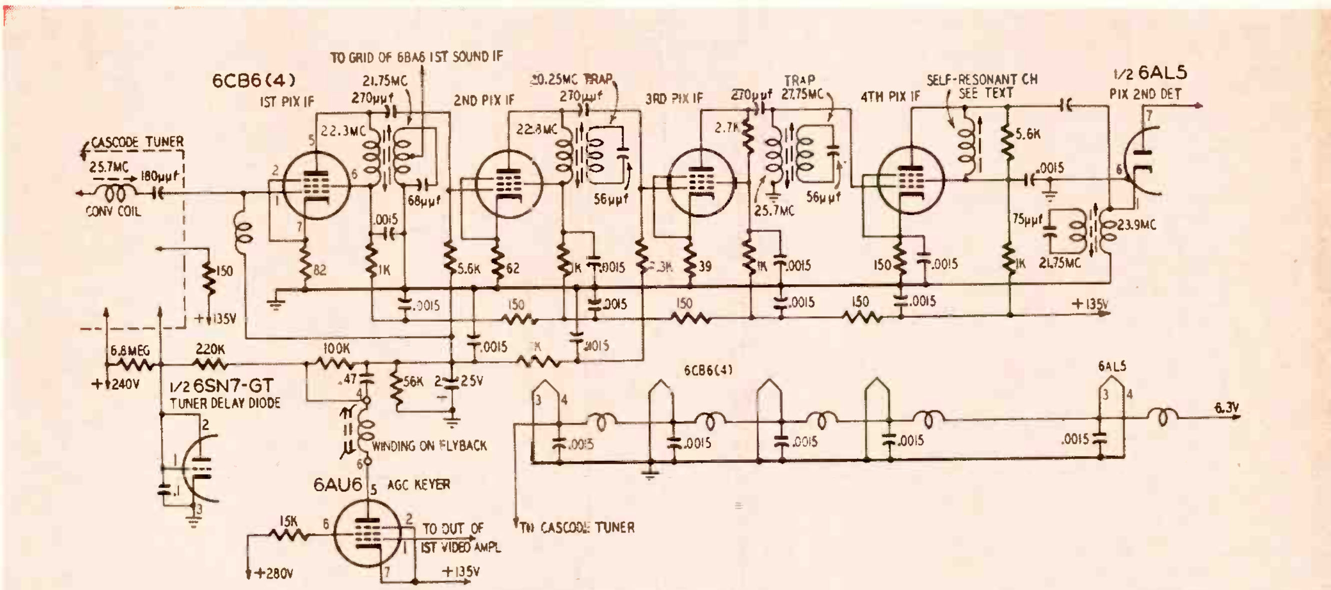
As a result of experience to date, WSM's engineers believe that ". . . the present development offers a cheap and effective means of raising the signal level over a town to the point where satisfactory pictures can be obtained at very low cost to the consumer. The power consumed by the booster equipment is little more that that needed to run the average TV set." Cost is reduced by fully automatic operation, so that labor required is reduced to a weekly checkup by a maintenance man. "The initial cost appears to be low enough to warrant installation in fairly small communities which certainly will not be able to support TV stations of their own for many years to come." END

MODERN 630 CIRCUITRY



The remarkable RCA 630TS, discussed on the following pages, has undergone very few changes. It remains a TV receiver yardstick

By ROBERT F. SCOTT
TECHNICAL EDITOR



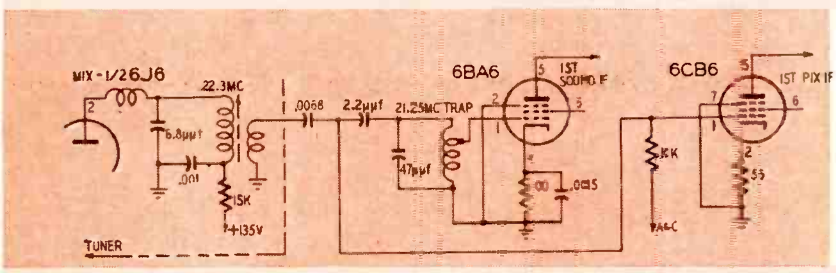
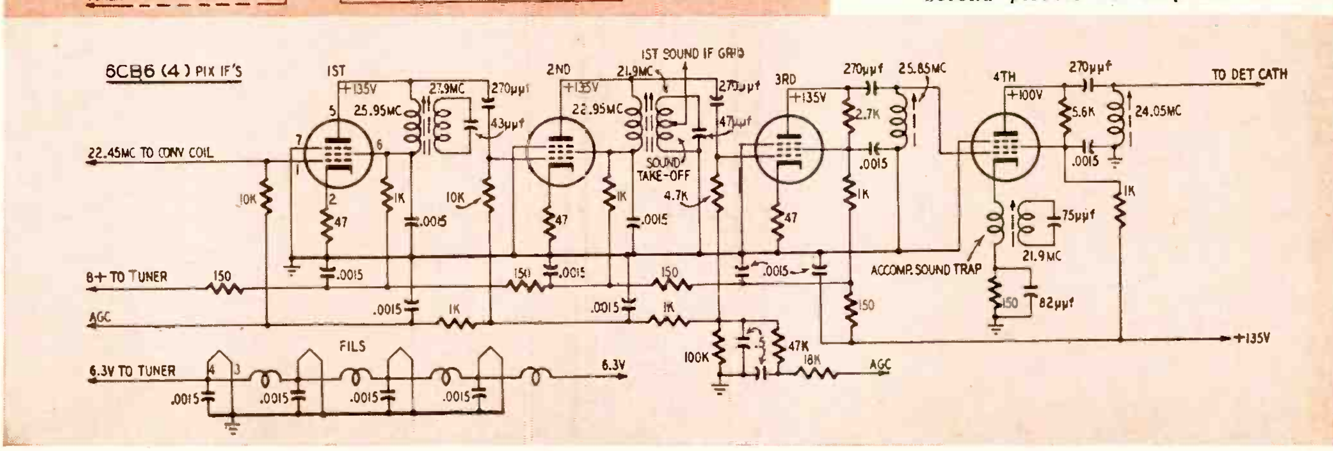


Fig. 1—Above–Video i.f. strip used in Video Products and Mattison models.

Fig. 2—Left–Tuner coupling of video and sound i.f. amplifiers in Regal.

Fig. 3—Below–Schematic diagram shows sound take-off coupled to the plate of second picture i.f. amplifier in Airex.



IN THE fall of 1946, which was about one year after its introduction, the top-notch performance of the RCA 630TS had made the TV world 630-conscious. Its high sensitivity, sync stability, and reliability had become yardsticks by which other sets were rated. Several large competitive manufacturers and many small ones obtained rights to manufacture 630-type chassis through RCA's licensing service. Nearly all these manufacturers included "630" in their model or chassis numbers.

The larger manufacturers have replaced the 30-tube 630 chassis with simpler types using fewer tubes. However, a number of small manufacturers are still producing 630 type kits, custom chassis, and complete receivers which incorporate all of the latest components and circuit developments. The owners of older 630 type chassis can improve their sets and bring them up to date by making many of the improvements described here. Table I lists new circuit features and tube changes covered in the text. Table II compares traps and sound and sync take-off points in the 630TS with those in the 1953-1954 models.

The i.f. amplifier

Circuitwise, the i.f. amplifiers in the 1953-1954 630 type chassis are pretty close to the original. The most outstanding changes have been made in the video i.f. strip to provide higher gain and to permit use of the Standard Coil cascode tuner. The Philmore is the only set covered in this survey that retains the four 6AG5 video i.f. amplifiers. All other makes except Regal have four 6CB6's. The Regal models use a 6AG5 or 6BC5 in the fourth video i.f. stage. The circuit of a typical video i.f. strip is shown in Fig. 1.

In primary service areas where a booster is used, the signal level may drive the fourth video i.f. amplifier to the point where video and sync signals are compressed, resulting in poor picture quality and sync instability. This problem is overcome by shunting a small coil across the 5,600-ohm plate-load resistor. See Fig. 1. This raises the plate voltage and the point at which sync compression and clipping begins. (This is probably the reason why Regal uses 6AG5's or 6BC5's in this stage.)

As shown in Table II, the sound take-off point varies with the make and model. Fig. 2 shows the method of coupling the tuner output to the sound and video i.f. amplifiers in the Philmore and Regal sets. In all others except the Transvision model, the sound take-off is at the plate of the first or second video i.f. amplifier. Fig. 1 illustrates a sound take-off point coupled to the plate of the first video i.f. stage.

Fig. 3 shows the sound i.f. strip of a receiver with the sound take-off coupled to the plate of the second picture i.f. amplifier. I was startled to note that with this arrangement there is no adjacent-channel picture-carrier trap. In some areas where it is possible to receive stations on adjacent channels, this can be a source of trouble.

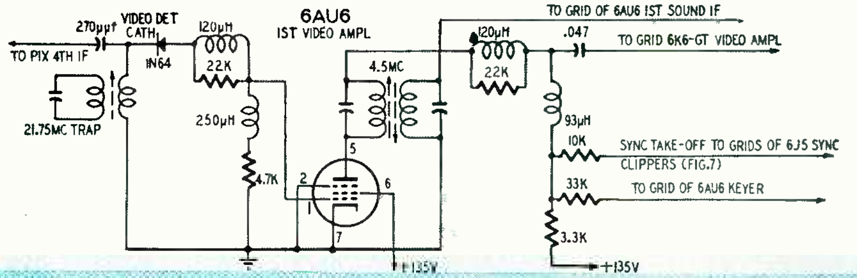


Fig. 4—Transvision sound take-off from plate of first video amplifier.

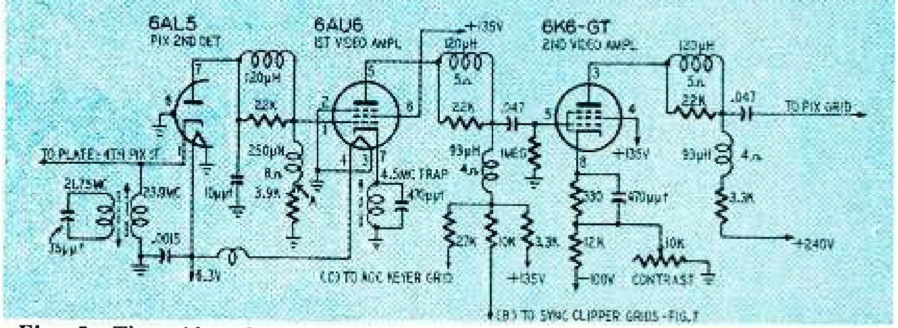


Fig. 5—The video detector and amplifier circuits used by Video Products.

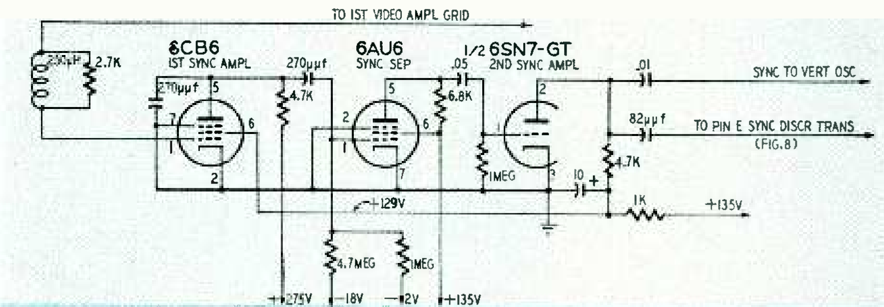


Fig. 6—Original RCA 630TS sync circuit, with modern tubes substituted.

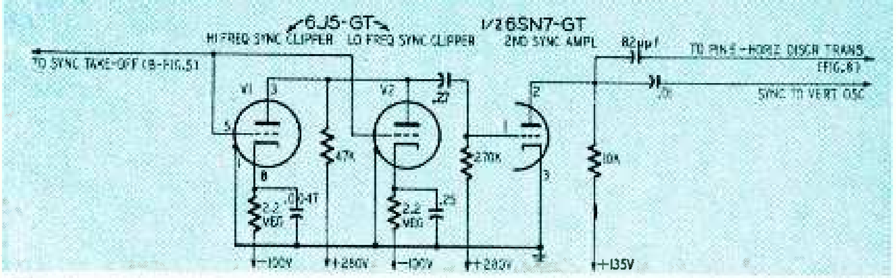


Fig. 7—New type of sync separator. Circuit designed to stabilize sync pulses.

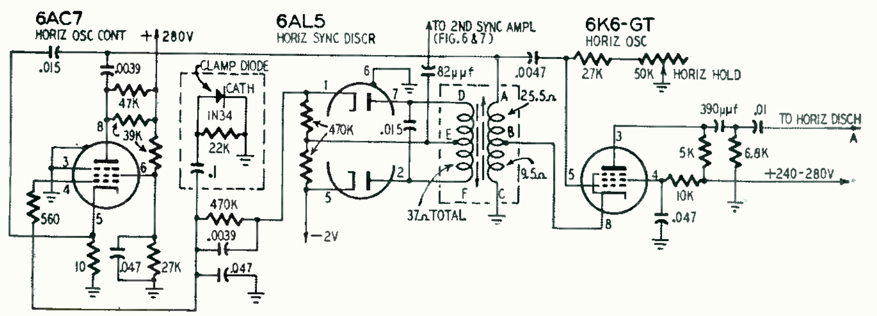


Fig. 8—The Synchrolock horizontal a.f.c. circuit used in the 630TS.

The Transvision set is an *intercarrier* type with the sound take-off coupled to the plate of the first video amplifier as shown in Fig. 4. This radical change from the original 630 circuit was probably made to minimize picture and sound separation when receiving u.h.f. stations. This set is the only one to use a germanium diode as the video detector. The others use 6AL5's.

The video amplifier

In all the sets, the first video amplifier is a 6AU6 and the video output is a 6V6 or 6K6. See Table I. The contrast control is in the cathode circuit of the video output stage.

The 630 is a wide-band receiver. When 16-inch and larger picture tubes were substituted for the old 10BP4, there were complaints of a strong 4.5-mc beat causing interference in the picture. A 4.5-mc trap was installed to prevent this. In some sets, this trap is inserted in the plate circuit of the first video amplifier. In the Transvision set (Fig. 4), the sound-take-off transformer also serves as a 4.5-mc trap. The cathode is grounded when the trap is in the plate circuit. The Philmore model does not employ a 4.5-mc trap.

The video detector and amplifier circuits of the Video Products 630K4C are shown in Fig. 5. Here, the 4.5-mc beat is eliminated by a low-Q degenerative trap in the cathode return on the 6AU6. This trap is made by shunting a 470-μμf capacitor across a 630 type third or fourth picture i.f. coil. This arrangement is also used in the Mattison, Airex 630 FA, and Regal sets.

Mfr.	Model	No. of tubes	Horiz. output	Vert. output	Audio output	Video output	Horiz. Blank.	Vert. Blank.	Delayed a.g.c.	High Voltage (kv)
RCA	630TS	30	6BG6-G	6K6-GT	6K6-GT	6K6-GT	No	No	No	9
Airex	630FA	31	6BG6-G	6K6-GT	6AQ5[1]	6V6-GT	No	Yes	No	14.5–15
	630FA-2	31	6CD6-G	6S4	6AQ5[1]	6V6-GT	No	Yes	No	16
	630FA-2-A	31	6CD6-G	6S4	6AQ5[1]	6V6-GT	No	Yes	No	16
Mattison	630-6A	30	6BG6-G or 6BQ6	6K6-GT	6K6-GT	6K6-GT	No	Yes	Yes	14.5
Philmore	CP7-31D	31	6CD6-G	6K6-GT	6K6-GT	6K6-GT	No	No	No	14
Regal	See footnote	30	6BG6-G	6S4	6V6-GT	6V6-GT	No	Yes	No	14.5–15
Tech-Master	1930R-C	30	6CD6-G	6S4	6K6-GT	6V6-GT	No	Yes	No	16
	2430	30	6CD6-G	6S4	6K6-GT	6V6-GT	Yes	Yes	No	16
	2431P	31	6CD6-G	6S4	6AQ5[1]	6V6-GT	Yes	Yes	No	16
Transvision	630-A	30	6BG6-G	6K6-GT	6AQ5[1]	6K6-GT	No	Yes	Yes	14.5
Video Products	630K4C	30	6BG6-G or 6BQ6	6K6-GT	6K6-GT	6K6-GT	No	Yes	Yes	14.5

Note: Regal models are: 1731, 1736, 2031, 2036, 2131, 2136, 2431, and 2436. Chassis code 101.
[1]—Push-pull output stage.

Table I—630 comparisons. New circuit and tube changes covered in article.

Sync circuits

Two distinct types of sync circuits are used on the receivers discussed here. Philmore, Tech-Master (*Videola*), and the Airex 630FA-2 and 630FA-2-A use the original RCA type sync separator and sync amplifier circuits in Fig. 6. Tech-Master sets use a 6AC7 first sync amplifier and Airex sets have a 6CB6 in this stage in place of the 6SK7 in the 630TS. The 6SH7 in the 630TS has been replaced by the 6AU6 in all sets except the Philmore.

A new type of sync separator that some manufacturers are adopting is shown in Fig. 7. This circuit is designed to stabilize the sync pulses and minimize picture roll and tearing under severe noise conditions.

In a set which has a single time-constant sync clipper or separator, the time-constant is selected as a compromise value that provides good separation of horizontal and vertical sync pulses under normal conditions. With this arrangement, sustained noise bursts may gradually increase the operating bias on the clipper until it blocks. This causes momentary interruption of sync pulses, and the sweep oscillators may fall out of sync.

Mfr.	Model	Sound take-off point	Sync take-off point	Type of sync	Accompanying sound trap	Adj. chan. sound trap	Adj. chan. video trap	4.5-mc * trap
RCA	630TS	Converter plate	D.c. restorer	RCA	4th i.f. cathode	1st i.f. plate	2nd i.f. plate	None
Airex	630FA	1st picture i.f. ampl.	1st video amplifier	Dual	Detector cathode	2nd i.f. plate	4th i.f. grid	1st video cathode
	630FA-2	2nd picture i.f. ampl.	Video detector	RCA	4th i.f. cathode	1st i.f. plate	None	1st video plate
	630FA-2-A	2nd picture i.f. ampl.	Video detector	RCA	4th i.f. cathode	1st i.f. plate	None	1st video plate
Mattison	630-6A	1st picture i.f. ampl.	1st video amplifier	Dual	Detector cathode	4th i.f. grid	2nd i.f. plate	1st video cathode
Philmore	CP7-31D	Converter plate	Picture tube grid	RCA	4th i.f. cathode	1st i.f. plate	2nd i.f. plate	None
Regal	See footnote	Converter trans.	1st video amplifier	Dual	4th i.f. cathode	1st i.f. plate	2nd i.f. plate	1st video cathode
Tech-Master	1930R-C	2nd picture i.f. ampl.	Video detector	RCA	4th i.f. cathode	1st i.f. plate	None	1st video plate
	2430	2nd picture i.f. ampl.	Video detector	RCA	4th i.f. cathode	1st i.f. plate	None	1st video plate
	2431P	2nd picture i.f. ampl.	Video detector	RCA	4th i.f. cathode	1st i.f. plate	None	1st video plate
Trans-Vision	630-A	1st video plate	1st video plate	Dual	Detector cathode	4th i.f. grid	2nd i.f. plate	1st video plate
Video Products	630K4C	1st picture i.f. ampl.	1st video amplifier	Dual	Detector cathode	4th i.f. grid	2nd i.f. plate	1st video plate

Note: Regal models are: 1731, 1736, 2031, 2036, 2131, 2136, 2431, and 2436. Chassis code 101.

Table II—630 comparisons. Sound and video traps; sound and sync take-off points.

In the dual sync clipper in the Airex 630FA, Mattison, Regal, Transvision, and Video Products sets (see Fig 7), V1 and V2 are high- and low-frequency sync clippers, respectively. They operate with their grids in parallel and the plates connected to a common load resistor. The cathode circuit of V1 has a short time-constant, and V2 has a comparatively long time-constant.

The time-constant of V2 is designed to provide good separation of vertical and horizonal sync pulses. In strong-signal noise-free areas, the set will provide satisfactory sync operation with V1 removed from the circuit. When dual sync clippers are used in the presence of strong noise pulses, V2 may block, but the shorter time-constant of V1 enables it to continue to conduct.

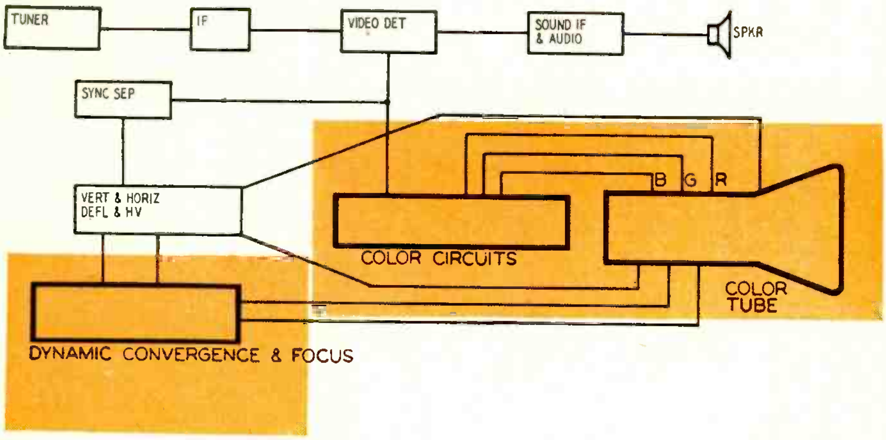
Although the short time-constant of V1 favors the passage of horizontal sync pulses over the vertical, the overall performance of the dual clipper in the presence of heavy noise is superior to that of any single time-constant type.

The sync take-off point is at the output of the video detector for the RCA type circuit in Fig. 6 and at the plate of the 6AU6 video amplifier for the dual sync clipper in Fig. 7. In the original RCA 630, sync take-off was at the plate of a 6AL5 d.c. restorer in the output of the second video amplifier.

Fig. 8 shows the Synchrolock horizontal a.f.c. circuit made famous in the 630TS. The 0.1-uf capacitor, 22,000-ohm resistor, and 1N34 germanium diode shown within the dashed lines are added components used in the Transvision 630-A and Airex 63FA receivers. In the Video Products and Mattison sets, diode plates and the grounded cathode of the 6AT6 first a.f. amplifier are used instead of the 1N34.

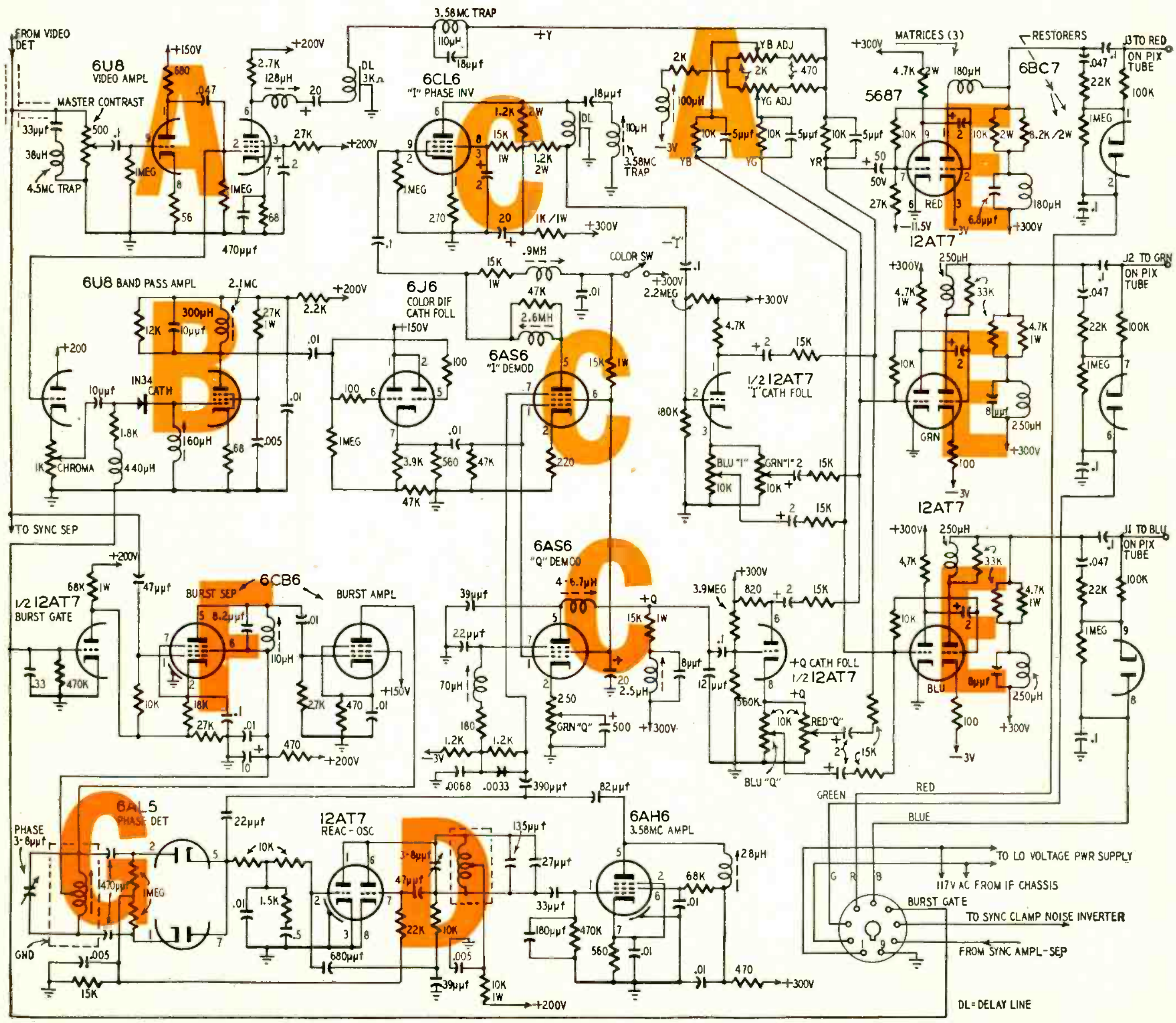
The 1N34 or 6AT6 diodes are used as clamps to stabilize the voltage on the horizontal sync discriminator in the presence of transients. The clamp diode regulates the voltage on the cathodes and eliminates the effects of transients.

TO BE CONTINUED



Have you ever asked yourself: "What new and different circuits are we going to find in a color TV receiver?" Here are the new and different parts, with a brief description of their function

COLOR CIRCUITS



COLOR RECEIVER CIRCUITS

A COMPLETE description of the circuits on this and the opposite page would constitute a complete course in color television. So the reader must expect the discussion to be incomplete and oversimplified. Some important circuits—time-delay networks for instance—have been passed over. Others—like the cathode followers—have been mentioned without explanation. All these points will be handled in detail in full articles within the next few months.

Up to the video detector, the only difference between a straight black-and-white and a color receiver is that the i.f. channel must be especially wide and flat. Therefore a color receiver may have more i.f. stages than has been common.

After the video detector, the signal is split into two parts. One goes to the luminance or "Y" (black-and-white) circuit (A); the other to the color circuits. The Y circuit consists of a two-stage video amplifier and a network through which the signal is applied to the grids of all three guns, essentially in parallel.

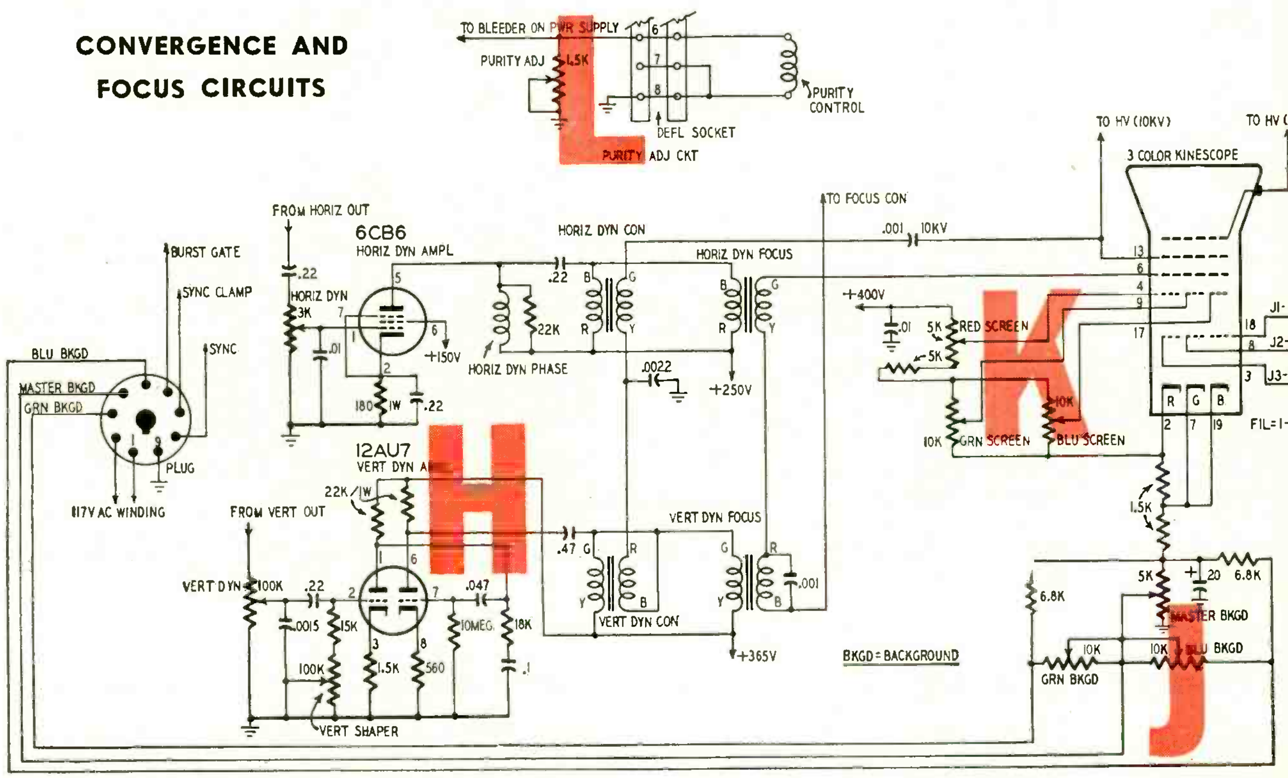
The first tube in the *chroma* circuit (B) is a bandpass amplifier which passes the 3.58-mc color carrier and its sidebands. It feeds a 6J6 color-difference cathode follower, which supplies the signal to the "I" and "Q" demodulating circuits (C). Since the color signal is phase-modulated for color, these detectors are there to find out the phase of the transmission. Their suppressors are supplied with a local 3.58-mc carrier generated by the 12AT7 triode section and amplified by a 6AH6 (D). The "I" ("in-phase") demodulator is fed direct; the "Q" (quadrature) through a 90-degree phase-shifting network. (Two values at right angles to each other—the "x" and "y" axes of trigonometry—can express any phase angle from 0 to 360°.) The "I" and "Q" signals then go (one of them through a phase inverter) to cathode followers which feed the three matrices or adder circuits (E) in which the color and luminance signals are combined. The cathode followers contain the controls for varying the individual colors. The matrix tubes are double triodes. The first half of each is a wideband mixer, the second half is an amplifier. Gain of each is set so that the picture tube receives color signals in correct proportion for good color balance. The diodes which are seen at the extreme right of the diagram are used as d.c. restorers.

The burst circuits (F) pick up an 8-cycle synchronizing burst sent at the end of each line, amplify it and feed it to a phase detector, which with the reactance tube, forms an a.f.c. circuit (G) for the local 3.58-mc oscillator.

Convergence circuits (H) appear below. A convergence electrode, supplied with 10,000 volts, is used to keep the spots in registry. But, since the path a spot travels is longer to the corners than to the center of the tube, that voltage must be varied. So signals are taken from the vertical and horizontal amplifier outputs, amplified and superimposed on the steady convergence voltage, as well as to the focus control, which keeps the spots registered and in focus at all points along the line. The background controls (J) are individual brightness controls for each color, and the screens (K) are adjusted for color balance. The purity coil (L) adjusts the axis of the three beams so that the spots strike the color dots on the screen accurately.

Our thanks to Emerson for supplying the original schematic of this prototype experimental receiver, and especially to Chief Engineer Dorman Israel and to William Feingold for assistance in expediting, for technical information, and for aid in checking the diagram. END

CONVERGENCE AND FOCUS CIRCUITS



TV DX in 1953

Another great year for dx hounds and students of propagation. Hardly a day went by without remarkable dx reports

By E. P. TILTON, W1DQ,
v.h.f. Editor, QST

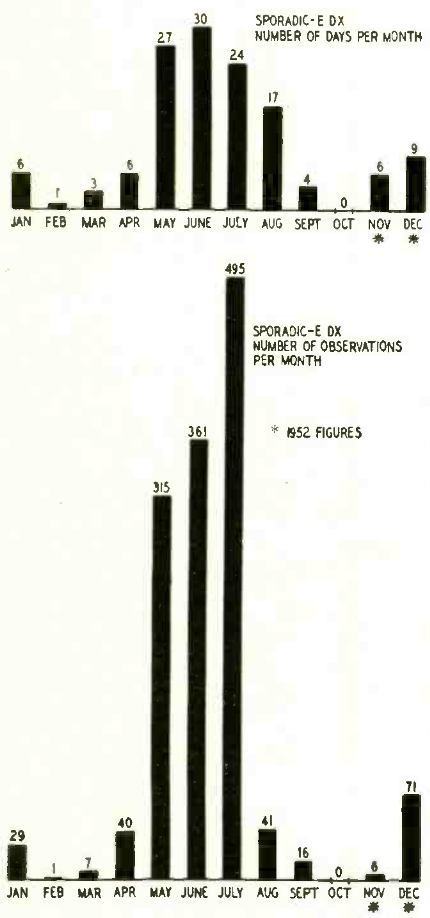


Fig. 1—Sporadic-E dx, report for 1953.

DESPITE all that's been written on the subject and the fact that hams have been working similar kinds of v.h.f. dx for nearly 20 years, it is still a source of amazement to most TV owners to discover that reception is possible over distances of more than 150 miles or so. Probably not one percent of all home viewers have seen any TV dx. Yet in 1953 *sporadic-E* TV dx was received in the United States on considerably more than one-third of the days; 133, to be exact. If we add all forms of dx, we find that hardly a day passed in 1953 without someone pulling in TV reception over distances that may seem incredible to the average viewer.

The nearly 150 people listed at the end of this article took the trouble to record their observations and send them in to RADIO-ELECTRONICS. They are all ages, of both sexes, and from varied walks of life; schoolboys of 14 or 15, invalids bedridden or confined to wheelchairs, TV service technicians, doctors, housewives. Quite a few are hams, and all seem to share that special blend of curiosity and enthusiasm that has made radio the fine hobby that it has been through the years.

Causes of TV dx

Probably the most intriguing cause of TV dx is sporadic ionization of the E region of the ionosphere, roughly 50 miles above the earth's surface. Normally v.h.f. waves go off into space, but at largely unpredictable times this region bends them back to earth at distances from 600 to 1,200 miles or so from where they started. They may come in as close as 300 miles on rare occasions, and multiple-hop propagation has been known to bring in stations as much as 2,500 miles distant. *Sporadic-E dx* is most common in May, June, and July, with a shorter period around Christmas time, but it can happen anytime.

More common is extended-range propagation associated with easily observable weather effects. *Tropospheric dx* can often be anticipated several hours to a day or two in advance. It is usually at its best just before a general rain, and is almost always associated with the middle or trailing edges of well-defined high-pressure areas. Tropospheric dx is most common in the warm months, reaching its peak in September and October.

Many other natural phenomena affect TV reception to some degree. The aurora borealis, meteors hurtling through space, high-flying planes, and various forms of scattering may cause weak signals to appear occasionally. All these are minor sources of TV dx. Except for aurora they can be neglected, and even the northern lights are seldom responsible for anything approaching entertainment quality reception.

Nature of sporadic-E dx

The seasonal character of E_s (sporadic-E) dx is shown clearly in Fig. 1. (November and December figures were taken from 1952 records.) The upper columns show the number of days in each month when dx was logged; the lower ones give the number of individual observations each month. The cycles for 1951[1] and 1952[2] were similar, but by no means identical. In 1951, May produced the largest number of reports, with June a close second. In 1952, June topped the list by a wide margin, with July second. This year we find July in the top spot, with August well ahead of previous years.

That frequency is a dominant factor in E_s dx is shown in Fig. 2. This shows the percentage of the total number of stations in each channel plotted against the percentage of the reports for that channel. It agrees well with previous years. Nearly half the dx was recorded by channel 2 stations, though only 20% of the low-band stations are in that channel. Channel 3 report and station columns are about equal. In channel 4, most populated of all, 34% of the stations yielded but 29% of the reports. Channels 5 and 6 together have one-third of the stations, but they account for a bare 13% of the dx.

Geographical situation of the station is important. Those receivable in all directions naturally outclass stations on either coast, but stations in lower latitudes enjoy another advantage: dx occurs much more often below the Mason-Dixon Line. Note the predominance of Cuban, Mexican, and Southern stations in the reports on Page 71.

A new champion!

For the first time since these reports have been collected, KPRC-TV, Houston, Texas, has been pushed out of first place. In 1953, KFEL-TV, Denver, Colo., nosed out the Houston station, 129 reports to 114. These two stations accounted for more than a third of all the channel 2 reports, and KFE[redacted] nearly 10% of *all* dx reported. Looks like Denver should be a good place for 50-mc ham work!

KMTV, Omaha, WKY-TV, Oklahoma City, KRLD-TV, Dallas, WBAP-TV, Fort Worth, and all the Cuban stations piled up impressive totals. A newcomer to the upper brackets was WCBS, New York, with nearly three times their 1952 score. Could it be that new Empire State Building antenna?

Tropospheric dx reports were received in great quantities in 1953. They show that the higher ERP's now being employed by many stations are having a considerable effect on coverage. They also reflect the recent improvements in receiver and antenna design. Particularly in the south, viewers are reporting reliable reception over distances in excess of 200 miles in a large number of instances.

Outstanding observers

The work being done by the more serious observers is most impressive, and the number of both reports and observers is well up over previous years. To record details of all would take most of this issue, but the work cited below is typical. Not a little of it is being done in areas where there is no local service at all. Some make a hobby of photographing dx for evidence, but such evidence is not always accepted as valid. Observer Penc, Utica, N. Y., says one fellow he showed his pictures to accused him of traveling around the country to get them!

Fantastic numbers of stations have been logged by several of the fraternity. Louis Matullo, Washington, Pa., holds unquestioned lead in this department, having identified 95 different stations! His list includes virtually every v.h.f. station within a 500-mile radius, and is very close to the maximum possible under present-day conditions. Lou is after more u.h.f. stations to add to the 7 he already has. There are 29 high-band v.h.f. stations on his list, along with 59 on channels 2 through 6.

Lou keeps involved records of weather and signal strength, and has photographed more than 50 different station identification slides and test patterns. He regularly logs up to 20 stations a day, and on July 15 he caught 36. Most home viewers refuse to believe that this many stations could be received in any day, but it's no record for Matullo. The top was 37, on September 9 of last year.

Richard Baker, Moberly, Mo., a schoolboy of 15, has 56 stations to his credit, and some fine tropospheric dx, including WHAS-11 and WAVE-3, 390 miles, WLWD-2 and WHIO-7, 450 miles, and Chicago, 300 miles, on all channels now in use, WAFM-13 and WBRC-6, 525 miles, and WXEL-9, 600 miles. Seeing the name of Gordon Amery, Braymer, Mo., listed among the 1952 observers, Baker made a trip up to compare notes. Both were pleased to find that they were the same age, and in the same grade in school!

Observer Van Gunten, Berne, Ind., has 63 stations logged, and has identified as many as 40 in a single 24-hour period. Akers, Charleston, W. Va., has 57, including all on channel 2 except the *nearest*, WFMY-TV. He is deep in a valley, with very mountainous terrain in the direction of Greensboro. Mellenbruch, Hiawatha, Kan. also has 57.

The favorable nature of the Gulf Coast for tropospheric dx shows in the reports of observers Atkisson and Blalock of Tallahassee, Fla. They report reception of Cuban stations on all channels in the warmer months, over distances up to 600 miles. Birmingham and New Orleans are also received frequently in Tallahassee. Walker of Daytona Beach has received WGUL-11, Galveston, Texas, more than 800 miles across the Gulf. Young of Orlando also received WGUL, about 775 miles, on September 13. At 10:15 pm Young was able to get a fine clear photograph of their beautiful seagull identification slide, and the signal remained in for about an hour thereafter. No low-band dx was in evidence. Rogers, of Mobile, also has seen WGUL.

Schuman, McAllen, Texas, logs KTBC-7, Austin, 309 miles, and KGUL-11, 340 miles, frequently. Even KPRC-2, Houston, 309 miles, can be received on a channel 11 antenna. Landry, Friars Point, Miss., has KPRC, WSB-2, WAVE-3, WSM-4, WBRC-6, WAFM-13, WTTV-10, KGUL-11, and WHAS-11 at distances from 285 to 450 miles. Hale of Natchez, Miss., has a similar list, covering about everything "from Natchez to Mobile; from Memphis to Saint Jo . . ." and Galveston to San Antonio, to boot.

A session of tropospheric dx that would look like E_s, if it weren't on high channels, is reported by Hedges of Kingman, Kansas. The night of May 21 WKY-4 and KOTV-6, his "locals" at 170 and 190 miles, were snow-free after about 8:45 pm, so he started looking around. Result: KFDX-3, 325 miles, WBAP-5 and WFAA-8, 360 miles, KSWO-7, 225 miles, KPRC-2, 600 miles, and WGUL-11, 625 miles. The steady reception or slow-fading change of tropospheric dx, as contrasted to the more rapid fluctuation of E_s, was present on these signals. They lasted until around 11 pm.

Not all the high-band dx is logged along the Gulf or in Texas and Oklahoma. Sproule, up in Toronto, lists WMAL-7 and WTOP-9, Washington, D.C., along with many nearer in Ohio, New York, and Pennsylvania. Teal of Burlington, N. C., says that the high-band stations give better service in that mountainous terrain than does WBTV-3. He gets WSLS-10, Roanoke, and WLVA-13, Lynchburg, better as a rule than the Charlotte station, though all are at about the same distance. The high-band stations run much lower power, but they have superior mountain sites. Teal has also received WROV-27, Roanoke, 120 miles, when the high-band signals were good.

High-band stations in Ohio, Kentucky, Illinois, and Indiana are reported by Guin, Russellville, Ala., who looks at Atlanta, 200 miles, on 8, 5, and 2 with considerable regularity. May 27 was an occasion of particularly good reception from the north. Adding a screen reflector made of chicken wire to his Skyline antenna has improved his reception markedly.

TV dx received under unusual and probably favorable conditions is reported by Radio Officer Proctor, of the S.S. Sabine. He and his captain see stations along the Gulf and Atlantic seaboard at distances up to about 250 miles more or less regularly.

A quite different sort of dx is described by Haley, Estes Park, Colo., and Beard, of Hayfork, Calif. Both are surrounded by mountains that provide a mass of reflections, making it almost impossible to tell the true direction of the station coming through. Haley caught a few minutes of sound and picture on channel 13 on December 18 of last year. He assumes that it came from KLAC, Los Angeles, but that's more than 700 miles away, directly over the 13,000-foot Continental Divide.

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1 "TV Dx in 1951," RADIO-ELECTRONICS, January 1952, p 40.

2 "TV Dx in 1952," RADIO-ELECTRONICS, January 1953, p 45.

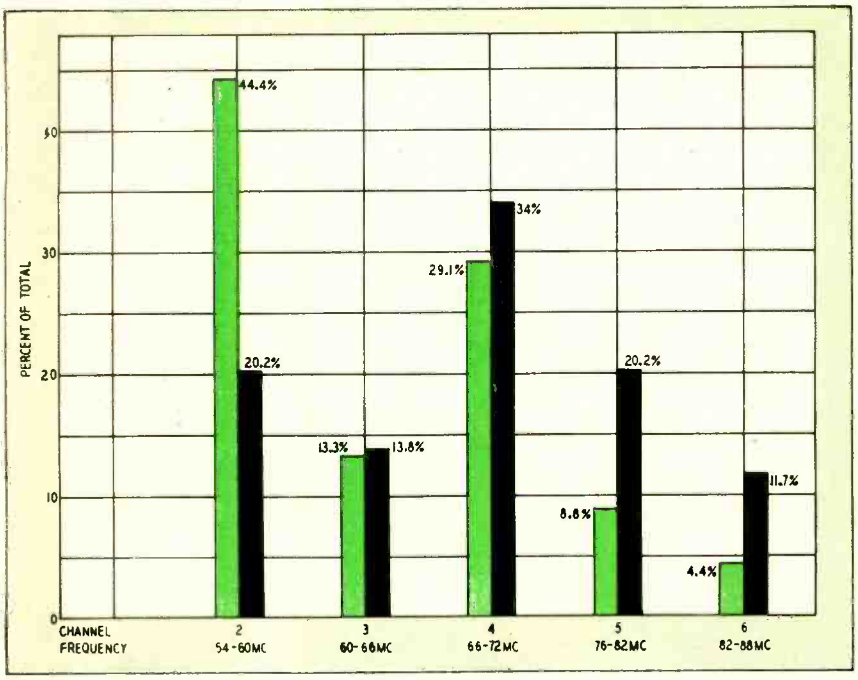


Fig. 2—Showing how the TV dx is divided among the low-band v.h.f. channels.

Beard's valley location, 200 miles north of San Francisco, is so full of reflections that when he caught KFEL-2, Denver, on July 4, he was able to distinguish six separate ghosts, all fading out of phase!

Dx on u.h.f., too

True to predictions in the monthly dx forecast appearing regularly in RADIO-ELECTRONICS, dx is beginning to show up in the u.h.f. channels. Honors for the first u.h.f. report that can be called dx go to Mrs. W. C. Breithaupt, Little Rock, Ark. She picked up WJTV-25, Jackson, Miss., at 10:15 am, April 9, a 200-mile haul. Other u.h.f. reports were contributed by observers Ross, Walker, Peters, Wieskamp, Teal, Hill, Grave, Kuehn, De Haven, Melson, Collins, Kidd, Ashworth, Perry, Paul, Richards, Cooper, Cafritz, and Carnes.

An Atlantic seaboard path that has produced many fine contacts for hams on 144 mc has shown itself capable of producing u.h.f. dx, too. Ashworth of New Bedford, Mass., pulled in WVEC-15, Hampton, Va., around 8 pm October 3. It's about 450 miles, the best u.h.f. dx yet reported by an observer. De Haven, Atlantic City, N. J., brought in WICC-43, Bridgeport, Conn., 150 miles, on August 25. Since then, Bob has logged WVEC-15, WEEU-33, WGLU-59, and WHUM-61, all in eastern Pennsylvania.

Midwestern reports include WTVO-39, Rockford, and WTVI, Belleville, Ill., by Kidd, of Decatur, 170 and 100 miles, respectively. WSBT-34, South Bend, Ind., is reported by Richards, Keensburg, Ill., more than 250 miles. WSBT is also mentioned by Kuehn of Milwaukee, 130 miles. Melson, Niagara Falls, N. Y., has logged WKBN-27, Youngstown, and WICA-15, Ashtabula, Ohio, 180 and 125 miles, respectively.

Over-water, coastal, and river-valley paths seem to produce u.h.f. dx in a manner now well established in v.h.f. work. At Quogue, Long Island, Perry has received WFPG-46, Atlantic City, nearly 150 miles, WHYN-55, Holyoke, Mass., and WKNB-30, New Britain, Conn. A shot of well over 300 miles, mostly over salt water, WCOS-25, Columbia, S. C., received by Walker, Daytona Beach, Fla., has already been reported in the monthly dx column as an early u.h.f. record.

Co-channel and adjacent-channel interference, not supposed to occur in the "interference-proof" u.h.f. region, has already reared its ugly head. Paul, Honeybrook, Pa., noting some interference on his local WEEU-33 the night of October 3 (remember this was a big night), turned his antenna and found the cause to be WKNB-30, three channels and 170 miles away in New Britain, Conn. (We repeat here the prediction made at the time the u.h.f. allocations plan was first announced: There's going to be a lot more interference between stations in the u.h.f. region than most people now anticipate. When tropospheric propagation is good on u.h.f., it's *terrific!*) Observer Paul holds the record, incidentally—8 u.h.f. stations identified, and in one evening.

The only West Coast u.h.f. report is from Cooper of Lafayette, Calif., formerly of Ithaca, N. Y. Bob sees KCCC-40, Sacramento, 100 miles, and KMJ-24 and KJEO-47, Fresno, 125 miles fairly regularly. This is made possible by a "relay rhombic" on a hill about a mile away from and 500 feet above his valley location.

Some really rare ones

Nearly all the dx reports, v.h.f. and u.h.f., can be classified according to well-established patterns. But every so often an observer comes up with a report that cannot be explained by any of the known theories. Such is the reception of KLAC-13, Los Angeles, by Phil Rader, Indianapolis, July 2. This far exceeds the amateur 144-mc record of 1,400 miles, and it's three times the best that has been done on 220 mc. Assuming that it's not a case of mistaken identification, how did it happen? Phil also reports reception of PRF-3, São Paulo, Brazil, July 8.

Cooper calls our attention to a report that appeared in *Broadcasting* regarding the reception of WKY-4, Oklahoma City, in England. The same publication also reported KTNT-11, by a viewer in McAllen, Texas. No details—but what dx, if true!

And here's the real killer. John Shipley, chief engineer of WKNB, New Britain, Conn., called the writer one afternoon last summer to pass along information on reported reception of their new channel-30 rig by a viewer in Ames, Iowa. The correspondent reproduced the WKNB test pattern accurately, and correctly identified the pitch of the tone that accompanied it. This neat 1,100-mile trick was turned shortly after noon on July 11. Can anyone explain it? We have a few things to learn, yet! END

1953 Observers

Akers, Dorsey W., Charleston, W. Va.
Anderson, A. Leland, Squirrell, Idaho.
Anderson, Leland, San Antonio, Texas.
Angelo, T. C., Little Rock, Ark.
Anglado, George R., Biloxi, Miss.
Artkin, W. H., Toronto, Ont.
Ashworth, Russell, New Bedford, Mass.
Atkisson, Jerry, Tallahassee, Fla.

Baker, Richard, Moberly, Mo.
Bare, Claude, Starr, S. C.
Bass, Chase, Colonial Heights, Va.
Batten, W. R., Rockford, Ill.
Baughman, R. D., Newport, Ohio.
Beard, R. N., Hayfork, Calif.
[redacted]rk, New Cumberland, Pa.
Blakeney, Justin, McAllen, Texas.
Blalock, Tommy, Tallahassee, Fla.
Bocker, Nick, Brandon, Man.
Breithaupt, Mrs. W. C., Little Rock, Ark.
Brierton, David, Watertown, N. Y.
Brown, N. L., St. Johnsville, N. Y.
Brasseur, Bob, Saginaw, Mich.
Buchanan, Francis D., Keokuk, Iowa.
Burnett, J. B., Scranton, Pa.

Cafritz, Carter and Conrad, Washington, D. C.
Caldwell, Alton L., Jr., Brockton, Mass.
Campbell, T. E., Douglas, Ariz.
Canning, L. A., Halifax, N. S.
Carnes, P. G., Orangeburg, S. C.
Carrier, G. M., Bedford, Ind.
Charlier, B. J., Kankakee, Ill.
Churchill, Harry R., Gravenhurst, Ont.
Cleveland, Bruce, Jamaica Plain, Mass.
Collier, J. W., Arlington, Va.
Collins, Art, Buffalo, N. Y.
Cooper, Robert B., Ithaca, N. Y.

Davies, W. L., Hamilton, Ont.
Davis, Dr. G. W., Sydenham, Ont.
DeGeer, M. W., Tulsa, Okla.
DeGroat, F. E., Salamanca, N. Y.
DeHaven, Bob, Atlantic City, N. J.
Dell, Vernon W., Mapleton Depot, Pa.
Dochak, Sudbury, Ontario.
Downs, Snyder H., Los Alamos, N. Mex.

Etherington, G. E., Hamilton, Ont.

Fellows, Harold L., Stockton, Calif.
Ferguson, George A., San Antonio, Tex.
Frahm, Lorene, Sidney, Neb.
Freiberger, Texas City, Texas.
Flora, Perry, Mt. Dora, Fla.
Fox, R. F., Raleigh, N. C.

Gibbs, P. W., Cobden, Ont.
Grave, Peter W., Germantown, Pa.
Guin, R. F., Jr., Russellville, Ala.
Guinn, Paul R., Oak Ridge, Tenn.
Guynes, George A., San Antonio, Texas.

Hale, James A., Natchez, Miss.
Haley, H. D., Estes Park, Colo.
Hall, C. D., Chillicothe, Ohio.
Hall, E. R., Miami, Fla.
Hansen, Floyd, Waukegan, Ill.
Harman, Oliver, Decatur, Ind.
Hartin, Robert, Mattawamkeag, Maine.
Hendershott, Myrl, Laramie, Wyo.
Hedges, John R., Kingman, Kan.
Hill, Joe C., Laurel, Miss.
Hill, Sherman A., Galata, Mont.
Hinton, Orval J., Spencer, Ind.
Hollis, James L., Clyde, Texas.
Horacek, Edwin C., Yankton, S. D.
Houde, W. D., Eureka, Mont.
Hughner, Robert, Canandaigua, N. Y.
Holt, H. D., East Hampton, Conn.

James, Edgar R., Chesham, N. H.
Johnson, Charles W., Little Falls, N. Y.
Johnson, Elmer W., Cornwall-on-Hudson, N. Y.

Kasticky, John S., Benwood, W. Va.
Kemery, Richard D., Columbia City, Ind.
Kidd, S. E., Decatur, Ill.
Kish, G. J., Temperance, Mich.
Koch, Stanley G., Caro, Mich.
Kuehn, Harvey, Milwaukee, Wis.

Landry, Duke, Friars Point, Miss.
Lapham, Harry, Towanda, Pa.
Larkins, Tommy, Clarksville, Tenn.
Leeson, Raymond H., Auburn, N. Y.
Lester, Cloyd M., Bristol, Va.
Lipskey, Edwin E., London, Ont.
Liszczak, John, Griffin, Ind.
Long, Terry, Wabash, Ind.

Mahler, Chrales F., Portland, Ore.
Manly, W. A., Auburn, Ala.
Mayo, S. D., Portland, Maine.
Mayernik, Joseph, Monessen, Pa.
McGehee, B., Arcadia, Fla.
McPhail, G. A., Renfrew, Ont.
McQuentin, George, Fullerton, N. Y.
Mellenbruch, Reuben, Hiawatha, Kan.
Melson, Frank, Niagara Falls, N. Y.
Millot, Dan, Louisville, Ky.
Minnix, Roy T., Murphys, Calif.
Morris, Dale, Austin, Texas.
Mueller, Ronald C., W. Milwaukee, Wis.
Meyer, J. H., Georgetown, Colo.
Martin, Jack R., Augusta, Ga.
Matullo, Louis M., Washington, Pa.

Nafzger, Paul K., Round Lake, Ill.
Nichols, Den, Mason, Mich.
Nienow, Virgil, Mapleton, Minn.

Oberto, G. P., Richmond, Va.

Parks, Lyle M., Bay City, Mich.
Patterson, Clay, Ainsworth, Neb.
Paul, Dr. John D., Jr., Honeybrook, Pa.
Penc, Stanley J., Utica, N. Y.
Perry, Arthur M., Quogue, N. Y.
Peters, Robert B., S. Orange, N. J.
Popper, Dennis, Cedar Rapids, Iowa.
Proctor, Gerald R., S. S. Sabine.

Rader, Phil, Indianapolis, Ind.
Radke, Merle, Seattle, Wash.
Rainey, Sidney, Shelbyville, Mo.
Richards, Wade, Keensburg, Ill.
Richardson, Stanley, County Line, Okla.
Riebman, R., Coatesville, Pa.
Roberts, Earl R., Indianapolis, Ind.
Rogers, James R., Prichard, Ala.
Ross, Leonard, E. Orange, N. J.

Salter, F. X., Norfolk, Va.
Savoy, David, Madison, Maine.
Scanlon, V. C., Toronto, Ont.
Schauperl, William, Winnipeg, Man.
Scriven, R. L., Cedar Rapids, Iowa.
Schuman, G. T., McAllen, Texas.
Schultz, Erwin F., Milwaukee, Wis.
Sechler, F. E., Denver, Colo.
Sloss, Raymond, Baton Rouge, La.
Smith, Millard, Malone, N. Y.
Smith, Wilfred E., Muskegon, Mich.
Smick, Robert, Oshkosh, Wis.
Stanek, John A., New Kensington, Pa.
Sproule, T., Toronto, Ontario.
Swann, Jesse F., Celina, Tenn.

Teal, Nelson B., Burlington, N. C.
Thompson, Sam, Klamath Falls, Ore.
Titsworth, V. O., Heavener, Okla.

Unsigned, Granite City, Ill.

Von Gnnten, Fred, Berne, Ind.
Vuylsteke, George, Story, Wyo.

Walker, R. J., Daytona Beach, Fla.
Warren, Bud, Cocoa, Fla.
Weems, R. C., Jr., State College, Miss.
Wenth, Allen W., Orlando, Fla.
Whiting, Larry D., Ilderton, Ont.
Wieskamp, H., Holland, Mich.
Wilcox, W. W., Richmond, Va.
Wilson, Don, Wichita, Kan.
Witschen, Robert B., St. Cloud, Minn.
Wolfe, Stanley H., Philadelphia, Pa.

Young, Ernest, Jr., Orlando, Fla.

Also reports excerpted from *The TV DXer* Hank Ward, Ponca City, Okla.

SPORADIC-E DX REPORTS BY STATION AND CHANNEL

Channel 2, 54–60 mc; 19 stations, 643 reports	
KFEL-TV, Denver, Colo.	129
KPRC-TV, Houston, Texas	114
CMQ-TV, Havana, Cuba	90
WCBS-TV, New York City	60
WSB-TV, Atlanta, Ga.	34
WBAY-TV, Green Bay, Wis.	32
WFMY-TV, Greensboro, N. C.	32
XEW-TV, Mexico City	29
WMAR-TV, Baltimore, Md.	28
WDTV, Pittsburgh, Pa.	21
KNT, Los Angeles, Cal.	20
CBFT, Montreal, Quebec	20
WJBK-TV, Detroit, Mich.	17
WLWD, Dayton, Ohio	11
WBBM-TV, Chicago, Ill.	2
XETV, Matamoros, Mexico	1
WKAQ-TV, San Juan, Puerto Rico	1
CBOT, (?) Ottawa, Canada	1
KFEQ-TV, St. Joseph, Mo.	1
Channel 3, 60–66 mc; 13 stations, 193 reports	
KMTV, Omaha, Neb.	55
WBTV, Charlotte, N. C.	25
WPTZ, Philadelphia, Pa.	19
KFDX-TV, Wichita Falls, Texas	16
WAVE-TV, Louisville, Ky.	15
WKZO-TV, Kalamazoo, Mich.	12
WSAZ-TV, Huntington, W. Va.	12
KDZA-TV, Pueblo, Colo.	12
WTMJ-TV, Milwaukee, Wis.	11
CMQ-TV, Cuba	11
WLWC, Columbus, Ohio	3
WDTV, Pittsburgh, Pa.	1
PRF3, Saõ Paulo, Brazil	1
Channel 4, 66–72 mc; 32 stations, 422 reports	
CMUR-TV, Cuba	47
WKY-TV, Oklahoma City, Okla.	44
KRLD-TV, Dallas, Texas	45
WOAI-TV, San Antonio, Texas	31
WSM-TV, Nashville, Tenn.	29
WTVJ, Miami, Fla.	29
WDAF-TV, Kansas City, Mo.	25
WCCO-TV, Minneapolis, Minn.	21
WMBR-TV, Jacksonville, Fla.	17
WBZ-TV, Boston, Mass.	16
XHTV, Mexico City, Mexico	14
KDYL-TV, Salt Lake City, Utah	13
WTAR-TV, Norfolk, Va.	12
KGNC-TV, Amarillo, Texas	10
WNBT, New York City	10
WHBF-TV, Rock Island, Ill.	9
WNBW, Washington, D. C.	8
WWJ-TV, Detroit, Mich.	7
KOB-TV, Albuquerque, N. Mex.	7
WOI-TV, Ames, Iowa	5
WBEN-TV, Buffalo, N. Y.	5
WBBM-TV, Chicago, Ill.	3
KRON-TV, San Francisco, Cal.	2
WNBK, Cleveland, Ohio	2
WRGB, Schenectady, N. Y.	2
KROD-TV, El Paso, Tex.	1
WOC-TV, Davenport, Iowa (5?)	1
KHQ-TV, (??) Spokane, Wash.	1
WLWC, Columbus, Ohio	1
WBKB, Chicago, Ill.	1
Channel 5, 76–82 mc; 19 stations, 128 reports	
CMQ-TV, Santa Clara, Cuba	20
KSD-TV, St. Louis, Mo.	14
WMCT, Memphis, Tenn.	14
WBAP-TV, Ft. Worth, Texas	21
KTSP-TV, Minneapolis-St. Paul, Minn.	10
KEYL, San Antonio, Texas	8
KPHO-TV, Phoenix, Ariz.	6
WCSC-TV, Charleston, S. C.	6
KCSJ-TV, Pueblo, Colo.	5
WAGA-TV, Atlanta, Ga.	4
WLWT, Cincinnati, Ohio	4
WSYR-TV, Syracuse, N. Y.	4
WNBQ, Chicago, Ill.	3
KSL-TV, Salt Lake City, Utah	3
WABD, New York City	2
KING-TV, Seattle, Wash.	1
WTTG, Washington, D. C.	1
WEWS, Cleveland, Ohio	1
Channel 6, 82–88 mc; 11 stations, 63 reports	
CMQ-TV, Havana, Cuba	19
WOW-TV, Omaha, Neb.	9
WDAY-TV, Fargo, N. Dak.	8
WDSU-TV, New Orleans, La.	6
WBRC-TV, Birmingham, Ala.	6
KOTV, Tulsa, Okla.	4
WFIL-TV, Philadelphia, Pa.	3
WNHC-TV, New Haven, Conn.	3
WFBM-TV, Indianapolis, Ind.	2
XETV, Matamoros, Mex.	2
WTVR, Richmond, Va.	1

Note: Where the same call appears on two different channels it is a case of a shift in channel during the year. There is also the possibility of a mistake in identification by the observer, or reception on the wrong channel by a detuned turret oscillator.

U.H.F. DESIGN PROMOTES TVI?

IN A letter to the FCC, A. Budlong of the American Radio Relay League pointed out that although u.h.f. TV is relatively free from interference problems that are common to v.h.f., there are indications that there may be serious interference from amateurs and other communications services. The v.h.f. sets which receive u.h.f. stations by installing special tuning strips are particularly susceptible to u.h.f. TVI.

These sets use double conversion for the u.h.f. channels. A harmonic of a local v.h.f. oscillator beats with the incoming signal to produce the first intermediate frequency. The fundamental of the oscillator heterodynes the first i.f. to the set's i.f. in the 21- or 45-mc range. In his letter, Budlong illustrates how unavoidable interference may be caused by operation of a normal 144-mc amateur transmitter.

Suppose that a channel 14 (475.75 mc) strip is installed in a set having a 21.25-mc i.f. The local oscillator is set to approximately 165.67 mc with its second harmonic (331.33 mc) beating with the channel 14 signal to produce the first i.f. at 144.42 mc (475.75–331.33). The fundamental of the oscillator beats with the 144.42-mc first i.f. to create the second i.f. at 21.25 mc.

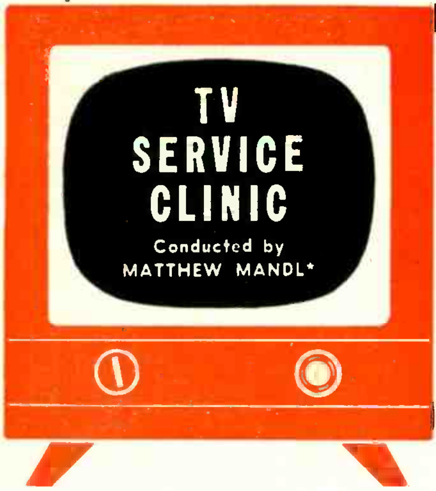
Note that the first i.f. falls in the 144–148-mc (2-meter) amateur band. Since the 144-mc tuned circuit is near the antenna input of a comparatively wide-open front end, signals from 2-meter transmitters may, through no fault of the operator or his equipment, ride through and wipe out the picture.

Assuming a normal 6-mc TV bandwidth and a 21.25-mc i.f. system, 2-meter transmissions may cause interference on u.h.f. channels 14 to 18, 40 to 48, and 69 to 77. Sets using 41.25-mc i.f. circuits are liable to 2-meter TVI on channels 20 to 25, 51 to 58, and channels 82 and 83. Thus, more than half of the total number of u.h.f. TV channels are subject to unavoidable 2-meter TVI.

Amateur stations are not the sole source of interference on the u.h.f. channels when the receiver is a double conversion type having the first i.f. around 144 mc. Tuning these sets to channels other than those mentioned above places the first i.f. on one side or the other of the 144–148-mc amateur band. The band each side of the 2-meter band is similarly occupied by other communications services which also may cause unavoidable TVI.

Of course, TVI works both ways. Not only are u.h.f. receivers and converters generally more susceptible to interference from amateur and other services, but they also emit spurious radiations.

Recently, the chairman of RETMA's TV receiver committee recommended that companies which have sold receivers or converters or turret strips, assume it as a moral obligation to satisfy the customer in each case of complaint. The situation as it stands is an unhappy one. END



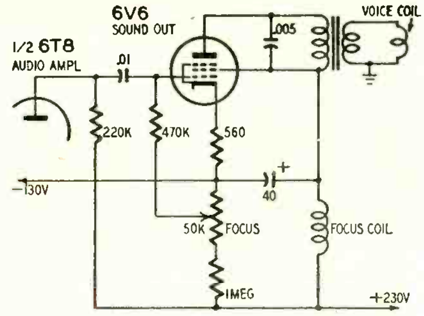


Fig. 1—Focus circuit in Emerson 663B.

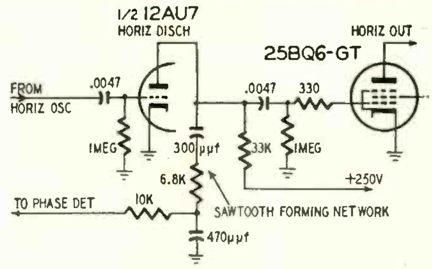


Fig. 2—Drive circuit in G-E 21C208.

MANY set owners buy and install their own u.h.f. converters. They don't *seem* to present any installation problems, since they are designed to operate with any v.h.f. receiver. You simply attach the u.h.f. and v.h.f. antenna lead-ins to their respective terminal posts, and fasten the necessary length of line from the output of the converter to the antenna terminals of the v.h.f. receiver.

What a pity it doesn't work out that way! More than occasionally, the set owner finds that no amount of switching or tuning brings in that local u.h.f. station which the neighbors are enjoying, or if it does appear it is snowy and lacks contrast.

Eventually the converter is returned to the dealer who checks it and finds it all right. Then the puzzled owner at last calls the technician. Since the troubles he has to cure are common to all installations, let's review them briefly for the guidance of those who are still unfamiliar with u.h.f.

Converters like the Mallory, Sylvania, and others take the incoming u.h.f and mix it with the frequency generated by the oscillator in the converter. The *difference* frequency output is acceptable to the v.h.f. receiver only if the latter is tuned to *either* channel 5 or 6. If one of these channels is on the air locally, the receiver must be set for the other channel. Here's where one trouble often occurs.

When receivers are installed, they are usually checked for performance on the local channels. Thus, when the converter is used on a channel that had not been adjusted, it may be impossible to bring the circuit into resonance with the fine-tuning control. The converter can't bring the u.h.f. station in on the v.h.f. receiver.

If the receiver tuning isn't too far off and the u.h.f. station can be seen faintly, the local oscillator slug of the receiver can be adjusted for best picture at the center setting of the fine-tuning control. If the oscillator slug is so far off that the u.h.f. station can't be brought in, the problem is much more severe.

Converter dials are apt to be slightly inaccurate and this complicates things.

If the dial of the converter is set for the u.h.f. station and the local oscillator slug of the receiver is tuned, you're never sure whether or not the converter is really tuning in the station. So the converter dial should be rocked several degrees above and below the dial frequency while tuning the slug in the receiver. In one receiver with a drum tuner, even this failed to produce results. Later it was found the contact points for channel 6 (the unused v.h.f. station) had worn to the point where reception was impossible. Since this channel could not be received in the area, the owner knew nothing about the trouble until he tried to use the u.h.f. converter.

Where the set owner also installed his own u.h.f. antenna, better take a little time out to inspect it. Misorientation is a common fault and it isn't uncommon to find the lead-in wrapped around the mast "so the wind won't blow it." One owner even had 10 turns wrapped around his water-pipe in the basement to save the cost of a lightning arrester.

In strong-signal areas, aging of the r.f. and mixer tubes in the tuner may not affect the picture enough to be noticed. For u.h.f., however, the weaker signal needs all the amplification it can get. For this reason the r.f. and mixer-oscillator tubes should be checked and replaced if below par. The r.f. tube will help the signal amplification, while the new oscillator tube will minimize the drift often experienced with u.h.f. converters when an unstable local oscillator tube is in the receiver.

Emerson focus circuit

I have an Emerson model 663B with intermittent bad focus. When the picture blurs, the focus control brings it back into focus for perhaps fifteen minutes; then it goes out of focus again. After two hours, the control no longer is effective. I have checked the focus control and the 6V6, but could not find the trouble. P. J. L., Randolph, Mass.

As shown in Fig. 1, the focus control regulates the bias on the 6V6 sound output stage, thus regulating the current through the focus coil, which is in series with the plate of the tube and the power supply. Since you have checked the 6V6, you should also check the 6T8 tube preceding the sound output, because a gassy or defective 6T8 would draw excessive currents and disturb the voltage applied to the 6V6 and the focus coil.

A leaky 0.01-μf coupling capacitor, as well as other parts which change value during warmup also can cause the trouble you described.

Make sure the voltages shown in Fig. 1 are as indicated. If not, check for defective resistors from the voltage feed of the power supply to the output circuit. Also check the 40-μf capacitor at the focus coil. If none of these checks disclose anything wrong, the focus coil may have shorted turns or leakage, and should be tested or replaced with a new one. During warmup, the expanding wire of the coil may develop shorts.

Repeated 1X2 failure

The 1X2 high-voltage rectifier keeps breaking down after about 30 hours of operation. The heaters open with a popping sound only when the set is turned on, and not while in operation. What could cause this? F. F. E., Oaklyn, N. J.

During warmup, the peak voltage is higher than normal and the danger of arcing is greater. It is possible that an intermittent arc occurs in the high-voltage lead which loads down the rectifier and causes an excessive amount of current flow. In time, this could cause filament failure. Inspect the lead dress, and make sure there is good spacing between high-voltage wires and that no sharp bends are present. Space wires well away from the chassis, and use anticorona dope where you feel corona or arcing are likely to occur. Also inspect the 1X2 socket for arcover. Check the high-voltage filter, and make sure drive to the horizontal output tube is not excessive.

With receivers using 16,000 volts (approximately) for the high voltage, 1X2 failure is often due to the pull exerted on the filament by the high electrostatic fields set up in the tube during

* Author: Mandl's Television Servicing

Fig. 3—Picture is improperly centered.

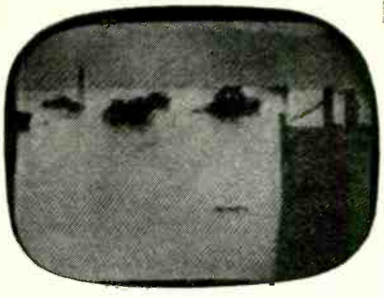


Fig. 4—Adjacent channel interference.

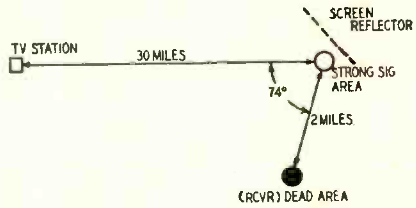


Fig. 5—Application of screen reflector.

the negative peak of the waveform. Eventually the filament bends sufficiently to short to the anode of the tube.

Indoor antenna length

Several months ago our channel 4 changed to channel 2. A customer was using an indoor antenna and could get other channels, but not channel 2 until I installed several turns of wire at the center of the antenna, in series with the two dipole elements. I stumbled on this solution accidentally, and would appreciate an explanation. E. F. W., Riverside, Ill.

Most indoor antennas do not have good gain for channel 2 because manufacturers try to keep down the physical size. For best reception of channel 2, the element lengths should span 97 inches from end to end. Coils help to increase the *electrical* length when the physical length is too short to provide maximum antenna gain. Some manufacturers utilize some sort of coil or other loading device on their indoor antennas so that channel 2 gain will not suffer, while at the same time minimizing the awkward antenna lengths which would result with a full span.

No drive control

In a G-E 21C208 there is pronounced left-hand stretch which I can't eliminate by adjusting the width or horizontal linearity control. I noted in a previous issue that you suggest adjusting the drive control, but I can't locate one in this receiver. What must I do to restore drive to normal? E. W. S., Newcomerstown, Ohio.

That receiver does not have a drive control, and when left-hand stretch and center compression occur, the component parts between the discharge tube and the grid of the horizontal output tube must be checked for defects or off-values. Also check the B voltages. As shown in Fig. 2, the sawtooth forming network is in the output of the 12AU7 horizontal discharge tube.

Pix off-center

When there is no station on a Tele-King model 201, the picture tube has a complete raster. As soon as the set is on a station, the picture is over to the right hand-side, with a black strip two inches wide on the left. A portion of the picture on the right is lost. I have checked voltages, including the voltages on the yoke, and they agree with the schematic. I can't seem to correct the condition and would appreciate some advice. I. B., Jackson, Mich.

Try centering the picture with the *focus* assembly. This applies to a receiver using either the focus magnet ring with centering lever, or a focus coil. Misadjustment will result in improper centering and corner shadows as shown in Fig. 3. Centering should be done with a picture on the screen, and not just the raster. The picture is always narrower than the raster because of the space taken by the blanking which is transmitted. After centering, the width and height controls must be adjusted so the picture fills the mask. If the focus assembly is unable to bring the picture over to the left, the idling voltage through the horizontal deflection coils will have to be changed. After centering, readjust the ion trap for maximum brilliancy. Never use the ion trap to eliminate corner shadows.

Adjacent-channel interference

In our area, channel 2 blocks out channel 3 which is a fringe station about 100 miles farther from us than channel 2. When the channel 2 station is on, we get nothing on channel 3 except the sound. I have tried several types of wave traps and also half-wave-length stubs, but none help. I would like to know what else can be tried? M. S., Malone, N. Y.

When a strong local station is in the area, it may be very difficult to receive a distant adjacent channel. Solutions consist of careful adjustment of the adjacent-channel traps of the receiver, plus realignment of the tuner and video i.f. stages so the bandpass characteristics are not too broad. An additional lower-adjacent-channel trap can also be installed in the video i.f. stages. These measures will block the local sufficiently to permit reception, though the diagonal line interference shown in Fig. 4 will probably still appear in the picture.

Intermittent picture tube

The brightness in a Muntz model 17A3 takes about 45 minutes to come up to normal. If the picture tube neck is struck lightly, the brightness comes on full and will stay on, until the receiver is shut off.

Would any of the picture-tube brightners help? S. V., Lodi, N. J.

These symptoms indicate a defective picture tube which should be replaced. Sometimes, flakings from the cathode structure short out gun elements and cause this condition, or there are loose connections within the tube neck. The brightners will not help, as they are useful only when emission is low.

Reception at angle

Perhaps you can help me with an installation as follows: This area is hilly with spots of very high signal and others with none. We are trying to receive on channel 12, but the receiver is located in an area where there is no reception. About two miles across the lake there is a very high signal area, a possible site for a reflector. I have tried a rhombic to reflect across the lake, but get severe ghosts. When a train goes by near the reflector site, we get an excellent picture. The station is about 30 miles from the site of high signal, and the receiver is located at an angle of 74° from it. Do you think it is possible to use a large plane reflector and bisect the angle as per the sketch submitted? (Fig. 5.) A. L., Ithaca, N. Y.

The angle involved lends itself nicely to the erection of a screen reflector. At that distance, however, the reflector would have to be oriented carefully and also moved toward and away from the receiving antenna to strike a signal loop area. (With airplane reflections you will note the increase and decrease of signal as the plane reflects in-phase and out-of-phase signals in conjunction with those received directly.) Space loops occur about every wavelength. The approximate height or maximum results will have to be determined experimentally. Use a channel 12 Yagi to pick up the reflected signal, and orient carefully. END

Improving U.H.F. Performance

To obtain maximum gain at u.h.f., special attention must be paid to antenna selection and installation

By EDWARD M. NOLL and MATTHEW MANDL

TO get consistently good reception at u.h.f. much more attention must be given to antenna selection, methods of installation, and procedures for reducing losses. Many an installation is giving poor or erratic results because of a hurried job which overlooked any one of the numerous factors which must be observed at u.h.f.

The technician must learn the precautions and limitations imposed by u.h.f. Knowledge of such principles will erase the mystery of poor performance and enable the technician to take proper steps for getting the most signal with the least effort. Installations will be more dependable, and callbacks because of ghosts, fading, or intermittent reception will be minimized.

Reception factors

The frequencies involved in u.h.f. as compared with v.h.f. make a considerable difference in reception. Shadow effect is more pronounced. This means that the signal does not bend around buildings or hills as it does for v.h.f. For this reason many dead spots will exist for some distance behind obstructions.

The higher the frequency the more such waves assume some of the characteristics of light waves. For this reason, u.h.f. signals reflect to a greater extent from surrounding objects than would v.h.f. signals. Ghost reception is therefore worse at u.h.f.

The u.h.f. signal suffers greater attenuation, so the transmitter needs more power to provide a satisfactory signal at the receiver. The greater absorption also means that the reception can be affected by trees with heavy foliage.

It can be seen that greater care must be exercised in the placement of the antenna so that it is clear of surrounding buildings and trees. The antenna should also have a sharp pattern when situated where reflections occur. The mast should also be reinforced with guys so that the antenna will not sway. At u.h.f., a swaying antenna will cause the picture contrast to vary. Technicians often refer to this as *picture breathing.*

In a series of articles which ran from January to June, 1949, in RADIO-ELECTRONICS the authors described how the direct television waves and the reflected waves cause a series of high and low signal spots in both a vertical and horizontal plane. These were referred to as *space loops* to indicate areas where signal intensity was high, and as *space nodes* for sections having low signal strength. Tests showed that a space loop occurred approximately each wavelength of distance along either a horizontal or vertical plane. This meant that if an antenna were shifted for a distance of one-half wavelength, the difference in reception could be increased from a point where the picture was snowy and weak to a point of high signal-to-noise ratio.

At u.h.f., such space loop conditions are even more pronounced than at v.h.f. The effect is even more noticeable in locations where there are surrounding buildings, hills, or other reflecting surfaces. This means that a lateral or vertical shift of the antenna can mean the difference between excellent reception and very poor reception. Thus, for weak signal areas it is extremely important that a preliminary test be made by shifting the antenna location along a horizontal plane or raising it up or down.

If proper precautions are taken for installation, consistent u.h.f. reception is possible up to 50 miles from the station in areas of flat terrain. If the signal-to-noise ratio is reasonably good, the primary advantages of u.h.f. reception can be realized. These include freedom from static, ignition noise, or other types of impulse-noise interference.

These advantages, however, are difficult to achieve unless an outdoor antenna of considerable height is used. Many set owners have found that an indoor antenna will provide satisfactory reception in metropolitan areas where the u.h.f. station is nearby. The indoor antenna, however, is closer to noise sources than the outdoor type, and the signal-to-noise ratio is usually poor.

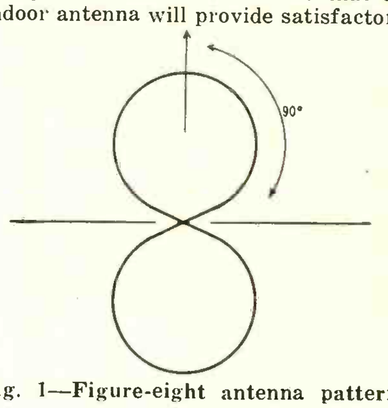


Fig. 1—Figure-eight antenna pattern.

In extensive tests with low antennas, the authors have found that cars traveling across the line of sight between the receiver and transmitter affected the picture and caused considerable variation in signal intensity. This was the case, even though signal strength was exceptionally high, because the receiver was less than 10 miles from the station. In most instances, the a.g.c. system was inadequate to hold the signal level constant.

Antennas at u.h.f.

Most broad-band v.h.f. antennas, such as biconicals, double-V types, and folded dipoles, can be used for u.h.f. reception. Such antennas, however, have numerous lobes when operated at frequencies substantially higher than those for which they are designed.

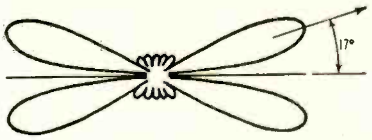


Fig. 2—Antenna operating at frequency nine times higher than fundamental.

A channel 2 antenna, for instance, has a figure-eight pattern such as shown in Fig. 1 when it is operating on the lower v.h.f. channels. When used at the ultra-high frequencies it acts as a long-wire antenna. Fig. 2 shows the multiple lobes present for a frequency nine times higher than the fundamental frequency. Thus, for u.h.f. channel 21 (512–518 mc), four primary lobes are present, which would make orientation more critical. At the same time the additional lobes are more likely to create ghost reception by picking up reflected signals.

Even for v.h.f. reception, broad-band antennas have additional lobes in the higher channels. For this reason, biconical antennas are usually tilted forward so that the lobes combine into a unidirectional pattern. At the upper v.h.f. channels an antenna designed for channel 2 would also exhibit a cloverleaf pattern, but the lobes would not incline as much toward the antenna elements as shown in Fig. 2. As the frequency which is received becomes higher the lobes incline more and more toward the antenna elements.

It is difficult to design a single antenna which has a unidirectional pattern for both v.h.f. and u.h.f. One approach to this problem is the double-V type (Fig. 3). This antenna, has adjustable elements so that the pattern

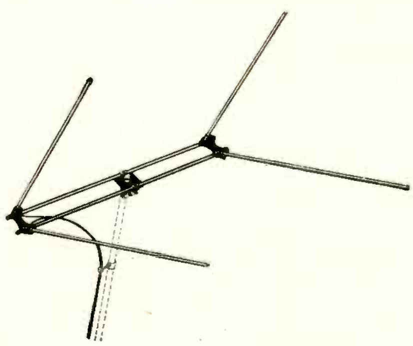


Fig. 3—The double-V type antenna.

can be adjusted to pick up stations primarily from one direction. The double-V types have two dipoles spaced a quarter wavelength apart which produce a unidirectional pattern for the v.h.f. stations. As shown in Fig. 4, a sharp pickup pattern is produced for the low u.h.f. stations when the antenna elements are tilted 60° apart, and a somewhat broader pattern is obtained for the high u.h.f. channels. A 45° angle between elements is suitable for the upper u.h.f. channels, as indicated in Table I. This shows the relative db gain for this type of antenna over a matched dipole.

	V.H.F.				Channel Numbers								U.H.F.		
	2	3	4	5	6	7	8	9	10	11	12	13	14-35	36-55	55-83
Ward U-VEE															
90° V's	−2	1/2	2	1	0	6	6½	7½	7½	8	7½	7½	6*	7*	—
60° V's	−2	−1	0	1	2	5	5½	5½	6	6	6½	6	10	12	—
45° V's	←——— Not recommended ———→													9*	12

*Split-lobe Pattern.

Table I—Relative db gain of double-V type antenna over matched dipole.

The disadvantage of this type of antenna is that the gain for the low v.h.f. stations is poor. For areas where there are no low v.h.f. stations, or where such stations are close enough to produce a high signal, the antenna would be satisfactory. Because of its critical directional characteristics a motor is required for orienting stations in scattered directions. Some split-lobe characteristics show up at the upper ultra-high frequencies, as shown by the dotted line pattern of Fig. 4.

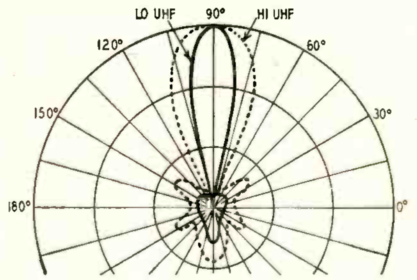


Fig. 4—Horizontal pattern for double-V antenna. Elements are tilted 60°.

For weak-signal u.h.f. areas the Yagi and corner-reflector types provide high gain with a sharp unidirectional pattern. As shown in Fig. 5, the screen acts as shield for signals arriving from the rear. The reflector screen also increases forward gain. Fig. 6 indicates the type of pattern such antennas produce. It can be seen that the front-to-back ratio is excellent and the beam is narrower for the higher u.h.f. channels. This type, as well as a Yagi antenna, is excellent for minimizing ghost reception.

Installation hints

Except in areas where the signal strength is exceptionally good, the u.h.f. antenna should be installed above an existing v.h.f. type. The antenna should be raised and lowered a few feet experimentally to take advantage of space lobes.

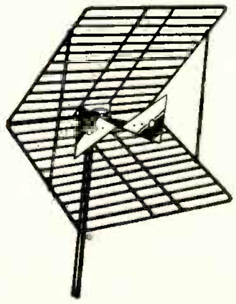


Fig. 5—The JFD u.h.f. corner reflector.

Many technicians do not disturb the existing v.h.f. installation, but run a separate transmission line from the u.h.f. antenna to the receiver: the u.h.f. and v.h.f. types are attached to the u.h.f. converter, and most models automatically switch the proper antenna to the system as the selector knob is changed from v.h.f. to u.h.f. If the converter has no provisions for automatic antenna switching, a double-pole, double-throw switch can be installed.

A u.h.f. antenna should not be coupled

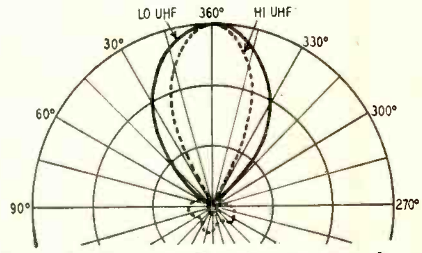


Fig. 6—Horizontal pattern for bow-tie antenna with corner reflector.

directly to a v.h.f. type because it will result in severe loading. This will affect both antennas and will result in a decrease in pickup from each.

If a single transmission line is desired for both the u.h.f. and v.h.f. antennas, a coupler such as shown in Fig. 7 can be used. The one shown uses a

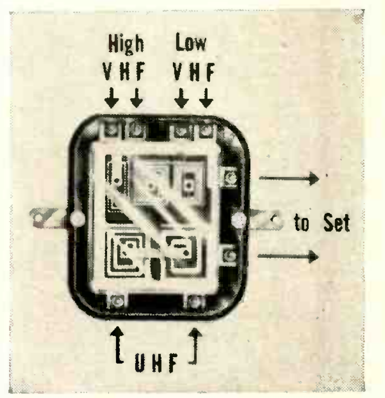


Fig. 7—U.h.f.-v.h.f. antenna coupler.

printed circuit. Others use more conventional wiring. Filter networks are used to isolate the various antenna systems to minimize interaction.

Some couplers of this type also introduce losses to both the v.h.f. and u.h.f. antennas, and the technician should check one before buying them in quantity.

END

PICTURE TUBE REPLACEMENT GUIDE

By E. W. SCOTT

IN THE course of their daily labors, TV service technicians sometimes find it necessary to replace an expensive, obsolete, or hard-to-get picture tube with a different type. Parts distributors may find that a desired tube type is not included in the brand or brands that they have in stock, so they must be prepared to recommend a type that can be substituted with the least amount of work. This chart is designed to aid in making a wise selection. Tubes are classified according to size, shape, diagonal deflection angle, and type of focusing. In each basic class, tubes are listed according to dimensions, the largest one first.

Whenever possible, the replacement type should be an improved type which will be more pleasing to the set owner. There are several different types of face plates: clear, grey (tinted), frosted, etched, aluminized, or combinations of types, with cylindrical or spherical surfaces. Grey and neutral-tint glass increases the apparent contrast. Frosted and etched types reduce reflection of room light, and aluminized (metal-backed) types provide greater

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°						
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°, electrostatic focus						
10DP4	10 1/2	17 5/8	None	5	Cavity	a
12 1/2-inch round, 50°						
B1034	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
12 1/2-inch glass round, 40°, electrostatic focus						
12AP4	12 3/16	25 3/8	None	4	Cap	a, c
14-inch glass rectangular, 70°						
14FP4	13 13/16	16 1/2	Single	1	Cavity	a
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	a
14-inch glass rectangular, 70°, h.v. electrostatic focus						
14GP4	12 21/32	17 3/16	Single	5	Cavity	
15-inch glass round, 50°						
15CP4	15 3/4	21 7/8	Double	1	Cavity	a
15-inch glass round, 52°						
15EP4	15 1/10	22 4/10	Single	1	Cap	
15-inch glass round, 57°						
15AP4	15 3/4	20 7/8	None	1	Ball	a
15DP4	15 3/4	20 7/8	Single	1	Ball	a
B1015	15 3/4	20 7/8	Single	1	Cavity	k
16-inch glass round, 50-60°						
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°, l.v. electrostatic focus						
16AEP4	17 1/8	19 1/8	Single	5	Cavity	
16-inch glass rectangular, 70°						
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 1/8	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
16ABP4	16 1/8	18 3/4	Single	1	Cavity	t
16-inch glass round, 70°						
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°						
16AP4	15 7/8	22 5/16	Double	1	Cone	a
16-inch metal round, 60°						
16EP4	15 7/8	19 5/8	Double	1	Cone	a
16-inch metal round, 70°						
16GP4	15 7/8	17 11/16	Single	1	Cone	a, i
16-inch glass round, 60°, self-focus						
16ACP4	15 7/8	20 7/8	Single	6	Cavity	
17-inch glass rectangular, 70°						
17BP4	16 3/4	19 5/8	Single	1	Cavity	i
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°, 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°						
17CP4	17	19	Single	1	Cone	a

brightness. Tubes that are electrically and mechanically interchangeable can be substituted without regard to type of face-plate. A different mask must be used when cylindrical and spherical types are interchanged.

Tubes of the same basic type are often available with several different types of face plates, which may be indicated by a suffix letter. As an example, the 17BP4 and 17BP4A have gray face-plates. The 17BP4B has a grey aluminized face-plate and the 17BP4C is grey frosted. Unfortunately the suffix letters have not been standardized, so they do not mean the same on all tube types. On the 17BP4A, the A indicates that this type has an external conductive coating while the basic type does not. In another type of tube, A may indicate that the face-plate is tinted and frosted.

Last year there were only three 90° tubes: two 27-inch rectangular and one 30-inch round. Now, there are a great many more. Replacement type 90° yokes and output transformers are available, so the technician can use 90° tubes in conversion jobs. However, he should approach this type of conversion with caution. Aside from the special yokes and transformers, 90° tubes require considerably more deflection power than 70° and smaller types. Above all, he must be sure that the set has enough reserve power and extra space for the paralleled horizontal output and damper tubes which may be necessary for conversion. END

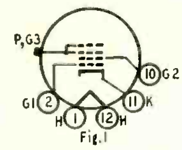


Fig.1

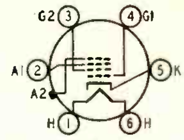


Fig.4

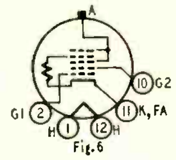


Fig.6

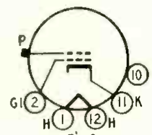


Fig.2

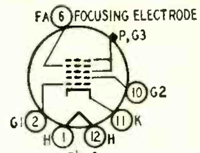


Fig.5

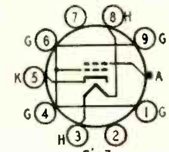


Fig.7

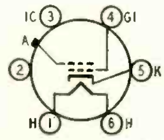


Fig.3

Tube type	Bulb diameter or diagonal (inches)	Over-all length	Ion trap type	Base diagram Fig. No.	Anode connector	Notes
17-inch metal rectangular, 70°, 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°						
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°						
19AP4	18 3/4	22	Single	1	Cone	a
19-inch glass rectangular, 70°						
19JP4	18 5/8	21 3/16	Single	1	Cavity	a
19QP4	18 5/8	21 1/8	Single	5	Cavity	r
19EP4	17 1/8	21 1/2	Double	1	Cavity	
20-inch glass round, 54°						
20BP4	20 3/8	28 3/4	None	1	Cap	a
20-inch glass rectangular, 70°						
20CP4	20 7/32	21 13/16	Single	1	Cavity	a, n
20DP4	20 3/32	21 7/8	Single	1	Cavity	
20-inch glass rectangular, 70°, 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°, self focus						
20JP4	20 7/32	22 1/8	Single	6	Cavity	
21-inch metal rectangular, 70°						
21DP4	22 5/8	21	Single	5	Cone	a, s
21GP4	22 5/8	21	Single	6	Cone	a, t
21MP4	21	22 5/8	Single	5	Cone	a, r
21AP4	20 3/4	22 5/8	Single	1	Cone	
21-inch glass rectangular, 70°						
21JP4	21 11/32	23 1/2	Internal	1	Cavity	
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
21ZP4	21 7/32	23 3/8	Single	1	Cavity	
21WP4	20 5/8	22 5/8	Single	1	Cavity	
21WP4X	20 5/8	22 1/8	Single	1	Cavity	q
21-inch glass rectangular, 70°, electrostatic focus						
21AFP4	21 11/32	23	Single	5	Cavity	a, r
21XP4	20 5/8	22 1/4	Single	6	Cavity	
21-inch glass rectangular, 90°						
21AMP4	20 1/4	20	Single	1	Cavity	

Tube type	Bulb diameter or diagonal (inches)	Over-all length	Ion trap type	Base diagram Fig. No.	Anode connector	Notes
21-inch glass rectangular, 70°, l.v. electrostatic focus						
21YP4	21 3/8	23 3/8	Single	5	Cavity	
22-inch metal round, 70°						
22AP4	24 1/8	22 7/8	Single	1	Cone	a
24-inch metal round, 70°						
24AP4	24 1/8	24 7/16	Single	1	Cone	a
24-inch metal round, 70°, l.v. electrostatic focus						
24BP4	24 1/8	24 7/16	Single	5	Cone	a
24-inch glass rectangular, 90°						
24CP4	24	21 1/8	Single	1	Cavity	a
24VP4	24	21 1/8	Single	1	Cavity	
24XP4	24	21 1/8	Single	1	Cavity	a
24-inch glass rectangular, 90°, l.v. electrostatic focus						
24DP4	24	21 1/8	Single	5	Cavity	
24QP4	24	21 1/8	Single	1	Cavity	
24TP4	24	21 1/8	Single	1	Cavity	
27-inch metal rectangular, 90°						
27AP4	26 7/8	21 7/8	Single	1	Cone	
27MP4	26 7/8	22 3/16	Single	1	Cone	
27-inch glass rectangular, 90°						
27EP4	27	23 3/32	Single	1	Cavity	a
27GP4	27	23 7/16	Single	1	Cavity	a
27LP4	27	24 23/64	Single	1	Cavity	
27NP4	27	23 3/8	Single	1	Cavity	
27RP4	27	23 3/8	Single	1	Cavity	
30-inch metal round, 90°						
30BP4	30 1/8	23 9/16	Single	1	Cavity	a

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—Face-plate curvature has 20-inch radius; all others in this group have 40-inch radius.
e—Requires JETEC-RETMA type 106 focus coil; others in this group use type 109 focus coil.
f—Face-plate curvature has 56-inch radius; others in this group have 27-inch radius.
g—Deflection angle is 50°. The deflection angle for other tubes in this group is 60°.
h—Radius of face-plate curvature is 56 inches.
i—Radius of face-plate 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 face-plate 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.

U.H.F. CONVERTERS

Manufacturer	Model	Channels	Tubes, Crystals	Tuning system	Impedance	Installation
Alliance Manufacturing Co. **Alliance, Ohio**	C2	All	1–6AF4 or 6T4 1–6CB6 1–1N72	Tuned lines	300	Cab.
	AC80	All		Spiral inductor	300	Cab.
The Astatic Co. **Conneaut, Ohio**	CB-1	All[1]	1–6T4Q 1–6J6 1–6BQ7A 1–1N82	Circular lines	300[2]	Cab.
Blonder-Tongue Labs., Inc. **526-536 North Avenue** **Westfield, N. J.**	BTU	All	1–6T4 1–6AB4 1–1N72	Circular line	300	Cab.
David Bogen Co., Inc. **29 Ninth Ave.** **New York, N. Y.**	UCT-1	All	1–6BZ7 or 6BK7A 1–6AF4 or 6T4 1–[3]	Circular lines	300	Cab.
Allen D. Cardwell Mfg. Co. **Plainville, Conn.**	ES-1	All	1–6AF4 1–6CB6 1–1N72	Prntd-ckt lumped constant	300	Cab.
	ES-2	(As above, Serviceman's Tuner for internal mounting)				
Electro-Voice, Inc. **Buchanan, Mich.**	3300	All	1–6AF4 or 6T4 1–6BC5 1–1N72	Tuned lines	300	Cab.
General Electric Co. **Electronics Park** **Syracuse, N. Y.**	UHF-103	Any 3	1–6AF4 1–6BK7A 1–1N72	Turret	300	Int.
General Instrument Corp. **829 Newark Ave.** **Elizabeth, N. J.**	63 and 64	All	1–6J6 1–6CB6 1–1N82 1–G7C	Coaxial line	300	Cab.
Granco Products, Inc. **36-17 20th Ave.** **Long Island City, N. Y.**	LCU	All	1–6AF4 1–6CB6 1–1N82	Cavity tuner	300	Cab.
	MTU	All	1–6AF4 1–6BQ7 1–1N82	Cavity tuner	300	Cab.
I.D.E.A., Inc. (Regency) **7900 Pendleton Pike** **Indianapolis, Ind.**	RC-600	All	1–6AF4 1–6BK7 1–1N72	Tuned lines	300	Cab.
	RC-53	All	1–6AF4 1–TS-2	Tuned lines	300	Cab.
P. R. Mallory & Co., Inc. **3029 E. Washington St.** **Indianapolis, Ind.**	TV-101	All	1–6AF4 or 6T4 1–6CB6 1–1N72	Induc-tuner	300	Cab.
Radio Corporation of America **RCA Victor Division** **Camden, N. J.**	**U70**	**All**	**1–6AF4** **2–6CB6** **1–1N82**	**Lumped constants**	**72 or 300**	**Cab.**

Manufacturer	Model	Channels	Tubes, Crystals	Tuning system	Impedance	Installation
RCA (continued)	U2	Any 2	1-6BQ7 1-6CB6 1-CK710	Lumped constants	72 or 300	Cab.
Note: U2 and U2A have certain differences in input arrangement.	U2A	Any 2	1-6BQ7A 1-6CB6 1-CK710	Lumped constants	72 or 300	Cab.
Note: U1A has plug for 6AQ5; U1B for 6K6-GT or 6V6; both get power from TV receiver.	U1A, U1B	Any 1	1-6AF4 1-CK710	Lumped constants	72 in; 300 out	Rear
Radio Receptor Co., Inc. **84 North Ninth St.** **Brooklyn, N. Y.**	C-1709-P	All	1-6AF4 1-6BQ7A 1-1N82	Cavity tuner	300	Cab.
Rex Electronics Corp. **1351 East DeLoss St.** **Indianapolis 3, Ind.**	UC-1	All	1-6AF4 1-6CB5 1-1N72	Prntd-ckt Tuned lines	300	Cab.
Sutton Electric Co., Inc. **426 West Short St.** **Lexington, Ky.**	22B	All[1]	1-6AF4 1-6J6 1-1N82	Circular lines	300	Cab.
Transvision, Inc. **New Rochelle, N. Y.**	UHF-1	Any 1	1-6AF4 1-CK710	Lumped constants	75 in; 300 out	Rear
The Turner Company **Cedar Rapids, Iowa**	TV-3	All	1-6AF4 1-6BZ7 or 6BQ7A 1-1N82	Cavity tuner	300	Cab.
Videon Electric Corp. **222 East Ohio St.** **Indianapolis 4, Ind.**	C-232 Savoy	All	1-6AF4 1-1N72	Parallel lines	300	Cab.
	C-222 Navarre	All	1-6AF4 1-6BC5 1-1N72	Parallel lines	300	Cab.
Walsco Electronics Corp. **3602 Crenshaw Blvd.** **Los Angeles, Calif.**	2000 Imperial	All	1-6AF4 1-6BK7A 1-1N82	Turret	300	Cab.

Notes: [1]Booster on channels 2–13; converter for u.h.f. channels.
[2]U.h.f. input 300 ohms; v.h.f. output (and v.h.f antenna input) 300 or 75 ohms.
[3]Gahagan, Inc. u.h.f. crystal.
Converter output channels are 5 and 6 on most converters. The G-E UHF-103 is designed for channel 5 but adjustable for 6; Astatic will operate on 3, 4, 5, and 6, and the Videon can be adjusted to work on 4 and 5 instead of 5 and 6. The 1-channel Transvision UHF-1 can be specified to receive a signal on any u.h.f. channel and convert it to any of the channels from 2 to 6.

Practically all the converters are self-powered, with isolating power transformers and selenium or tube rectifiers (not included among tubes and crystals in the listing). The RCA U1A and U1B, as well as the Transvision UHF-1, take their power from the TV receiver.

U.H.F. BOOSTERS

Manufacturer	Model	Channels	Tube(s)	Tuning system	Impedance	Installation
David Bogen Co., Inc. **29 Ninth Ave.** **New York, N. Y.**	UHB	All	6AN4	Tuned cavity	300	Cab.
Electro-Voice, Inc. **Buchanan, Mich.**	3400	All	2-6AJ4	Parallel lines	300	Cab.
Industrial Television Inc. **369 Lexington Ave.** **Clifton, N. J.**	IT-133A	All	1-6AJ4	[4]	300	Cab.
Tele-Matic Industries, Inc. **One Joralemon St.** **Brooklyn, N. Y.**	UH-14-83	All	1-6AJ4	[5]	300[6]	Cab.

Notes: [4]Series-resonant circuit consisting of inductor and capacitor metallized on glass tubing, with silverplated slug tuning.
[5]Input broad-band fixed tuning. Output high-Q transmission line selective network.
[6]50- or 75-ohm impedance available on request.

Explanation of terms: "Tubes and crystals" do not include those in power supplies. "Tuning system" generally follows manufacturer's nomenclature. "Circular lines" and "spiral tuner" may describe the same equipment; "tuned lines" may, but is more likely to refer to straight parallel lines. "Impedance" is both input and output impedance unless otherwise noted. Abbreviations under "Installation" refer to converters or boosters in separate cabinet, mounted on rear of or inside the receiver.

TV STATION LIST as of November 23, 1953

* = Station shares time.

Alabama

WABT	Birmingham	13
WBRC-TV	Birmingham	6
WALA-TV	Mobile	10
WKAB-TV	Mobile	48
WCOV-TV	Montgomery	20

Alaska

KFIA	Anchorage	2

Arizona

KTYL-TV	Mesa (Phoenix)	12
KOOL-TV	Phoenix	10
KOY-TV*	Phoenix	10
KPHO-TV	Phoenix	5
KOPO-TV	Tucson	13
KVQA-TV	Tucson	4
KIVA	Yuma	11

Arkansas

KFSA-TV	Fort Smith	22
KRTV	Little Rock	17

California

KAFY-TV	Bakersfield	29
KERO-TV	Bakersfield	10
KHSL-TV	Chico	12
KIEM-TV	Eureka	3
KJEO	Fresno	47
KMJ-TV	Fresno	24
KECA-TV	Los Angeles	7
KHJ-TV	Los Angeles	9
KLAC-TV	Los Angeles	13
KNBH	Los Angeles	4
KNXT	Los Angeles	2
KTHE	Los Angeles	28
KTLA	Los Angeles	5
KTTV	Los Angeles	11
KMBY-TV*	Monterey	8
KCCC-TV	Sacramento	40
KSBW-TV*	Salinas	8
KFMB-TV	San Diego	8
KFSD-TV	San Diego	10
KGO-TV	San Francisco	7
KPIX	San Francisco	5
KRON-TV	San Francisco	4
KVEC-TV	San Luis Obispo	6
KEYT	Santa Barbara	3
KCOK-TV	Tulare	27

Colorado

KKTV	Colorado Springs	11
KRDO-TV	Colorado Springs	13
KBTV	Denver	9
KFEL-TV	Denver	2
KLZ-TV	Denver	7
KCSJ-TV	Pueblo	5
KDZA-TV	Pueblo	3

Connecticut

WICC-TV	Bridgeport	43
WKNB-TV	New Britain	30
WNHC-TV	New Haven	8
WATR-TV	Waterbury	53

Delaware

WDEL-TV	Wilmington	12

District of Columbia

WMAL-TV	Washington	7
WNBW	Washington	4
WTOP-TV	Washington	9
WTTG	Washington	5

Florida

WFTL-TV	Fort Lauderdale	23
WMBR-TV	Jacksonville	4
WTVJ	Miami	4
WEAR-TV	Pensacola	3
WPFA-TV	Pensacola	15
WSUN-TV	St. Petersburg	38
WIRK-TV	W. Palm Beach	21

Georgia

WAGA-TV	Atlanta	5
WLWA	Atlanta	8
WSB-TV	Atlanta	2
WJBF-TV	Augusta	6
WDAK-TV	Columbus	28
WRBL-TV	Columbus	4
WETV	Macon	47
WMAZ-TV	Macon	13
WROM-TV	Rome	9

Hawaii

KGMB-TV	Honolulu	9
KONA	Honolulu	11

Idaho

KIDO-TV	Boise	7
KBOI	Meridian	2

Illinois

WCIA	Champaign	3
WBBM-TV	Chicago	2
WBKB	Chicago	7
WGN-TV	Chicago	9
WNBQ	Chicago	5
WTVP	Decatur	17
WEEK-TV	Peoria	43
WTVH-TV	Peoria	19
WGEM-TV	Quincy	10
WREX-TV	Rockford	13
WTVO	Rockford	39
WHBF-TV	Rock Island	4
WICS	Springfield	20

Indiana

WTTV	Bloomington	10
WFIE	Evansville	62
WKJG-TV	Fort Wayne	33
WFBM-TV	Indianapolis	6
WFAM-TV	Lafayette	59
WLBC-TV	Muncie	49
WRAY-TV	Princeton	52
WSBT-TV	South Bend	34

Iowa

WOI-TV	Ames	5
KCRI-TV	Cedar Rapids	9
WMT-TV	Cedar Rapids	2
WOC-TV	Davenport	6
KGTV	Des Moines	17
KQTV	Fort Dodge	21
KVTV	Sioux City	9
KWWL-TV	Waterloo	7

Kansas

KTVH	Hutchinson	12
KOAM-TV	Pittsburg	7
WIBW-TV	Topeka	13
KEDD-TV	Wichita	16

Kentucky

WEHT	Henderson	50
WAVE-TV	Louisville	3
WHAS-TV	Louisville	11
WKLO-TV	Louisville	21

Louisiana

WAFB-TV	Baton Rouge	28
KTAG-TV	Lake Charles	25
KFAZ	Monroe	43
KNOE-TV	Monroe	8
WDSU-TV	New Orleans	6
WJMR-TV	New Orleans	61

Maine

WABI-TV	Bangor	5
WPMT	Portland	53

Maryland

WAAM	Baltimore	13
WBAL-TV	Baltimore	11
WMAR-TV	Baltimore	2

Massachusetts

WBZ-TV	Boston	4
WNAC-TV	Boston	7
WTAO-TV	Cambridge	56
WHYN-TV	Holyoke	55
WWLP	Springfield	61
WWOR-TV	Worcester	14

Michigan

WPAG-TV	Ann Arbor	20
WBKZ-TV	Battle Creek	64
WWJ-TV	Detroit	4
WJBK-TV	Detroit	2
WXYZ-TV	Detroit	7
WTAC-TV	Flint	16
WOOD-TV	Grand Rapids	7
WKZO-TV	Kalamazoo	3
WILS-TV	Lansing	54
WJIM-TV	Lansing	6
WKNX-TV	Saginaw	57

Minnesota

KMMT	Austin	6
WFTV	Duluth	38
KSTP-TV	Minneapolis - St. Paul	5
WCCO-TV	Minneapolis	4
WTCN-TV*	Minneapolis	11
KROC	Rochester	10
WMIN-TV*	St. Paul	11

Mississippi

WJTV	Jackson	25
WTOK-TV	Meridian	11

Missouri

KACY	Festus-St. Louis	14
KHQA-TV	Hannibal	7
KCMO-TV	Kansas City	5
KCTY	Kansas City	25
KMBC-TV*	Kansas City	9
WDAF-TV	Kansas City	4
WHB-TV*	Kansas City	9
KFEQ-TV	St. Joseph	2
KSD-TV	St. Louis	5
KSTM-TV	St. Louis	36
WTVI	St. Louis - Belleville	54
KTTS-TV	Springfield	10
KYTV	Springfield	3

Montana

KOOK-TV	Billings	2
KOPR-TV	Butte	4
KXLF-TV	Butte	6

Nebraska

KFOR-TV	Lincoln	10
KOLN-TV	Lincoln	12
KMTV	Omaha	3
WOW-TV	Omaha	6

Nevada

KLAS-TV	Las Vegas	8
KZTV	Reno	8

New Jersey

WFPG-TV	Atlantic City	46
WATV	Newark	13

New Mexico

KGGM-TV	Albuquerque	13
KOAT-TV	Albuquerque	7
KOB-TV	Albuquerque	4
KSWS-TV	Roswell	8

New York

WROW-TV	Albany	41
WNBF-TV	Binghamton	12
WBEN-TV	Buffalo	4
WBES-TV	Buffalo	59
WBUF-TV	Buffalo	17
WECT-TV	Elmira	18
WTVE	Elmira	24
WABC-TV	New York	7
WABD	New York	5
WCBS-TV	New York	2
WNBT	New York	4
WOR-TV	New York	9
WPIX	New York	11
WHAM-TV	Rochester	6
WHEC-TV*	Rochester	10
WVET-TV*	Rochester	10
WRGB	Schenectady	4
WHEN	Syracuse	8
WSYR-TV	Syracuse	3
WKTV	Utica	13

North Carolina

WISE-TV	Asheville	62
WBTV	Charlotte	3
WFMY-TV	Greensboro	2
WNAO-TV	Raleigh	28
WSJS-TV	Winston-Salem	12
WTOB-TV	Winston-Salem	26

North Dakota

WDAY-TV	Fargo	6
KCJB-TV	Minot	13

Ohio

WAKR-TV	Akron	49
WICA-TV	Ashtabula	15
WCPO-TV	Cincinnati	9
WKRC-TV	Cincinnati	12
WLWT	Cincinnati	5
WEWS	Cleveland	5
WNBK	Cleveland	4
WXEL	Cleveland	9
WBNS-TV	Columbus	10
WLWC	Columbus	4
WTVN	Columbus	6
WHIO-TV	Dayton	7
WIFE	Dayton	22
WLWD	Dayton	2
WLOK-TV	Lima	73
WSPD-TV	Toledo	13
WFMJ-TV	Youngstown	73
WKBN-TV	Youngstown	27
WHIZ-TV	Zanesville	50

Oklahoma

KSWO-TV	Lawton	7
KLPR-TV	Oklahoma City	19
KTVQ	Oklahoma City	25
WKY-TV	Oklahoma City	4
KCEB	Tulsa	23
KOTV	Tulsa	6

Oregon

KBES-TV	Medford	5
KOIN-TV	Portland	6
KPTV	Portland	27

Pennsylvania

WFBG-TV	Altoona	10
WLEV-TV	Bethlehem	51
WCHA-TV	Chambersburg	46
WGLV	Easton	57
WICU	Erie	12
WHP-TV	Harrisburg	55
WTPA	Harrisburg	71
WARD-TV	Johnstown	56
WJAC-TV	Johnstown	6
WGAL-TV	Lancaster	8
WLBR-TV	Lebanon	15
WKST-TV	New Castle	45
WCAU-TV	Philadelphia	10
WFIL-TV	Philadelphia	6
WPTZ	Philadelphia	3
WDTV	Pittsburgh	2
WENS	Pittsburgh	16
WKJF-TV	Pittsburgh	53
WEEU-TV	Reading	33
WHUM-TV	Reading	61
WGBI-TV	Scranton	22
WTVU	Scranton	73
WBRE-TV	Wilkes-Barre	28
WILK-TV	Wilkes-Barre	34
WNOW-TV	York	49
WSBA-TV	York	43

Rhode Island

WJAR-TV	Providence	10

South Carolina

WCSC-TV	Charleston	5
WCOS-TV	Columbia	25
WIS-TV	Columbia	10
WNOK-TV	Columbia	67
WGVL	Greenville	23

South Dakota

KELO-TV	Sioux Falls	11

Tennessee

WJHL-TV	Johnson City	11
WROL-TV	Knoxville	6
WTSK	Knoxville	26
WHBQ-TV	Memphis	13
WMCT	Memphis	5
WSIX-TV	Nashville	8
WSM-TV	Nashville	4

Texas

KRBC-TV	Abilene	9
KFDA-TV	Amarillo	10
KGNC-TV	Amarillo	4
KTBC-TV	Austin	7
KRLD-TV	Dallas	4
WFAA-TV	Dallas	8
KROD-TV	El Paso	4
KTSM-TV	El Paso	9
WBAP-TV	Fort Worth	5
KGUL-TV	Galveston	11
KGBS-TV	Harlingen	4
KNUZ-TV	Houston	39
KPRC-TV	Houston	2
KUHT	Houston	8
KTVE	Longview	32
KCBD-TV	Lubbock	11
KDUB-TV	Lubbock	13
KTXL-TV	San Angelo	8
KEYL	San Antonio	5
WOAI-TV	San Antonio	4
KCEN-TV	Temple	6
KCMC-TV	Texarkana	6
KETX	Tyler	19
KANG-TV	Waco	34
KFDX-TV	Wichita Falls	3
KWFT-TV	Wichita Falls	6

Utah

KDYL-TV	Salt Lake City	4
KSL-TV	Salt Lake City	5

Virginia

WVEC-TV	Hampton-Norfolk	15
WSVA-TV	Harrisonburg	3
WLVA-TV	Lynchburg	13
WACH	Newport News	33
WTAR-TV	Norfolk	4
WTOV-TV	Norfolk	27
WTAP	Parkersburg	15
WTVR	Richmond	6
WSLS-TV	Roanoke	10

Washington

KVOS-TV	Bellingham	12
KING-TV	Seattle	5
KOMO-TV	Seattle	4
KHQ-TV	Spokane	6
KXLY-TV	Spokane	4
KMO-TV	Tacoma	13
KTNT-TV	Tacoma	11
KIMA-TV	Yakima	29

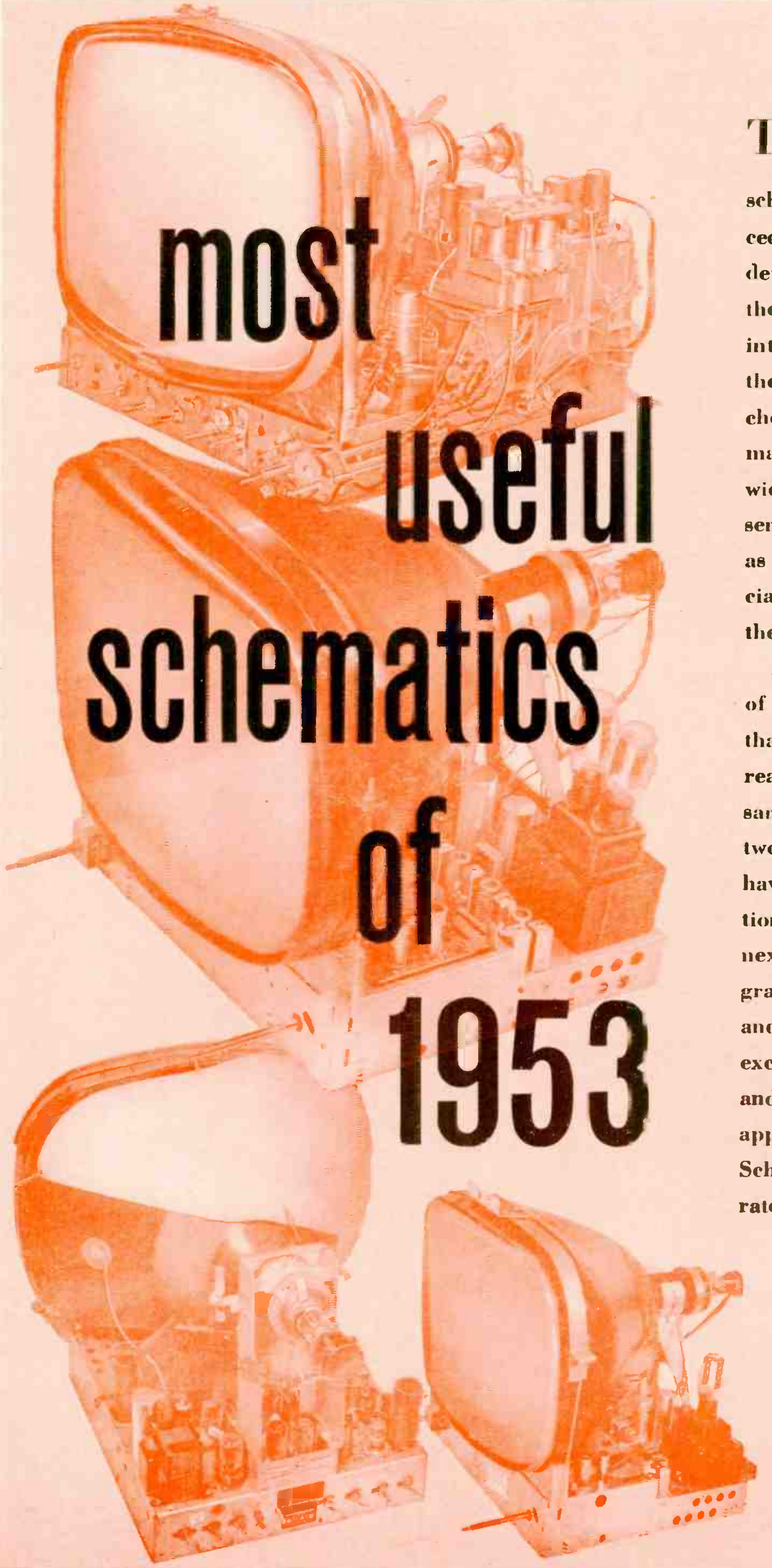
West Virginia

WKNA-TV	Charleston	49
WSAZ-TV	Huntington	3
WTAP	Parkersburg	15
WTRF-TV	Wheeling	7

Wisconsin

WBAY-TV	Green Bay	2
WKOW-TV	Madison	27
WMTV	Madison	33
WCAN-TV	Milwaukee	25
WOKY-TV	Milwaukee	19
WTMJ-TV	Milwaukee	4
WOSH-TV	Oshkosh	48

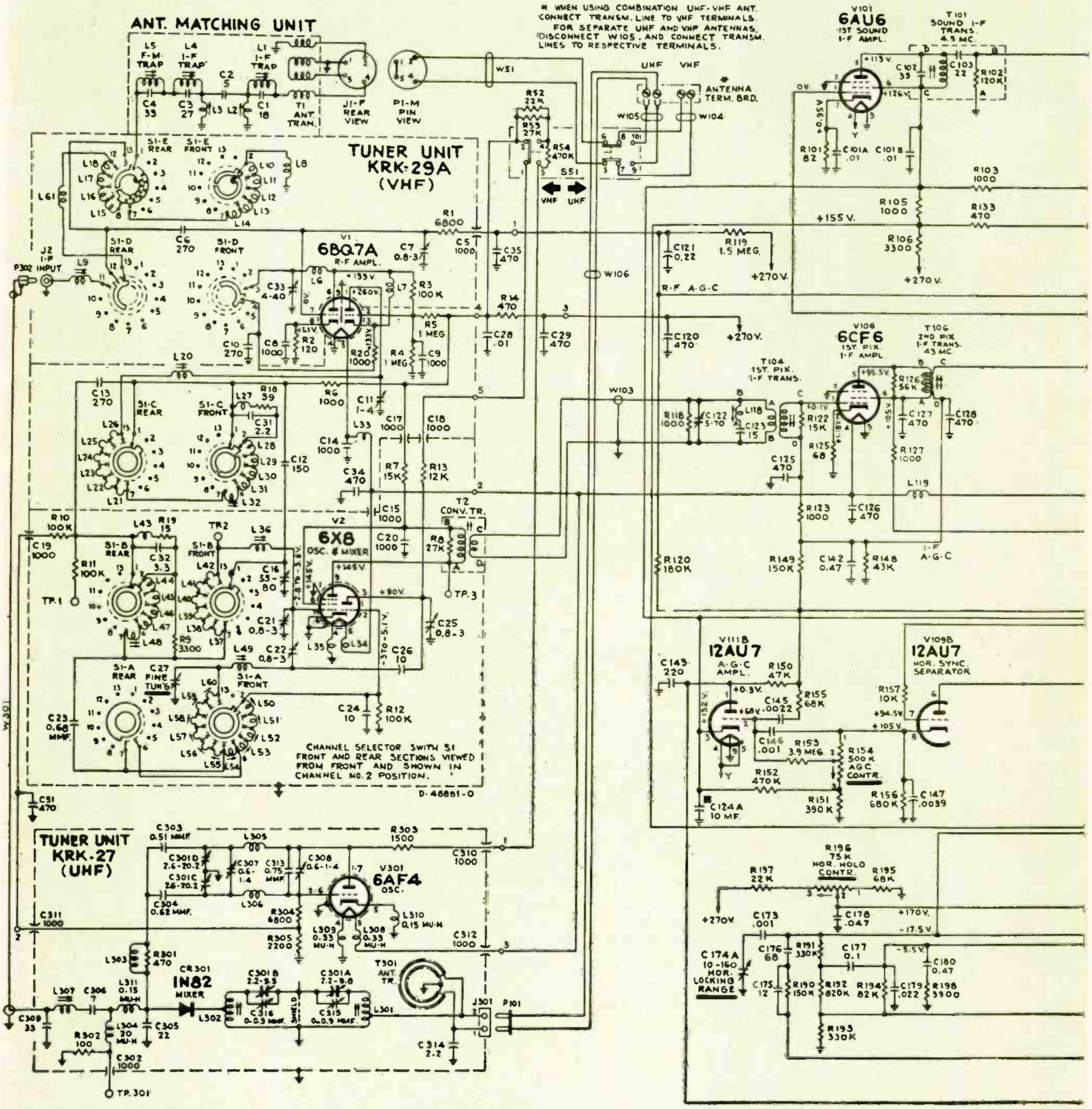
most useful schematics of 1953



There is a steady and constant demand by readers for TV set schematics. While we cannot accede to all these requests without devoting the whole magazine to the task, the following pages are intended to meet the demand in the most efficient way. We have checked with the more popular manufacturers as to their most widely sold receivers, and are presenting the diagrams of these sets as those which the service technician is most likely to meet during the next year or two.

After alloting space for a group of schematics, it was discovered that—to be readable enough to be really useful—it would be necessary to print most of them across two pages. Therefore a number have been left over, and this section will be repeated during the next few months. One or two diagrams presented special problems, and two were accompanied with excellent articles on the receiver and its servicing. These will also appear in future "Most Useful Schematic" sections, or as separate articles.

RCA Models 21-S-354U



All resistance values in ohms. K = 1000

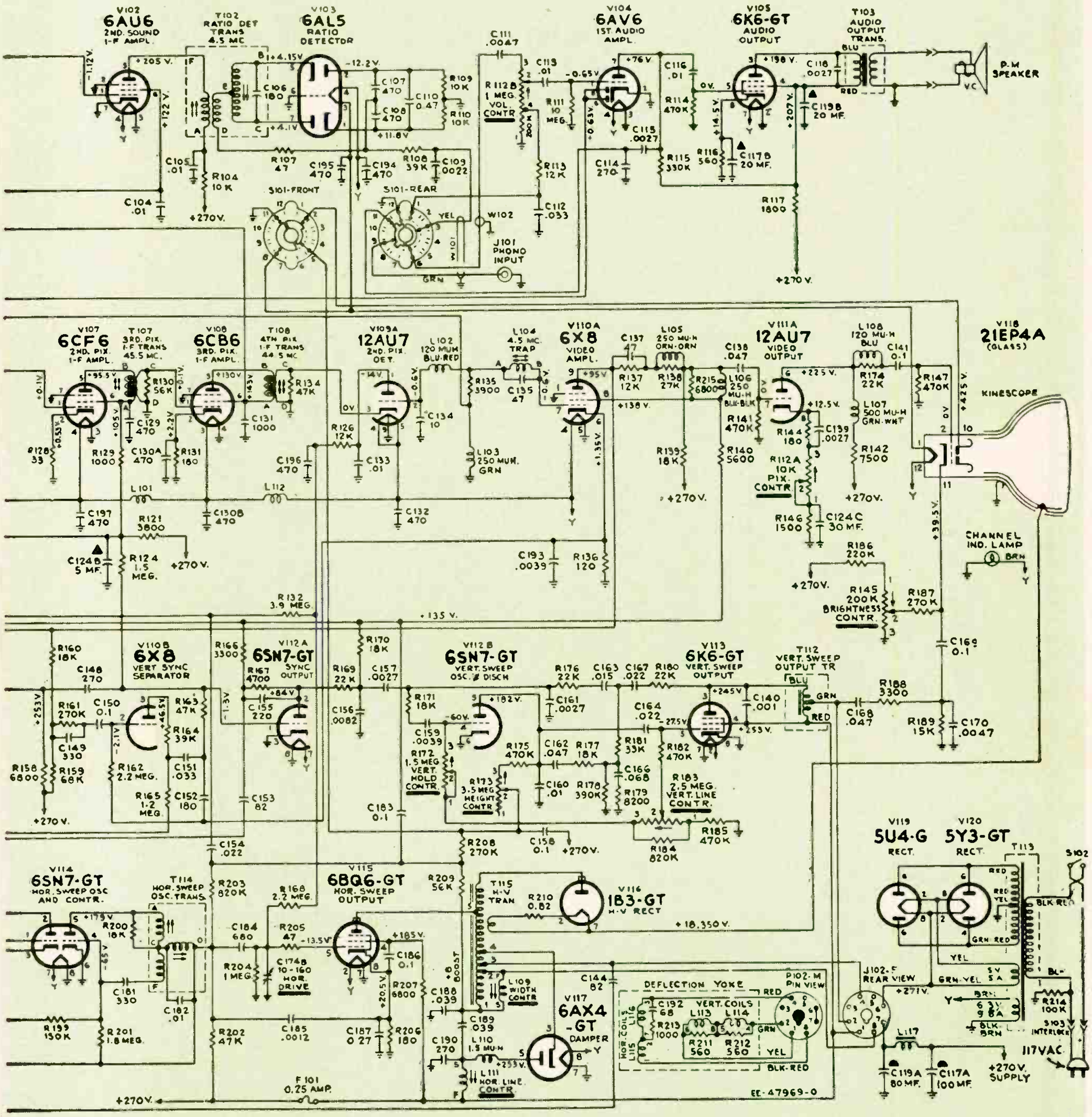
Direction of arrows at controls indicates clockwise rotation.

All voltages measured with *Volt-Ohmyst* and with no signal input. Voltages should hold within ±20% with a 117-volt a.c. supply.

Picture i.f. carrier—45.75 mc.
Sound i.f. carrier—41.25 mc.

Antenna input impedance:
U.h.f.—300 ohms balanced.
V.h.f.—300 ohms balanced.

and 21-S-362U

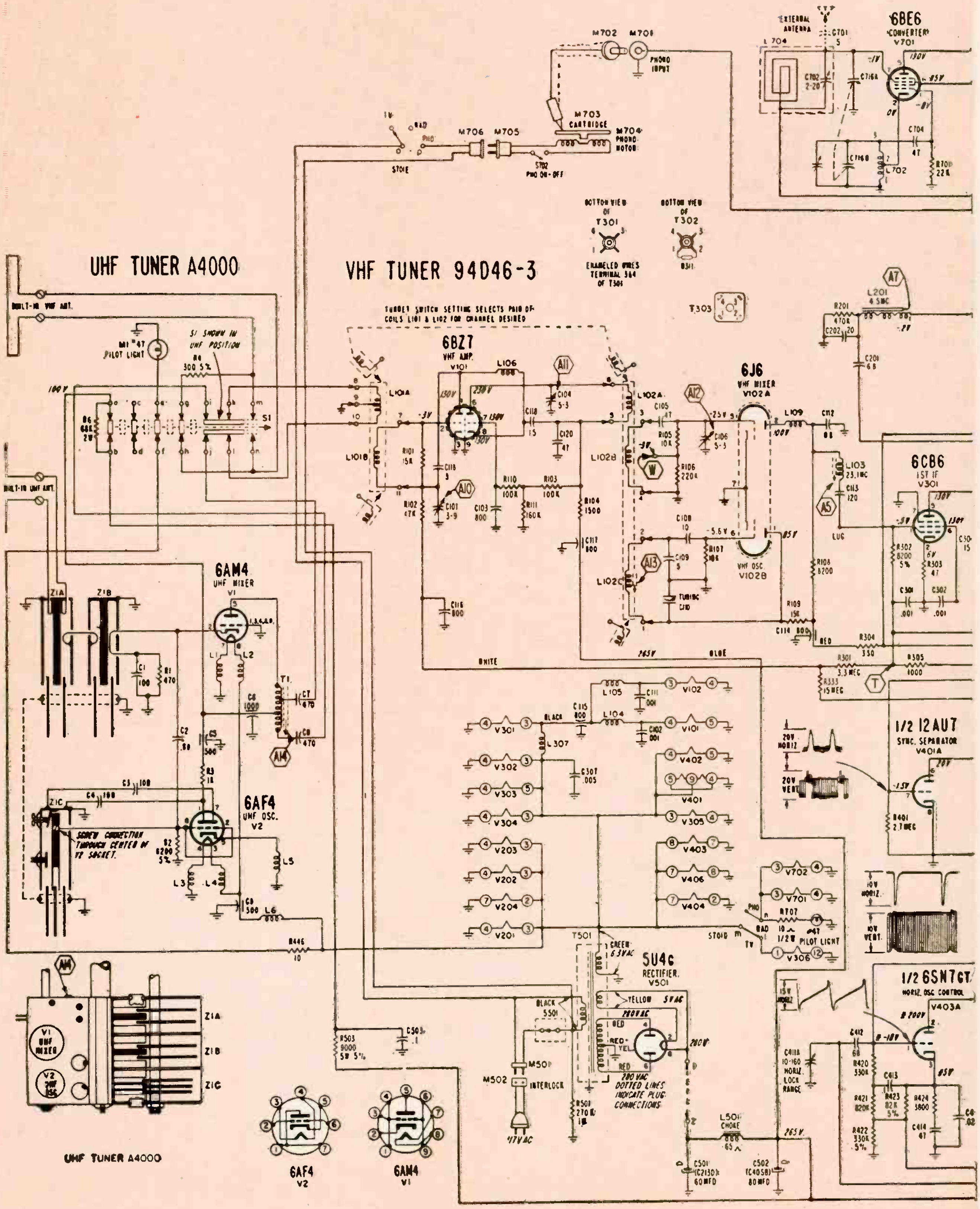


Function switch S101 front and rear, viewed from front with control shaft in maximum counterclockwise position (No. 1).

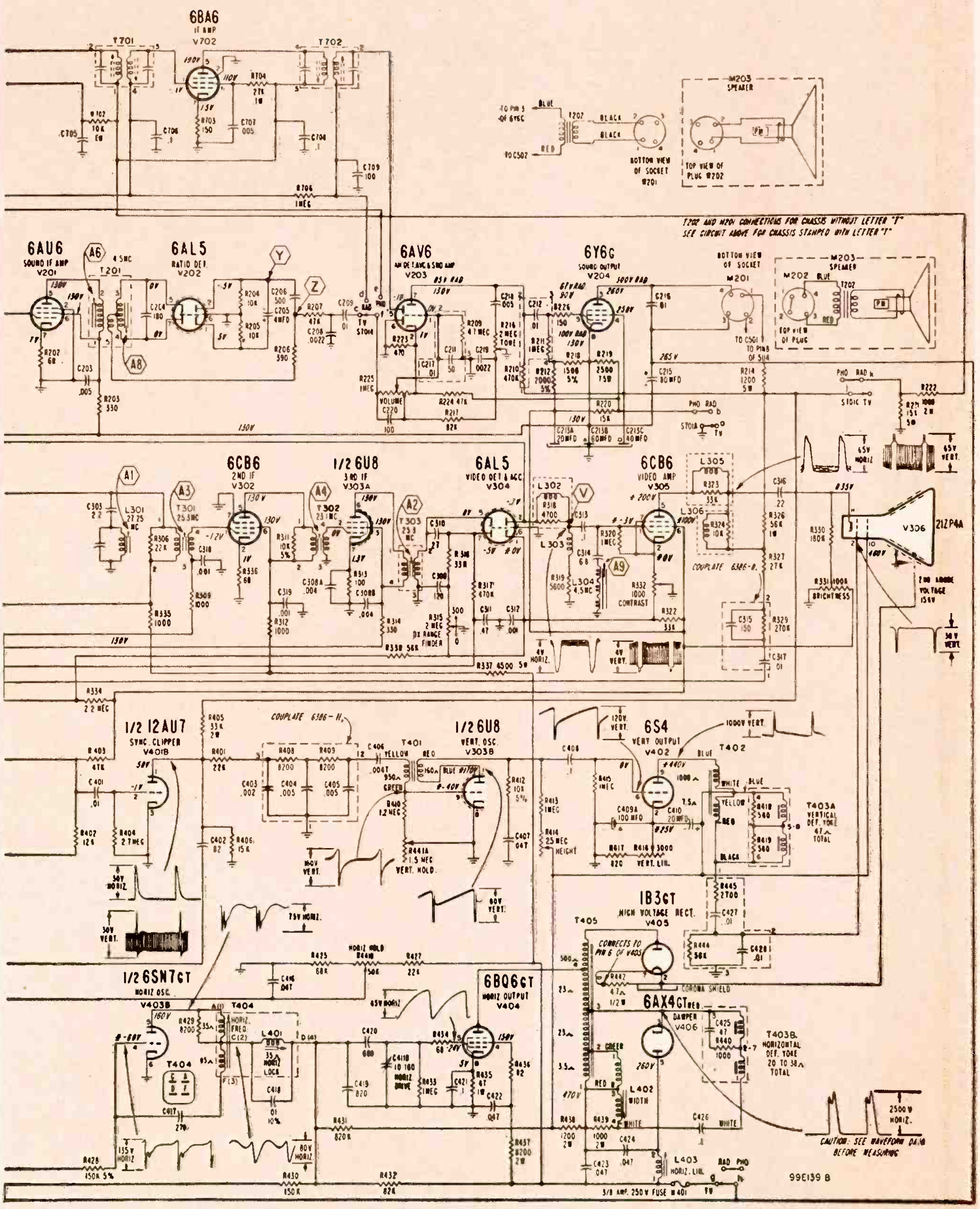
Position 1—TV min. highs
2—TV normal
3—TV min. lows
4—Phono min. highs
5—Phono normal
6—Phono min. lows

Video response to 3.5 mc.
TV r.f. range:
70 u.h.f. channels—470-890 mc.
12 v.h.f. channels—54-88 mc, 174-216 mc.

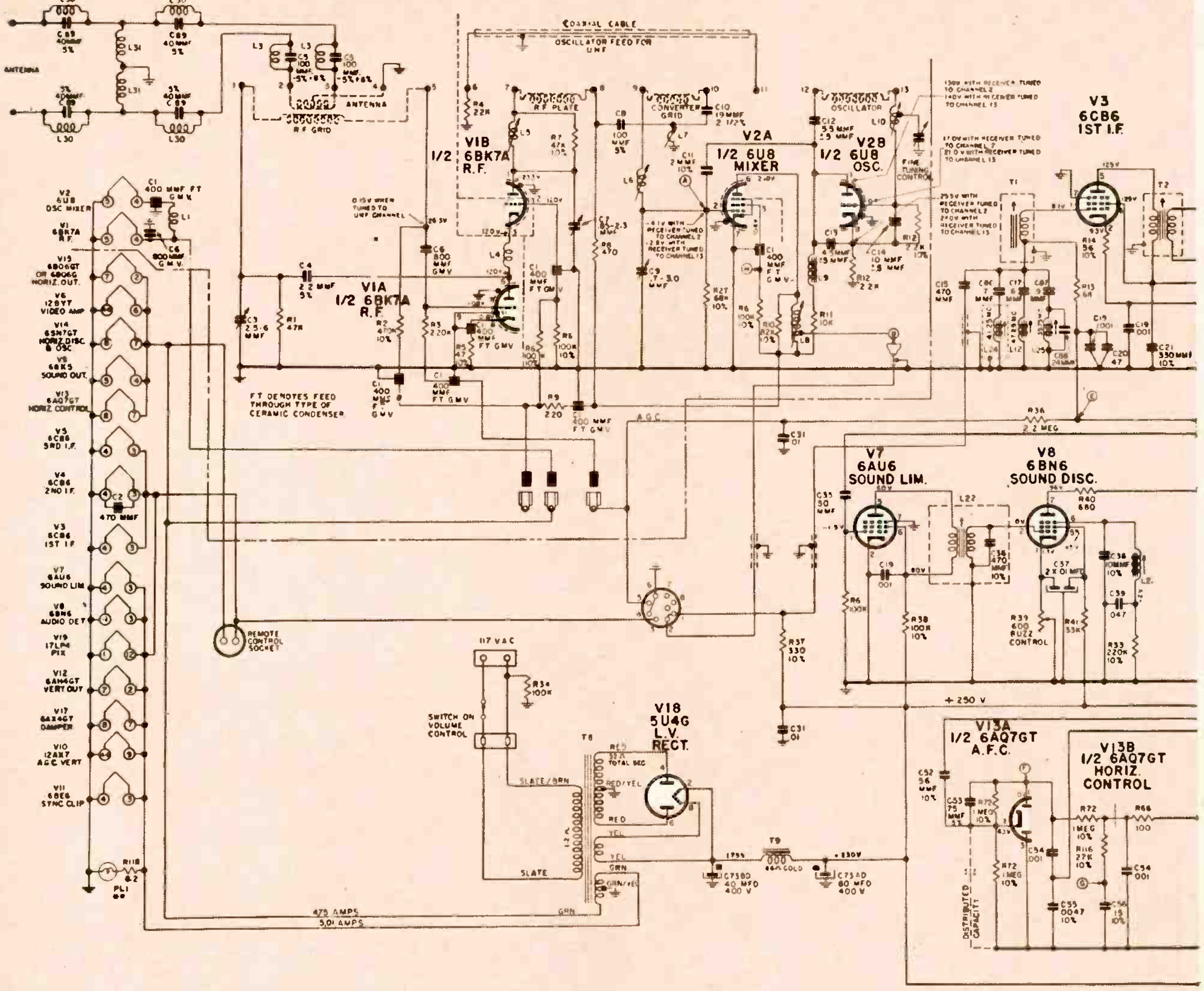
Admiral 19PI V.H.F.—U.H.F.



TV and Radio Chassis



ZENITH Chassis 19L26-19L28



All voltages measured from chassis to points indicated; all are d.c. unless otherwise specified.

All d.c. voltages to be measured with v.t.v.m. with 11-megohm input resistance.

All voltages measured with no signal present; normal setting of controls; channel selector set to 2 unless otherwise specified.

All capacitor values in microfarads unless otherwise specified.

Resistance measurements shown with coils disconnected from circuit.

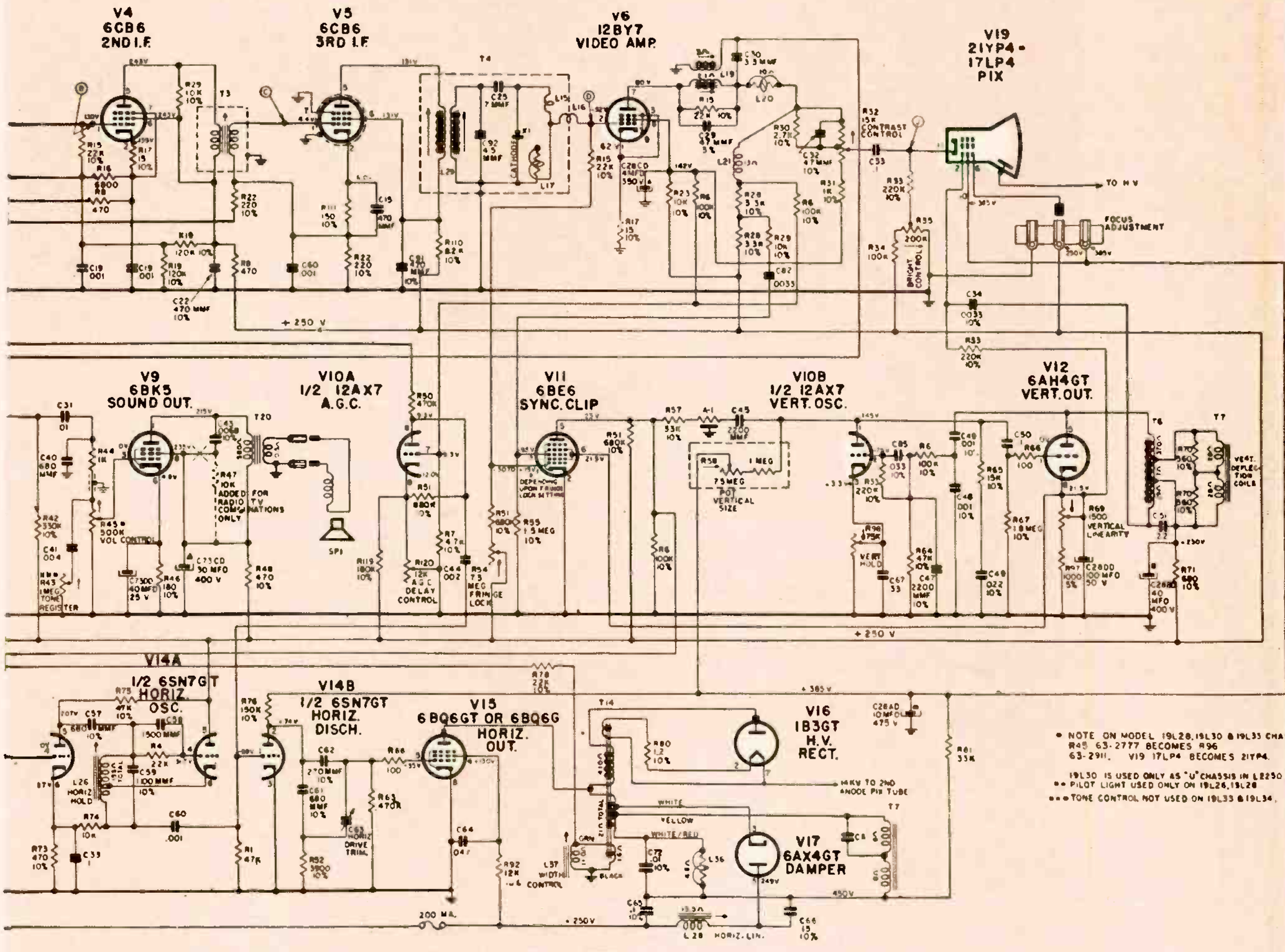
Coil resistances not given are under one ohm.

Cathode-ray tube second anode voltage to be measured with electrostatic or with 20,000 ohm-per-volt high voltage meter.

Arrows on potentiometers indicate clockwise rotation.

Circled letters indicate alignment and test points.

19L30-19L33-19L34

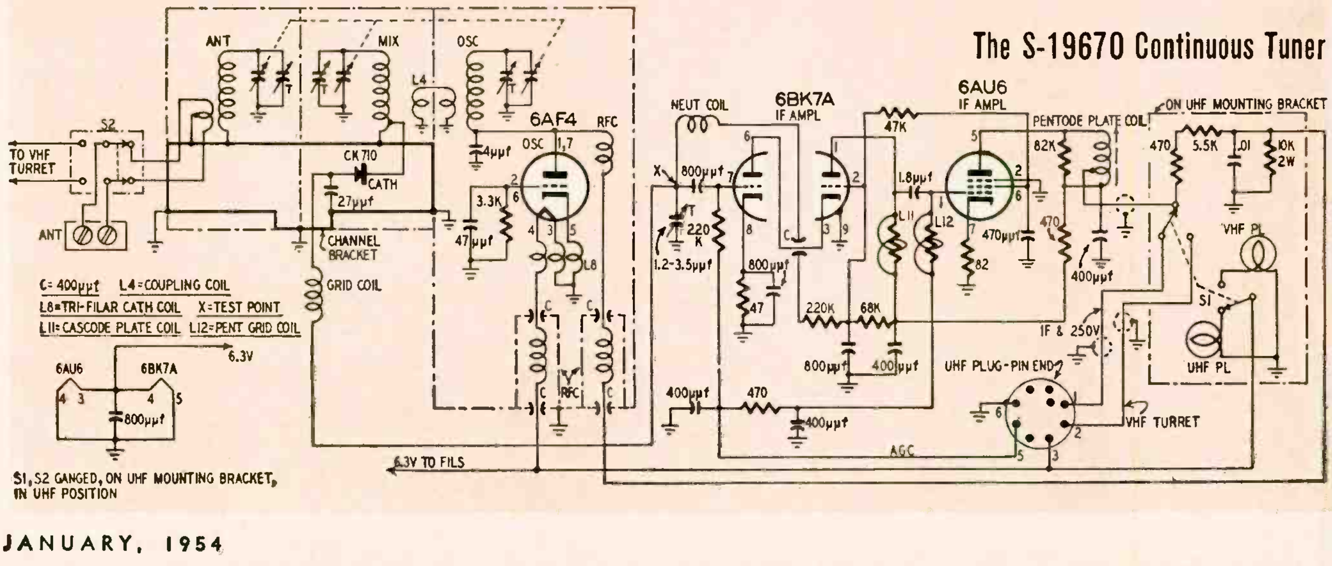


• NOTE ON MODEL 19L28, 19L30 & 19L33 CHASSIS R45 63-2777 BECOMES R96 63-2911. V19 17LP4 BECOMES 21YP4.

19L30 IS USED ONLY AS "U" CHASSIS IN L2250 CAB.

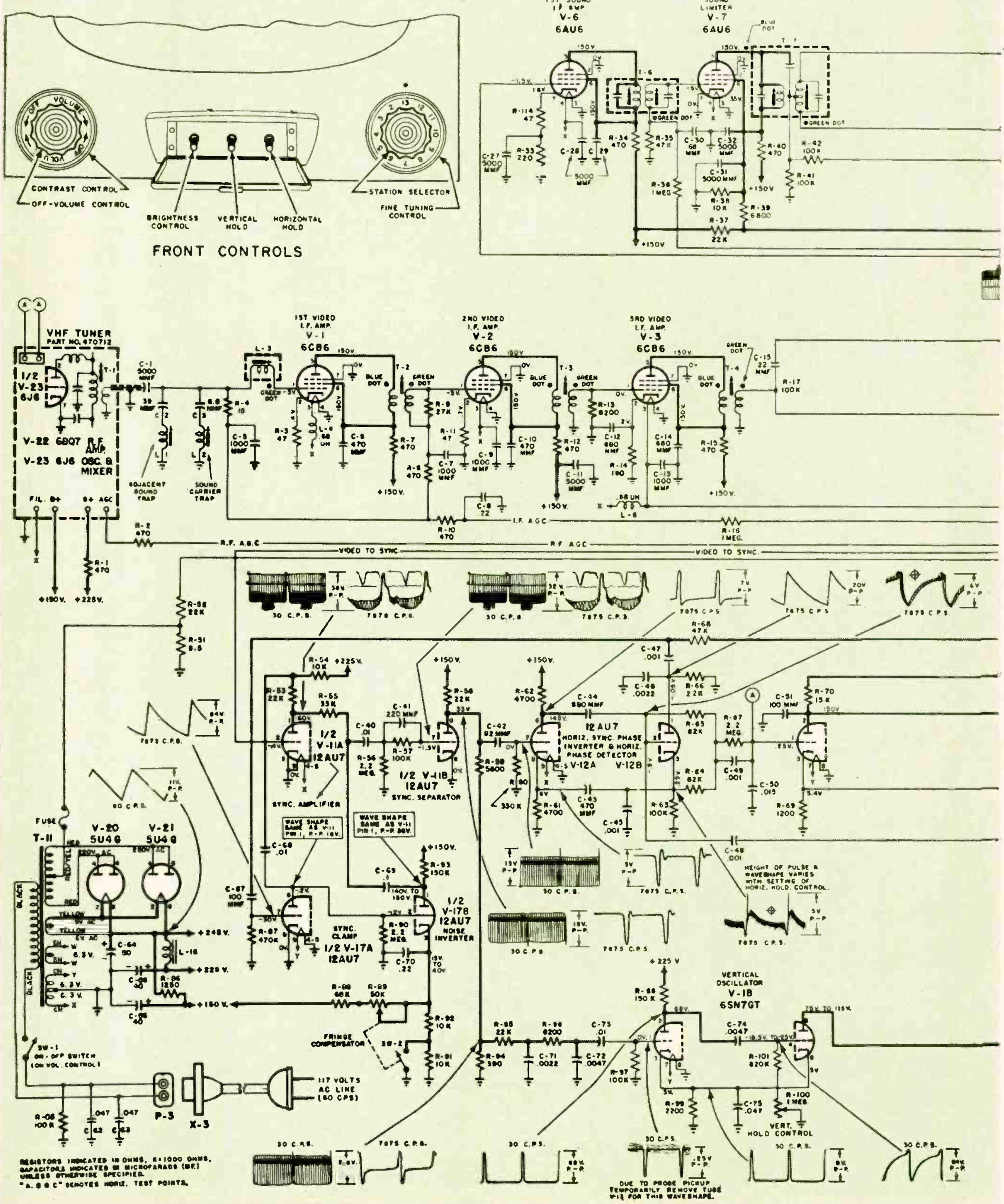
•• PILOT LIGHT USED ONLY ON 19L26, 19L28

••• TONE CONTROL NOT USED ON 19L33 & 19L34.

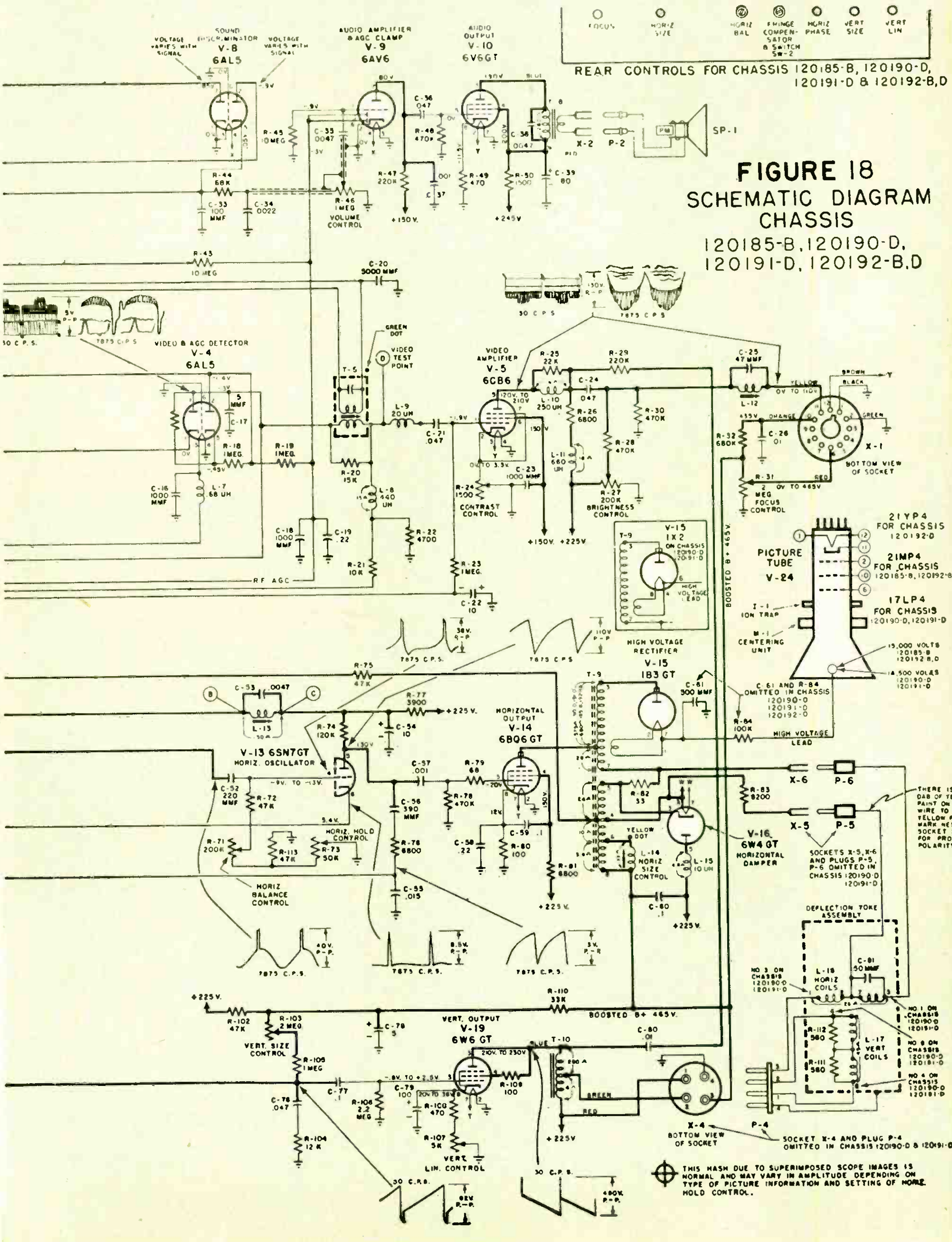


The S-19670 Continuous Tuner

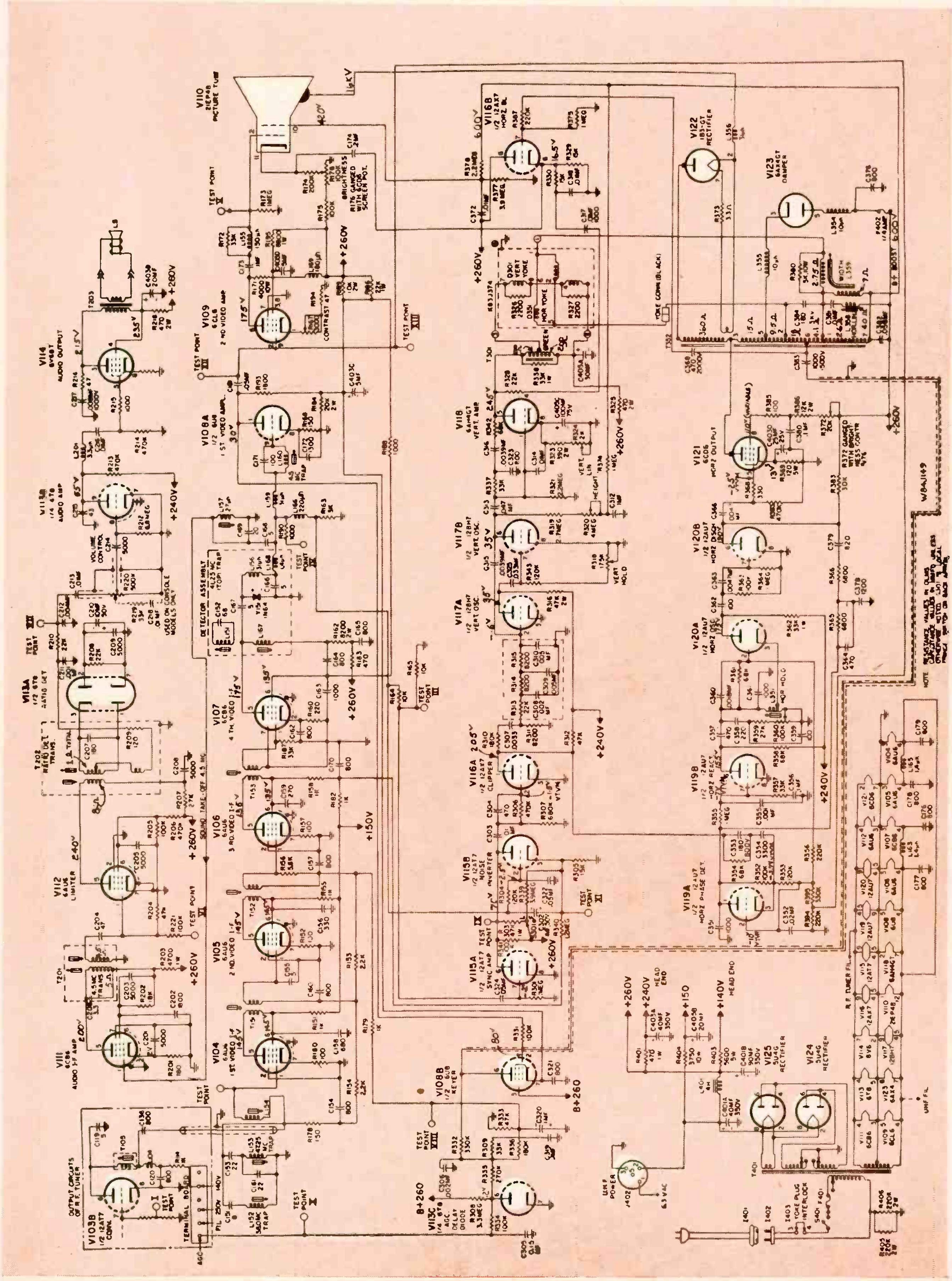
Emerson Chassis 120185B, 120190-D,



120191-D, 120192-B,D



G-E Model S-21C225-B TV Receiver



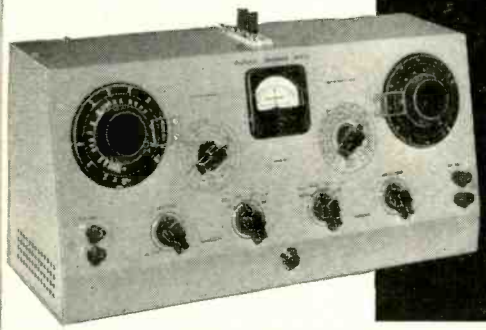
Heathkit

IMPEDANCE BRIDGE KIT

MODEL IB-2

$59.50

SHIPPING WT. 15 LBS.



Features

- Simpson 100-0-100 microampere meter.
- Completely AC operated.
- Built-in phase shift generator and amplifier.
- Battery type tubes, no warm-up required.
- Newly designed two section CRL dial.
- Single knob D, Q, and DQ functions.
- Special impedance matching transformer.
- New modern cabinet styling.
- ½% precision resistors and silver mica condensers.

Another new, outstanding instrument design so typically characteristic of Heathkit operation in producing high quality instrument kits at the lowest possible price. A new, improved model Impedance Bridge kit featuring modern cabinet styling, with slanted panel for convenience of operation and interpretation of scales at a $10.00 price reduction over the preceding model. Built-in adjustable phase shift oscillator and amplifier with all tubes of the battery operated type completely eliminates warm-up time. The instrument is entirely AC line operated. No bothersome battery replacements.

The Heathkit IB-2 Impedance Bridge Kit actually represents four instruments in one compact unit. The Wheatstone Bridge for resistance measurements, the Capacity Comparison Bridge for capacity measurements, Maxwell Bridge for low Q, and Hay Bridge for high Q inductance measurements. Read Q, D, DQ all on one dial thereby eliminating possible confusion due to the incorrect dial reference or adjustment. Only one set of instrument terminals necessary for any measurement function. Panel provisions provided for external generator use.

A newly designed two section CRL dial provides ten separate "units" switch settings with an accuracy of .5%. Fractions of units are read on a continuously variable calibrated wire-wound control. A special minimum capacity, shielded, balanced impedance matching transformer between the generator and the bridge. The correct impedance match is automatically switch selected to provide constant load operation of the generator circuit. The instrument uses ½% precision resistors and condensers in all measurement circuits.

The new Heathkit IB-2 provides outstanding design features not found in any other kit instrument. The single low price includes the power supply, generator, and amplifier stages. No need to purchase separate instrument accessories in order to obtain the type of operation desired.

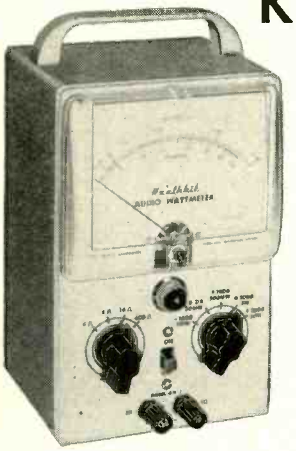
Heathkit

AUDIO WATTMETER KIT

MODEL AW-1

$29.50

SHIPPING WT. 6 LBS.



A new Heathkit design for the audio engineer, serious hi fi enthusiast, recording studio, or broadcast station; the Heathkit Audio Wattmeter Kit. This specialized instrument instantly indicates the output level of the equipment under test without requiring the use of external load resistors. All readings are taken directly from the calibrated scales of a 4½" 200 microampere Simpson meter.

The Heathkit Audio Wattmeter features five full scale power measurement ranges from 5 milliwatts up to 50 watts with db ranges of −15 db to +48 db. The instrument has a power measurement rating of 25 watts continuous and 50 watts maximum for intermittent operation. Non-inductive resistance load impedances of 4, 8, 16, and 600 ohms are provided through a panel impedance selector switch. Frequency effect is negligible from 10 cycles to 250 kc. A conventional VTVM circuit utilizes a 12AU7 twin triode tube. The meter bridge circuit uses four germanium diodes for good linearity.

With the Heathkit AW-1 desired information can be obtained instantly and conveniently without bothering with the irksome setups and calculations usually required. Useful for power curve measurements, frequency response checks, monitoring indicator, etc. Convenient calibration directly from 110 volt AC line source. This new instrument will help to supply the answers to your audio operating or power output problems.

Heathkit

LABORATORY GENERATOR KIT

MODEL LG-1

$39.50

SHIP. WT. 16 LBS.

Another welcome new addition to the popular line of Heathkit instruments, the Heathkit Laboratory Generator. Specifically designed for flexibility of operation, accuracy and versatility beyond the performance level provided by the conventional service type generator. Frequency coverage of the Colpitts oscillator is 150kc to 30mc in five convenient ranges with provisions for internal or external modulation up to 50%, and .1 volt RF output throughout the frequency range. Panel mounted 200 microampere Simpson meter for RF "set reference level" to provide relative indication of RF output. Individually shielded oscillator and shielded variable and step attenuator provide flexible control of RF output.

The circuit features a 6AF4 high frequency oscillator, a 6AV5 amplifier with grid modulation, 12AU7 400 cycle oscillator and modulator, OB2 voltage regulator tube, and a selenium rectifier for the transformer operated power supply. The smart professional instrument appearance and over-all flexibility of operation will prove a decided asset to any industrial or educational laboratory. The Heathkit Laboratory Generator sets a new level of operation, far superior to any instrument in this price classification.

HEATH COMPANY • Benton Harbor 20, Mich.

CHECK THESE *Features*

- New 5UP1 CR tube
- Re-trace blanking
- Voltage regulation
- Extended band width
- Peak-to-peak calibrating provisions
- Good square wave response
- Astigmatism control
- New heavy duty shielded power transformer

NEW 5" *Heathkit*

OSCILLOSCOPE KIT

MODEL O-9

$59.50

SHIPPING WT. 28 LBS.

Announcing the latest addition to a brilliant series of Heathkit Oscilloscopes, the new Model O-9. This outstanding instrument incorporates all of the features developed and proven in the production of well over 50,000 kits, in addition to a host of many new design features for truly outstanding performance. This new scope features a brand new (no surplus) commercially available 5UP1 cathode ray tube for fine focusing, high intensity, and freedom from halation. The 5" CR tube is the standard size for design and industrial laboratories, development engineers, and service men. The only size CR tube offering a wide range of types, colors, phosphors, and persistence. The answer to good oscilloscope performance lies in improved basic design and operating characteristics, and not in the use of larger CR tubes.

VERTICAL AMPLIFIER — New extended band width vertical amplifier with sensitivity of .025 volts per inch, down 3 db at 2 mc. down only 5½ db at 3 mc. Three step vertical input attenuator, quality ceramic variable capacitors for proper input compensation, provisions for calibrated 1 volt peak-to-peak reference, with calibrated screen for direct reading of TV pulses.

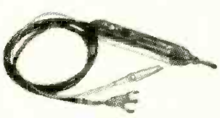
HORIZONTAL AMPLIFIER — New input selector switch provides choice of horizontal input, 60 cycle sweep input, line sync, internal sync, and external sync. Expanded horizontal sweep produces sweep width several times the cathode ray tube diameter. New blanking amplifier for complete retrace blanking and new phasing control.

POWER SUPPLY — New high voltage power supply and filtering circuit for really fine hairline focusing. New heavy duty power transformer with adequate operating reserve. Voltage regulated supply for both vertical and horizontal amplifiers for absolutely rock steady traces and complete freedom from bounce and jitter due to line variations.

The acid test of any oscilloscope operation is the ability to reproduce high frequency square waves and the new Heathkit O-9 will faithfully reproduce square waves up to 500 kc. This is the ideal all around, general purpose oscilloscope for educational and industrial use, radio and TV servicing, and any other type of work requiring the instantaneous reproduction and observation of actual wave forms and other electrical phenomena.

Heathkit LOW CAPACITY

PROBE KIT



NO. 342

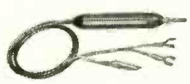
$3.50 SHIP. WT. 1 LB.

Oscilloscope investigation of high frequency, high impedance, or broad bandwidth circuits encountered in television work requires the use of a low capacity probe to prevent loss of gain, distortion, or false service information. The Heathkit Low Capacity Probe features a variable capacitor to provide the necessary degree of instrument impedance matching. New probe styling with bright polished aluminum housing and polystyrene probe ends.

Heathkit

SCOPE DEMODULATOR

PROBE KIT



NO. 337-B

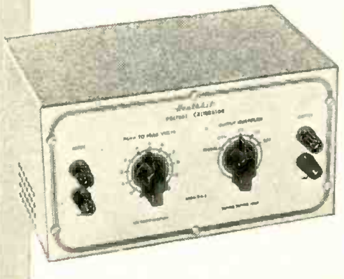
$3.50

SHIP. WT. 1 LB.

In applications such as trouble shooting or aligning TV, RF, IF, and video stages, the frequency ranges encountered require demodulation of signals before oscilloscope presentation. The newly-styled Heathkit Demodulator Probe in polished aluminum housing will fulfill this function and readily prove its value as an oscilloscope service accessory. Detailed assembly sheet provided, including instructions for probe operation.

Heathkit

VOLTAGE CALIBRATOR KIT



The Heathkit Voltage Calibrator provides a convenient method of making peak-to-peak voltage measurements with an oscilloscope by establishing a relationship on a comparison basis between the amplitude of an unknown wave shape and the known output of the voltage calibrator. Peak-to-peak voltage values are read directly on the calibrated panel scales. To offset line voltage supply irregularities, the instrument features a voltage regulator tube.

With the Heathkit Voltage Calibrator, it is possible to measure all types of complex wave forms within a voltage range of .01 to 100 volts peak-to-peak. A convenient "signal" position on the panel switch by-passes the calibrator completely and the signal is applied to the oscilloscope input thereby eliminating the necessity for transferring test leads.

MODEL VC-2

$11.50

SHIPPING WT. 4 LBS.

Heathkit

ELECTRONIC SWITCH KIT

The basic function of the Heathkit S-2 Electronic Switch Kit is to permit simultaneous oscilloscope observation of two separate traces which can be either separated or superimposed for individual study. A typical example would be observation of a signal as it appears at both the input and output stages of an amplifier. It will also serve as a square wave generator over the range of switching frequencies, often providing the necessary wave form response information without incurring the expense of an additional instrument.

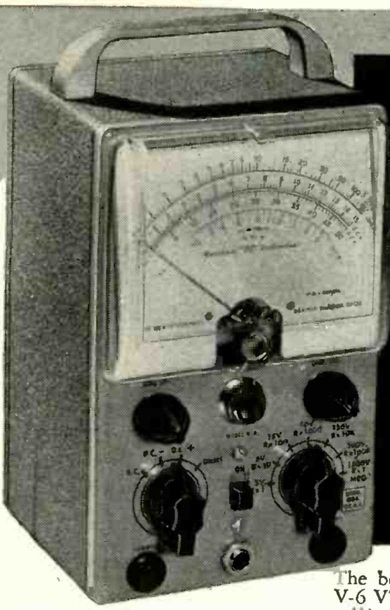
Continuously variable switching rates in three ranges from less than 10 cps to over 2,000 cps. Individual controls for each input channel and a positioning control. The five tube transformer operated circuit utilizes two 6SJ7, two 6SN7, and one 6X5 tubes. Buy this kit and enjoy increased versatility of operation from your oscilloscope.

MODEL S-2

$23.50

SHIP. WT. 11 LBS.

HEATH COMPANY • Benton Harbor 20, Mich.



Heathkit VACUUM TUBE VOLTMETER KIT

MODEL V-6

$24.50

SHIPPING WT. 6 LBS.

Features

- New 1½ volt full scale low range
- 1,500 volt upper limit DC range
- Increased accuracy through 50% greater scale coverage
- High impedance 11 megohm input
- Center scale zero adjust
- Polarity reversal switch
- 1% precision resistors
- Clearly marked db scales

The beautiful Heathkit Model V-6 VTVM, the world's largest selling kit instrument, now offers many outstanding new features in addition to retaining all of the refinements developed and proven in the production of over 100,000 VTVM's. This is the basic measuring instrument for every branch of electronics. Easily meets all requirements for accuracy, stability, sensitivity, convenience of ranges, meter readability, and modern styling. It will accurately measure DC voltages, AC voltages, offers tremendous ohmmeter range coverage, and a complete db scale for a total of 35 meter ranges.

New 1½ volt full scale low range provides well over 2¼" of scale length per volt. Upper DC scale limit 1,500 volts. DC ranges 0-1.5, 5, 15, 50, 150, 500, 1,500 volts full scale. AC ranges 0-1.5, 5, 15, 50, 150, 500, 1,500 (1,000 volts maximum). Seven ohmmeter ranges from .1 ohm to 1,000 megohms. For added convenience a DC polarity reversing switch and a center scale zero adjustment for FM alignment.

The smartly styled, compact, sturdy, formed aluminum cabinet is finished in an attractive gray crackle exterior. The beautiful two-color, durable, infra-red, baked enamel panel further adds to the over-all professional appearance.

Top quality components used throughout. 1% precision resistors — silver contact range and selector switches — selenium rectifier — transformer operated power supply. Individual calibration on both AC and DC for maximum accuracy. DB scale printed in red for easy identification, all other scales a sharp, crisp black for easy reading. A variety of accessory probes shown on this page still add further to over-all instrument usefulness.

Heathkit 30,000 VOLT DC PROBE KIT

For TV service work or any similar application where the measurement of high DC voltage is required, the Heathkit Model 336 High Voltage Probe Kit will prove invaluable. A precision multiplier resistor mounted inside the two-color, sleek, plastic probe body provides a multiplication factor of 100 on the DC ranges of the Heathkit 11 megohm VTVM. The entire kit includes precision resistor, two-color plastic probe, tip connector spring, test lead, phone plug panel connector, and complete assembly instructions.

No. 336

$4.50

SHIP. WT. 2 LBS.

Heathkit PEAK-TO-PEAK PROBE KIT

No. 338-B

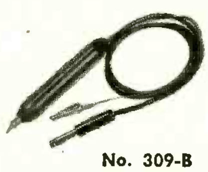
$5.50

SHIP. WT. 2 LBS.

Now read peak-to-peak voltages on the DC scales of the Heathkit 11 megohm VTVM. Readings can be directly made from the VTVM scale without involved calculations. Measurements over the frequency range of 5 kc to 5 mc. Use this probe to extend the usefulness of your VTVM in radio and TV service work. The Peak-to-Peak Probe Kit features the new polished aluminum housing with two-color polystyrene probe ends. Detailed assembly sheet including instructions for probe operation.

Heathkit RF PROBE KIT

The Heathkit RF Probe used in conjunction with any 11 megohm VTVM will permit RF measurements up to 250 mc, ± 10%. A useful, convenient accessory for those occasions when RF measurements are desired. The RF probe body is housed in the new, smartly-styled polished aluminum probe body featuring two-color polystyrene probe ends and a low capacity flexible shielded test lead. The kit is complete with all necessary material and a detailed assembly sheet as well as instructions for probe operation.



No. 309-B

$3.50

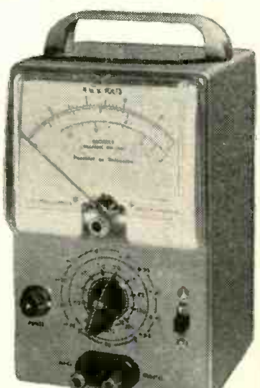
SHIP. WT. 2 LBS.

Heathkit AC VACUUM TUBE VOLTMETER KIT

MODEL AV-2

$29.50

SHIPPING WT. 5 LBS.



The new Heathkit AC VTVM that makes possible those sensitive AC measurements required by laboratories, audio enthusiasts, and experimenters. Especially useful for hum investigation, sensitive null detection, phono pick-up output measurements, making frequency response runs, gain measurements, ripple voltage checks, etc. Low level measurements are easy to make because of the complete voltage coverage of the instrument and the one knob operation.

The large 200 microampere Simpson meter has clearly marked and easy to read meter scales. Ten voltage ranges covering from .01 rms full scale to 300 volts rms full scale, with frequency response ± 1 db from 20 cycles to 50,000 cycles. Instrument input impedance 1 megohm, ten db ranges from −52 db to +52 db. For stability and good linearity characteristics the meter bridge circuit features 4 germanium diodes. Attractive instrument styling, a companion piece for the popular Heathkit VTVM and the new AW-1 Audio Wattmeter.

HEATH COMPANY • Benton Harbor 20, Mich.

New *Heathkit* 12 Volt BATTERY ELIMINATOR KIT

MODEL BE-4

$31.50

SHIPPING WT. 18 LBS.

CHECK THESE *Features*

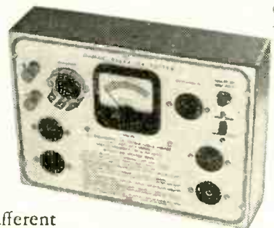
- Either 6 or 12 volt operation
- Continuously variable voltage output
- Constant ammeter and voltmeter monitoring
- Automatic overload relay — self-resetting
- Two 10,000 mf condensers
- New 18 disc split type heavy duty rectifier unit
- Fuse protection

Here is the new Heathkit Battery Eliminator necessary for modern, up-to-date operation of your service shop. The Heathkit Model BE-4 furnishes either 6 volts or 12 volts output which can be selected at the flick of a panel switch. Use the BE-4 to service the new 12 volt car radios in addition to the conventional 6 volt radios.

This new Battery Eliminator provides two continuously variable output ranges, 0-8 volts DC at 10 amperes continuously, or 15 amperes maximum intermittent; 0-16 volts DC at 5 amperes continuously or 7.5 amperes maximum intermittent. The output voltage is clean and well filtered as the circuit uses two 10,000 mf condensers. The continuously variable voltage output feature is a definite aid in determining the starting point of vibrators, the voltage operating range of oscillator circuits, etc. Panel mounted meters constantly monitor voltage and current output and will quickly indicate the presence of a major circuit fault in the equipment under test. The power transformer primary winding is fuse protected and for additional safety an automatic relay of the self-resetting type is incorporated in the DC output circuit. The heavy duty rectifier is a split type 18 plate magnesium copper sulfide unit used either as a full wave rectifier or voltage doubler according to the position of the panel range switch.

Here is the ideal battery eliminator for all of your service problems and as an additional feature, it can also be used as a battery charger. Another new application for the Heathkit Battery Eliminator is a variable source of DC filament supply in audio development and research. More than adequate variable voltage and current range for normal applications.

Heathkit VIBRATOR TESTER KIT



Your repair time is valuable, and service use of the Heathkit Vibrator Tester will save you many hours of work. This tester will instantly tell you the condition of the vibrator being checked. Checks vibrators for proper starting and the easy to read meter indicates quality of output on a large Bad-?-Good scale. The Heathkit VT-1 checks both interrupter and self rectifier types of vibrators. Five different sockets for checking hundreds of vibrator types.

The Heathkit Vibrator Tester operates from any battery eliminator capable of delivering continuously variable voltage from 4 to 6 volts DC at 4 amperes. The new Heathkit Model BE-4 Battery Eliminator would be an ideal source of supply.

MODEL VT-1

$14.50

SHIPPING WT. 6 LBS.

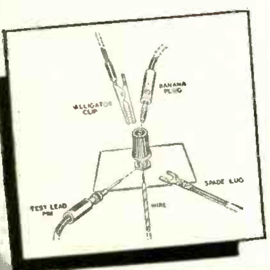
NEW *Heathkit* VARIABLE VOLTAGE ISOLATION TRANSFORMER KIT

The new Heathkit Isolation Transformer Kit provides line isolation for AC-DC radios (not an auto transformer), thereby eliminating shock hazard, hum problems, alignment difficulties, etc. The output voltage is variable from 90 to 130 volts AC and is constantly monitored by a panel mounted AC volt meter. Use it to increase AC supply voltage in order to induce breakdown of faulty components in circuits thereby saving service time. Use it also to simulate varying line voltage conditions and to determine the line voltage level at which oscillator circuits cease functioning, particularly in three-way portable radios. Rated at 100 watts continuous operation and up to 200 watts maximum intermittent operation. A useful radio and TV service tool.

MODEL IT-1

$16.50

SHIP. WT. 9 LBS.



Heathkit BINDING POST

Binding post kit now available so that standardization of all instrument connectors is possible. This new, five-way binding post will accommodate an alligator clip, banana plug, test lead pin, spade lug, or hook-up wire. Sold in units of 20 binding post assemblies. Each assembly includes binding post, flat and shoulder fiber washers, solder lug, and nut. 120 pieces in all. Kit 362, $4.00.

Heathkit TECHNICAL APPLICATION BULLETINS

An exclusive Heathkit service. Technical application bulletins prepared by recognized instrument authorities outlining various combinations of instrument applications. Available now with 40 four-page illustrated bulletins and an attractive flexible loose-leaf binder. Only $2.00. (No c.o.d. on this item, please.)

HEATH COMPANY • Benton Harbor 20, Mich.

CHECK THESE *Features*

- INCREDUCTOR controllable inductor sweep
- TV and IF sweep deviation 12-30 mc
- 4 mc- 220 mc continuous frequency coverage
- Oscillator operation entirely on fundamentals
- Output in excess of 100,000 microvolts
- Automatic amplitude circuit
- Voltage regulation
- Simplified operation

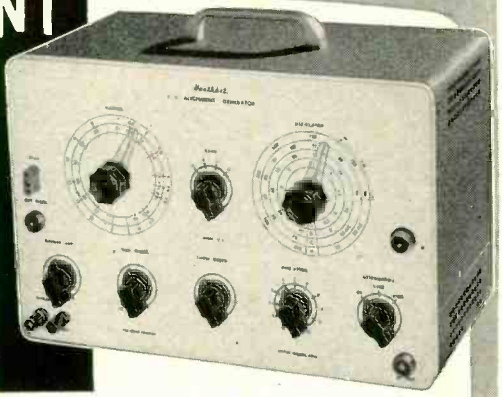
NEW *Heathkit*

TV ALIGNMENT GENERATOR KIT

MODEL TS-3

$44.50

SHIPPING WEIGHT 18 POUNDS



Proudly announcing an entirely new, advanced model TV and FM Sweep Generator, the Heathkit Model TS-3. This new design provides features and combinations of functions not found in any other service type instrument. Every design consideration has been given to the requirements of the TV service man to provide a flexible, variable sweep source with more than adequate RF output and complete frequency coverage throughout the TV and FM spectrum.

The frequency range of the TS-3 is from 4 mc to 220 mc in four switch selected ranges. All frequency ranges are overlapping for complete coverage. A particularly important feature of the instrument is that the oscillator operates entirely on fundamentals, thereby providing complete freedom from spurious oscillation and parasitics normally encountered in beat frequency type oscillators. This circuity assures a much higher total RF output level and simplifies attenuation problems.

The new TS-3 features an entirely new principle of sweep operation. Sweep action is entirely electronic with no moving parts or electro-mechanical devices so commonly used. The heart of the sweep system is a newly-developed INCREDUCTOR controllable inductor. With this system, the value of inductance of each oscillator coil is electrically varied with an AC control current, and the inductance variation is achieved by a change in the magnetic state of the core on which the oscillator coils are wound. This system provides a sweep deviation of not less than 12 mc on all TV frequencies, and up to a maximum of 30 mc on TV IF frequencies. The high RF output level throughout the instrument frequency range overcomes the most common complaint of the older type sweep generators. A new, automatic amplitude control circuit maintains the output level flat to ± 2 db throughout the instrument range. For convenience of operation a low impedance 50 ohm output is used.

Operation of the instrument has been simplified through the reduction of panel controls and separate panel terminals provide for external synchronization if desired. The circuit uses a voltage regulator tube to maintain stable instrument operation. A built-in variable oscillator marker further adds to flexibility of instrument operation. Provisions are also made for the use of an external marker, such as your service type signal generator, if desired. Use the Heathkit TS-3 for rapid, accurate TV alignment work, and let it help you solve those time consuming, irksome problems so frequently encountered.

NEW *Heathkit*

SIGNAL GENERATOR KIT

MODEL SG-8

$19.50

SHIPPING WEIGHT 8 POUNDS

Announcing the new Heathkit Model SG-8 service type Signal Generator, incorporating many design features not usually found in an instrument in this price range. The RF output is from 160 kc to 100 mc in five ranges, all on fundamentals, with useful harmonics up to 200 mc. The RF output level is in excess of 100,000 microvolts throughout the frequency range.

The oscillator circuit consists of a 12AT7 twin triode tube. One half is used as a Colpitts oscillator, and rhe other half as a cathode follower output which acts as a buffer between the oscillator and external load. This circuity eliminates oscillator frequency shift usually caused by external circuit loading.

All coils are factory wound and adjusted, thereby completely eliminating the need for calibration and the use of additional calibrating equipment. The stable low impedance output features a step and variable attenuator for complete control of RF level. A 6C4 triode acts as a 400 cycle sine wave oscillator and a panel switching system permits a choice of either external or internal modulation.

The transformer operated circuit is easy to assemble, requires no calibration, and meets every service requirement for an adjustable level variable frequency signal source, either modulated or un-modulated.

NEW *Heathkit*

BAR GENERATOR KIT

MODEL BG-1

$14.50

SHIPPING WEIGHT 6 POUNDS

The Heathkit BG-1 Bar Generator represents another welcome addition to the fast growing line of popular Heathkits. The station transmitted test pattern is rapidly disappearing, and the bar generator is the logical answer to the TV service man's problem in obtaining quick, accurate adjustment information without waiting for test patterns.

The Heathkit BG-1 produces a series of horizontal or vertical bars on a TV screen. Since these bars are equally spaced, they will quickly indicate picture linearity of the receiver under test. Panel switch provides "stand-by position" — "horizontal position" — "vertical position." The oscillator unit utilizes a 12AT7 twin triode for rhe RF oscillator and video carrier frequencies. A neon relaxation oscillator provides low frequency for vertical linearity tests. The instrument will not only produce bar patterns but will also provide an indication of horizontal and vertical sync circuit stability, as well as overall picture size.

Instrument operation is extremely simple, and merely requires connection to the TV receiver antenna terminal. The unit is transformer operated for safety when used in conjunction with universal or transformerless type TV circuits.

HEATH COMPANY • Benton Harbor 20, Mich.

NEW *Heathkit*

TUBE CHECKER KIT

MODEL TC-2

$29.50

SHIP. WT. 12 LBS.

CHECK THESE NEW *Features*

- Simplified harness wiring
- Improved, smooth, anti-backlash roll chart action
- Optional roll chart illumination
- Individual element switches
- Portable or counter style cabinet
- Spare blank socket
- Contact type pilot light test socket
- Simplified test set-up procedure
- Line adjust control
- 4½" three-color meter

The new Model TC-2 Heathkit Tube Checker features many circuit improvements, simplified wiring, new roll chart drive and illumination of roll chart. The instrument is primarily designed for the convenience of the radio and TV service man and will check the operating quality of tubes commonly encountered in this type of work. Test set-up procedure is simplified, rapid, and flexible. Panel sockets accommodate 4, 5, 6, and 7 pin tubes, octal and loctal, 7 and 9 pin miniatures, 5 pin Hytron and a blank socket for new tubes. Built-in neon short indicator, individual three-position lever switch for each tube element, spring return test switch, 14 filament voltage ranges, and line set control to compensate for supply voltage variations, all represent important design features of the TC-2. Results of tube tests are read directly from a large 4½" Simpson three-color meter, calibrated in terms of Bad-?-Good. Information that your customer can readily understand. Checks emission, shorted elements, open elements, and continuity.

The use of closer tolerance resistors in critical circuits assures correct test information and eliminates the possibility of inaccurate test interpretation. Improvement has been made in the mechanical roll chart drive system, completely eliminating diagonal running, erratic operation, and backlash. The thumb wheel gear driven action is smooth, positive, and free running. As an additional feature, the roll chart is illuminated for easier reading, particularly when the tube checker is used on radio or TV home service calls.

Wiring procedure has been simplified through the extended use of multi-cable, color coded wires, providing a harness type installation between tube sockets and lever switches. This procedure insures standard assembly and imparts that "factory built" appearance to instrument construction. Completely detailed information is furnished in the new step-by-step construction manual, regarding the set-up procedure for testing of new or unlisted tube types. No delay necessary for release of factory data.

The new Heathkit Tube Checker will prove its value in building service prestige through usefulness — simplified operation — attractive professional appearance. Don't overlook the fact that the kit price represents a savings of $40.00 to $50.00 over the price of a comparable commercially built instrument. At this low price, no service man need be without the advantages offered by the Heathkit Tube Checker.

New

HEATHKIT

PORTABLE TUBE CHECKER KIT

MODEL TC-2P

$34.50

SHIP. WT. 14 LBS.

The portable model is supplied with a strikingly attractive two-tone cabinet finished in rich maroon, proxylin impregnated, fabric covering with a contrasting gray on the inside cover. Detachable cover, brass-plated hardware, sturdy plastic handle help to impart a truly professional appearance to the instrument.

PORTABLE TUBE CHECKER CABINET as described above will fit all earlier Heathkit TC-1 Tube Checkers. Shipping weight 7 lbs. Cabinet only, 91-8, $7.50.

Heathkit TV PICTURE TUBE

TEST ADAPTER

No. 355
Ship. Wt. 1 Lb.

$4.50

The Heathkit TV Picture Tube Test Adapter used with the Heathkit Tube Checker will quickly check for emission, shorts, etc., and determine picture tube quality. Consists of standard 12 pin TV tube socket, four feet of cable, octal socket connector, and data sheet.

Heathkit POWER SUPPLY KIT

MODEL PS-2

$33.50

SHIPPING WT. 17 LBS.

The Heathkit Laboratory Power Supply features continuously variable, regulated voltage output with good stability under wide load variations. A 4½" Simpson plastic enclosed panel mounted meter provides accurate meter output information of voltage or current. All panel terminals completely isolated from the cabinet. Separate 6.3 volt AC supply at 4 amperes for filament requirements. Ripple component exceptionally low, stand-by switch provided to eliminate warm-up time of the five tube circuit.

LABORATORY AND SERVICE SHOP BOOKLETS

"Planning Your Service Business" by John T. Frye, and "Establishing the Industrial Electronics Laboratory" by Louis B. Garner, Jr., are booklets available to Heathkit customers at no charge. These booklets, written by nationally recognized authorities, outline the various requirements and considerations for establishing your own service business or for setting up an industrial electronics laboratory. Full attention is given to various details that are frequently overlooked when projects of this nature are undertaken. Just write in to the Heath Company requesting your free copy, or attach a memo to your next order.

HEATH COMPANY • Benton Harbor 20, Mich.

Heathkit VISUAL-AURAL SIGNAL TRACER KIT

CHECK THESE *Features*

- Visual and aural signal tracing
- Two channel input
- High RF sensitivity
- Unique noise locater circuit
- Calibrated wattmeter
- Substitution test speaker
- Utility amplifier
- RF, audio probes and test leads included

MODEL T-3

$23.50

SHIPPING WEIGHT 10 POUNDS

An entirely new type of signal tracer incorporating a combination of features not found in any other instrument. Designed expressly for the radio and TV service man, particularly for the servicing of AM, FM, and TV circuits. Here in a five tube, transformer operated instrument are all of the useful functions so necessary for speedy, accurate isolation of service difficulty.

This new signal tracer features a special high gain RF input channel, used in conjunction with a newly-designed wide frequency range demodulator probe. High RF sensitivity permits signal tracing at the receiver antenna input. A separate low gain channel and probe available for audio circuit exploration. Both input channels are constantly monitored by an electron ray beam indicator, so that visual as well as aural signal indications may be observed. The instrument can also be used for comparative estimation of gain per stage.

A decidedly unusual feature is a noise localizer circuit in conjunction with the audio probe. With this system, a DC potential is applied to a suspected circuit component and the action of the voltage in the component can be seen as well as heard. Invaluable for ferreting out noisy or intermittent condensers, noisy resistors, controls, coils, IF and power transformers, etc. A built-in calibrated wattmeter circuit is very useful for a quick preliminary check of the total wattage consumption of the equipment under test. Separate panel terminals provide external use of the speaker or output transformer for substitution purposes. Saves valuable service time by eliminating the necessity for speaker removal on every service job. The terminals also permit the utilization of other shop equipment, such as your oscilloscope or VTVM. The T-3 Signal Tracer can be used as a high gain amplifier for checking tuners, record changers, microphones, phono crystals, etc.

Don't overlook the interesting service possibilities provided through the use of this new instrument and let it work for you by saving time and money. The kit is supplied complete with all tubes, circuit components, demodulator probe, audio probe, and additional test leads.

Heathkit DECADE RESISTANCE KIT

MODEL DR-1 **$19.50** SHIP. WT. 4 LBS.

The Decade Resistance Kit provides individual switch selection of resistance values using twenty 1% resistors providing a choice of 1 to 99,999 ohms in 1 ohm steps. Ceramic wafer switches, silver-plated contacts, smooth, positive detent action, baked enamel panel, and handsome, polished birch cabinet.

Heathkit DECADE CONDENSER KIT

The Heathkit Decade Condenser Kit features silver mica, precision condensers with a rated accuracy of ± 1%. Capacity values are arranged in three decades from 100 mmf to .111 mf in steps of 100 mmf. Ceramic wafer switches with silver-plated contacts and smooth detent action. Useful in laboratory work, for circuit development.

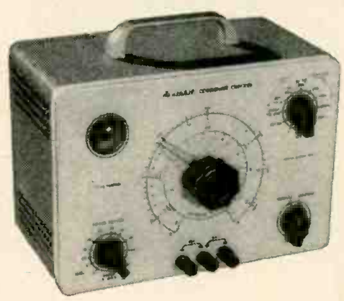
MODEL DC-1 **$16.50** SHIP WT 4 LBS.

Heathkit RESISTANCE SUBSTITUTION BOX KIT

MODEL RS-1 **$5.50** SHIP. WT. 2 LBS.

The Heathkit Resistance Substitution Box provides individual switch selection of any one of 36 RTMA 1 watt 10% standard value resistors, ranging from 15 ohms to 10 meghoms. Many applications in circuit development work, and also in radio and TV service work. Ideal for experimentally determining resistance values and for quickly altering circuit operating characteristics. Entire unit housed in attractive Bakelite cabinet, featuring the new universal type Heathkit binding posts to simplify circuit connections.

Heathkit CONDENSER CHECKER KIT



MODEL C-3

$19.50

SHIPPING WT. 8 POUNDS

Use the Heathkit C-3 Condenser Checker to quickly and accurately measure those unknown condenser and resistor values. All readings are taken directly from the calibrated panel scales without requiring any involved calculation. Capacity measurements in four ranges from .00001 mf to 1,000 mf. Checks paper, mica, ceramic, and electrolytic condensers. A power factor control is available for accurate indication of electrolytic condenser measurements. A leakage test switch with switch selection of five polarizing voltages, 25 volts to 450 volts DC, will indicate condenser operating quality under actual load condition. The spring return leakage test switch automatically discharges the condenser under test and eliminates shock hazard to the operator.

Resistance measurements can be made in the range from 100 ohms to 5 megohms. Here again all values are read directly on the calibrated scale. Increased circuit sensitivity coupled with an electron beam null indicator increases overall instrument usefulness.

For safety of operation the circuit is entirely transformer operated and the instrument is housed in the attractive, newly-styled Heathkit cabinet, featuring rounded corners, and drawn aluminum panel. The outstanding low kit price for this surprisingly accurate instrument includes necessary test leads. Good service shop operation requires the use of this specialized instrument, designed for the express purpose of determining unknown condenser values and operating characteristics.

HEATH COMPANY • Benton Harbor 20, Mich.

Heathkit AMATEUR TRANSMITTER KIT

MODEL AT-1

$29.50

SHIPPING WEIGHT 16 POUNDS

CHECK THESE NEW *Features*

- Single knob band switching
- Pre-wound coils
- Metered operation
- 52 ohm coaxial output
- Crystal or VFO excitation
- Built-in power supply
- Rugged, clean construction

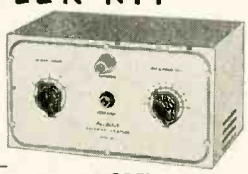
Here is the latest Heathkit addition to the ham radio field, the AT-1 Transmitter Kit, incorporating many desirable design features at the lowest possible dollar-per-watts price. Panel mounted crystal socket, stand-by switch, key click filter, AC line filtering, good shielding, etc. VFO or crystal excitation — up to 35 watts input. Built-in power supply provides 425 volts at 100 ma.

This kit features pre-wound coils, single knob band switching, 52 ohm coaxial output, plug in chassis provisions for VFO or modulator and rugged clean construction. Frequency range 80, 40, 20, 15, 11, and 10 meters. Tube line-up 6AG7 oscillator-multiplier, 6L6 amplifier-doubler, 5U4G rectifier. Physical dimensions 8⅛" high x 13⅛" wide x 7" deep.

This amazingly low kit price includes all circuit components, tubes, cabinet, punched chassis, and detailed construction manual. The ideal kit for the novice just breaking into ham radio. It can be used later on as a stand-by rig or an all band exciter for higher powered transmitter.

NEW *Heathkit* ANTENNA COUPLER KIT

New Heathkit Antenna Coupler, specially designed for the Heathkit AT-1 Transmitter. The Antenna Coupler can be used with any 52 ohm coaxial input — up to 75 watts power. Low pass filter with cut-off frequency of approximately 36 mc — L section tuning network — neon tuning indicator — rugged, compact construction — transmitter type variable condenser, and high Q coil are all outstanding features. The AC-1 has both inductance and capacity tuning for maximum operating versatility. Dimensions 8⅛" wide x 4⅜" high x 4⅞" deep.



MODEL AC-1

$14.50 SHIP. WT. 3 LBS.

Heathkit ANTENNA IMPEDANCE METER

Use the Heathkit Antenna Impedance Meter for measuring antenna impedance for line matching purposes — adjustment of beam antennas — phone monitor, etc. It will determine antenna resistance at resonance, match transmission line for minimum SWR, determine receiver input impedance, and provide a rough indication of SWR. Precision resistors, germanium diode, 100 microampere Simpson meter. Dial calibrated from 0-500 ohms. Shielded aluminum cabinet. 7" long x 2½" wide x 3¼" deep.

$14.50

SHIP. WT. 3 LBS.

MODEL AM-1

Heathkit COMMUNICATIONS RECEIVER KIT

MODEL AR-2

$25.50 SHIP. WT. 12 LBS.

Here is the new receiver kit you have repeatedly asked for, the Heathkit Communications Receiver. The perfect companion piece for the AT-1 Transmitter kit. Many outstandingly desirable features have been incorporated in the design of the AR-2; such as, electrical bandspread for logging and tuning convenience — high gain miniature tubes — IF transformers for high sensitivity and good signal to noise ratio — separate RF gain control with optional automatic volume control or manual volume control, in addition to the conventional audio gain control. Noise limiter — stand-by switch — stable BFO oscillator circuit — headphone jack — transformer operation, etc., all contribute to a high performance standard.

Frequency coverage is continuous from 535 kc to 35 mc in four ranges. For added convenience, various ham bands have been separately identified in respect to their relative placement on the slide rule tuning scale. A chassis mounted, 5½" PM speaker is included with this kit. Tube line up 12BE6 mixer oscillator, 12BA6 IF amplifier, 12AV6 detector AVC audio, 12BA6 BFO oscillator, 12A6 beam power output, 5Y3GT rectifier.

RECEIVER CABINET

Proxylin impregnated, fabric covered, plywood cabinet with aluminum panel designed expressly for the AR-2 Receiver. Part 91-10, shipping weight 5 lbs., $4.50.

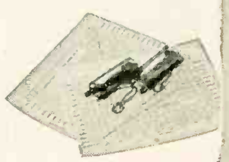
IMPROVED *Heathkit* GRID DIP METER KIT

$19.50 SHIP. WT. 4 LBS.

MODEL GD-1B

The invaluable instrument for service men, hams, and experimenters. Useful in TV service work for alignment of traps, filters, IF stages, peaking compensation networks, etc. Locates spurious oscillation, provides a relative indication of power in transmitter stages, use it for neutralization, locating parasitics, correcting TVI, measuring C, L, and Q of components, and determining RF circuit resonant frequencies. With oscillator energized, useful for finding resonant frequency of tuned circuits. With the oscillator not energized, the instrument acts as an absorption wave meter. Variable meter sensitivity control, head phone jack, 500 microampere Simpson meter. Continuous frequency coverage from 2 mc. to 250 mc. Pre-wound coil kit and rack, new three prong coil mounting, 6AF4 high frequency triode.

Two additional plug-in coils are available and provide continuous extension of low frequency coverage down to 355 kc. Dial correlation curves included. Shipping weight 1 lb., kit 341, $3.00.



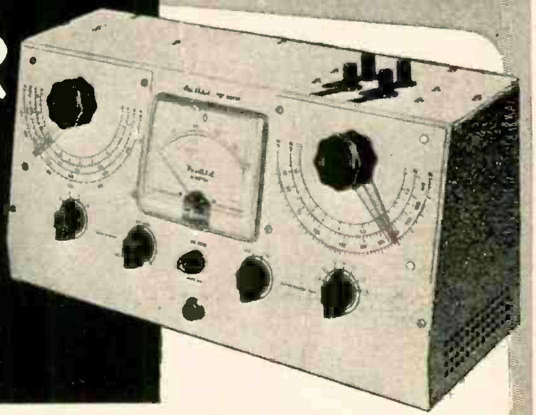
HEATH COMPANY • Benton Harbor 20, Mich.

Heathkit "Q" METER KIT

MODEL QM-1

$44.50

SHIPPING WT. 14 POUNDS



CHECK THESE *Features*

- First popular priced Q Meter
- Reads Q directly on calibrated scale
- Oscillator supplies RF frequencies of 150 kc to 18 mc
- Calibrate capacitor with range of 40 mmf to 450 mmf with vernier of ± 3 mmf
- Measures Q of condensers, RF resistance, and distributed capacity of coils
- Many applications in design and development work
- Useful in TV service work for checking deflection yokes, coils, chokes, etc.

Another outstanding example of successful Heathkit engineering effort in producing a Q Meter Kit within the price range of TV service men, schools, laboratories, and experimenters. This Q Meter meets RF design requirements for rapid, accurate measurement of capacity, inductance, and Q at the operating frequency and all indications of value can be read directly on the meter calibrated scales. Oscillator section supplies RF frequencies of 150 kc to 18 mc. Calibrate capacitor with range of 40 mmf to 450 mmf, with vernier of ± 3 mmf.

Particularly useful in TV service work for checking peaking coils, wave traps, chokes, deflection coils, width and linearity coils, etc. At this low kit price research laboratory facilities are within the range of service shops, schools, and experimenters.

Heathkit INTERMODULATION ANALYZER KIT

MODEL IM-1

$39.50

SHIPPING WT. 17 POUNDS

The Heathkit IM-1 is an extremely versatile instrument specifically designed for measuring the degree of inter-action between two signals in any portion of an audio chain. It is primarily intended for making tests of audio amplifiers, but may be used in other applications, such as checking microphones, records, recording equipment, phonograph pick-ups, and loud-speakers. High and low test frequency source, intermodulation unit, power supply, and AC vacuum tube volt meter all in one complete instrument. Per cent intermodulation is directly read on the calibrated scales, 30%, 10%, and 3% full scale. Both 4:1 and 1:1 ratios of low to high frequency easily set up. With this instrument the performance level of present equipment, or newly developed equipment can be easily and accurately checked. At this low price, you can now enjoy the benefits of intermodulation analysis for accurate audio interpretation.

Heathkit AUDIO GENERATOR KIT

A Heathkit Audio Generator with frequency 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. Calibrated, continuously variable, and step attenuator output controls provide convenient reference output level. Distortion is less than .4% from 100 cps through the audible range. The ideal controllable extended frequency sine wave source for audio circuit investigation and development.

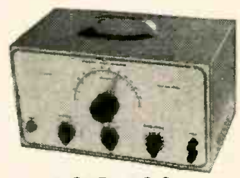
MODEL AG-8

$29.50

SHIP. WT. 11 LBS.

Heathkit AUDIO OSCILLATOR KIT

Sine or square wave coverage from 20 to 20,000 cycles in three ranges at a controllable output level up to 10 volts. Low distortion, 1% precision resistors in multiplier circuits, high level output across entire frequency range, etc., readily qualify this instrument for audio experimentation and development work. Special circuit design consideration features thermistor operation for good control of linearity.



MODEL AO-1

$24.50

SHIP. WT. 11 LBS.

Heathkit AUDIO FREQUENCY METER KIT

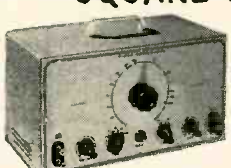
MODEL AF-1

$34.50

SHIP. WT. 12 LBS.

The Heathkit Audio Frequency Meter provides a simple and convenient means of checking unknown audio frequencies from 10 cycles to 100 kc at any voltage level between 3 and 300 volts rms with any non-critical wave shape. Instrument operation is entirely electronic. Just set the range switch, feed an unknown frequency into the instrument, and read the frequency directly on the calibrated scale of the Simpson 4½" meter.

Heathkit SQUARE WAVE GENERATOR KIT



MODEL SQ-1

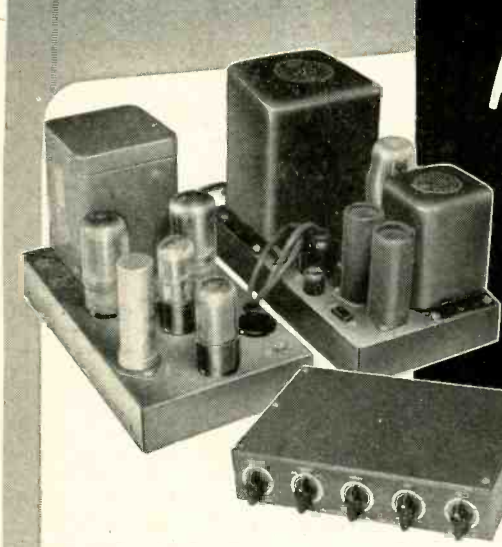
$29.50

SHIP. WT. 12 LBS.

The Heathkit Square Wave Generator provides an excellent square wave frequency source with completely variable coverage from 10 cycles to 100 kc. This generator features low output impedance of 600 ohms and the output voltage is continuously variable between 0 and 20 volts, thereby providing the necessary degree of operating flexibility. An invaluable instrument for those specialized circuit investigations requiring a good, stable, variable square wave source.

HEATH COMPANY • Benton Harbor 20, Mich.

Heathkit
WILLIAMSON TYPE
AMPLIFIER KIT
MODEL W-2



Particularly designed for custom installations, featuring separate cable connected units for simplicity of installation. Sheet metal work finished in attractive gray hammertone for smart appearance. All control shafts of the adjustable length break-off type.

$69.50

PRICES OF COMBINATIONS

W-2 Amplifier Kit including main amplifier, power supply, and WA-P1 Preamplifier Kit. Shipping Weight 37 lbs. Shipped Express only. **$69.50**

W-2M Amplifier Kit includes main amplifier and power supply. Shipping Weight 29 lbs. Shipped Express only. **$49.75**

WA-P1 Preamplifier Kit only. Shipping Weight 6 lbs. Shipped Express or Parcel Post. **$19.75**

When selecting an amplifier for the heart of your high fidelity audio system, investigate the outstanding advantages offered by the Heathkit Williamson Type Amplifier. Meets every high fidelity audio requirement and makes listening to recorded music a thrilling new experience.

This outstanding amplifier is offered with optional output transformer operation, providing either the conventional triode output circuit or the new extended power circuity in which the screen supply voltage is obtained from separate transformer primary taps. Frequency response within ± 1 db from 10 cycles to 100 kc. Tube complement — 6SN7 cascade amplifier and phase splitter, 6SN7 push pull driver, two 5881 push pull power amplifiers, one 5V4G cathode type rectifier.

Matching preamplifier available providing three switch selected inputs, correct compensation, and individual bass and treble tone controls. Uses 12AY7 (or 12AX7) preamplifier — 12AU7 tone control amplifier.

Particularly designed for the novice kit builder and requires no specialized knowledge or equipment for successful assembly and operation.

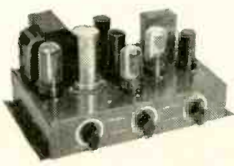
NEW *Heathkit* 20 WATT
High Fidelity AMPLIFIER KIT
MODEL A-9A

$35.50
SHIP. WT. 18 LBS.

A new 20 watt high fidelity amplifier, designed especially for custom audio installations demanding clean reproduction, adequate power, and flexibility to meet individual requirements. Separate treble and bass tone controls provide up to 15 db boost or cut. Four switch selected inputs, each with the necessary compensation for the service desired. Output transformer impedances of 4, 8, and 16 ohms.

Preamplifier, tone control, and phase splitter circuits utilize 9 pin twin triode miniature tubes for low hum and noise level. Two 6L6 push pull power output tubes provide full 20 watts power. Frequency response ± 1 db, 20-20,000 cycles. Total harmonic distortion 1% (at 3 db below rated output). Tube line-up: 12AX7 preamplifier, 12AU7 voltage amplifier and tone control, 12AU7 voltage amplifier and phase splitter, two 6L6 push pull pentode power output, 5U4G rectifier. Truly outstanding amplifier performance coupled with low cost.

Heathkit ECONOMY 6 WATT
AMPLIFIER KIT



MODEL A-7B
$15.50
SHIP. WT. 10 LBS.

The new Heathkit Model A-7B Amplifier offers many unusually fine features not normally expected in this low price range. Either of the two input circuits may be individually switch selected for phono or tuner operation. Separate bass and treble tone controls. Output impedances of 4, 8, and 15 ohms. Push pull beam power output stage for balanced reproduction. Excellent voltage gain characteristics, good frequency response, and full 6 watts power output. 12J5 amplifier, 12SL7 second amplifier and phase splitter, two 12A6 beam power output, one 5Y5 GT rectifier.

A-7C incorporates preamplifier stage with special compensated network to provide necessary gain for operation with variable reluctance or low output level phono cartridge. Circuit is properly compensated for microphone operation. $17.50.

NEW *Heathkit*
BROADCAST BAND
RECEIVER KIT

Another new Heathkit for the student, beginner, or hobbyist. If you have ever had the urge to build your own radio receiver, this kit warrants your attention.

New high gain miniature tubes and IF transformers provide excellent sensitivity and good signal to noise ratio. A built-in ferrite core rod type antenna has been provided. A chassis mounted 5½" PM speaker provides excellent tone and volume. Convenient phono input. Can be operated either as a receiver or tuner. Simplified construction manual outlines circuit theory. Ideal for students. Tube line-up: 12BE6 mixer oscillator, 12BA6 IF amplifier, 12AV6 detector-AVC-first audio, 12A6 beam power output, 5Y3GT rectifier.

MODEL BR-2
$17.50 SHIP. WT. 11 LBS.

CABINET — Proxylin impregnated fabric covered plywood cabinet. Shipping weight 5 lbs. Part number 91-9, $4.50.

Heathkit
FM TUNER KIT

MODEL FM-2
$22.50
SHIP. WT. 9 LBS.

The Heathkit FM-2 Tuner was specifically designed for simplified kit construction. Can be operated through the "phono" portion of your radio or with a separate amplifier. The kit features a pre-assembled and adjusted tuning unit, three double tuned IF transformers, and a discriminator transformer in an 8 tube AC operated circuit. Frequency coverage 88 to 108 mc. Experience the thrill of building your own FM tuner and at the same time enjoy all of the advantages of true FM reception.

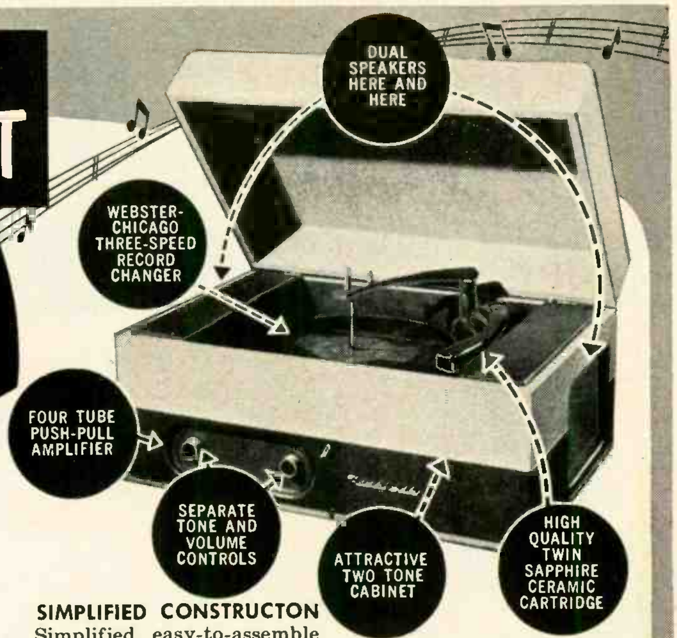
Free CATALOG

Write for free catalog containing latest price information, schematics, specifications, and descriptions of all Heathkits.

HEATH COMPANY • Benton Harbor 20, Mich.

NEW HEATHKIT *Dual* RECORD PLAYER KIT

New MODEL RP-2
$69.50
SHIPPING WT. 33 LBS.



DUAL MATCHED SPEAKERS
A new economical introduction to high quality record reproduction. A simple-to-operate, compact, table-top model with two matched speakers in an acoustically correct enclosure reproduce all of the music on the record.

DIFFUSED SOUND
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HIGH-QUALITY AUDIO

By RICHARD H. DORF*

Part V—More on pickups: The construction and application of crystal and magnetic types

THERE are two principal types of phonograph pickups; crystal and magnetic. Before electrical recording and playback, pickups were acoustical—that is, the needle vibrated a membrance which set air in motion. Acoustical pickups are seldom used today, and then only on small portable phonographs. Present-day high-quality pickup types also include the capacitive and the strain-gauge. Though the magnetic pickups are the ones principally used for high-quality home music systems, we shall discuss all types, because all are used to some extent.

Pickup requirements

The requirements of a good pickup are in part the same as for any other good audio equipment. It should have a wide frequency range, extending from at least 40 to 10,000 cycles. The best pickups cover from 20 or 30 to above 15,000 cycles.

The pickup should have smooth frequency response, without obvious peaks or valleys in the response curve. In fact, a pickup with less range and greater smoothness is preferable to one with wide range but a sharp peak in the early thousands of cycles. A peak in the neighborhood of 3,000 cycles, which is common with less expensive crystals, not only emphasizes record surface noise, but also makes the music seem high-pitched or screechy. The effect is very unpleasant.

Of course, distortion should be low. Unfortunately, it is very difficult to design an electromechanical transducer with low-level intermodulation. Even the best pickups have some intermodulation distortion; at least 1 or 2%. The subject of intermodulation in pickups has never been thoroughly explored because it is very difficult. When it is measured by playing back test records, it is almost impossible to separate the distortion created by the pickup from that created by the record cutter during recording. Harmonic distortion is not bad on the better pickups. However, with good records, both types of distortion are so low that the user of a fine pickup is not troubled.

A characteristic of pickups is stylus compliance. The stylus must be very free to move with respect to the pickup element, as explained in last month's article. This compliance must be high at all frequencies—the stylus must easily comply with the movement instructions given it by the record groove. The stylus assembly must also be free of resonance as explained last month in connection with arm resonance. While arm resonance takes place at low frequencies and causes *juke-box* boom, stylus-assembly resonance takes place at high frequencies because of its much smaller mass. This results in undesirable peaks in pickup output at the resonant frequencies.

The old-fashioned needle chuck was undesirable from a sound quality standpoint. It was the assembly into which a steel needle was inserted and held by tightening a knurled set-screw. The massiveness of the assembly made it less compliant than it should have been, though there was little loss, because the pickup elements themselves were not capable of good quality.

Ideally, a good pickup should give sufficiently high output so as to require little amplification. Here we run into a law of nature that says roughly you can't eat your cake and have it too. Either you build for high output—which requires the stylus assembly and the grooves to do some work—and corresponding poor quality, or you settle for low output and good quality. These of course, are the extremes. Crystal pickups give higher output than magnetic types, when the quality is the same. But a crystal, when built primarily for quality, does not have the same output as a medium-quality crystal built for use in department-store sets.

Crystal pickups

The crystal pickup is the least expensive type in general use today, though a few of the very best crystal pickups are equal in price to some magnetics. Its heart is an element known as a piezoelectric crystal, made of either rochelle salts (sodium potassium tartrate), or an artificial ceramic substance such as barium titanate. These crystalline materials, when sliced into blocks, have the property of generating a voltage across opposite faces when they are physically stressed—squeezed or twisted. The voltage output is directly proportional to the physical stress over a certain frequency range, depending on the dimensions of the block and the type of stress. A stylus is coupled in some manner to the crystal so that lateral stylus movements cause stress on the crystal, which produces a voltage output.

Fig. 1 shows the construction of a typical crystal pickup. The crystal element has at the right, a clamp (nose piece), to which is attached a torque wire. At the end of this fairly stiff wire

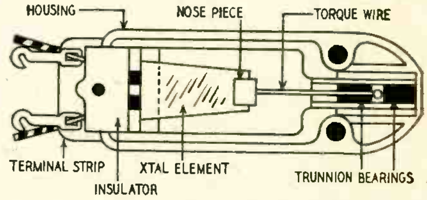
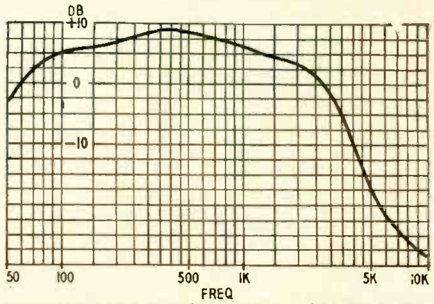


Fig. 1—Construction of crystal pickup.

is cemented a stylus, consisting of a shank with a piece of sapphire at its end. When the stylus is driven by the record groove the wire twists, and through the nose-piece, imparts a twisting stress to the crystal. Silver-foil leads attached to the opposite faces of the crystal pass the generated voltage to the pickup terminals.

Actual construction of various pickups differs in many respects but the principle is always the same. Rubber or artificial rubber mounting and damping blocks are used, as well as additional mechanical necessities such as trunnion bearings which hold the stylus assembly and allow it to move in only one manner. Almost all crystal cartridges are equipped with mounting holes to allow mounting in any standard arm. Almost all crystal cartridges



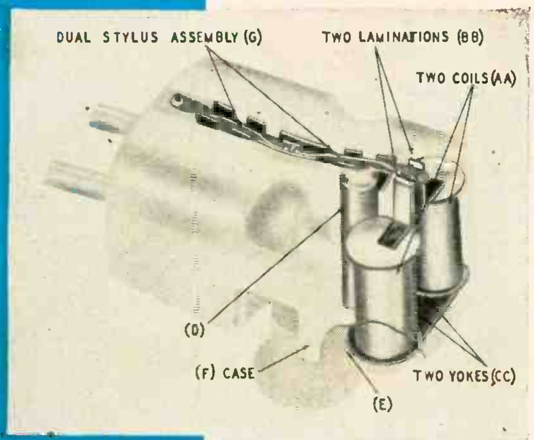
ASTATIC 14L3-AG WITH RCA 12-5-31V TEST RECORD: LOAD RESISTANCE 1 MEGΩ; LOAD CAPACITANCE 100μμf; 0 REF LEVEL 1.V; TEMPERATURE 75°F

Fig. 2—Frequency response curve of a typical crystal pickup cartridge.

*Audio Consultant, New York City

Fig. 3—The type U Astatic cartridge.

Fig. 5—G-E's RPX-050 dual cartridge.



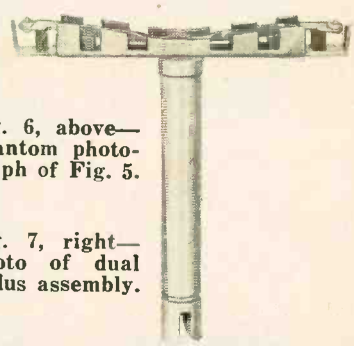


Fig. 6, above—Phantom photograph of Fig. 5.

Fig. 7, right—Photo of dual stylus assembly.

found in manufactured radio-phono sets have medium to poor frequency response. The curve of Fig. 2 is an example. These cannot be considered for high-quality systems.

On the other hand, cartridges such as the Astatic type U illustrated in Fig. 3 are flat within 2 decibels from 50 to 10,000 cycles when used on LP records similar to those made by Columbia. Its maximum output is 0.5 volt. It needs no preamplifier and cannot pick up hum from a turntable motor. The stylus is held by a friction type assembly and can be replaced. It is only one of many models with comparable performance available from several manufacturers.

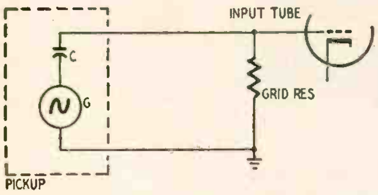


Fig. 4—Equivalent of crystal pickup.

An outstanding cartridge is the new Electro-Voice ceramic unit (type 84). It provides high-fidelity, having a flat response of plus or minus 2.5 db from 20 to 15,000 cycles. Because of its high output (1.5 volts—working into a 3-megohm load), it requires no preamplifier.

Using crystal pickups

The question of whether to use a crystal pickup depends on consideration of advantages and disadvantages. On the black side of the ledger are the high output and zero hum pickup. Some facts appear on the red side.

The crystal pickup must always be operated very close to the amplifier; the cable certainly cannot be carried across a room. The pickup, *seen* electrically from the amplifier end of the line, consists of two electrodes separated by a dielectric—the crystal itself. This is effectively a capacitor, and the pickup is said to be capacitive. The cable itself is capacitive, consisting of two wires (or a wire and a shield) separated by the insulation of the cable. The longer the line, the more capacitance is placed in parallel with the pickup, and the smaller is the part of

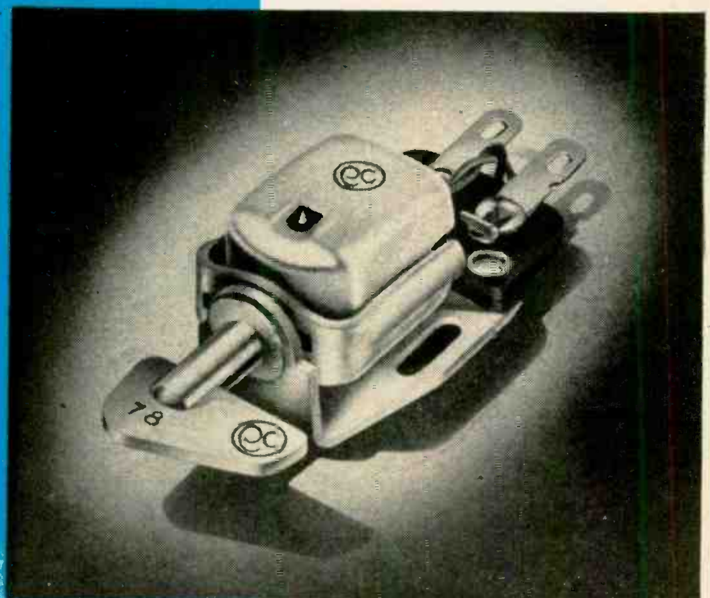


Fig. 8—Pickering model 260 cartridge.

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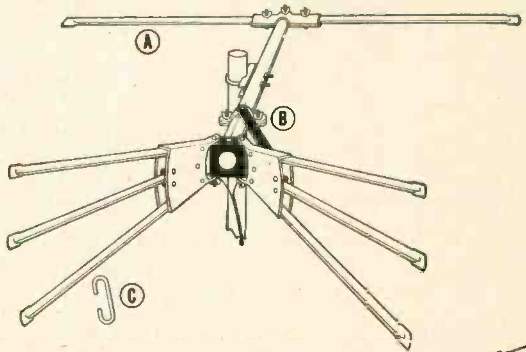
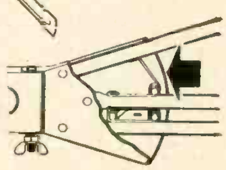
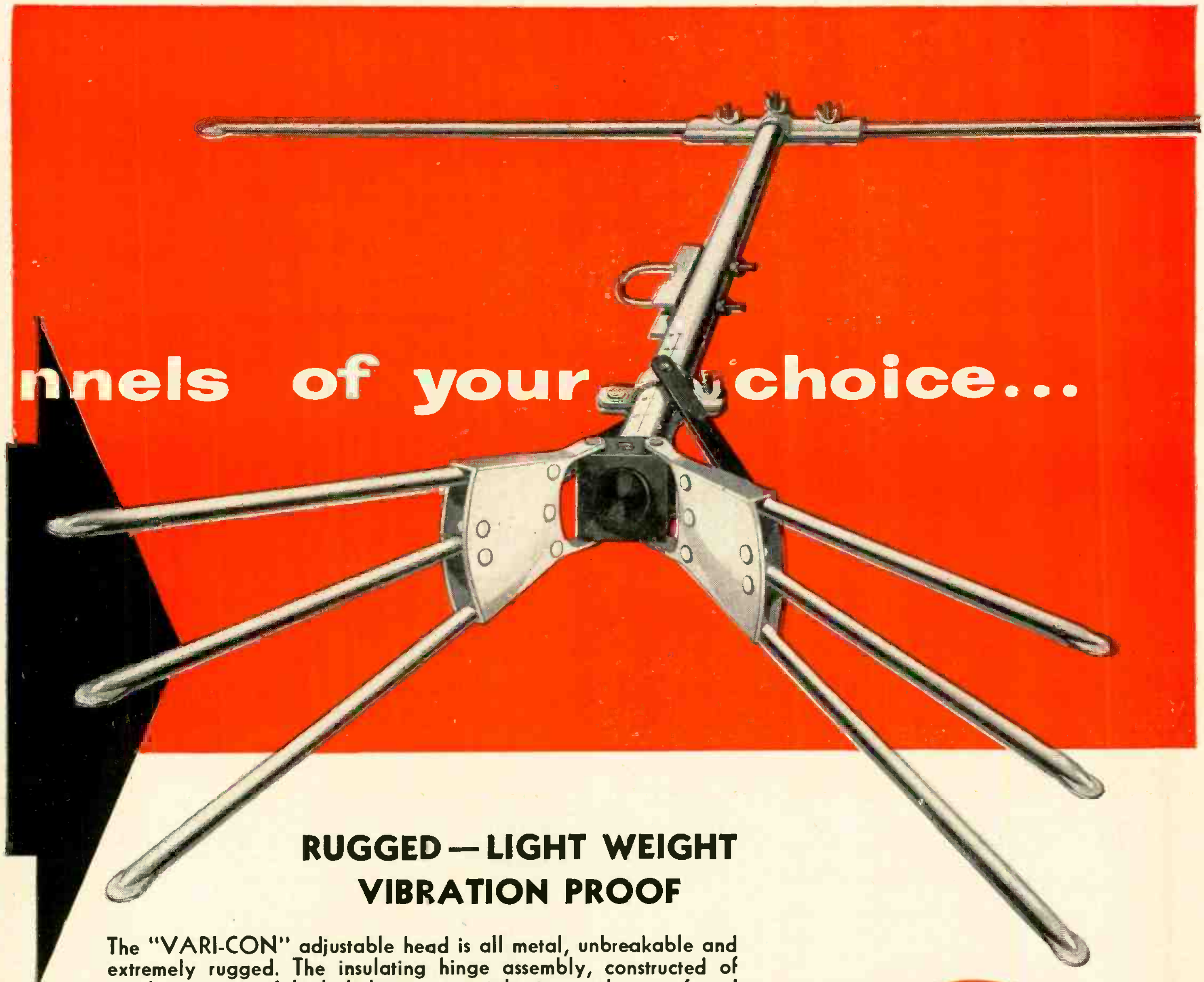
You only need swing reflector elements (A) into position and tighten wing nuts. Slide adjusting sleeve (B) to calibrated channel range on which added gain is desired and tighten wing nuts. It's just like opening an umbrella. Remove retaining clamps (C) from dipole elements; the elements automatically fan out and are locked securely in position by snap-action spring assemblies.



Once opened the elements are locked in rigid, vibration-proof position by the 90° angle of the arms. Spring action is NOT employed to hold elements in position.





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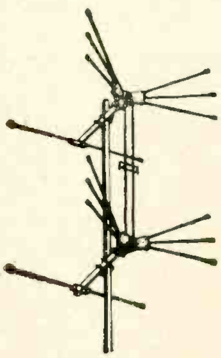

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Falcon ANTENNAS *bring in the picture* the total capacitance contributed by the pickup. As the line gets longer, the output at the amplifier end goes down, being shunted by the capacitance of the cable.

Contrary to popular belief, the capacitance of the long cable does not reduce the high-frequency response of the crystal pickup. It reduces the overall level of the signal at the amplifier end of the cable, and allows any noise picked up by the cable to be more effective.

The low-frequency response of the crystal is dependent on the value of the grid resistor. Fig. 4 is a schematic diagram of an ordinary crystal pickup input circuit, with the pickup shown by its electrical equivalent. Electrically, the pickup consists of an a.c. generator G of zero internal impedance in series with a capacitance C. C and the grid resistor form an ordinary r-c high-pass filter—series capacitance and shunt resistance. As in all filters of this kind, the cutoff frequency—the frequency below which the response begins to drop—depends on the impedances of the two filter components, R and C. The higher the shunt impedance or the lower the series impedance, the lower the frequency at which attenuation begins. In order to keep this frequency down as far as possible—preferably below the range of hearing—the resistance and

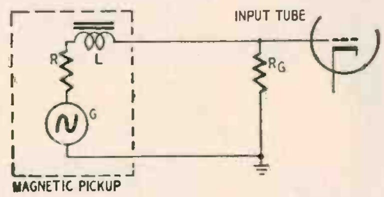


Fig. 9—Equivalent of magnetic pickup.

capacitance must be made as large as possible. The capacitance is fixed by the crystal itself, so a large grid resistor is necessary; at least 0.5 megohm.

This makes for a very high-impedance grid circuit. Noise, induced line hum, and the like are hard to keep out. The most thorough shielding right up to the tube's grid pin is essential. This is skimped sometimes in inexpensive sets, on the theory that speakers are not good enough to show up hum, and the high pickup output level tends to cover it. But in a home music system this is usually not true.

Magnetic pickups

The modern electromagnetic pickup has an advantage over the crystal in that the stylus assembly does no sigficant physical work other than that required to overcome the tiny inertia caused by its own mass and any stiffness in its mounting. Therefore, the stylus can have much greater compliance. Magnetic pickups can be made self-resonant well above the audible spectrum, producing relatively flat frequency response.

While magnetic pickups vary in construction and operation, the General Electric cartridge is useful for illustration of the general principle. Fig. 5 shows the RPX-050, a dual cartridge used for playing both standard and LP discs. Its frequency response is flat from 30 to 15,000 cycles with 3 db or less variation. Its output is 10 millivolts minimum into an open circuit (no shunt resistor), and damping is sufficient for good transient response and lightweight tracking.

Fig. 6 is a phantom photograph showing the inner works of the cartridge. Two coils AA are mounted on a pair of yokes CC. A small cylindrical magnet D is mounted in a hole in the phenolic base behind the coils. Mounted in a hole behind the magnet is a dual stylus assembly G which can be seen in detail in Fig. 7. One of the cantilevers with its sapphire or diamond stylus at the end, extends over the magnet and between two laminations BB which extend from the cores of the coils. The laminations, cores, yokes, and cantilevers are made of a high- permeability (easily magnetized and demagnetized) alloy, while the magnet is made of Alnico V, powerful permanent-magnet material.

A path of magnetic flux exists from the upper end of the magnet to and through the cantilever which is in play-

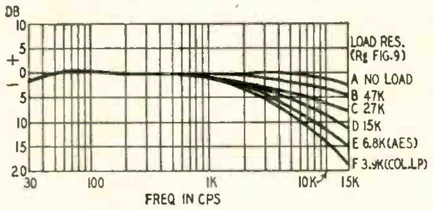
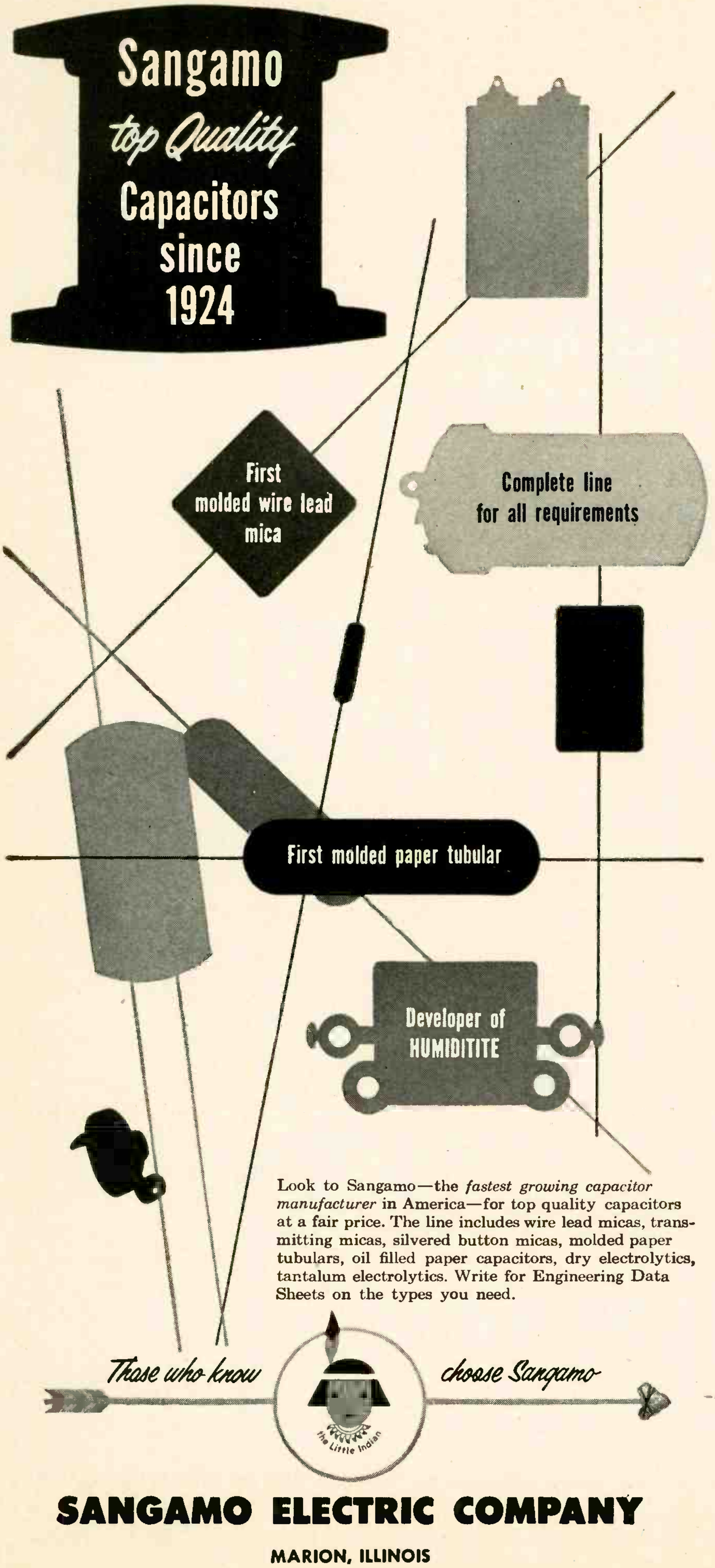


Fig. 10—Treble response of G-E pickup.

ing position. From the outer end of the cantilever the flux divides evenly between the two core laminations, through each core. At the bottoms of the cores the flux combines in the yokes and returns to the bottom of the magnet, completing the magnetic circuit.

The outer end of the cantilever is normally placed equidistant from the two core laminations. When the stylus and cantilever move in response to record modulation, the cantilever is swung alternately closer to and further from each lamination. Thus, with each cycle of modulation, there is greater magnetic flux passing through first one core, and then the other. The reluctance (magnetic resistance) of the air path between the cantilever and the lamination has changed because of the change in distance. This is why the pickup is referred to as the *variable-reluctance* type.

The constant change of flux in the cores causes constantly rising and falling magnetic lines of force around the cores. These lines cut the turns of the coils and induce a.c. voltages in them, which are replicas of the audio waveforms in the record groove. The cores are connected series opposing and thus produce a combined push-pull voltage which is fed to the amplifier. This can happen only when magnetic lines of force cut each coil separately and alternately. If a magnetic field cuts the two coils as a whole—for instance, a 60-cycle field from a motor—the result-



ing induced coil voltages tend to cancel, and produce no hum output.

The stylus cantilevers are fitted with small rubber-like blocks to damp out resonance and help keep the cantilever equidistant from the two pole pieces. The cantilever assemblies may be reversed by pushing in and turning the small knob, to bring either stylus into position. A case covers the entire assembly. Made of high-permeability metal, it provides shielding.

Fig. 8 shows another very popular magnetic cartridge, the Pickering model 260. The cartridge turns over completely, to place the other stylus in position. Its characteristics are as good as the G-E. Its output is approximately 30 millivolts.

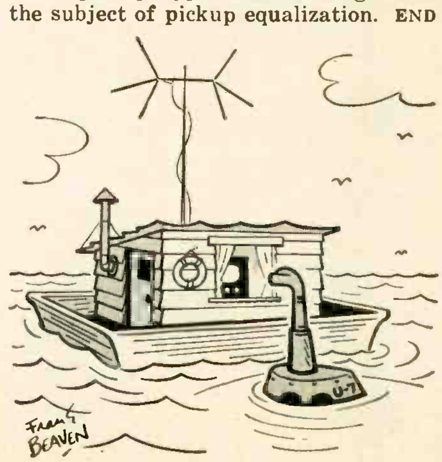
Using magnetic cartridges

Because their output is much lower than that of crystals, magnetic cartridges invariably require extra amplification. This can be obtained simply by using the microphone channel of the amplifier rather than that intended for crystal pickups. Usually, a separate preamplifier is inserted between the pickup and the amplifier.

The high-frequency response of a magnetic cartridge is affected by the load into which it operates. The reason is similar to the low-frequency limit of crystal pickups, and is illustrated by Fig. 9. The magnetic pickup is shown by its equivalent electrical circuit, a generator G of zero internal impedance, in series with an inductance L and resistance R. R is the resistance of the coil winding and can be ignored for explanation purposes. The grid-leak resistor R_g and the inductance L form a low-pass filter. For a high cutoff frequency with a fixed inductance, the resistance must be as high as possible.

The curves of Fig. 10 show how the treble response of the G-E pickup drops off as R_g becomes lower. With no resistor at all (the pickup itself acts as the grid leak) curve A shows only a 3-db drop at 15 kc. Curves B, C, D, E, and F show what happens with various resistance values. They also show that the choice of shunt resistor can provide the high-frequency equalization necessary for various record types.

Next month we shall discuss two other pickup types and shall go into the subject of pickup equalization. END



Suggested by Gerald Drew, Sacramento, Calif.

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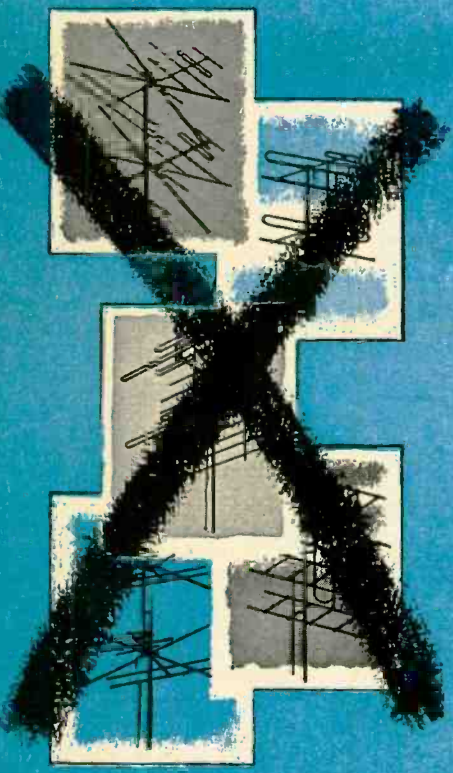

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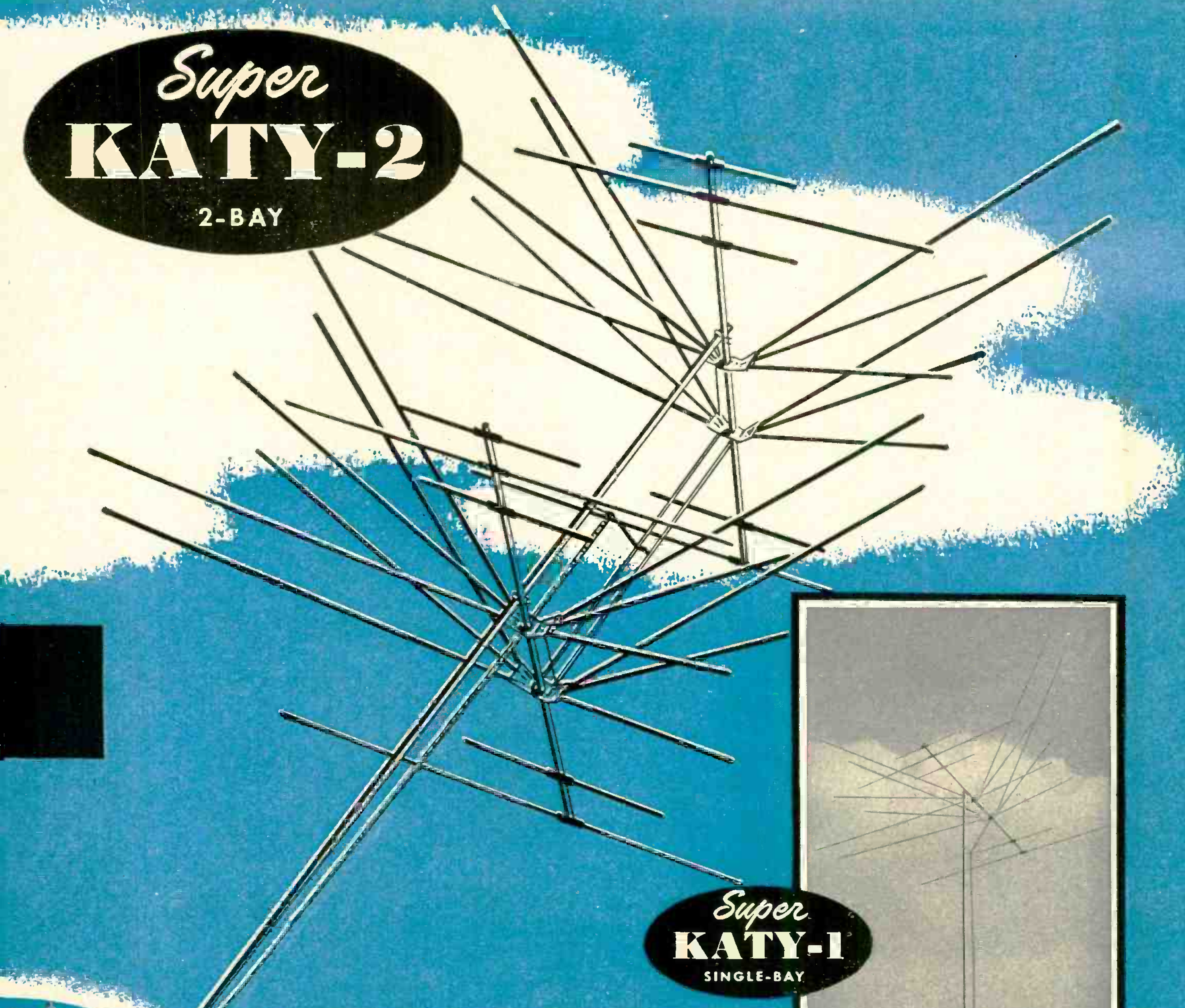

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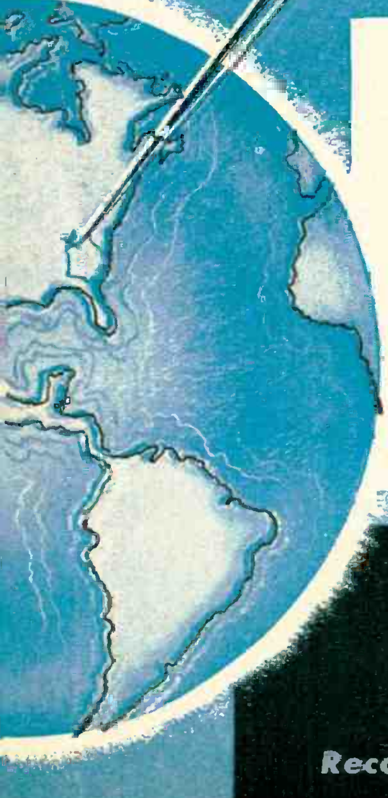

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MORE ABOUT ATTENUATORS

Maintaining proper attenuation and impedance reflection when connecting two different impedances

By N. H. CROWHURST

IN THE preceding article (page 36, December) on the design of constant impedance attenuators, the author stated that attenuators perform correctly only when properly terminated. If terminated with impedances other than those on which the design is based, both attenuation and impedance reflection through the attenuator become incorrect. Two of the three charts here deal with the result of using an attenuator of the constant-impedance type with incorrect impedances, while the third shows how to design matching pads for connecting together two different impedances so that both terminating impedances are matched.

Chart I is a simple alignment abac (alignment chart or monogram) with two impedance scales on the outside and a reference line in the middle, giving on the left, the ratio between the impedances on the outside scales, and on the right, the mismatch loss resulting from connecting these impedances together.

If a constant-impedance attenuator is connected to one of the working impedances, and is correctly designed for

(TEXT CONTINUED ON PAGE 120)

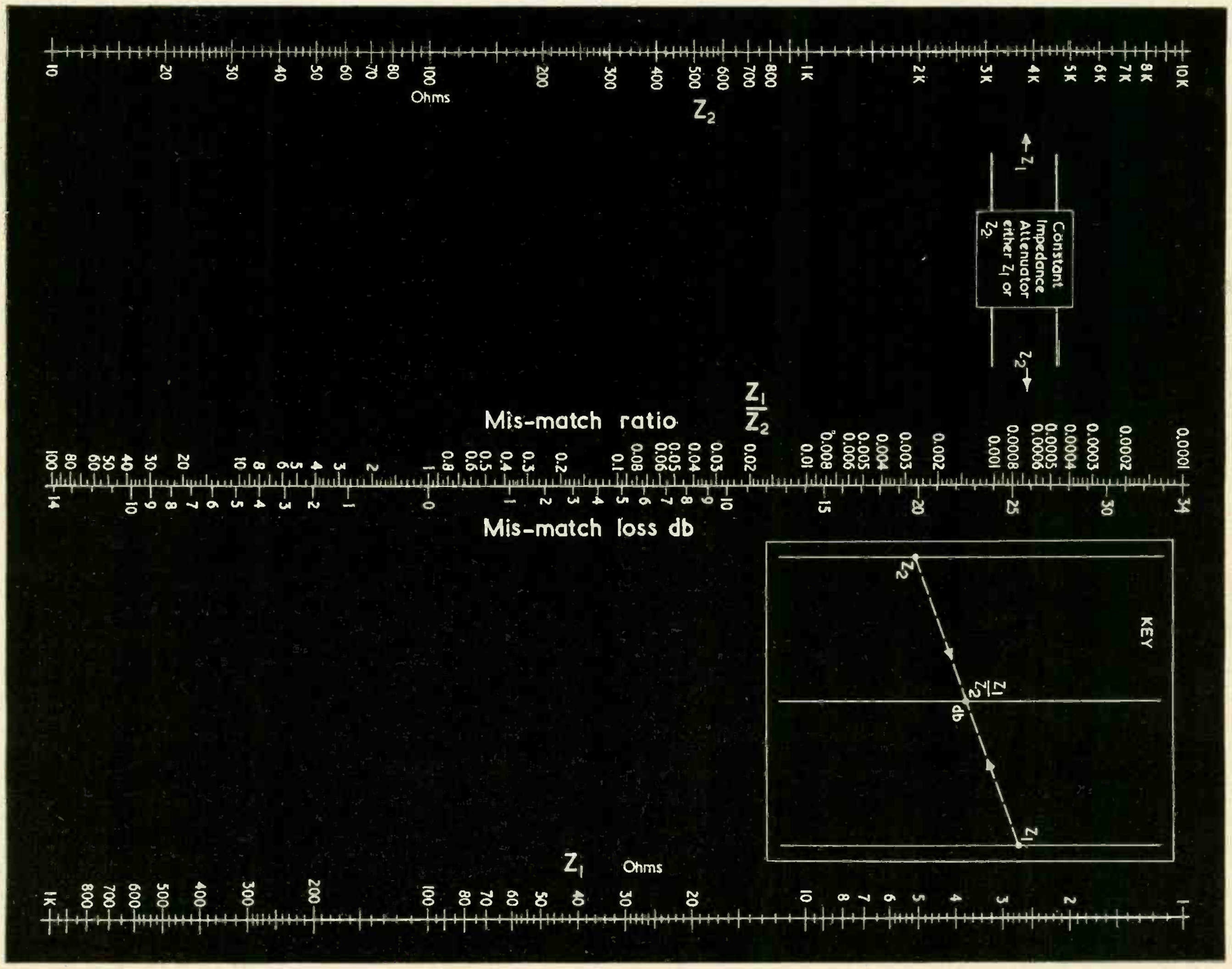

Chart I—Reference line in the middle gives the ratio between the impedances and attenuation resulting from mismatch.

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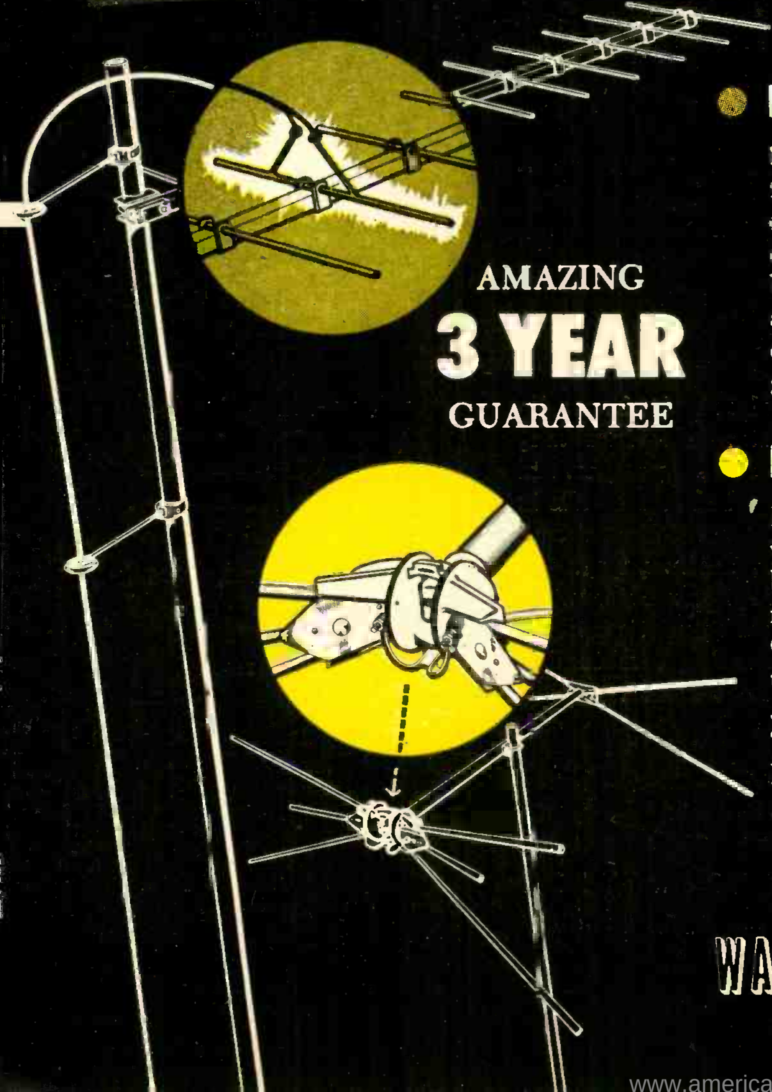

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Here's the first radical improvement in Conicals. A new insulator which utilizes "barrier discs" and *2 inches of air space* between the terminals prevents "shorts." Soot deposits, dirt, moisture, salt, etc., *cannot* affect the insulator. This great, new Conical will therefore maintain high gain performance under any and all weather conditions. Front-end hardware is *stainless steel* to prevent corrosion losses permanently. Takes only 2 minutes to assemble because there's no loose hardware. Nothing compares to the Walsco Conical at any price . . . and it's backed by the *only* 3 year unconditional guarantee!

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The complete line of AMPHENOL VHF and UHF antennas are a dealer's best investment in his business—selling up to quality with AMPHENOL results in customer satisfaction and better profits.

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Better business also results from selling up to quality. Sales increase, profits increase, dealers prosper. An important savings in service calls is made with quality AMPHENOL antenna installations—the antenna stays up, provides top reception for years.

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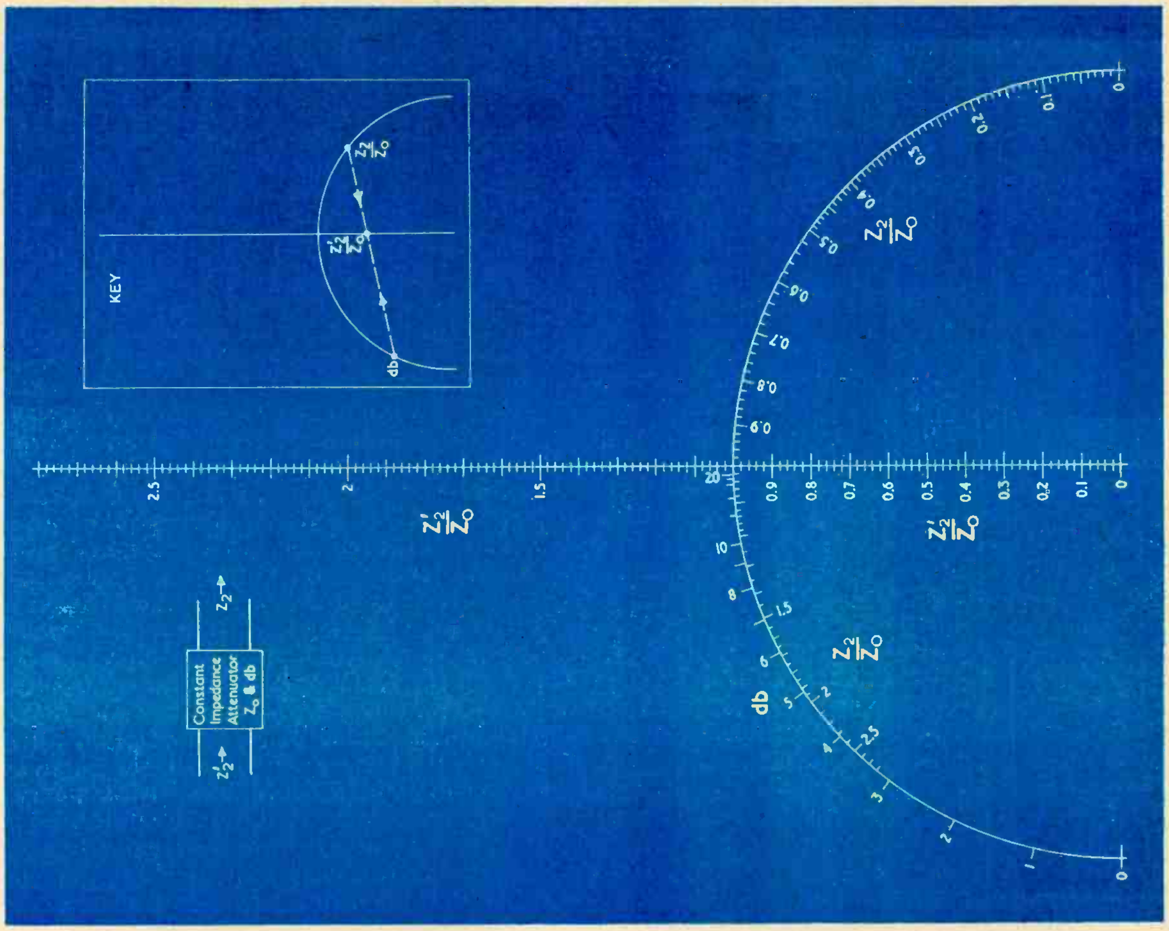

Chart II—For determining mismatch reflection through the attenuator when attenuator is improperly terminated.

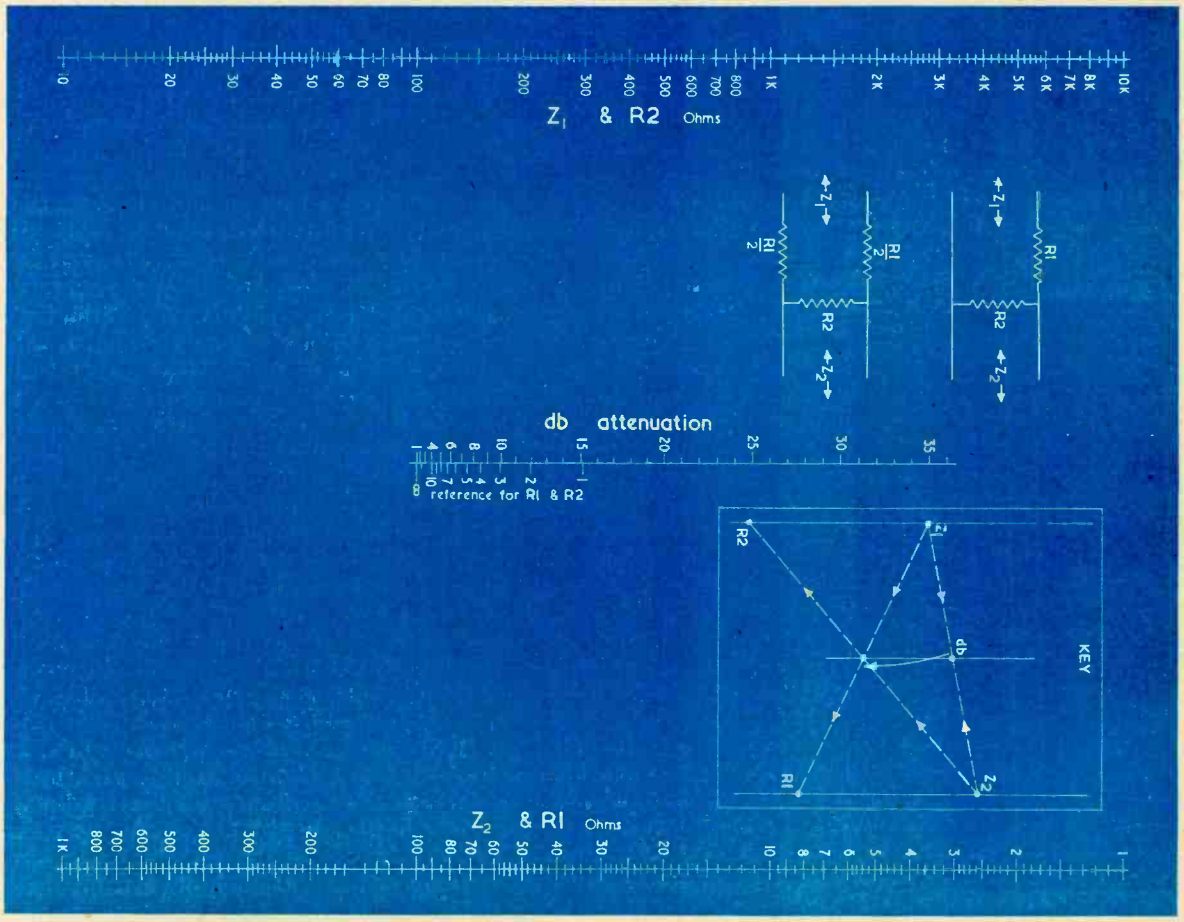

Chart III—To determine minimum attenuation necessary for correct matching, and resistor values required for L-pads.

that impedance, the presence of the attenuator will not affect the mismatch loss, because the impedance reflected to the opposite terminals will be the same as the correct impedance terminating it. This applies to only those attenuators, either where the constant impedance characteristic applies for both directions, or, in the case of L pads, where the attenuator is correctly terminated in the direction for which it is designed to have constant impedance. It would be pointless to extend the chart for other cases using L pads, because there seems to be no reason why the correct matching type L pad could not be used.

The mismatch loss, over and above the attenuation of the attenuator, will be quite independent of either the type of attenuator or the amount of attenuation for which it is designed.

Chart II deals with the mismatch reflection through the attenuator. The diagram on page 119 shows that the attenuator is designed for a working impedance Z_0 and a specific attenuation in db. It is, however, improperly terminated by the impedance Z_2. As a result, the chart shows what impedance will appear at the opposite end of the attenuator, represented by the symbol Z_2'. The type of attenuator is unimportant. What affects the mismatch reflection is the design figure of attenuation for the particular unit.

It is also unimportant whether the designed attenuation is achieved in one stage or in a number of separate stages. For example, the mismatch reflection would be the same through 40 db of constant-impedance attenuation, whether this was made up in a single pad, or of a number of separate pads of, say, 20 plus 10 plus 5 plus 2 plus 2 plus 1.

Example 1

A constant-impedance attenuator designed for 5,000 ohms is terminated by a resistance load of 5 ohms resulting in a mismatch loss.

To find the mismatch loss: Chart I, using Z_2 5,000 ohms and Z_1 5 ohms, gives 24 db. Using Chart II to find the mismatch reflected impedance, Z_2/Z_0, as given from Chart I, is .001, which will be indistinguishable from zero at the right-hand side of Chart II. This means, that, to all intents and purposes, a 5-ohm resistance connected to a 5,000-ohm attenuator is a short circuit. Suppose the attenuation is designed for 20 db, then by using the straight-edge, or ruler, as shown in the key on Chart II, Z_2'/Z_0 is given as .98, which means the input impedance is .98 x 5,000 ohms, or 4,900 ohms.

If the attenuation was 10 db, Z_2'/Z_0 becomes .82, making the impedance at the input end of the attenuator 4,100 ohms.

Example 2

An attenuator is designed for 250 ohms and is actually terminated by 600 ohms. Using Chart I, the ratio Z_1/Z_2 is 2.4, and the mismatch loss attenuation is slightly less than 1 db.

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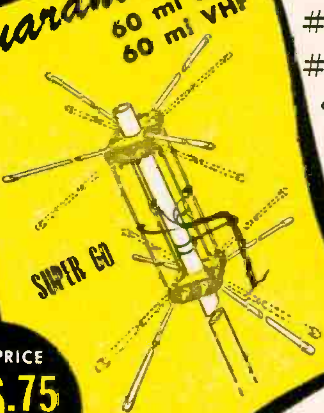

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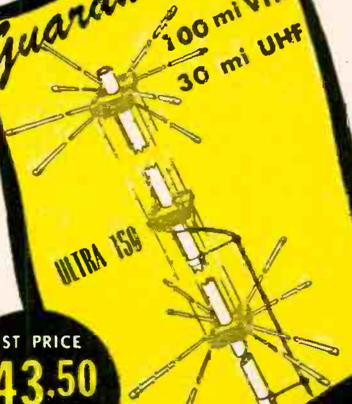

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The Super 60 is the general purpose model for conditions prevailing in most communities today. Within a short time 15 to 20 UHF-VHF stations will be on the air within a 60 mile radius of every fair sized community. With the installation of the Super 60, you are improving your present reception in all directions and you are ready for the future.

The Suburban 40 has been developed for suburban areas where the stations are closer and trouble with distance is less of a problem — but the advantage of all direction all channel reception is necessary. A low priced high quality antenna for the present and the future.

Here is the real go-getter of the All Channel family. The Ultra 150 reaches out at long distances on VHF and gives you a bright, clear picture 150 miles and more. This antenna has solved the problem for thousands throughout the country where long range reception was otherwise impossible.

9 POSITION ELECTRONIC ORIENTATION SWITCH

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Antenna arrays · necessary stacking bars · 9 position switch · switch-to-set coupler · necessary hook-up harness - 7½" stand-offs Individually boxed in mailable carton.

Yes, we said YOUR area. With the FCC allocating over 2,000 new TV Stations covering 12 VHF and 70 UHF channels, your area is due to change and you will require an antenna able to receive both UHF and VHF channels from all directions. All Channel Antenna Corp. has just the antenna to fill your needs and money back guaranteed to positively bring you at your location, clearer, sharper, pictures than any combination of present day antennas using expensive rotor motors, boosters, etc. With a flick of the 9 position electronic beam selector switch, any station in any area is instantly brought in on any TV set clearer and sharper.

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Turning to the mismatch impedance transfer, using 2.4, Z_2/Z_0, which is in the left hand part of the arc on Chart II, and supposing the attenuator is designed for an attenuation of 6 db, alignment gives a reading of 1.24 for Z_2'/Z_0. So, the reflected impedance is 1.24 × 250, or 310 ohms.

If the attenuation is 20 db, the mismatch drops to a ratio of 1.01, representing 252.5 ohms.

To avoid any trouble due to mismatch, which in r.f. can result in reflections and their consequent troubles as well as just losses (as in television attenuators), it is advisable to design a matching pad so that both impedances are correctly matched. This can be done quite easily with Chart III.

The chart gives the minimum attenuation necessary to produce correct matching, and the resistor values for an L-pad to produce such matching. This pad can of course be combined with further attenuators of the constant-resistance type, designed at either of the working impedances, using one of the charts in the earlier article.

To use Chart III, the two impedances to be matched, denoted by Z_1 and Z_2, are aligned; and the db attenuation can be found on the left-hand side of the center reference line. The figure from this scale is then transferred to the scale on the right-hand side of the same reference line, and aligned with Z_1 and Z_2. This locates the values of R_1 and R_2 as shown in the key on the chart.

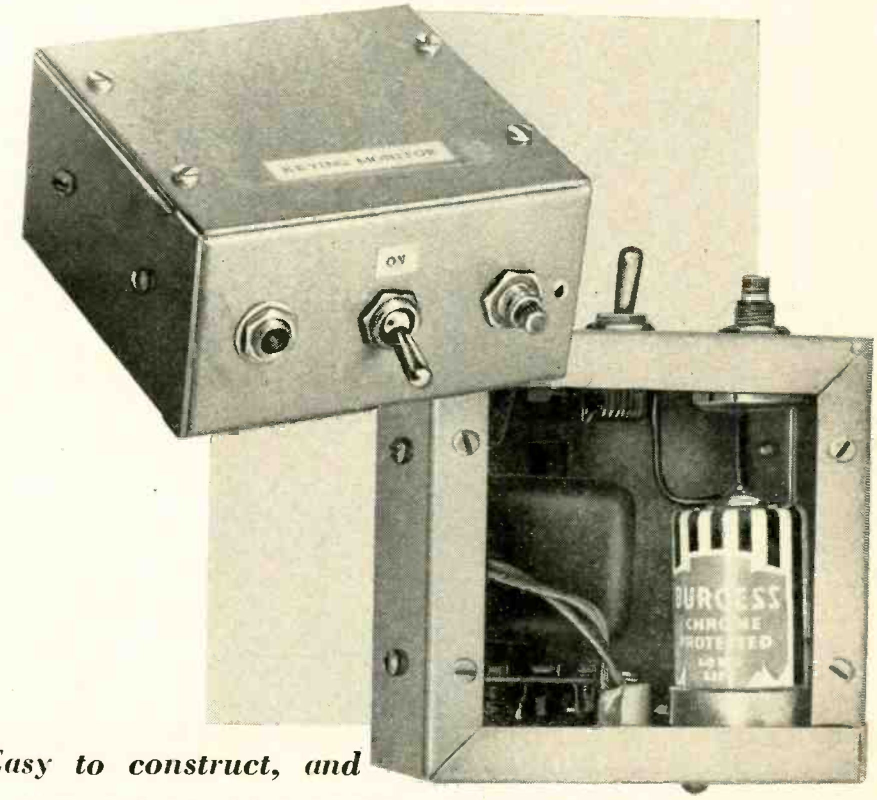
Example 3

Take the case of 5,000 ohms being matched down to 5 ohms. To do this correctly, using Z_1 5,000 ohms and Z_2 5 ohms, the attenuation is 36 db. On the right-hand center scale, 36 db is so close to the infinity point as to be indistinguishable from it. In aligning 5,000 ohms with this point to find the value of R_1 the straight-edge falls beyond the bottom of the right-hand line; similarly for the value of R_2. This can be overcome by dividing by 10 on the Z scales; then converting the R value back again by multiplying by 10. Aligning Z_1 at 500 with the infinity mark gives R_1 as 500, which means its actual value will be 5,000 ohms; similarly R_2 is 5 ohms.

Now consider the case where the impedances are closer—the second example given above—working between 250 and 600 ohms. Using Z_1 as 600 and Z_2 as 250, the attenuation is about 8.8 db. Transferring this to the right-hand reference scale on the center reference line, R_1 is 440 ohms and R_2 is 325 ohms.

Values as calculated from the chart are the exact values required for perfect matching. In practice, the closest preferred value resistor in the 5% or 10% range will probably give a good enough match for all practical purposes. It will almost certainly result in obtaining much closer matching than using an attenuator without giving proper attention to matching. In most cases 10% resistors will do. END

TRANSISTOR KEYING MONITOR



Upper left, photo of the transistor keying monitor. Above, internal view shows simplicity of construction.

Easy to construct, and easy to use, the monitor makes for clean keying

By I. QUEEN

MANY c.w. operators monitor their keying by listening to the blocking of the receiver or to the clicks of the key. These methods are O.K. when sending at slow speeds but are definitely no go when sending at 15 words per minute and higher speeds. Receivers often block for periods long enough to convert a dot into a dash and make the operator stumble over his own fist. Using a bug without a keying monitor is one sure way to make the other fellow break off the contact with some weak excuse like QRM, QRN, or gotta QRT for chow.

This keying monitor makes it possible for you to follow your own keying with ease so you are more relaxed and can really enjoy the contact. Your keying will be cleaner and the fellow on the other end will find it easier to copy and won't be so eager to run off and work someone else. It is so easy to construct and use that no c.w. man should be without one.

The circuit is essentially an a.f. oscillator with trigger characteristics. No positive emitter bias is used, so the transistor tends to remain blocked. If a positive signal energizes the emitter, the transistor begins to conduct. Current flows in the high-resistance base circuit. Due to the voltage drop in this circuit, a positive bias is placed on the emitter. The transistor, once conducting, tends to remain that way.

The base resistor is adjustable. It may be set to a *medium* value, so that triggering is only temporary. Then the circuit oscillates only for an instant after its emitter is energized. Removing the external signal permits oscillations to die out at once and the transistor blocks again. This is the correct adjustment for a keying monitor. The monitor is coupled very loosely to a transmitter antenna or final tank. When the key is pushed down, the strong r.f. field triggers the transistor and a tone is heard. Releasing the key stops the tone. I didn't need a crystal to rectify the r.f. field. Evidently the periodic disturbance of the r.f. keeps the circuit triggered and operates the oscillator. This circuit will follow dots up to any speed Mackay can transmit.

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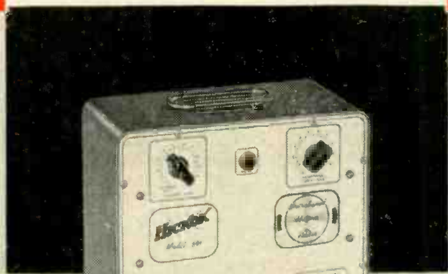
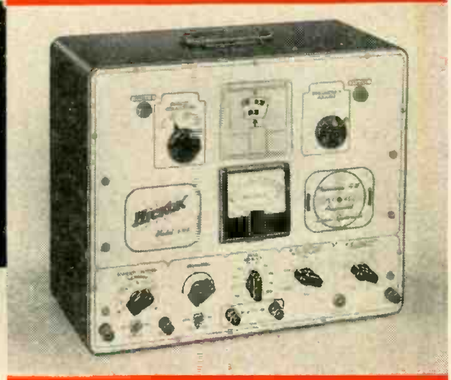




Model 690 Marker Generator

Crystal controlled. High .25 volt R.F. output. Provides dual markers with any TV sweep generator. This unit features another HICKOK First by incorporating a Non-Parallax shadow type dial. In conventional type dials, error generally is introduced in setting frequencies since the hairline or indicator is at a slight distance from the scale. This distance, however slight, can introduce error if the scale is not viewed directly at right angles.

In alignment of any type of receiver the marker generator is the unit that is to be relied upon and must therefore be consistently accurate in frequency settings. The Hickok Non-Parallax dial can be viewed from any angle without introducing error. The 45 inches of dial can be self calibrated to within crystal accuracy (.05%) since the unit includes a self contained crystal calibrator.

Leading features of this unit are:

(1) The simple and time saving method employed in calibration of the dial—there is no counting of beats—no interpolation—no remembering of frequencies.

(2) Provision for calibrating any other signal generator to crystal accuracy.

(3) Complete R.F. coverage up to and including channel 83. All channels have picture and sound settings marked directly on the scale—this eliminates checking on these values when they become applicable.

(4) The marker can be modulated by a self contained 400 cycle signal. This is especially valuable in stage - by - stage alignment and eliminates the introduction of another instrument.

(5) Position for adding two other crystals is provided in addition to the 2.5 Mc crystal which is included.

(6) It is possible to view two markers at once on the response curve. This will include the main marker and a marker corresponding to the crystal value selected. For instance, a 4.5 Mc crystal may be used to obtain two markers with a 4.5 Mc separation. This will greatly speed up alignment procedures since it is not necessary to re-set dials to check response curve width.

(7) Both an electronic eye tube and a headphone jack are available for either visual or audible indications of zero beat.

(8) Attenuation is controlled by both a step attenuator and vernier to attain complete regulation of output.

(9) The unit is completely double shielded to assure a minimum of leakage.

(10) All frequencies are covered on fundamentals with the exception of U.H.F channels. There are no spurious or confusing beats or frequencies generated by the unit. It is an all around instrument in view of its very complete R.F. coverage.

This entirely new and advanced alignment equipment represents the latest HICKOK achievement in offering a complete, fast and accurate solution to TV alignment.

Many leading TV engineers have tested this new equipment and highly compliment its practical design for individual unit use or compatible set use.

The stability frequency and accuracy of this new equipment plus its ease of use make the 690 - 691 - 695 today's best tools for a more profitable TV service business.

Model 691 Heterodyned Marker Adder

This unit, in conjunction with the Model 695 Sweep Generator and Model 690 Marker Generator provides the utmost in television alignment techniques. It takes the guesswork out of receiver alignment and eliminates any errors previously introduced by overloading due to markers.

The 691 provides a marker visible at all times (including trap points) and will not change in amplitude or distort the response curve what-so-ever. This feature, in addition to the accuracy and minimum leakage of the other units (690 - 695), will greatly simplify any alignment.

The outputs of the sweep generator and marker generator are heterodyned and applied to an oscilloscope in such a manner that the marker signal will never pass through the receiver itself—therefore cannot cause overloading.

In short, we can say that we are calibrating the oscilloscope with a marker which is visible at all times—even on the base line.

The 691 is specifically designed as a companion to the HICKOK 690 Marker and 695 Sweep Generator; however, it will work well with any of your present equipment that has an output of 50,000 microvolts or more.

Many leading TV engineers have tested this new Hickok equipment and highly compliment its frequency, stability and ease of use in offering today's fastest, most complete and accurate solution to TV alignment tasks. See your jobber today or write factory direct for complete technical information.

Model 695 Sweep Generator

This is a completely new electronic sweep generator that will exactingly fill top requirements of the professional TV serviceman or lab. There are no moving parts to produce vibration or to wear out. This unit, although moderately priced, features a sweep signal that is absolutely linear and without amplitude modulations.

This unit has technical advantages over other sweep generators because:

(1) The unit is completely triple shielded to insure that there is as little leakage from the unit as is engineeringly possible. It is possible to attenuate the signal down to 3 microvolts, and the unit has a maximum output of 300,000 microvolts.

(2) A bias voltage, variable from 0 to 12 volts, and metered directly by the voltmeter on the front panel, eliminates the usual time-consuming method of obtaining bias voltage from dry cells. Since this bias voltage is variable with continuous tuning, one can determine more accurately the effects of bias on the overall response curve and can align sets to more sensitive for "fringe area" reception or align them to prevent "overloading" when the station signal is very powerful.

(3) Three RF oscillators provide complete VHF coverage (Channels 2 - 13) on fundamentals and hetrodyned output IF frequencies 0 - 50 Mc. This assures a strong signal necessary for aligning "front ends."

(4) Continuous tuning and an easy-to-read scale marked off in channels literally provides the serviceman with a foolproof method of alignment.

(5) An internal method of "retrace blanking" provides a reference base line and eliminates confusion sometimes brought about by retrace curves.

(6) Even though the sweep width is varied, it will not be necessary to readjust the phasing control.

(7) As is common to all Hickok Signal generators, a Standby position is incorporated in which the plate voltage is removed from all the tubes leaving filament voltage alone to keep the unit at a constant temperature and ready to operate the moment the Range Selector Switch is rotated.

(8) The instruction manual accompanying the unit gives complete, detailed and easy-to-follow instructions on correct alignment procedures, uses of the instrument, and a thorough understanding of alignment.

HICKOK

All of these features have been developed with the TV serviceman in mind.

THE HICKOK ELECTRICAL INSTRUMENT COMPANY

10531 Dupont Avenue • Cleveland 8, Ohio

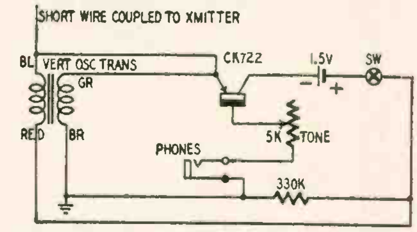
See your parts jobber or write direct for technical details.

Few adjustments or controls are needed. Finding the proper resistance between switch and ground may require a little experimenting. I found 330,000 ohms O.K. If it is too high, oscillations will continue with the key up. If too low, the circuit may not oscillate.

The base resistor varies tone. It also determines trigger conditions. Near zero, the transistor will be too critical. It will oscillate at the slightest touch of the headphones. Results are best with about 4,000 ohms in the base circuit.

The transformer is the type used in a TV vertical blocking oscillator. It measures 250 ohms across the primary (between GR and BR) and 1,600 ohms across the secondary. There is no reason why high-ratio audio transformers should not work in this circuit.

I have used this monitor on all bands with a low-power (30-watt input) transmitter. The only coupling procedure required is to wrap the short insulated lead from the emitter once or twice around the antenna. Placing it near the final tank also works fine.



Schematic of transistor keying monitor.

Materials for Keying Monitor

Resistors: 1—330,000 ohms, ½ watt; 1—5,000 ohms, potentiometer.

Miscellaneous: 1—vertical blocking oscillator type transformer; 1—transistor, type CK-722; 1—s.p.s.t. toggle switch; 1—1.5-volt dry cell; 1—phone jack; 1—4 x 4 x 2-inch utility box.

This instrument can also serve as an excellent a.f. oscillator. The base resistor varies tone over a fairly wide range, almost 3 octaves. With a larger resistor, the variation is even greater. If much use is to be made of this unit as a generator, it might be better to add a switch to disconnect the high resistance. This will do away with the trigger characteristic and permit the transistor to oscillate at all times.

This circuit has another curious characteristic, mentioned earlier. When used as a trigger circuit, you will find that the instrument is sensitive to mechanical shock as well as acoustic and r.f. signals. For this reason, turn the tone control as near to zero as you can without oscillations. Now, if you tap the headphones ever so lightly, the circuit will be tripped and oscillations will be heard. Speaking or whistling into the phones will do the same thing. Once oscillations begin, they may be stopped by turning off the switch or returning the tone control to maximum. This resets the trigger.

Most c.w. men take pride in their signal quality, and this transistor keying monitor will enable them to hear themselves as others hear them. Its compactness and ease of installation make it a valuable instrument. END

BLOOD AND TEARS

NOBODY knows what TV repairmen go through—nobody, that is, except other TV repairmen and, because we've been looking into the subject, us. We've learned, for example, that one of the greatest hazards they face in the slow completion of their appointed rounds is children. Hell hath no fury like a tot about to be deprived of even an extremely fuzzy image of Roy Rogers, and TV repairmen invariably try to sneak sets out of the house while children are at school or (but this is chancy) napping. Children are known to have kicked, pommelled, clawed, and bitten men engaged in removing TV sets. Children also go in for making their own TV repairs, often by kicking, pommelling, and clawing the sets. A repairman in Scarsdale tells us he was recently called in to examine a 1948 model that appeared absolutely done for—no image, no sound, nothing. Now, 1948 is the paleolithic, or flint-chipping, era of TV, and the repairman was about to report to the mistress of the house that the set had better be scrapped when a two-year-old, the son of next-door neighbors, darted into the room. The little fellow hadn't yet learned to speak but had evidently been fooling around with TV all his life. Sizing up the situation, he brushed the repairman aside, took off a sandal, and slammed it as hard as he could against the back of the set. There followed a sound of tinkling glass from inside the set, a gummy substance started running out of the bottom of it, and then clear on the screen and loud from the speaker came "Shop, Look, and Cook, with Ruth Bean."

Children not only repair sets; they like to experiment with them. Forcing foreign objects into the cabinet to see what will happen next is the favorite sport of many an infant Edison, and in the past few years repairmen have reaped a rich harvest of pennies, buttons, paper clips, marbles, and dead grass.

Occasionally, a TV set will outdo itself by accident. Take the case of a set we've heard about that, thanks to the combination of a defective tube and a film of furniture polish on the screen, managed to produce a sort of color. The owner of the set was furious when a well-meaning repairman, summoned to adjust the antenna, replaced the tube, and the screen reverted to plain old black-and-white.

Some accidental improvements are both pleasant and alarming. Not long ago, a lady in Forest Hills discovered that whenever she turned on her set, her living room began to smell exactly like the cider mill on her grandfather's farm in New England, which she hadn't visited in twenty years. Luckily, she got in touch with her repairman before getting in touch with her doctor, and he traced the singular fragrance to its source. One of the children in the house had emptied a jar of apple jelly into the set, and as the tubes warmed up,

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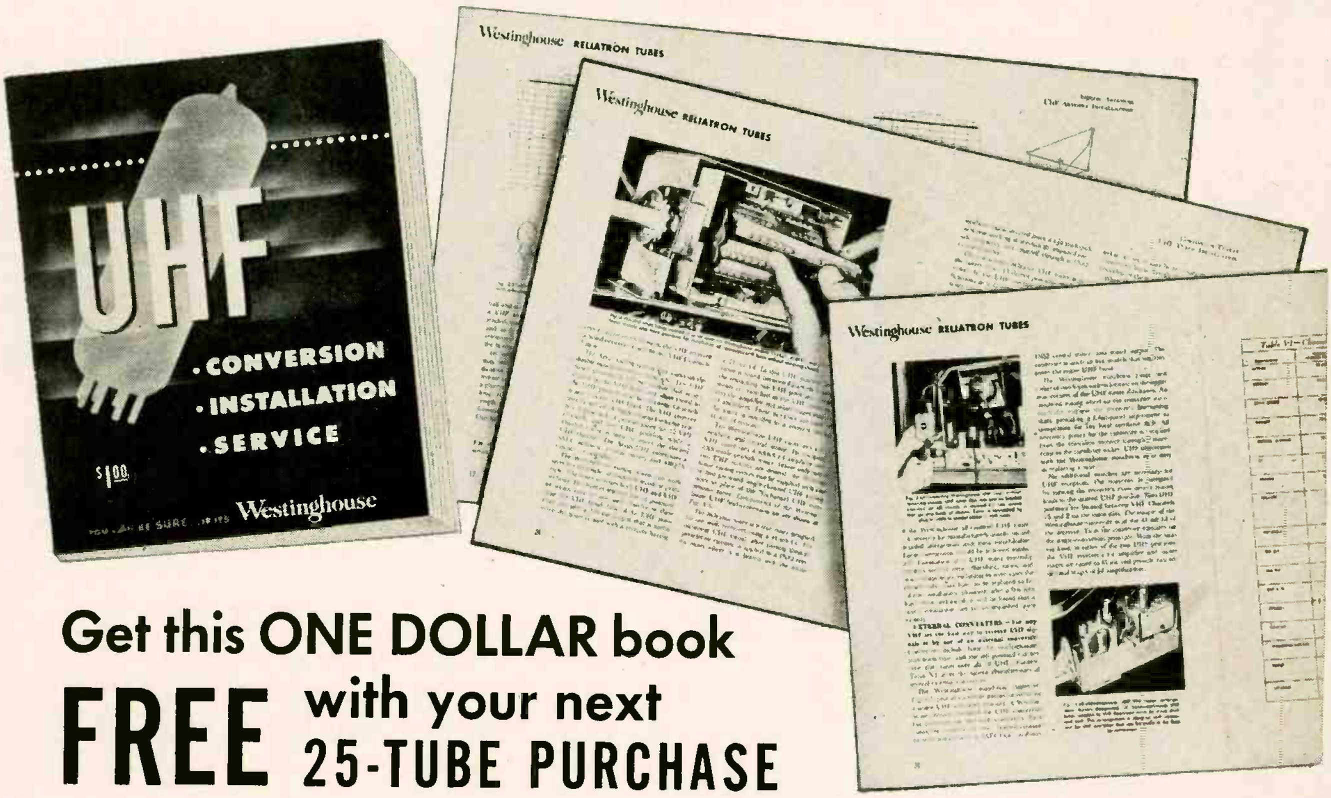

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— Warren Radio Co.
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Hallowell — Powell Radio Supply

MARYLAND
Baltimore — Wholesale Radio Parts Co. Inc.

MASSACHUSETTS
Boston — Commercial Radio Corp.
— Gerber Radio Supply Co.
— Lincoln Electronic Supply Corp.
— Radio Wire Television, Inc.
Lynn — Essex Electrical Supply Co. Inc.
Natick — Willett Radio Supply
New Bedford — E. A. Ross & Co.
Springfield — Regent Sales, Inc.

MICHIGAN
Battle Creek — Electronic Supply Corp.
Benton Harbor — Benton Electronic Supply Co., Inc.
Detroit — Glendale Electronic Supply
Flint — Lifsey Distributing Company
Grand Rapids — Radio Parts, Inc.
Wholesale Radio Co.
Highland Park — Hi-Park Distributor
Jackson — Matteson Electronics, Inc.
Muskegon — Bell Lourim Electronics, Inc.
Pontiac — Electronic Supply Co.

MINNESOTA
Duluth — Lew Bonn Co.
Minneapolis — Electronic Center, Inc.
— Lew Bonn Co.
St. Paul — Lew Bonn Co.

MISSOURI
Kansas City — Manhattan Radio Supply
— Radiolab
St. Louis — Van Sickle Radio Co.
— Radonics Co.

NEW JERSEY
Hackensack — American Distributing Co.
Hillside — Sherwood Distributors, Inc.
Jersey City — Hallmark Electronics Corp.
Manville — Masters TV Supply Co.
Newark — Emerson-New Jersey, Inc.
— Radio Wire Television, Inc. of N.J.
— Variety Electric Co., Inc.
North Bergen — American Distributing Co.
Paterson — Jersey Electronic Distributing Co.
Perth Amboy — Bennett's Radio Supply
Teterboro — Van Dusen Aircraft Supplies
Trenton — Allied Electrical Appliance Parts, Inc.

NEW YORK
Albany — Air Waves Electronic-Radio Dist. Co.
Binghamton — Stack Electronic Supply Co.
Brooklyn — Ace Electronics
— Bay Electronic Distributors
— Benray Electronics Corp.
— Hygrade Electronics, Inc.
Buffalo — Buffalo Electric Co. Inc.
— Radio Electric Products, Inc.
Elmira — Le Valley McLeod, Inc.
Fredonia — Barker-Higbee, Inc.
Ithaca — Stallman of Ithaca, Inc.
Mineola — Emerson-Long Island, Inc.
Monticello — Fleisher Distributors, Inc.
Newburgh — Chief Electronics, Inc.
New Rochelle — Transvision, Inc.
New York City — Barry Electronic Corp.
— Bay Electronic Distributors
— Emerson-New York, Inc.
— House of Electronics
— Magic-Vue Television Corp.
— Midway Radio & Television Corp.
— Milo Radio & Electronics Corp.
— Radio Wire Television, Inc.
— Sanford Electronics Corp.
Patchogue — South Bay Radio Distributors
Poughkeepsie — Chief Electronics, Inc.
Rochester — Maseline Radio & Electronic Equipment, Inc.
Rome — Rome Electronic Supply
Staten Island — B & D Distributing Co.
Syracuse — Karl-Williams Co., Inc.
Troy — Troy Electronics Distributing
Utica — Electronic Laboratories & Supply Co.
White Plains — Emerson Radio Westchester, Inc.

NORTH CAROLINA
Charlotte — Dixie Radio Supply Co.
— Westinghouse Electric Supply Co.
Greensboro — Westinghouse Electric Supply Co.
Hickory — Victor Radio TV Supply Co.
Raleigh — Raleigh-Allied Electronics, Inc.
— Westinghouse Electric Supply Co.
Salisbury — Leonard Electronics of Salisbury, Inc.

OHIO
Akron — Sun Radio Co.
Canton — Burroughs Radio, Inc.
Cincinnati — Holub & Hogg
— Mytronic Co.
— Radio TV & Refrigeration Supply, Inc.
Cleveland — Radio Electronic Parts Corp.
Columbus — Buckeye Electronics
— Electronic Supply Corp.
— Whitehead Radio Co.
Dayton — Allied Supply Co., Inc.
— Stotts-Friedman Co.
Lima — Allied Supply Co., Inc.
Mansfield — Burroughs Radio Inc.
Marion — Servex Distributing Co.
Toledo — Lifetime Electronics
— Warren Radio Co.
Warren — Radio Specialties
Youngstown — Radio Parts Co.

OKLAHOMA
Oklahoma City — Dulaney's
— Electronic Supply Co.
Tulsa — S & S Radio Supply

PENNSYLVANIA
Allentown — Radio-Television Supplies
Braddock — Marks Parts Co.
Erie — B & D Wholesale Distributing Co.
Harrisburg — Harrisburg Radio Laboratory Supply
Hazelton — Moyer Electronic Supply Co., Inc.
New Brighton — Television Parts Co.
Philadelphia — Allied Elec. Appliance Parts, Inc
— Almo Radio Co.
— Barnett Bros. Radio Co.
— Herbach & Rademan Co.
Pittsburgh — Cameradio Co.
— Radio Parts Co. Inc.
— Tydings Co.
Scranton — General Radio & Refrigeration Co.
— Penn Electrical Engineering Co.
Wilkes-Barre — General Radio & Electronic Co.
York — York Radio & Refrigeration Parts

RHODE ISLAND
Providence — Television Accessory House

SOUTH CAROLINA
Columbia — Dixie Radio Supply Co.
— Westinghouse Electric Supply Co.
Florence — Dixie Radio Supply Co.
Greenville — Dixie Radio Supply Co.
— Westinghouse Electric Supply Co.
Spartanburg — McElhanney Co., Inc.

TENNESSEE
Chattanooga — Mills & Lupton Supply Co.
— Specialty Distributing Co.
Kingsport — Chemcity Radio & Electric Co.
Knoxville — Chemcity Radio & Electric Co.
Memphis — Electronic Supply, Inc.
— McGregor's, Inc.
— W & W Distributing Co.
Nashville — Currey's Wholesale Distributors
— Electra Distributing Co.
— Moore-Handley Hardware Co., Inc.

TEXAS
Amarillo — Dulaney's Co., Inc.
Beaumont — Covington Distributing Corp.
Corpus Christi — Hayes Radio Supply Co.
Dallas — Adleta Co.
— Crabtree's Wholesale Radio Co.
Denison — Denison Radio Supply
Ft. Worth — Sutton's Wholesale Electronics
Houston — Angie Radio & Supply Co.
— Electro-Mechanical Products Co.
— Hall, Inc.
Midland — Henderson-Hoff
San Antonio — Mission Radio, Inc.
— Modern Radio Supply
Tyler — Radio Service Supply Co.

VIRGINIA
Bristol — Bristol Radio Supply Corp.
Fredericksburg — J & J Appliance Co.
Lynchburg — Eastern Electric Co.
Newport News — Noland Co., Inc.
Norfolk — Radio Parts Distributing Co.
Richmond — Meridan Electronic Equipment Co.
Roanoke — Leonard Electronics of Roanoke, Inc.
Winchester — Leonard Electronics of Winchester, Inc.

WEST VIRGINIA
Bluefield — Superior-Sterling Co.
Huntington — TV Supply Co.

WISCONSIN
Madison — Superior Radio Co. of Madison
Milwaukee — Electronic Expeditors Co.
— Marsh Radio Supply Co.
Racine — Superior Radio Co.
Wausau — Electronics, Inc.

The above listing was closed as of November 10, 1953. Watch for new Westinghouse Distributor Appointments in your area.

ET-95046

the jelly melted.

TV sets are sometimes thrown out of kilter by mice, most of which are *not* planted by children. Neither are they planted by repairmen, though the accusation has been made. It appears that mice consider the warm, dark coziness of the sets ideal for nesting.

Clambering about on the upper reaches of peoples' houses is one of the risks of a repairman's life. The weekly meeting of a women's bridge club in East Orange was broken up early this month when a TV man who was rigging an antenna in an unfinished attic slipped between two rafters, plunged through the living-room ceiling, and landed right in the middle of a card table. The man wasn't hurt, but the table was wrecked and two cards in dummy's club suit simply disappeared.

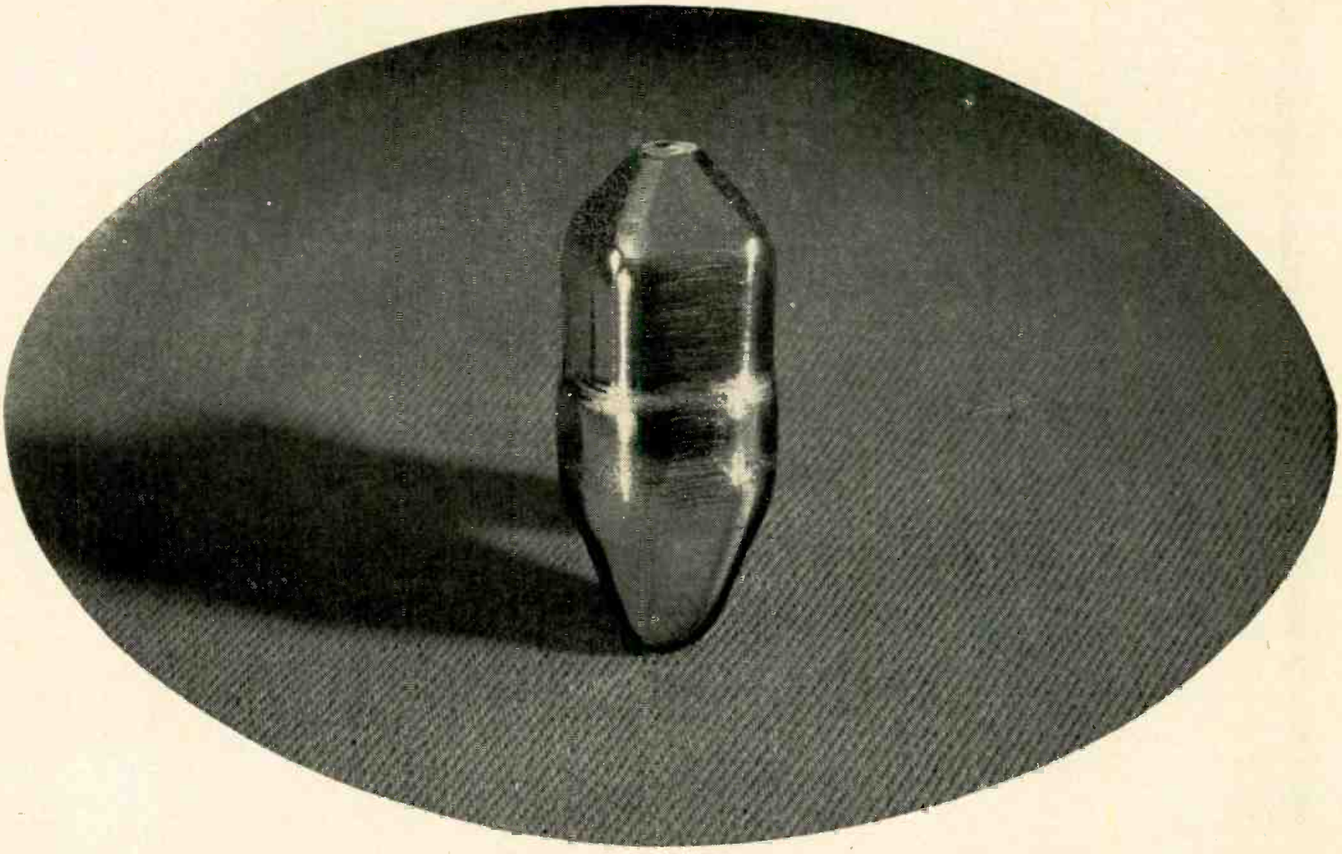
Last week in Brooklyn, a TV addict complained to his repairman that his TV screen tended to fog over late in the evening. He'd made the same complaint a dozen times before, and the TV man had checked the set a dozen times without finding anything wrong with it. Acting on a hunch, he stopped in at his customer's house along about 11 P.M. and, sure enough, it wasn't the screen but the owner of the set, a man highly susceptible to the beer ads on TV, who tended to fog over late in the evening.

Also last week, trouble in the Bronx: A TV repairman got a call from a Mr. Schneider, at such-and-such an address, asking him to pick up a set that had gone haywire. The repairman had previously done work for a Schneider at that address, and next morning he sent his driver around for the set. Schneider wasn't at home, so the driver explained his mission to a maid, who let him take the set away. The following day, the TV man called Schneider to say that the set had been repaired and would be delivered in an hour or so. "What set?" Schneider asked. "I'm looking at my set this minute. It works fine." The TV man had no sooner apologized and hung up than the telephone rang; it was Schneider, calling to ask when his blankety-blank set would be picked up, if ever. The TV man said he'd be right over, and over he went, to find that there were *three* Schneiders living in one apartment building. The third Schneider had already notified the police that his set was missing, and they were scouring the neighborhood for a thief posing as a TV repairman.

RADIO-ELECTRONICS will be happy to print future contributions similar to the ones in the above article, giving personal experiences of radio and television technicians. We shall pay $10 for each contribution used by this department. The contribution may be either serious or humorous, but should be an actual experience encountered by a service technician.

Address all contributions to:

Editor, THE SERVICE RUNAROUND
℅ RADIO-ELECTRONICS
25 West Broadway
New York 7, New York



Germanium crystal grown at Bell Telephone Laboratories (life size). It is sliced into hundreds of minute pieces to make *Transistors*. Transistor action depends on the flow of positive current-carriers as well as electrons, which are negative. Arsenic —a few parts per 100,000,000—added to germanium produces prescribed excess of electrons. With gallium added, positive carriers predominate. Latest junction type *Transistor* uses both kinds of germanium in the form of a sandwich.

THEY GREW IT FOR TRANSISTORS

Heart of a ***Transistor*** – Bell Telephone Laboratories' new pea-size amplifier – is a tiny piece of germanium. If ***Transistors*** are to do their many jobs well, this germanium must be of virtually perfect crystalline structure and uniform chemical composition. But it doesn't come that way in nature.

So—Bell scientists devised a new way to *grow* the kind of crystals they need, from a melt made of the natural product. By adding tiny amounts of special alloying substances to the melt, they produce germanium that is precisely tailored for specific uses in the telephone system.

This original technique is another example of the way Bell Laboratories makes basic discoveries – in this case the ***Transistor*** itself – and then follows up with practical ways to make them work for better telephone service.

Section of natural germanium, left, shows varying crystal structure. At right is sectioned single crystal grown at Bell Laboratories.

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NO INTEREST!!

Buy on our radically new

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Superior's new Model 670-A

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
OUTPUT VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
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
INDUCTANCE: .15 to 7 Henries 7 to 7,000 Henries
DECIBELS: −6 to +18 +14 to +38 +34 to +58

ADDED FEATURE:

The Model 670-A includes a special GOOD-BAD scale for checking the quality of electrolytic condensers at a test potential of 150 Volts.

The Model 670-A comes housed in a rugged, crackle-finished steel cabinet complete with test leads and operating instructions.

$28.40 NET

Superior's new Model TV-11

TUBE TESTER

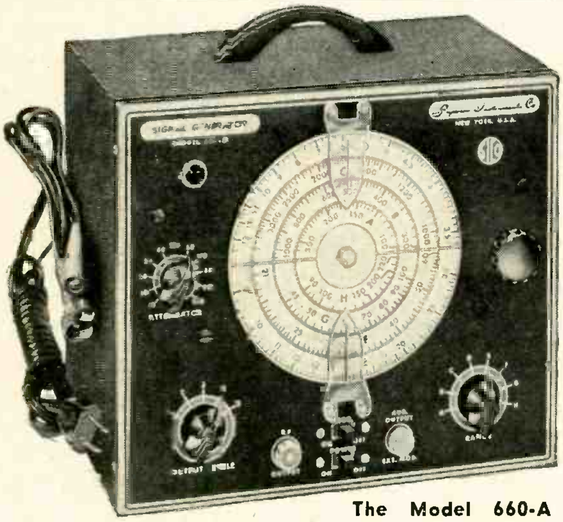
SPECIFICATIONS:

★ Tests all tubes including 4, 5, 6, 7, Octal, Lock-in, Peanut, Bantam, Hearing Aid, Thyratron, Miniatures, Sub-miniatures, Novals, Sub-minars, Proximity fuse types, etc.
★ 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.
★ The Model TV-11 does not use any combination type sockets. Instead individual sockets are used for each type of tube. Thus it is impossible to damage a tube by inserting it in the wrong socket.
★ Free-moving built-in roll chart provides complete data for all tubes.
★ Newly designed Line Voltage Control compensates for variation of any Line Voltage between 105 Volts and 130 Volts.
★ NOISE TEST: Phono-jack on front panel for plugging in either phones or external amplifier will detect microphonic tubes or noise due to faulty elements and loose internal connections.

The model TV-11 operates on 105-130 Volt 60 Cycles A.C. Comes housed in a beautiful hand-rubbed oak cabinet complete with portable cover

$47.50 NET

EXTRA SERVICE — The Model TV-11 may be used as an extremely sensitive Condenser Leakage Checker. A relaxation type oscillator incorporated in this model will detect leakages even when the frequency is one per minute.



The Model 660-A comes complete with coaxial cable test lead and instructions.

Superior's New Model 660-A **AN AC OPERATED**

SIGNAL GENERATOR

PROVIDES COMPLETE COVERAGE for AM-FM & TV Alignment

SPECIFICATIONS:

• Generates Radio Frequencies from 100 Kilocycles to 60 Megacycles on fundamentals and from 60 Megacycles to 220 Megacycles on powerful harmonics. • Accuracy and Stability are assured by the use of permeability trimmed Hi-Q coils. • R.F. available separately or modulated by the internal audio oscillator. — Built in 400 cycle sine wave audio oscillator used to modulate the R.F. signal also available separately for audio testing of receivers, amplifiers, hard of hearing aids, etc. • R.F. Oscillator Circuit: A high transconductance heptode is used as an R.F. oscillator, mixer and amplifier. Modulation is effected by electron coupling in the mixer section thus isolating the oscillator from load changes and affording high stability. • A.F. Oscillator Circuit: A high transconductance heptode connected as a high-mu triode is used as an audio oscillator in a High-C Colpitts Circuit. The output (over 1 Volt) is nearly pure sine wave. • Attenuator: A 5 step ladder type of attenuator is used.

Tubes used: 1—6BE6 as R.F. Oscillator, mixer and amplifier. 1—6BE6 as Audio Oscillator. 1—6H6 as Power Rectifier.

$42.95 NET

MOSS ELECTRONIC DISTRIBUTING CO., INC.
Dept. B-90, 3849 Tenth Ave., New York 34, N. Y.

Please send me the units checked. I am enclosing the down payment with order and agree to pay the monthly balance as shown. It is understood there will be no carrying, interest or any other charges, provided I send my monthly payments when due. It is further understood that should I fail to make payment when due, the full unpaid balance shall become immediately due and payable.

Name..

Address..

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

☐ MODEL 670-A ......Total Price $28.40 $7.40 down payment. Balance $3.50 monthly for 6 months.
☐ MODEL TV-11 ......Total Price $47.50 $11.50 down payment. Balance $6.00 monthly for 6 months.
☐ MODEL 660-A ......Total Price $42.95 $12.95 down payment. Balance $5.00 monthly for 6 months.
☐ I enclose $..........as down payment.
☐ Ship C.O.D. for the down payment.

NO INTEREST!!

Buy on our radically new

Time Payment Plan

NO CARRYING CHARGES!!

Superior's New Model 770-A *The FIRST Pocket-Sized*

VOLT-OHM MILLIAMMETER

USING THE NEW "FULL-VIEW" METER

71% MORE SCALE AREA!!

Yes, although our new FULL-VIEW D'Arsonval type meter occupies exactly the same space used by the older standard 2½" Meters, it provides 71% more scale area. As a result, all calibrations are printed in large easy-to-read type and for the first time it is now possible to obtain measurements instead of approximations on a popular priced pocket-sized V.O.M.

Features

- ★ Compact—measures 3⅛" x 5⅞" x 2¼"
- ★ Uses "Full View" 2% accurate, 850 Microampere D'Arsonval type meter
- ★ Housed in round-cornered, molded case
- ★ Beautiful black etched panel. Depressed letters filled with permanent white, insures long-life even with constant use.

Specifications

6 A.C. VOLTAGE RANGES: 0-15/30/-150/300/1500/3000 Volts. 6 D.C. VOLTAGE RANGES: 0-7.5/15/75/150/-750/1500 Volts. 2 RESISTANCE RANGES: 0-10,000 Ohms, 0-1 Megohm. 3 D.C. CURRENT RANGES: 0-15/150 Ma., 0-1.5 Amps. 3 DECIBEL RANGES: −6 db to +18 db, +14 db to +38 db, +34 db to +58 db.

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

$15.85 NET

Superior's New

TELEVISION BAR GENERATOR

THROWS AN ACTUAL BAR PATTERN ON ANY TV RECEIVER SCREEN

Two Simple Steps

1. Connect Bar Generator to Antenna Post of any TV Receiver.
2. Plug Line Cord into A.C. Outlet and Throw Switch.

Result: A stable never-shifting vertical or horizontal pattern projected on the screen of the TV receiver under test.

SPECIFICATIONS:

Power Supply: 105-125 Volt 60 Cycles
Power Consumption: 20 Watts
Channels: 2-5 on panel, 7-13 by harmonics
Horizontal lines: 4 to 12 (Variable)
Vertical lines: 12 (Fixed)
Vertical sweep output: 60 Cycles
Horizontal sweep output: 15,750 Cycles

FEATURES:

Provides linear pattern to adjust VERTICAL linearity, height, centering • Provides linear pattern to adjust HORIZONTAL drive, width, peaking, linearity, centering • Provides vertical sweep signal for adjusting and synchronizing vertical oscillator discharge and output tubes • Provides vertical signal to replace vertical oscillator to check vertical amplifier operation • Provides horizontal sweep signal for adjusting and synchronizing horizontal oscillator A.F.C. and output tubes • Provides horizontal sweep signal to check H.V. section of fly-back and pulse operating power supplies • Provides signal for testing video amplifiers • Can be used when no stations are on the air.

TV BAR GENERATOR COMES COMPLETE WITH SHIELDED LEADS AND DETAILED OPERATING INSTRUCTIONS. ONLY

$39.95 NET

SUPERIOR'S NEW MODEL TV-40

C.R.T. TUBE TESTER

A complete picture tube tester for little more than the price of a "make-shift" adapter!!

The Model TV-40 is absolutely complete! Self-contained, including built-in power supply, it tests picture tubes in the only practical way to efficiently test such tubes; that is by the use of a separate instrument which is designed exclusively to test the ever increasing number of picture tubes!

EASY TO USE:

Simply insert line cord into any 110 volt A.C. outlet, then attach tester socket to tube base (*Ion trap need not be on tube*). Throw switch up for quality test . . . read direct on Good-Bad scale. Throw switch down far all leakage tests.

Tests *all* magnetically deflected tubes . . . in the set . . . out of the set . . . in the carton!!

SPECIFICATIONS:

- Tests *all* magnetically deflected picture tubes from 7 inch to 30 inch types.
- Tests for quality by the well established emission method. All readings on "Good-Bad" scale.
- Tests for inter-element shorts and leakages up to 5 megohms.
- Test for open elements.

Model TV-40 C.R.T. Tube Tester comes absolutely complete—nothing else to buy. Housed in round cornered, molded bakelite case. Only ....

$15.85 NET

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Dept. B-90, 3849 Tenth Ave., New York 34, N. Y.

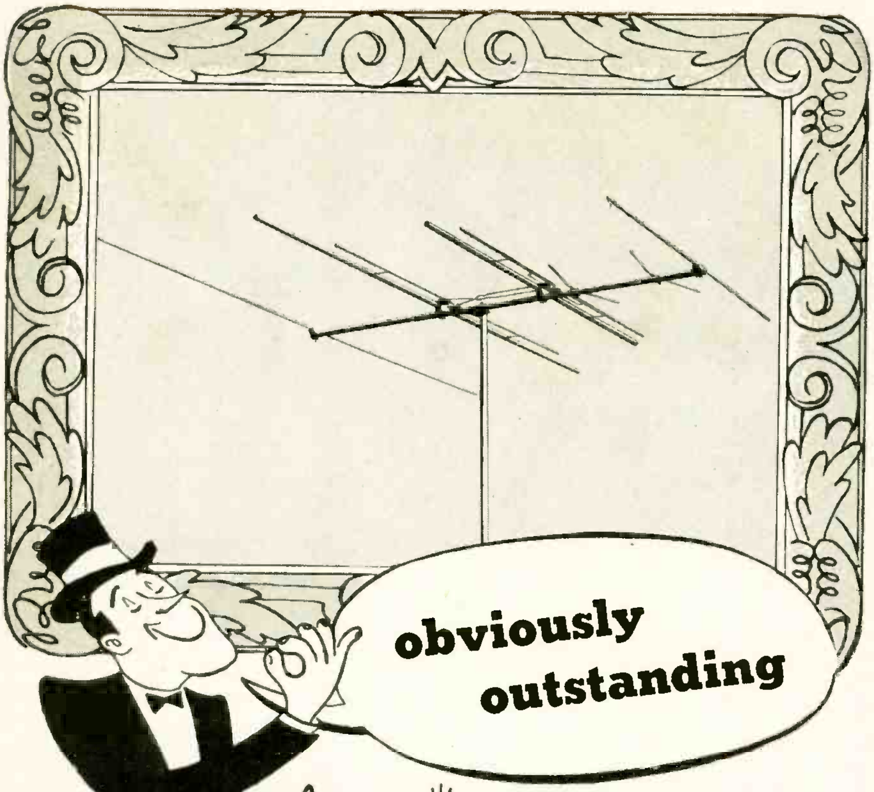
Please send me the units checked. I am enclosing the down payment with order and agree to pay the monthly balance as shown. It is understood there will be no carrying, interest or any other charges, provided I send my monthly payments when due. It is further understood that should I fail to make payment when due, the full unpaid balance shall become immediately due and payable.

Name..

Address..

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

- ☐ Model 770-A ....Total Price $15.85 $3.85 down payment. Balance $4.00 monthly for 3 months.
- ☐ Bar Generator ......Total Price $39.95 $9.95 down payment. Balance $5.00 monthly for 6 months.
- ☐ Model TV-40 ......Total Price $15.85 $3.85 down payment. Balance $4.00 monthly for 3 months.
- ☐ I enclose $.........as down payment.
- ☐ Ship C.O.D. for the down payment.



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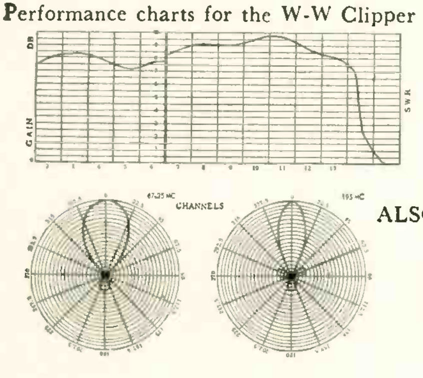
Not Just Claims But Unquestioned Proof Of

- **PERFORMANCE** — an engineering accomplishment providing an outstanding antenna designed for increased sensitivity and higher gain in both primary and fringe areas.
- **ACCEPTANCE** — a phenomenal customer acceptance resulting from WW's superb performance characteristics — thousands in use throughout the U.S.
- **SALES** — performance, design, workmanship . . . outstanding selling points to create unprecedented sales demand. Get your share now!

Specifically engineered and designed for true and complete all-channel VHF reception.

Performance charts for the W-W Clipper



CHECK THESE FEATURES

High Uniform Gain — One Major Foreward Lobe — Narrow Beam Reduces Ghosts and Noise Pickup—High Signal to Noise Ratio — Good Front-to-Back Ratio Eliminates Co-Channel Interference—Perfect 300 Ohm Match — Light, Rigid, Quickly and Easily Installed to All Heights — Low Wind Resistance.

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Models 10 and 20 UHF Fans — Models 30 & 40 Colinear Fans — Model UH 6 element UHF Yagi — Model HT High Band VHF Antenna — K series Original Hairpin, Combination Yagi Antenna.

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television accessory mfgrs.
DEPT. RE, BURLINGTON, IOWA

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Easily Installed
consisting of rectangular tube, 70 degree yoke, beautiful mask, flyback transformer and width coil.

17" Conversion Kit, as above, complete	$24.95
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24" Conversion Kit, as above, complete	69.95
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27" Kit Contains 90° yoke

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Insulated ½, 1 and 2-watt assortment of most used values, I.R.C. Ohmite, Stackpole, Speer. 100 for ... $2.95

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8BP4	23.00	16WP4A	21.45
10BP4	14.95	17BP4A	20.95
12JP4	16.95	17GP4A	23.95
12LP4		17CP4A	22.45
12UP4A	18.45	17HP4	22.45
14BP4A	17.95	17TP4A	23.95
15AP4	21.95	19AP4A	25.45
16AP4	19.95	19DP4A	23.95
16AP4A		19FP4	
16DP4		20CP4A	24.95
16DP4A	19.95	21AP4A	28.45
16EP4A	21.45	21EP4A	26.95
16GP4A		21FP4	28.45
16JP4A	19.95	21MP4A	29.95
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16LP4A	21.45	27NP4	89.95

ONE FULL YEAR WARRANTY ON ALL TYPES
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NEW precise MODEL 308K 8½" OSCILLOSCOPE

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- ★ INTENSIFIER ANODE
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- ★ 8½ INCH TUBE (A Precise First)
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See Precise Ad Page 122

The only 8½" Oscilloscope on the commercial market today. We have this Precise "scope" for you . . .

NEW 7" Oscilloscope Kit	$ 94.95
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OTHER PRECISE KITS AVAILABLE:

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MODEL 610KA—RF SIGNAL GENERATOR (pre-assembled head)	$28.95
MODEL 635K—UNIV. AF SINE, SQ. & PULSE GEN.	$33.50

Terms: All merchandise shipped FOB Alhambra, California. Prices slightly higher in the West. Prices and specifications subject to change without notice. Include 20% deposit for C.O.D.'s. WRITE FOR NEW CATALOG — FREE!

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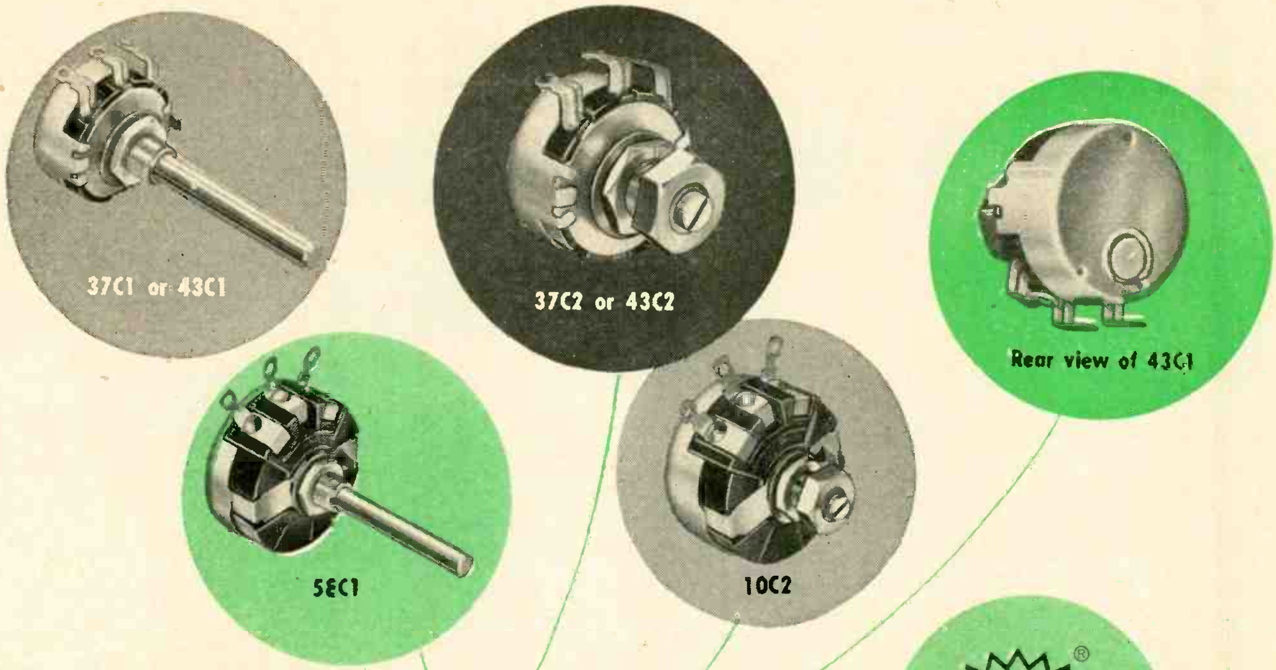

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A new line of composition-element and wire-wound controls designed specifically for custom-built, industrial, laboratory or other semi-critical applications. These controls are *de luxe versions* – mechanically and electrically – of the popular Clarostat standard types widely used in radio-TV sets and for the servicing thereof.

With factory-assembled fixed 1⅝" round shaft (C1) or ⅛" screwdriver-slot shaft (C2) with split locking bushing.

All exposed metal parts have corrosion-resistant finish. Terminals have suitable finish for ease of soldering.

Close-fitting covers — no holes or cut-outs. Maximum protection against dust and dirt.

Ratings: 37C1 and 37C2 composition-element, 1 watt; 43C1 and 43C2 wire-wound, 2 watts; 58C1 and 58C2, 3 watts; 10C1 and 10C2, 4 watts.

Electrical tolerances plus/minus 10% for composition-element controls up to 100,000 ohms; plus/minus 20% from 100,000 ohms to 10 megohms.

Wire-wound controls within plus/minus 5% in all ohmages. Independent linearity to plus/minus 1% for 58C1 and 58C2, and 10C1 and 10C2 controls; for 43C1 and 43C2, plus/minus 2%.

Available with switches on special order.

Units sealed in dustproof plastic bags within standard Clarostat cartons. Factory-fresh appearance and condition, regardless of shelf life.

If you want still better-than-standard quality, performance and life, insist on Clarostat C-LINE controls.

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CLAROSTAT Controls & Resistors

CLAROSTAT MFG. CO., INC., DOVER, NEW HAMPSHIRE
In Canada: Canadian Marconi Co., Ltd., Toronto, Ontario

PHASE SHIFT OSCILLATOR

An R-C audio-frequency oscillator that produces an excellent waveform

By DARWIN H. HARRIS

THE phase-shift oscillator is a simple audio-frequency generator. It produces an excellent waveform, and is not disturbed by supply-voltage fluctuations. Positive plate-to-grid feedback is applied through a resistance-capacitance network (Fig. 1), which shifts the phase of the plate signal. Oscillation takes place at the frequency where the feedback is maximum. The approximate frequency may be predicted by the formula:

$$F = \frac{6 \times 10^4}{RC}$$

in which RC is in microseconds (ohms times microfarads or megohms times micromicrofarads) and F is in cycles per second. The phase reversal results in a large signal loss, so a high-gain tube is necessary. A pentode is commonly used, but a high-mu triode is satisfactory at low and medium frequencies. (In the writer's opinion, triodes—particularly the 6SL7-GT—produce better waveforms than pentodes, and are preferable.)

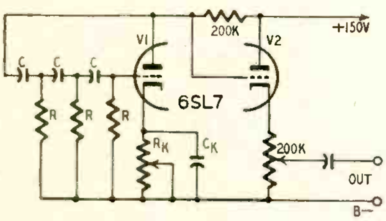

Fig. 1—The phase-shift oscillator.

Several other types of phase-shifting circuits may be used instead of the network shown in Fig. 1. Of these, the most important one has the configuration shown, but uses a four-R-C network. In that type the network loss is much lower, and the gain requirement is less important. Hence it is more useful for triode operation, especially at higher frequencies. The factor 6 in the frequency equation is changed to 12 in this case. The discussion here, however, is about the three-R-C oscillator.

In spite of its good reputation, the oscillator has certain disadvantages. The waveform is not always perfect. Often, too much feedback is fed to the grid; the grid is overdriven, and the signal is distorted. Thus, a scope must always be used in setting up the oscillator. A variable cathode resistor is the best way to control the gain, and, in turn, the waveform. A rheostat of 10,000 ohms or so is required. In adjusting this, the output will rise from a minimum (zero) at the extremes of the resistor to a maximum at some intermediate value. If distortion appears at maximum output, good waveform will usually be found with the resistor adjusted on the cathode side of maximum. If distortion remains at maximum resistance, it indicates that the B voltage is too high and should be reduced. A 150-volt supply is ample in most cases. An interesting effect that accompanies the resistance change is a small (about 10%) frequency variation; this is one reason the frequency equation is approximate. When varying the resistance from zero to maximum, the frequency first decreases sharply. As the resistance is increased, the frequency keeps decreasing, reaching a minimum at the point of maximum output. The frequency then rises as the resistance is made larger. The rise in frequency from its lowest point is only a fraction of the decrease that occurs initially.

Another disadvantage is the sensitivity of the oscillator to the output load, affecting both frequency and voltage. A buffer amplifier is used between the oscillator and load to serve as an impedance transformer. Since the generated voltage is often higher than required (a pentode with a 150-volt B supply may have 25 volts undistorted output, or 40 volts maximum), amplification is not necessary. The writer suggests a cathode follower as a buffer in place of an amplifier. The simple arrangement of Fig. 1 is recommended. Two points should be observed: the load resistor of V2 should be about the same as the plate resistor of V1; and the direct voltage at the cathode of V2 (more positive than the plate of V1) should be less than the rated cathode-to-filament voltage for the tube. This limits the maximum B voltage in this circuit. This type of cathode follower cannot be shunted with a small load since negative peak clipping takes place when the peak a.c. is equal to the d.c.

A definite maximum frequency exists for a given tube and B voltage, which is related to the tube gain. Experiments by the writer gave these approximate maxima: 12AT7, 150-volt B supply, 300 c.p.s.; 12AX7 and 6SL7, 150 volts, 900 c.p.s.; 6SJ7, 150 volts, 5 kc; 6SH7, 150 volts, 8 kc; and 6AG7, 300 volts, over 100 kc. This is partly due to the fact that when R is reduced, as required for higher frequencies, the necessary gain increases. Ginzton and Hollingsworth show[1] that the gain needed for oscillation, A, depends on the ratio of the net load at the plate, R_L, to R, as follows:

$$A = 29 + 23\left(\frac{R_L}{R}\right) + 4\left(\frac{R_L}{R}\right)$$

R is the resistance of each of the network resistors; they are of equal value. Similarly, C, the network capacitors, are also equal. R_L is the parallel resultant of the plate resistance, plate resistor, and load resistor. The gain, when R_L/R is unity, is nearly double that needed when R is much larger than R_L.

Frequency is determined not by R alone but by C as well. Neither R nor C can be reduced beyond a certain point. Minimum C values found by the writer were, 12AT7, .001 µf; 6SL7, 500 µµf; 12AX7, 200 µµf; 6SJ7, 6SH7, and 6AG7, 25 µµf. Operation at minimum C is not advisable because of oscillator instability. Minimum R values were: 12AT7, 6SL7, and 12AX7, 150 volts, 150,000 ohms; 6SJ7 and 6SH7, 150 volts, 100,000 ohms; and 6AG7, 300 volts, 10,000 ohms. Oscillation will not occur with both R and C at minimum. The smallest R-C product is reached with C at twice minimum and R at minimum. Thus, minimum values for the 6SH7 at 150 volts are 25 µµf and 100,000 ohms, but the highest frequency is reached with 50 µµf and 100,000 ohms.

The writer believes that 10 kc is the practical upper limit since above this point the oscillator becomes extremely sensitive to stray capacitance.

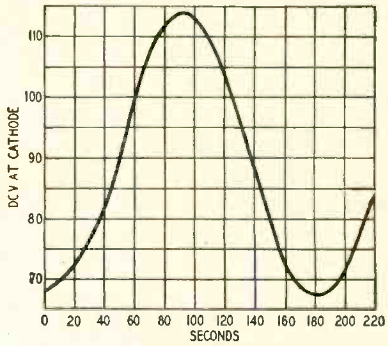

Fig. 2—Graph shows waveform generated at a frequency of 0.0055 c.p.s.

The equation for the oscillation fre-

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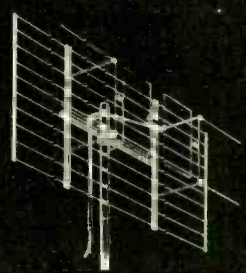

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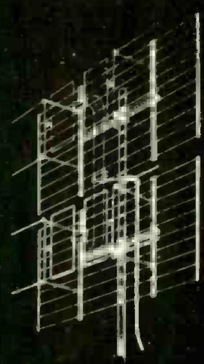

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quency derived by Ginzton and Hollingsworth is:

$$F = \frac{1}{2\pi RC\sqrt{6 + 4\left(\frac{RL}{R}\right)}},$$

where R_L is the same quantity involved in the gain equation. The equation shows how the frequency is affected by varying the load and by changing the cathode resistor (both affect R_L). The factor 6 in the approximate equation given earlier corresponds to the R_L/R ratio of ¼. If the ratio is 1/100, the factor becomes 6.5; at ½, the factor is 5.6; while at unity, the figure is 5.0. It is not necessary to use this equation in designing an oscillator. The approximate form is sufficient.

Maximum feedback occurs when the R-C sections are equal, but this is important only near the high-frequency limit of operation, where the feedback falls off. Since feedback is reduced by inequality among the R-C elements, this is a way of correcting overdrive. The effect of variations in R and C is complicated. However, in the simplest case, where only one component is changed at a time, the following relations seem to be general: the effect of varying C is the same, regardless of its position in the network; any C may be decreased by 0.5 or increased by 5 to 10; the effect of varying R differs with its network position; the resistor nearest the plate may be decreased by 0.3 or increased by 1.5; the center resistor may be decreased by 0.5 or increased by 2 or 2.5; the resistor nearest the grid may be decreased by a factor of 0.7 or increased by 4 or 5.

An advantage of the oscillator is its excellent waveform at very low frequencies. The writer was interested in finding how well the wave appeared at the lowest frequency that could be conveniently produced. That turned out to be 0.0055 c.p.s., or 180 seconds per cycle. The waveform, Fig. 2, was smooth; apparently a sine wave. The circuit of Fig. 1 was used, with R, 1 megohm, C, 10 μf (oil-filled), R_K, 2,700 ohms, and C_K, 10,000 μf (electrolytic, 25 volts). Data for Fig. 2 were taken by reading the d.c. voltage at the V2 cathode at 10-second intervals. The fluctuation was from 68 to 114 volts or 46 volts peak-to-peak, equal to 16 volts r.m.s.

It appears that the size of the capacitors, especially the cathode bypass, becomes the limiting factor at low frequencies. In this example, 10,000 μf seems none too large since the reactance is about 3,000 ohms. Oscillation at a reduced amplitude took place with half that value, but ceased with 3,000 μf. At extremely low frequencies no ordinary v.t.v.m. will read a.c. volts. However, frequency measurement is very easy: just count the cycles! An oscillator operating around 0.1 to 1 c.p.s. would be excellent for demonstrating the fundamental action of a vacuum tube—the generation of an a.c. voltage from a fluctuating direct current. END

Reference

[1]E. L. Ginzton and L. M. Hollingsworth, "Phase-Shift Oscillators," *Proc. IRE.*, Vol. 29, p. 43 (1941).

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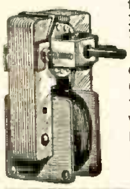

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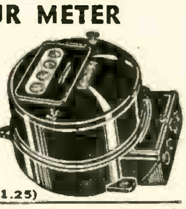

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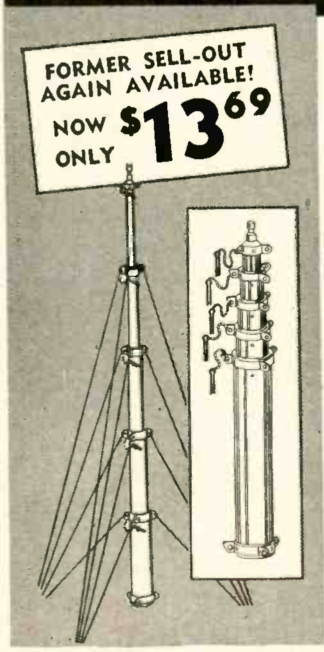

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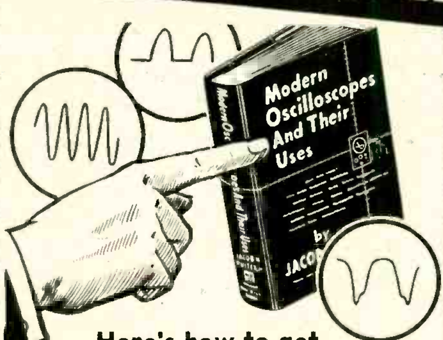

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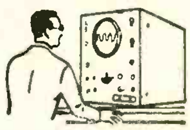

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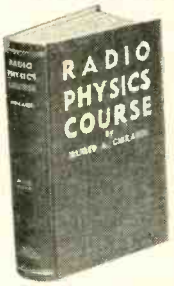

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WITH THE TECHNICIAN

EASTERN CONFERENCE

Samuel Brenner, PRSMA, and Max Liebowitz, ARTSNY, were appointed chairman and co-chairman in charge of arrangements for an Eastern Conference of electronic technicians and service dealers. Appointments were made at the October meeting of the National Electronic Technicians and Service Dealers Association, held in Trenton, N. J. The meeting also considered plans for the proposed conference.

It was decided by the delegates that under the organization's charter, three meetings will be held a year, on the first Sundays of February, May, and October. The next meeting will be in Philadelphia, February 7.

NATESA AWARD TO ARTSD

Fred Colton of ARTSD, Columbus, Ohio, was proclaimed by Frank Moch, president of the National Alliance of Television and Electronic Service Associations as the "regional vice-president who during the year did the most to make the convention a success." Mr. Moch also gave credit to the Columbus Association, which turned out the biggest delegation outside of Chicago. A suitable award, known as "The President's Cup," will be presented to Mr. Colton.

ARTSD TEN YEARS OLD

The November issue of the *Associated Radio-Television Service Dealers' News* (Columbus, Ohio) reminds us that ARTSD was 10 years old November 11. The association was formed with five members, Francis Gibb, Leo Loudner, Frank Knoderer, Harvey Brower, and John Graham. Three of the original members are still active.

Despite the November 11 anniversary, the organization decided to postpone celebration of its 10th birthday to the January meeting, at which time the officers for 1954 would be installed.

RCA WILL ISSUE BOOK

A complete color text for the service technician is promised soon by the Radio Corporation of America. The book, tentatively titled "Practical Color Television for the Servicing Industry," may be available early in the year.

ARTSNY ON THE AIR

Associated Radio and Television Service Technicians of New York City are co-operating with NBC's TV station WNBT and radio station WNBC in a campaign for better—and better paid—radio and television service in the New York City area. The case of the service technician is being presented in a number of radio and television spots that would be worth more than $20,000 if purchased as straight paid advertising.

Station manager Ernest de la Ossa, in pointing out that the service technicians rate such attention, stated: "We have long realized that we at WNBC and WNBT rely on the hundreds of reputable service technicians who keep millions of radios and television receivers in operation. We commend ARTSNY's continuing project of better, more fairly priced service, and its technical help to its membership."

WITH THE TECHNICIAN

ARTSNY DINNER

A testimonial dinner to president Max Liebowitz was held by the Associated Radio and Television Servicemen of New York City on November 19th. The dinner was attended by more than 60 members and guests.

Master of ceremonies Sam Marshall, an early officer of the organization, led in hailing Max as founder and sustaining spirit of the association and one of the leading figures in the organization of the state and national federations. Others who paid tribute to ARTSNY's president were John Rider, Fred Shunaman of RADIO-ELECTRONICS, Lewis Winner of *Service*, and Joseph Forman, attorney for the organization. The appreciation of the membership was expressed by Arthur Rhine, Phil Goldfarb, O. Capitelli and Henry Levine.

INVITE COMPLAINTS

Service technicians of Kalamazoo, Michigan, plan a series of "clinics" to clear up any complaints of improper TV service. Forms have been placed in shops of all members of the Kalamazoo Radio and TV Association, and members of the public invited to fill out details on any case in which he feels he may have been cheated, misled, or otherwise improperly treated. The complaints, together with evidence that the customer paid the bill are addressed to the offices of Kalamazoo RTA.

The organization's plan is to send trucks to pick up all sets under dispute and to examine them at a public clinic —or series of public clinics—then give a verdict on whether the work was done properly and if the charges were justified.

Paul Goeche, the organization's president, stated: "We intend to do this sort of thing regularly, and if possible eliminate any technicians who bring discredit to the field." END

Radio Thirty-Five Years Ago
In Gernsback Publications

HUGO GERNSBACK
Founder

Modern Electrics	1908
Wireless Association of America	1908
Electrical Experimenter	1913
Radio News	1919
Science & Invention	1920
Television	1927
Radio-Craft	1929
Short-Wave Craft	1930
Television News	1931

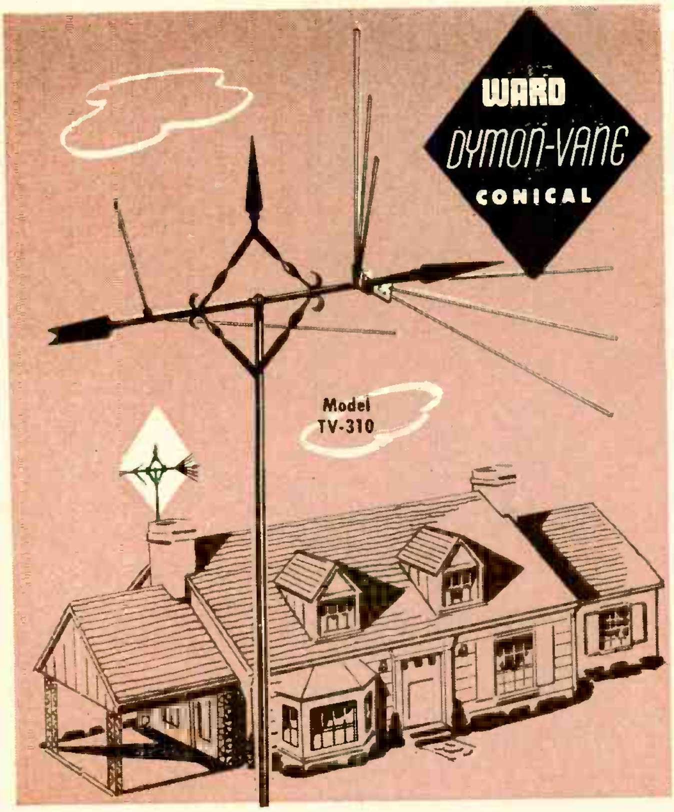
Some of the larger libraries still have copies of ELECTRICAL EXPERIMENTER on file for interested readers.

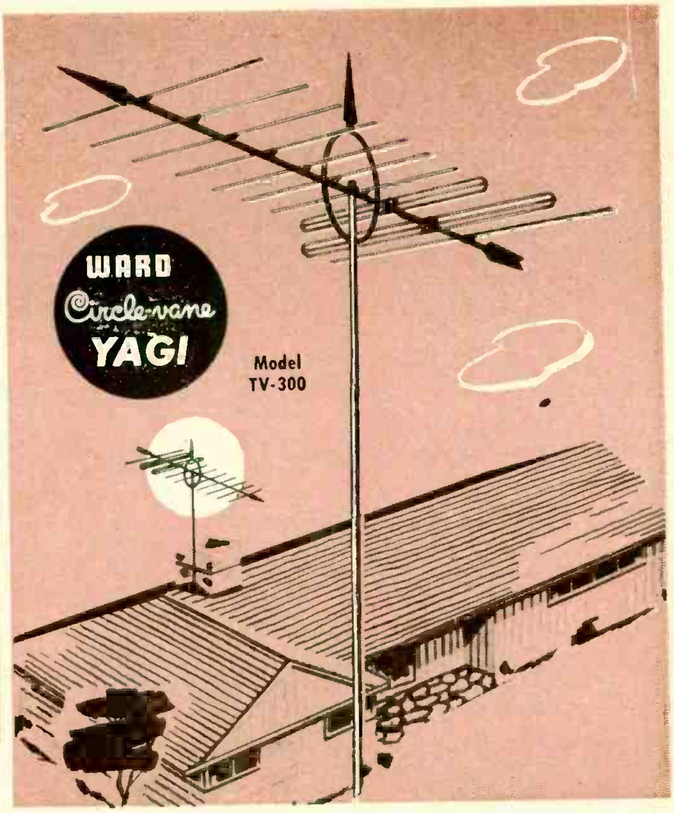
JANUARY 1920 ELECTRICAL EXPERIMENTER

A Celestial Short-Circuit, By H. Gernsback
Magnetic Storms, by Lindley Pyle
Learning Telegraphy and Radio at School
Is There a Sub-Electron?, by Rogers D. Rusk, M.A.
The Radio Compass, by Pierre H. Boucheron, U.S.N.R.F.
An Oscillion Radio Telephone and Telegraph
New Undamped Radio Receiver
Radio Fog Signalling a Success
New 165-ft. Portable Radio Mast

WARD TELE-VANES

styled for NEW BEAUTY on the housetops INCREASED SALES of TV antennas





Sell the antennas that are "selling" for you. Ward is promoting their new line of Tele-vane Antennas right to the consumer with national advertisements in:

- The American Home
- Architectural Forum
- Better Homes and Gardens
- Business Week
- House Beautiful
- Popular Mechanics Magazine
- Popular Science Monthly
- Time
- House and Garden Book of Building
- Newsweek

Write today for the giant Tele-vane Sales Kit that gives you the complete schedule plus many, many more selling aids. Tie-in with this gigantic selling campaign for the newest, most revolutionary idea in TV antennas yet.

THE WARD PRODUCTS CORP.

DIVISION OF THE GABRIEL COMPANY

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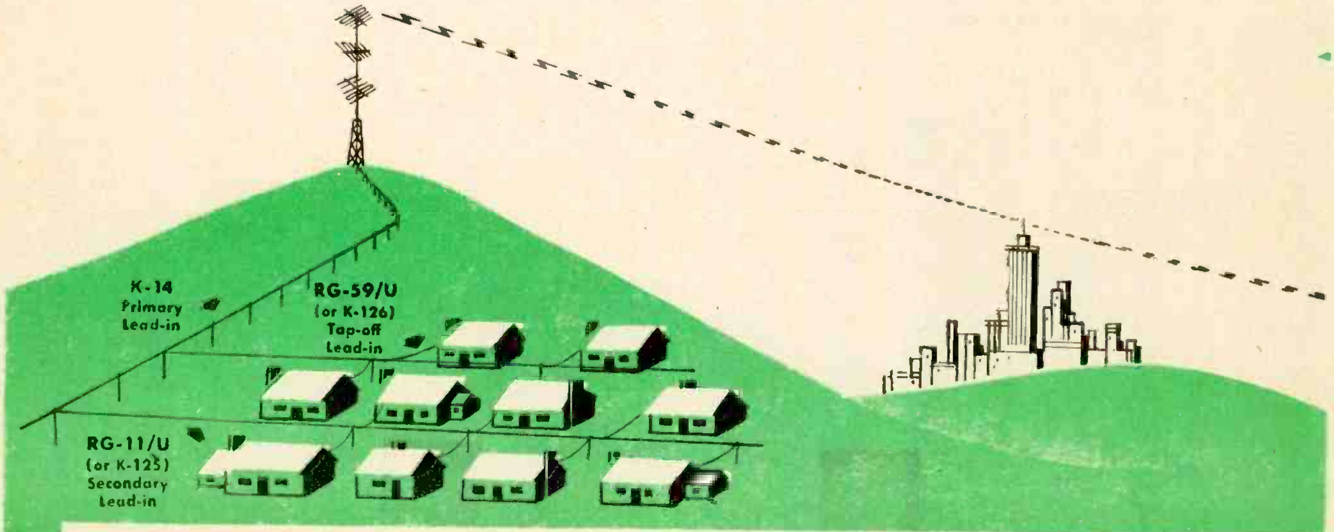
A GABRIEL PRODUCT

In Canada: Atlas Radio Co., Ltd., Toronto, Ont.

NORTH, EAST, SOUTH, WEST...

Federal has a lead-in

Whatever the area or atmosphere . . . city or fringe . . . rain, snow ice, heat, dust, salt spray, polluted air or radiation . . . you'll find the answer in these quality-controlled cables by Federal —



FOR COMMUNITY TV IT'S *Federal's* "BIG 5"

K-14—71-ohm shielded primary transmission line for community distribution systems. Famous for lowest line loss, long cable runs and fewer amplifiers required. Capacitance: 21.5 mmf/ft. Attenuation DB 100/ft: .57—50 Mc; .90—100 Mc; 1.42—200 Mc; 2.3—400 Mc.

RG-11/U—75-ohm shielded low-loss coaxial. One of the best small-diameter cables. Tops as a community TV secondary lead-in. Seven strands #26 tinned copper. Capacitance: 20.5 mmf/ft. Attenuation DB 100/ft: 1.5—50 Mc; 2.15—100 Mc; 3.2—200 Mc; 4.7—400 Mc.

RG-59/U—73-ohm coaxial TV lead-in cable. Highly efficient as a community system pole-to-house tap-off. Meets all needs wherever a high-grade installation is a must. Capacitance: 21 mmf/ft. Attenuation DB 100/ft: 2.7—50 Mc; 4.0—100 Mc; 5.7—200 Mc; 8.5—400 Mc.

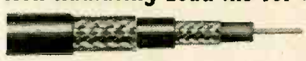
FOR URBAN CENTERS

K-111—300-ohm shielded, balanced TV lead-in developed by FTR. Minimizes noise, snow, ghosts due to transmission line pick-ups. Ideal for many areas where good TV was impossible before. Capacitance: 4.2 mmf/ft. Attenuation DB 100/ft: 3.4—100 Mc; 6.6—400 Mc.

TV-1184—300-ohm dumbbell-shaped TV lead-in. A standard low-cost lead-in for areas without unusual conditions. Cinnamon-brown color is highly resistant to ultraviolet. Two conductors: 7/#28. Capacitance: 4 mmf/ft. Attenuation DB 100/ft: 1.28—100 Mc; 3.0—400 Mc.

TV-1182—300-ohm deluxe type heavy-duty TV lead-in with 90 mil. web. Insulated with "silver" polyethylene, Federal development that provides maximum weather protection and long life. Capacitance: 4 mmf/ft. Attenuation DB 100/ft: 1.22—100 Mc; 2.85—400 Mc.

Non-Radiating Lead-ins for MULTIPLEX TV SYSTEMS



K-125–75-ohm coaxial TV lead-in cable. Double-shielded and jacketed. Formerly listed as SP-75.

K-126–73-ohm coaxial TV lead-in cable. Double-shielded and jacketed. Formerly listed as SP-76.

Use these 2 for Community TV radiation:

K-125 alternates for RG-11/U as secondary lead-in
K-126 alternates for RG-59/U as tap-off lead-in

If you want professional sound quality

Sound engineers know that the selection of a fine amplifier, pickup and speaker system is only part of the story; that unless the turntable is of equal quality, music reproduction must suffer. That is why they insist on such high standards for turntable performance.

do as the professionals do...

Rek-O-Kut precision turntables are made to conform to the highest standards in the professional field, and they certainly represent the finest you can use in the home. A Rek-O-Kut turntable will make all the difference in the world. The finer your present system, the more apparent the improvement will be. Whether you select the deluxe T-12H or the standard LP-743, the entire performance of your sound system will become a new and thrilling experience.

use a REK-O-KUT precision turntable

Rek-O-Kut Precision Turntables are priced from $59.50. Write for specifications and descriptive literature to Dept. J—13

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In Canada: Atlas Radio Corp., Ltd., 560 King Street, W., Toronto 2B

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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

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25 WEST BROADWAY NEW YORK 7, N. Y.

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20" Table $129.95 Pl. 10% Fed. Excise Tax

Check these luxury features: Ultra sensitivity, dynamic range control, UHF adaptability, Duo power supply, Acousticlear Sound System . . . All in a beautiful Mahogany Finish Cabinet.

20" Console $139.95 Pl. 10% Fed. Excise Tax

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Better Prices on quantity lots.

ALSO AVAILABLE T.V. CHASSIS

All sets have full 1 yr. factory picture tube warranty, and standard 90 day RTMA parts warranty.

MAIL and Phone orders filled. $25 deposit, Balance C.O.D., Shipping Charges Add'l.

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BUD HF-600 Filter
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Now you can stop or considerably reduce annoying picture disturbances caused by short wave broadcasting stations, amateur radio stations, diathermy and X-ray equipment or airplane and automobile ignition systems.

Keep your picture clear of distortions from interference picked-up by your antenna. A Bud Filter will not affect the strength or quality of your picture. Easily attached to the rear of your set. Simple instructions enclosed. Thousands now in use with excellent results.

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I enclose $____ please send me at once ____ Bud HF-600 Filters.
Name ____
Address ____
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NEW DESIGN

new tubes and Transistors

THE smallest TV camera tube ever developed for broadcast use has been announced by RCA. The vidicon, type 6326, weighs only two ounces, and promises greater efficiency and economy in the televising of movie films.

The new electronic "seeing eye" is only a fraction of the size of an iconoscope tube normally used for film pickup, yet it is up to three times more sensitive and has a spectral response approaching that of the human eye. The tube measures 1 inch in diameter and 6½ inches in length. Cameras using this new pickup tube can be used with any type TV-film projector.

Smallest TV camera tube, Vidicon 6326.

Developed from the well known industrial vidicon which is not suited to fine-detail work, the film-pickup type 6326 has a resolution capability of approximately 600 lines, and needs only one-third to one-half the light required by an iconoscope for television motion pictures.

The vidicon's visual equivalent of signal to noise ratio (the ratio of the intensity of desired video signal to that of undesired noise signal) has been measured as 300 to 1. The tube itself contributes no appreciable noise to the video signal. The new tube is also highly suitable for the reproduction of color films on a monochrome system.

G-E has announced the addition of tube type GL-6386 to its line of "Five Star" high-reliability tubes.

The 6386 is a miniature medium-mu triode with each section being of the

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MIDWEST *Presents*

For 1954 a Completely NEW LINE of

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TABLE MODELS
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COMPLETE CHASSIS
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YOUR CHOICE OF EITHER 12 CHANNEL VHF or All-Channel VHF-UHF Models

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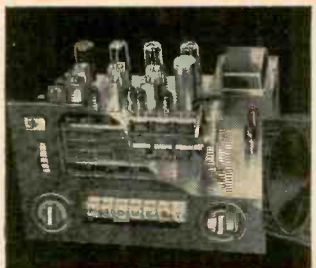
Also—Powerful New 1954 World-Ranging

MIDWEST Series 16 RADIOS

In Beautiful Consoles and Complete Chassis



Once again Midwest offers its famous series 16 five band AM-FM radio chassis and the magnificent new Symphony Grand Radio-Phonograph with 3-Speed Automatic Intermix Record Player. Also, a complete line of clock radios, table radios, and portables.

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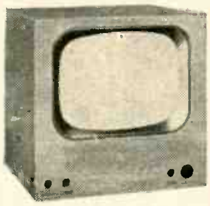
CUSTOM-BUILT CABINETS FOR #630 AND ALL OTHER TV SETS — from FACTORY to YOU

5 LEADING STYLES in genuine mahogany or walnut (blond 10% extra). • • • Ready drilled for any #630 TV chassis and cutout for any 14", 17", 19", 20" or 21" picture tube at no extras in price. • • • Also supplied with undrilled knob panel for any other TV set. • • • EVERYTHING NECESSARY for an easy perfect assembly is included • • • Each cabinet is delivered complete as pictured with mask, safety glass, mounting brackets, backboard, backcup, hardware and assembling instructions • • • Each cabinet is shipped in an air cushioned carton from FACTORY to YOU!

The VOGUE
Most Popular Table Model



H-25", W-26", D-22"

$39.89

VOGUE also available for 24" or 27" picture tube
H-31", W-27", D-23"

$62.54

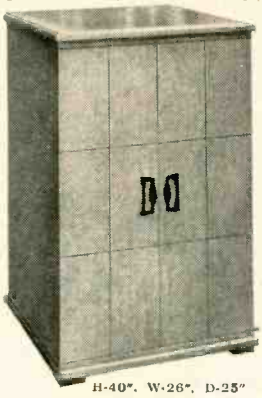
The MANHATTAN
Style, Quality, Price

H-41", W-25", D-23"

$59.37

MANHATTAN for 24" or 27" CRT
H-46½", W-27¾", D-24" **$86.22**

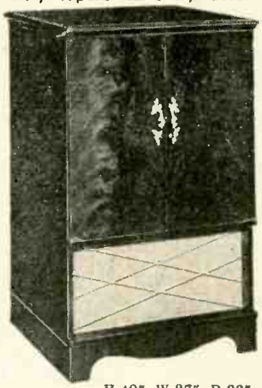
The MAYFAIR
Exquisitely modern, with an elegance of simplicity in styling.



H-40", W-26", D-25"

$98.56

The PLYMOUTH
Choice of interior Decorators, truly superb in every detail.



H-40", W-27", D-23"

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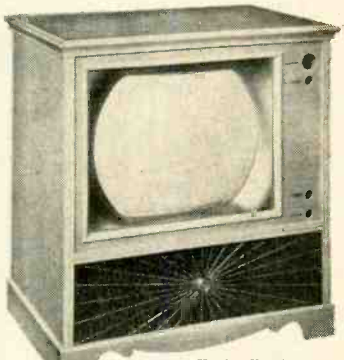
The TOWN & COUNTRY
Patterned after the popular credenza. Available for all size picture tubes 14" to 27"



H-42", W-36", D-24"

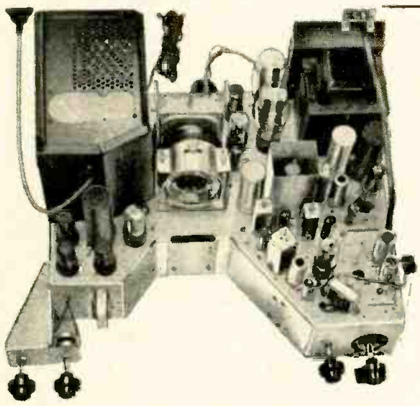
For 14", 16", 17", 19", 20", 21", 24" or 27" C.R.T.'s **$109.62**

SHELDON FINEST GUARANTEED PICTURE TUBES

MOST desirable 5 sizes — ALL RECTANGULAR • • • BRAND NEW in Factory Sealed Cartons — With a Full Year Guarantee

17" #17BP4A **$29.63**	20" #20CP4A **$39.74**	21" #21EP4A Aluminized **$44.68**	24" 90° #24CP4A Aluminized **$58.26**	27" 90° #27NP4A Aluminized **$82.57**

THE #630 TV RECEIVER remains unmatched for quality and performance • RCA designed and developed this set quality-wise *not* price-wise • The original 10" set retailed at $375.00 • Subsequent TV sets serve to prove the sacrifice of quality for price • What better proof can there be of its superiority than the fact that it is the choice of TV engineers and TV technicians! Herewith we offer you — YOUR BEST BUYS IN TV! All you pay is the price shown • • • Excise taxes have already been paid by us.



Build your own

#630 Super Deluxe TV CHASSIS with ... U. H. F.

With a #630 **SUPER DELUXE 31-TUBE TV KIT** including your favorite U.H.F. Station • OPERATES 16" TO 24" PICTURE TUBES • Engineered in strict adherence to the genuine RCA #630 plus added features • FULL 4MC BANDWIDTH • CASCODE TUNER • COSINE DEFLECTION YOKE • LARGER POWER TRANSFORMER • KEYED AGC • 12" SPEAKER • UNIVERSAL MOUNTING BRACKETS • CONDENSERS and RESISTORS at rated capacities and tolerances. You receive a COMPLETE SET of PARTS and TUBES, everything needed is included (less wire & solder). All I.F. Coils and Transformers are factory pre-aligned and tuned. You will enjoy building it with "LIFE-SIZE easy to follow step-by-step ASSEMBLING INSTRUCTIONS" included with each KIT.

NOTHING BETTER AT ANY PRICE *!*

only . . . **$119.44** (less CRT)

#630 SUPER DELUXE TV CHASSIS

with U.H.F.—Licensed under RCA patents

COMPLETE READY TO PLUG IN AND PLAY—Similar in characteristics and features to the TV KIT at left • Manufactured especially for us by Regal Electronics Corporation • No efforts or expense have been spared in workmanship or materials, to make this #630 SUPER DELUXE TV CHASSIS the Best obtainable for fringe areas, clarity and all-around-performance, regardless of price. Customers report reception better than 200 miles • Each Set is factory aligned and air-tested • All parts carry the RMA three month guarantee • Our mass volume of business on this CHASSIS (numbering thousands of pleased customers) now makes it possible for us to reduce the price to .... only **$157.97** (less CRT)

#630 TV SPECIALS BY TECH-MASTER

both with U.H.F.

TECH-MASTER Model C-30 TV CHASSIS. This Model has retained the outstanding characteristics of the RCA-630 circuitry, namely the four-stage, full bandwidth picture IF strip and the three-stage FM sound section • In addition, the latest innovations in synchronization and sweep circuits have been incorporated to produce a custom-quality receiver assuring outstanding performance • 30 tubes, 12" speaker.

Complete Ready to Plug in and Play.......... Special at **$149.50** (less CRT)

TECH-MASTER Gold Medal Model 2430-9 TV CHASSIS, 90° deflection, operates all 24" or 27" rectangular and 30" round picture tubes. The last word in TV achievement • Ideal for wall or custom-cabinet mounting • Detailed technical data mailed on request, however with the knowledge that this CHASSIS is a 30-tube #630 with both TECH-MASTER'S and OUR guarantee, you need not hesitate sending your order in now.

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#630 TV BASIC PARTS KIT

PUNCHED & DRILLED CHASSIS PAN
BRACKET & SHIELD KIT (18 items)
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POWER TRANSFORMER #201T6
VERTICAL OUTPUT TRANSFORMER
VERTICAL BLOCKING TRANSFORMER
FLYBACK TRANSFORMER #211T5
FOCUS COIL, 470 ohms #202D2
COSINE DEFLECTION YOKE 70°
Including LIFE-SIZE TV BUILDER INSTRUCTIONS

All for Only **$39.49**

Modernize a #630 or any TV Set with a

STANDARD CASCODE TUNER

For better all around performance

Complete with tubes, and Brooks CASCODE MANUAL with step-by-step instructions and all extra parts needed. **$22.49**

Brooks CASCODE MANUAL, how to install Cascode Tuner in any make TV Set. Postpaid ... **50¢**

PULSE KEYED AGC KIT

Finest, most accurate and the easiest Kit to install in a #630 or in any other make TV receiver. Improves performance, and insures a steady picture on all channels.

COMPLETE SET OF PARTS Including 6AU6 tube & Instructions **$4.59**

Brooks LIFE-SIZE TV INSTRUCTIONS, for building any #630 TV Receiver. Postpaid. **$2.49**

HINTS FOR BETTER PREFORMANCE on your #630 TV receiver. Postpaid....... **$1.00**

BROOKS RADIO & TV CORP., 84 Vesey St., Dept. A, New York 7, N.Y.

PARTS for #630 & Other TV SETS & EQUIPMENT

STANDARD CASCODE TUNER, incl. tubes	$22.49
ESCUTCHEON PLATE, for tuner	.69
COMPLETE SET OF KNOBS, incl. decals	1.34
POWER TRANSFORMER, 295ma. 201T6	9.97
VERTICAL OUTPUT TRANS. 204T2	2.69
VERTICAL BLOCKING TRANS. 208T2	1.32
HORIZONTAL OUTPUT TRANS. 211T1	2.47
HORIZONTAL OUTPUT TRANS. 211T5	3.98
FOCUS COIL, 247 ohms, 202D1	2.29
FOCUS COIL, 470 ohms, 202D2	3.42
DEFLECTION YOKE, 60° 201D1	2.97
DEFLECTION YOKE, Cosine 70° 206D1	3.98
SOUND DISCRIMINATOR TRANS. 203K1	1.12
1st PIX I.F. TRANSFORMER, 202K2	1.08
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HORIZONTAL DISCRIM. TRANS. 208T8	1.49
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FILAMENT CHOKES 204L1	.09
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PUNCHED CHASSIS PAN, cadmium plated	$4.87
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FOCUS COIL BRACKETS set	.49
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WIDTH CONTROL BRACKET	.16
TUNER SHAFT BRACKET	.17
FUSE (.25 amp.) & HOLDER	.24
HV RECTIFIER, SOCKET ASSEMBLY, single	.79
HV RECTIFIER, SOCKET ASSEMBLY, double	1.37
TV 6' LINE CORD, with both plugs	.29
INTERLOCK SAFETY CONNECTOR (input)	.17
COMPLETE TERMINAL STRIP KIT, set of 30	.98
AGC BRACKET & SOCKET	.39
MINIATURE WAFER SOCKETS	.07
MINIATURE MOLDED SOCKETS	.12
OCTAL WAFER SOCKETS	.07
CATHODE RAY TUBE SOCKET, 18" leads	.39
HV KINESCOPE LEAD, with clip	.39
AUDIO OUTPUT TRANSFORMER (6K6)	.69
8" PM SPEAKER, heavy alnico #5 magnet	3.97
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VARIABLE CONTROLS

PICTURE & SOUND, 10k ohms 1 meg. & switch	1.14
VERTICAL & HORIZ. 50k ohms 1 meg	1.04
BRIGHTNESS CONTROL, 50k ohms	.44
HORIZ. CENTERING, wirewound 20 ohms	.57
HEIGHT CONTROL, 2.5 megohms	.48
VERTICAL LINEARITY, 5000 ohms	.44
VERTICAL CENTERING, wirewound, 20 ohms	.96
FOCUS CONTROL, wirewound, 1500 ohms	.98
HORIZONTAL DRIVE, 20k ohms	.44

ELECTROLYTIC CONDENSERS — 85°C

40/10/80 mfd — 450/450/150 v	1.37
40/40/10 mfd — 450/450/450 v	1.49
80/50 mfd — 450/50 v	1.49
40/10/10 mfd — 450/450/350 v	1.37
20/80 mfd — 450/350 v	1.49
250/1000 mfd — 10/6 v	.98

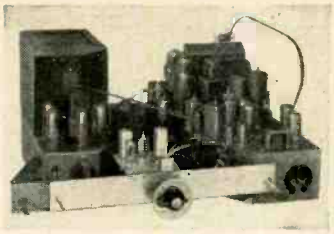
H.V. FILTER CONDENSERS—(Cartwheels)

15kv	500 mmf	.67
20kv	500 mmf	.79
30kv	500 mmf	1.49

#630 PARTS 'N COMPLETE SETS

TV WIRE & SOLDER KIT, for any Set	$1.49
VIDEO AND I.F. KIT, 19 items	7.84
VARIABLE CONTROL KIT, 9 controls	5.83
CARBON RESISTOR KIT, 107 resistors	6.98
WIREWOUND RESISTOR KIT, 4 resistors	2.31
BRACKET AND SHIELD KIT, 18 items	8.63
ELECTROLYTIC CONDENSER KIT, 6 cond	7.37
TUBULAR CONDENSER KIT, 38 condensers	4.28
CERAMIC CONDENSER KIT, 28 condensers	3.37
MICA CONDENSER KIT, 11 condensers	1.38
TERMINAL STRIP KIT, set of 30	.98
COMPLETE SET OF TUBES, 29 tubes	30.31

BELIEVE IT OR NOT!



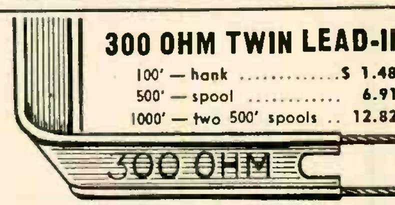
Lists for $24.95 — Its Yours for $7.89

AM SUPER RADIO FOR #630 or other TV. Complete, ready to install w/tubes & instructions.

72 OHM COAXIAL CABLE

100' — hank	$ 4.64
500' — spool	21.99
1000' — two 500' spools	39.86

300 OHM TWIN LEAD-IN



100' — hank	$ 1.48
500' — spool	6.91
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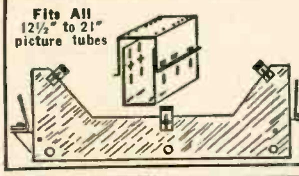

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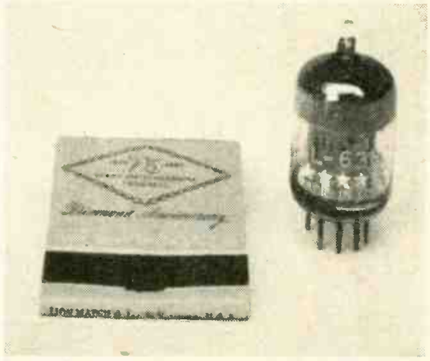
NEW DESIGN

remote-cutoff type. It is designed for applications as a cascode r.f. amplifier, i.f. amplifier, or mixer in circuits which use a.g.c. When used in cascode applications, the performance of the tube is



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Development of a 21-inch, 90° deflection TV picture tube has been announced by Westinghouse and Sylvania.

Designated as type 21AMP4 and type 21ANP4 for magnetic and electrostatic focus respectively, the tube produces a picture 5% larger than any previous 21-inch type.

The over-all length of the new tube is approximately 3 inches shorter than current 21-inch types.

Radio Receptor has announced production of their type RR38 P-N-P junction transistor. The RR38 is designed for operation at low power output levels. It is particularly applicable as the output stage for hearing aids and personal receivers.

Maximum ratings for the RR38 are: collector voltage, –25; collector current, –5 ma; collector dissipation, 50 mw; ambient temperature, 50° C.

RCA has announced a short multiplier phototube of the 9-stage type for automobile headlight-dimming.

Designated as the RCA-6328, it has instantaneous response to meet the critical timing requirements of headlight-control service, and is capable of providing stable performance over long periods. Its high luminous sensitivity allows use of an amplifier with relatively low-impedance input and fewer stages than required by a less sensitive tube.

The low dark current of the 6328 permits the use of high-resistance voltage-divider networks to minimize power requirements and to improve not only operating stability but also tube life.

Its maximum anode-supply voltage is 1,250, current, 0.1 ma. END

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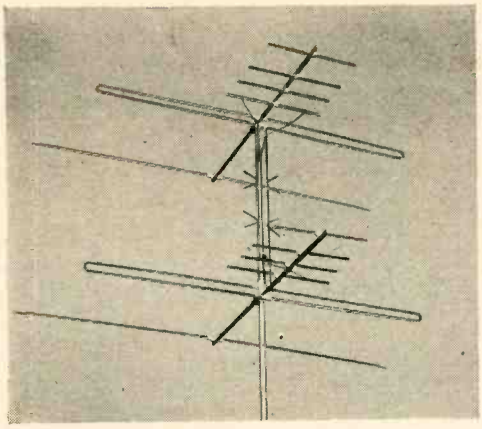
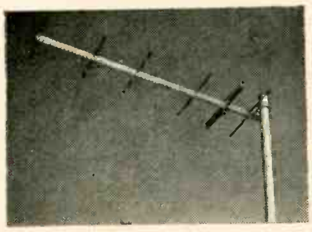


Model FDY VHF-UHF



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1S4	.52	6AG5	.46	6C4	.31	6W4GT	.41	19BG6G	1.16
1S5	.38	6AT6	.36	6C5	.41	6W6GT	.41	19T8	.61
1T4	.46	6AU6	.36	6CB6	.42	6X5GT	.31	25BQ6GT	.79
1U4	.46	6AV6	.36	6CD6G	1.08	12AT6	.31	25L6GT	.42
1U5	.38	6BG4	.79	6H6	.38	12AT7	.57	35B5	.46
1X2A	.52	6B5	.55	6J5GT	.34	12AU6	.34	35C5	.46
3Q5GT	.55	6BA6	.33	6J6	.51	12AU7	.52	35L6GT	.42
3S4	.46	6BC5	.46	6J7	.49	12BA6	.42	35W4	.32
3V4	.46	6BE6	.38	6K6GT	.36	12BE6	.42	35Z5	.33
5U4G	.44	6BG6G	1.16	6SA7	.44	12BH7	.53	50B5	.46
5Y3GT	.36	6BH6	.46	6SK7	.44	12C8	.49	50C5	.46
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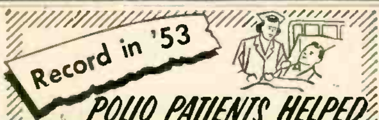

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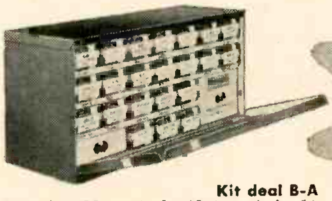

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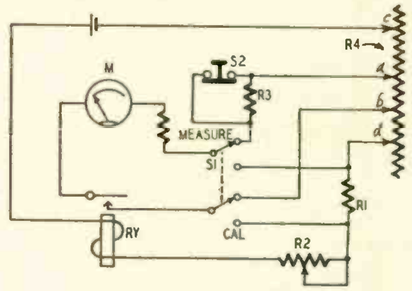
NEW PATENTS

MILLIOHMMETER PROTECTION

Patent No. 2,648,820
John H. Miller, Short Hills, N. J.
(Assigned to Weston Electrical Instr. Corp.)

A milliohmmeter measures thousandths of an ohm. The instrument is actually used as a millivoltmeter and is connected across the resistance to be measured. A controlled current flows through this resistance and the voltage drop is measured by the meter.



A milliohmmeter must be used with special care, for, if the unknown resistance is high or open-circuited, it will develop a very high voltage and will damage the meter. This patent shows the use of a relay to protect the meter.

In the diagram, R4 is the unknown resistor. Battery current flows through terminals c-d, but only the resistance a-b is to be measured. Since the meter consumes a very low current, the terminal resistance at a-b is negligible. Terminals c, d, are not within the measured circuit, so their resistance has no effect.

To make a measurement, depress S1. The meter M then measures a standard resistor R1. Adjust R2 till M reads full-scale. Then release S1 to its MEASURE position across a-b. Since the battery current is unchanged, the new reading will show the percentage of a-b to R1. M is calibrated in milliohms.

The relay coil RY is energized only when sufficient current flows through R4. If R4 is too high or open-circuited, RY will not attract its armature, and the meter circuit will be open. RY is adjusted to operate *only* if the unknown resistor is low enough for safe meter current.

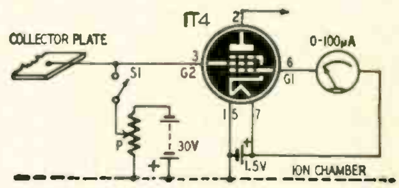
R3 is a range multiplier. Normally S2 is closed. With this switch open, the millohmmeter can measure higher resistance.

D.C. AMPLIFIER

Patent No. 2,646,515
Leslie Lynch, Bell, Calif.

This amplifier has a very high input resistance and a low output resistance. It is sensitive and consumes little power. The tube is connected as an inverted voltmeter. G1 acts as anode, and G2 is the control element. At the start of a measurement, S1 is closed momentarily to place a negative voltage on G2. Radiation causes loss of this negative charge so that the microammeter needle deflects upward.

The v.t.v.m. and associated parts are enclosed within an ionization chamber, one side of which is represented by a broken line. At the center of the chamber is a collector plate. When the switch is closed, the plate goes negative. Radiation acting within the chamber ionizes it and releases positive particles which fall on the plate.



They neutralize the negative charge and thus permit more current flow in the G1 circuit. With more intense radiation, the meter will deflect faster. The inventor has determined that a 1T4 or similar tube will have a linear output between 40 and 100 microamperes. Therefore P should be set for an initial meter reading of .40 µa. Normally, the circuit as shown here will saturate at about 100 µa, so no limiting device is needed.

In practice, errors may occur due to cosmic rays and leakage. These factors, like the radiation itself, cause a gradual loss of the negative charge

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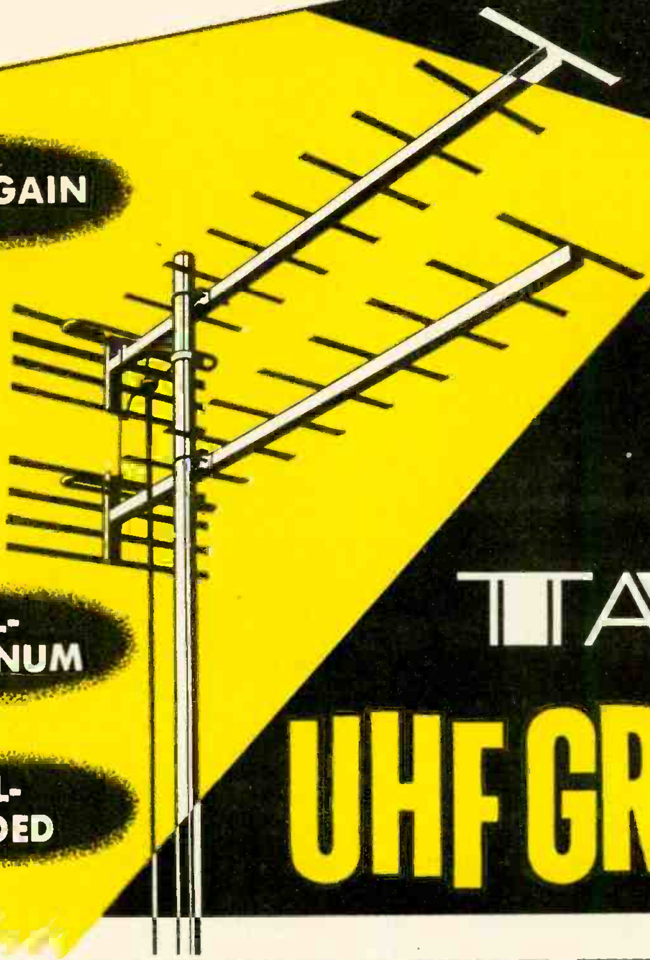

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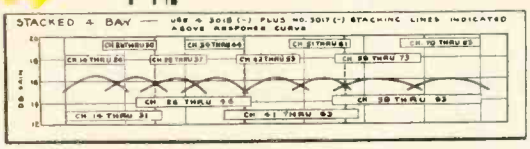

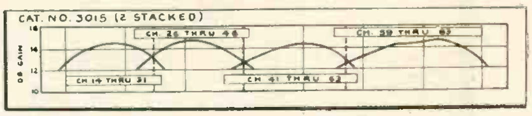

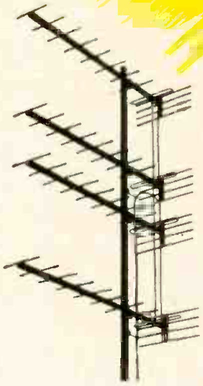

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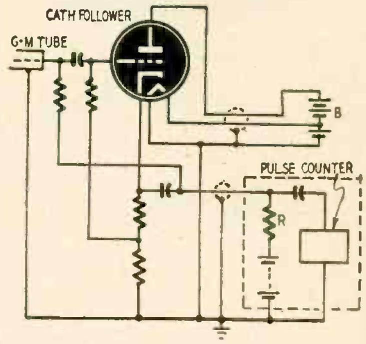
and a continual rise in the meter deflection. To offset these errors, the instrument should first be used with no radiation present. From the time S1 is momentarily closed, the meter reading will continue to rise toward the saturation value. This no-radiation measurement is the *back count*. When the instrument is placed within a radiation field, it measures both the unavoidable back count and the radiation. Allowance must be made for back count if radiation count is to be accurate.

REMOTE GEIGER-MULLER TUBE

Patent No. 2,642,539
Samuel W. Lichtman, Oxon Hill, Md.
(May be manufactured and used by the U. S. Government without royalty payments)

A Geiger-Muller tube must usually be operated near the radiation source it is measuring. Sometimes the source is not easily accessible and must be remotely probed. Often, the radiation is intense and presents a hazard to nearby personnel. In either case it is necessary to use the G-M tube far from its power supply and from the pulse counter into which it feeds.



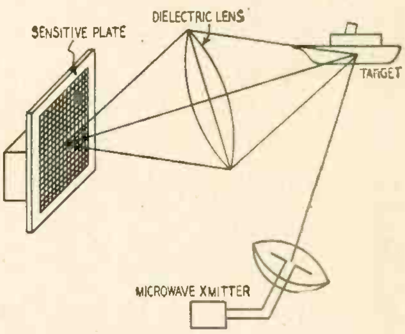
The G-M tube feeds directly into a cathode follower triode. These tubes are fed remotely by 2 cables as shown in the diagram. The lower cable contains the high voltage lead for the G-M tube. It also carries output from the cathode follower to the pulse counter. Due to the cathode follower connection, the output impedance of the triode is quite low. It can be made to match the line impedance. R is the termination load for the line. The upper cable contains the plate and filament supply from battery B to the triode.

RADAR CAMERA

Patent No. 2,627,600
Robert H. Rines, Brookline, Mass.

This patent discloses an idea for making photographs by radar. Radio waves reflected from a target are focused on a special sensitive plate and thereby photographed.

The photographic plate is made by spraying an aluminum compound on a suitable backing of any kind. Germanium or other semiconductive substance is mixed with the metal. Then a chemical compound sensitive to heat is applied. Under the influence of heat, the acid concentration (pH) of the compound is changed.



To make a radar photograph of a distant object, it is scanned by pulses of microwave energy from a highly directional transmitter. The reflected waves are focused by a dielectric lens onto the sensitive plate. The particles of the film receive and rectify the waves. Heat is liberated in proportion to signal strength and changes the pH of the chemical coating. Suitable dyes controlled by the acid concentration produce a permanent image. END

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TRANSISTOR TRIGGER

Patent No. 2,604,496

Lloyd P. Hunter, Pittsburgh, Pa.

(Assigned to Westinghouse Electric Corp.)

This circuit can be triggered by a positive pulse of about a volt. Triggering is extremely rapid, requiring only about 0.1 microsecond. Reset time is a few microseconds. See Fig. 1.

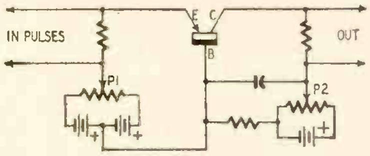


Fig.1

P1 and P2 adjust the emitter and collector voltages. The output characteristic of the point-contact transistor is shown in Fig. 2. The lowest portion AB shows positive resistance. At higher currents there is a kink in the curve indicated by BC. This portion has negative resistance. Thereafter, the resistance goes positive again (CD). The peak B varies with emitter bias. A more positive emitter reduces the peak, for example from B to H.

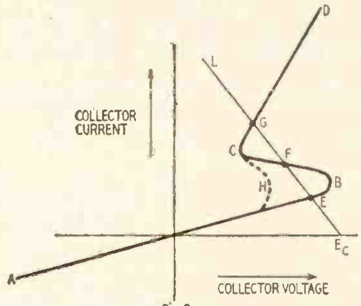


Fig.2

The collector load line is shown as L. It intersects the curve at 3 points: E, F, G. Since F lies on an unstable portion of the curve, there are only two permissible operating points. For this trigger application, E is chosen.

If a positive pulse arrives at the emitter, B is momentarily reduced to H. This leaves only one intersection (G) between load line and characteristic curve. The circuit is instantly tripped to this point, the collector current rising from about 1 ma to 10 ma. This output pulse lowers the collector voltage for an instant and the operating point returns to E.

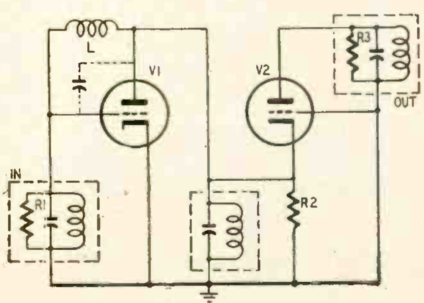
CASCODE AMPLIFIER

Patent No. 2,644,860

Christopher P. Gadsden, Belmont, Alan B. Macnee, Boston, and Henry Wallman, Cambridge, Mass.

(Assigned to United States of America as represented by the Secretary of the Navy)

The cascode combines the desirable features of the grounded-cathode and grounded-grid amplifiers, and eliminates their disadvantages. It has the high gain of a pentode and the low noise of a single triode. It is stable and covers a wide band. The equivalent source resistance (R1) is made high. The equivalent output resistance (R3) of the cascode is low for wide-band coverage. R2 is the equivalent low resistance of a grounded-grid amplifier. It prevents instability in the first triode. L neutralizes the grid-plate capacitance of V1. END



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1S4	.55	6AG5	.49	6C4	.34	6W4GT	.41	19BG6G	1.19
1S5	.41	6AT6	.34	6C5	.44	6W6GT	.31	19T8	.64
1T4	.49	6AU6	.37	6CB6	.45	6X5GT	.34	25BQ6GT	.82
1U4	.49	6AV6	.34	6CD6G	1.11	12AT6	.34	25L6GT	.41
1U5	.41	6B4G	.82	6H6	.41	12AT7	.60	35B5	.49
1X2A	.55	6B5	.55	6J5GT	.37	12AU6	.37	35C5	.49
3Q5GT	.58	6BA6	.36	6J6	.54	12AU7	.49	35L6GT	.45
3S4	.49	6BC5	.49	6J7	.49	12BA6	.41	35W4	.32
3V4	.49	6BE6	.41	6K6GT	.37	12BE6	.41	35Z5	.36
5U4G	.37	6BG6G	1.19	6SA7	.44	12BH7	.56	50B5	.49
5Y3GT	.34	6BH6	.49	6SK7	.44	12C8	.49	50C5	.49
6AC7	.71	6BJ6	.49	6SN7GT	.49	12SA7	.49	50L6GT	.45
6AH6	.64	6BL7GT	.79						

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UHF CONVERTER

P. R. Mallory & Co., Inc., 3029 E. Washington St., Indianapolis 6, Ind., has announced a redesigned all-channel u.h.f. converter, model 88. This converter is 50 percent smaller than their previous model. A single knob tunes all the u.h.f. channels in a total of 7½ turns. A second knob switches from u.h.f. to v.h.f. and also turns both the converter and television set on and off. When using the converter, the television set may be left on either channel 5 or 6, whichever receives less external interference.

The model 88 is continuously tuned for channels 14–83. It uses a 6AF4 or 6T4 oscillator tube, a 6CB6 i.f. amplifier, and a 1N72 u.h.f. diode detector. Input and output impedances are 300 ohms. The converter uses a power transformer, selenium rectifier, and resistance-capacitance filter, and requires about 25 watts from a 115-volt, 60-cycle power line. The cabinet measures 7½ x 4$\frac{5}{16}$ x 5¾ inches.

FLYBACK TRANSFORMERS

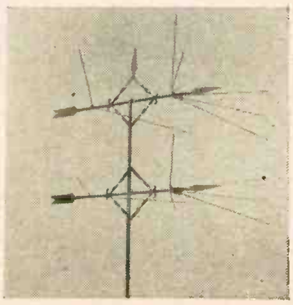
Chicago Standard Transformer Corp., Standard Division, Addison and Elston, Chicago 18, Ill., has announced three new Stancor replacement flyback transformers for Motorola sets.

Each unit has a horizontal-centering control, variable-gap width control, and a socket for a 1B3 rectifier.

These three transformers cover 91 Motorola models of 52 chassis. Stancor part number A-8224 replaces Motorola flybacks 24C711265, 24C711265-A, and 24C721290 in 56 models. A-8225 replaces 24K712193 in 15 models. A-8226 replaces 24K721301C and 24K721517C in 20 models.

TWO NEW TV ANTENNAS

Ward Products Corp., a Division of the Gabriel Co., Cleveland, Ohio, has developed two new antennas, the *Circle-vane* and the *Dymon-vane*. The Circle-vane is designed for use in rural or suburban fringe areas where a great deal of sensitivity is required. It is a 10-element Yagi type antenna with aluminum elements on a Permatube crossarm.



The Dymon-vane conical pictured above is recommended for areas where both low- and high-band television stations are in operation and transmitting in the same general direction. By supplementing the single unit with additional units or bays, this may be used to receive signals up to 100 miles from the transmitting station.

WAVE-TRAP SELECTOR

Vidaire Electronics Mfg. Co., Lynbrook, N. Y., has developed a wave-trap selector, the *Fil-Test*, which determines the type of filter or wave-trap needed by switching two dials.

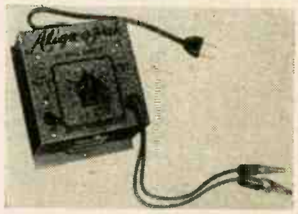
If a TV service technician makes a repair call and finds no interference present at the time, he can hook up this meter and explain to the set owner that when the trouble reoccurs, twist

the two dials until it clears. The technician then stops by later to take his reading and pick up the instrument, for he then knows what filter or trap to install.

Known as the model FT-100, the unit has wavetraps and filters which may be switched into the antenna and a.c. line circuits.

ALIGNMENT TOOL

Service Instruments Co., 422 S. Dearborn St., Chicago 5, Ill., has an-



nounced the *Align-O-Pak* unit to replace bias batteries when aligning TV receivers. Its output is variable from 0 to 10 volts d.c. Output leads are isolated from the metal case and power line to provide a fixed a.g.c. bias for any television receiver. If a stable picture appears when the bias leads are connected to the a.g.c. bus and the output is varied, then the a.g.c. is faulty.

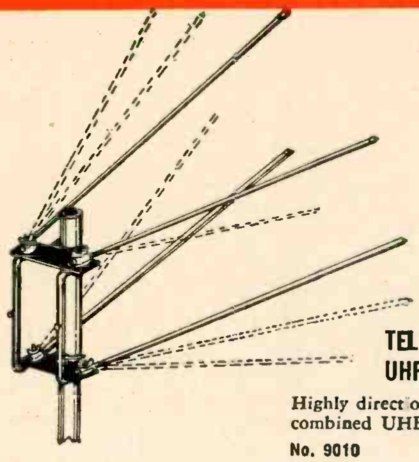
REMOTE CONTROL

Regency Division—I.D.E.A., 7900 Pendleton Pike, Indianapolis 26, Ind., is manufacturing a remote control for TV, model RT-700. This device is operated on a single-conductor cable, and selects stations, adjusts fine-tuning and controls contrast and volume from as far away as 100 feet.

ALL-CHANNEL ANTENNA

Trio Manufacturing Co., Griggsville, Ill., has announced an addition to their Zig-Zag line, the *Twin-Six*. This single-bay, all-channel antenna offers satisfactory u.h.f. reception in primary areas.

THE "TELCO TEN"



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TELCO "DOUBLE V" UHF-VHF ANTENNA

Highly directional...adjustable for combined UHF-VHF 50°-70°-90°.

No. 9010 List $6.95

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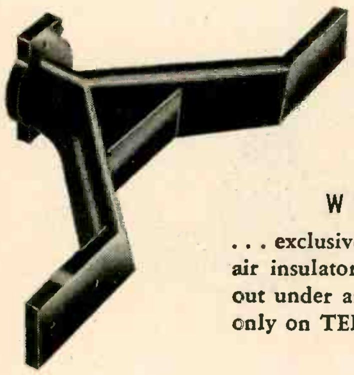

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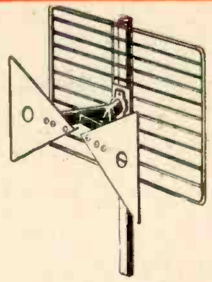
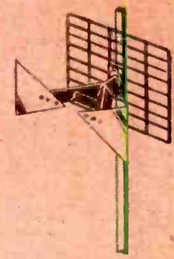


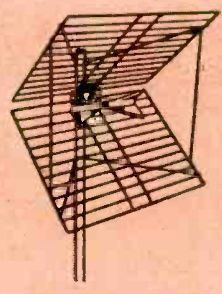
TELCO UHF "GOLDEN GRID" SUPER DELUXE BUTTERFLY ANTENNA

No. 8965 List $5.95



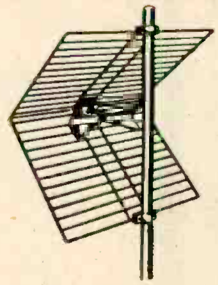
TELCO UHF "GOLDEN GRID" STANDARD BUTTERFLY ANTENNA

No. 9001 List $3.95



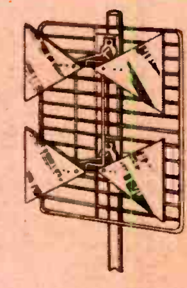
TELCO UHF "GOLDEN GRID" DELUXE CORNER REFLECTOR ANTENNA

No. 8984 List $11.25



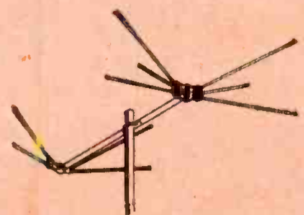
TELCO UHF "GOLDEN GRID" STANDARD CORNER REFLECTOR ANTENNA

No. 9002 List $11.25



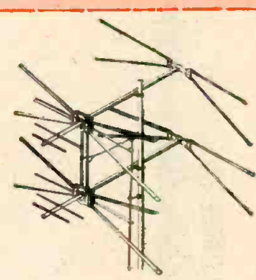
TELCO UHF "GOLDEN GRID" 2-STACK DOUBLE TIE ANTENNA

No. 9004 List $7.50 less mast



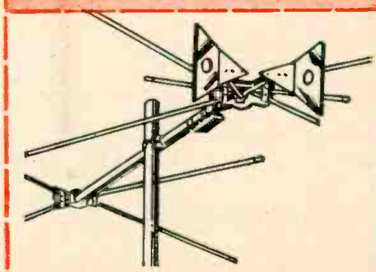
TELCO VHF CONICAL ANTENNA

No. 8700 List $9.25



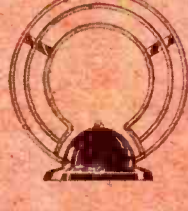
TELCO VHF SUPER CONICAL ANTENNA

No. 8902 List $19.85



TELCO UHF-VHF UNIVERSAL CONICAL ANTENNA

No. 8981 List $16.25

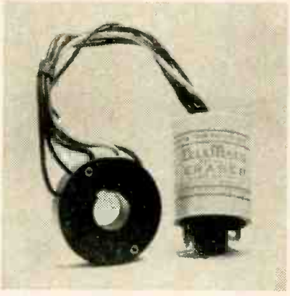


TELCO UHF-VHF "GOLDEN HALO" INDOOR ANTENNA

No. 9000 List $4.95

RETRACE ERASER

Tele-Matic Industries, Inc., 1 Joralemon St., Brooklyn 2, N. Y., has made available a device to eliminate retrace lines which interfere with TV reception. This unit, the model CR-59, is plugged into the back of the cathode-ray tube and connected to the yoke by one lead.



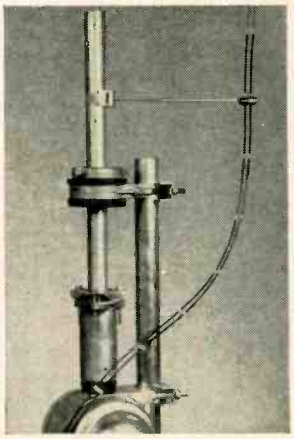
DEFLECTION YOKE

RCA, Harrison, N. J., has announced a magnetic deflection yoke for 27-inch rectangular picture tubes with horizontal deflection angles of 85° and diagonal deflection angles of 90°.

The horizontal and vertical coils of the deflection yoke type 219D1 are especially wound to compensate for deflection defocusing, and provide good side and corner resolution.

ROTOR SECTION

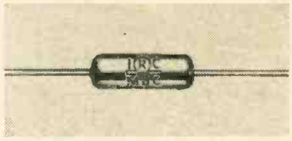
The Buchan Co., Bricelyn, Minn., is manufacturing the LL300 Rotor-Section, a 6-foot length of 300-ohm open-wire line with each conductor insulated with fiberglas tubing. Equipped with Nicopress-sleeve solderless connectors, it can be quickly and easily attached to 300-ohm open-wire line so that it can be used with an antenna rotor without danger of shorting, and still maintains the low-loss, long-life features of open-wire line.



PRECISION RESISTORS

International Resistance Co., 401 N. Broad St., Philadelphia 8, Pa., has developed a molded-boron carbon-film type precision resistor rated at 1/2 watt. This unit, type MBC, is molded in a special plastic housing to provide complete mechanical protection.

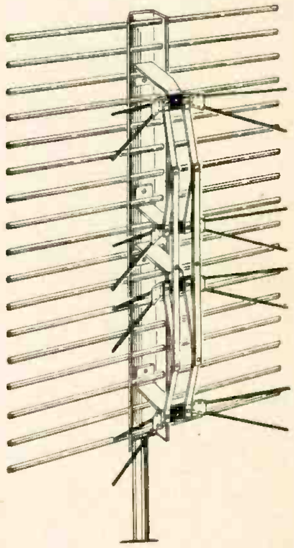
Its size is the same as a 1-watt composition resistor—body length 9/16 ± 1/32 inches, body diameter 5/32 ± 1/32



inches, lead length 1 1/2 ± 1/8 inches, and lead diameter .032 inches minimum. The resistor meets Signal Corps specification MIL-R-10509A, and is recommended for application where stability and high-voltage insulation are needed.

UHF ANTENNAS

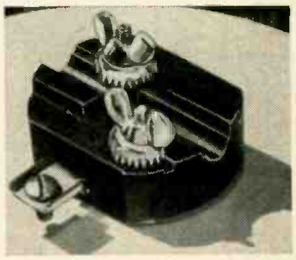
Telrex, Inc., Asbury Park, N. J. has announced the new "80" Series u.h.f. *Conical-V Beam* all-channel antennas. The series includes 1-, 2- and 4-bay models, a parabolic array, and a corner reflector. They are light-weight, all-aluminum antennas, and are single-clamp mounted to any standard mast.



LIGHTNING ARRESTER

iE Manufacturing, 325 N. Hoyne St., Chicago, Ill., is producing a lightning arrester for all common types of transmission lines, including tubular, small-oval, large-oval, open-wire, 300-ohm, and Anaconda line.

Positive contact is made by long,



piercing teeth which bite into the insulation. Insulation, regardless of thickness, need not be stripped. Impedance of the line is not disturbed. The unit is completely enclosed in plastic molded housing and is adaptable for indoor or outdoor installation on walls, windows, masts, or pipes.

PRINTED-CIRCUIT KITS

Centralab—Division of Globe Union, Dept. H-22, 900 E. Keefe Ave., Milwaukee 1, Wis., is now furnishing its *Printed Electronic Circuits* in four handy kit assortments. The four kits range from a group of 18 units to a complete stocking cabinet of 220 plates. With these units, sets can be made smaller and more compact, and circuits themselves are simplified when one component is used to replace 9 or 10 different parts. Solder connections are substantially reduced, and now even the original cost of the units is lower than the total of old-style components.

When trouble is located in a certain section of a radio or TV chassis, instead of spending time locating the exact faulty component, the service technician removes the entire circuit

part, replacing three to nine old-style components with a single printed circuit.

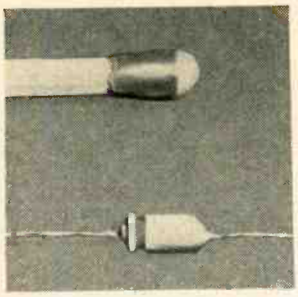
The smallest kit of 18 printed circuits will replace 42 resistors and 52 capacitors. Kits PCK-18 and PCK-45 contain 18 and 45 units respectively and come in plastic boxes. Kits PCK-110 and PCK-220 contain 110 and 220 units respectively and come packed in large, sturdy metal cabinets.

TANTALUM CAPACITOR

General Electric Co., Schenectady 5, N. Y., has announced a tantalum capacitor, believed to be the smallest high-capacitance unit ever designed for low-voltage direct-current applications. It is intended as a companion for the transistor. The unit is 5/16 inch long and 1/8 inch in diameter.

The major feature of the unit is the advantage in size per volt-microfarad over most other electrolytics. Other features include: long shelf and operating life, wide temperature range, and low leakage current. The unit is sealed against leakage or contamination and utilizes a nonacid electrolyte.

It is designed to operate over a temperature range of — 20 degrees C to + 50 degrees C and is suitable for storage at — 65 degrees C.

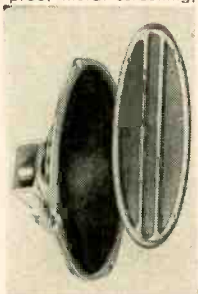


The new unit is available in ratings from 2 to 16 volts, 4 to 0.7 µf respectively. Another, larger capacitor—1/2 inch long—with similar characteristics and the same voltage range, but with 8 to 1.5 µf, has also been announced as available.

AUTO SPEAKER KIT

Lowell Manufacturing Co., 3030 Laclede Station Road, St. Louis, Mo., announces a new rear seat auto extension speaker baffle kit that replaces their older model.

The model R7-K includes a 6 x 9-inch oval speaker with 2.15-oz. magnet, a 3-way switch, knob, dial plate, stamped metal baffle plate with tamper-proof metal screening, 15 feet

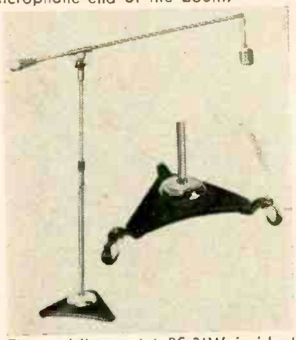


of cable, and complete mounting instructions.

The new kit is available with or without speaker, in chrome as well as in grey, light blue, or light bronze.

MICROPHONE STANDS

Atlas Sound Corp., 1451 39th St., Brooklyn 18, N. Y., has added the BS-36 professional boom type microphone stand to its line. This model features an "air-lock cushion" built into the vertical section to prevent slipping, and a new swivel joint at the microphone end of the boom.

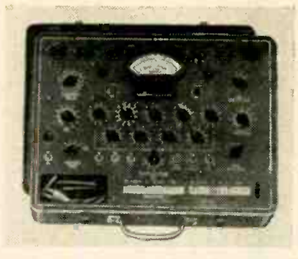


The mobile model BS-36W is identical to the BS-36, except for a base equipped with ball-bearing swivel casters. Boom length is 72 inches. An extension may be added if the microphone used is light-weight.

TUBE CHECKER

Weston Electrical Instrument Corp., 614 Frelinghuysen Ave., Newark 5, N. J., has announced a new tube checker, model 981, type 2. This unit measures proportional mutual conductances, emission characteristics of rectifiers and diodes, and the firing potential limits of voltage regulators and low-power thyratrons.

The model 981, type 2 provides 19 filament voltage settings from 0.65 to 115 volts and five plate voltages from



20 to 177, with a 45-volt source to facilitate testing of subminiature type tubes. Over-all voltage variations are corrected by a line-control adjustment. Signal voltages of 3.2, 1.6, .8, and .4 volts are provided at a frequency of 5 kc. For testing voltage-regulator tubes a selenium-rectifier supply furnishes 200 volts d.c. for a maximum current of 65 milliamperes. The instrument comes in a sturdy steel case of gray hammertone finish, measuring 17½ x 13¼ x 6 inches.

BINAURAL TAPE RECORDER

Electronic Teaching Laboratories, 1818 M St., N.W., Washington 6, D. C. has announced the new *Electro-Dual* binaural magnetic tape recorder designed especially for educational applications. It features simultaneous parallel tracking with either or both tracks in play or record. Instructions can be issued to the student on one channel and student responses can be recorded on the other.

The unit consists of separate miniaturized amplifiers using two 5879's, two 12AU7's, and one 6X4 for each channel. Response is ±2 db from 40 to 8,000 cycles at 3.75 inches per second and ±3 db from 50 to 12,000 cycles at 7.5 inches per second. Each amplifier has a meter for measuring signal input and output. One 3-circuit phone jack permits binaural phones to be used in monitoring either channel. Another jack is provided for binaural output.

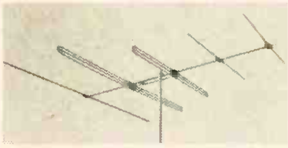
GUY-WIRE WINCH

Royal Television Supply Co., Modesto, Calif., has announced its new *Giline Winch*, designed to simplify the securing of guy lines.

The Giline Winch is mounted with one bolt. The channel and ratchets are made of 12-gauge steel, with drums of heavy steel rods. It is virtually foolproof, in that the cotter pins lock firmly in place against the ratchet pawls. A turn of the wrench gives proper tension to the guy lines.

VHF YAGI

Channel Master Corp., Ellenville, N. Y. has developed a 5-element broadband



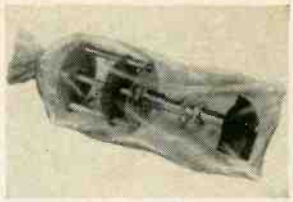
Yagi, model 626. The antenna covers channels 2–6.

A specially designed phasing harness keeps the gain flat over the entire band. The antenna has up to 7-db gain as a single bay and 9½-db gain stacked. The front-to-back ratio is over 20 db.

ROTARY SWITCHES

Erie Resistor Corp., Erie, Pa., has announced a new line of rotary selector and lever switches.

Among the new design features are a flat rivet which fastens contact to the stator to prevent loosening or rotating due to soldering heat. The rotor assembly is combined with the solid stator for rugged construction in which rotor blades do not support the assembly.



CAPACITY DECADE BOX

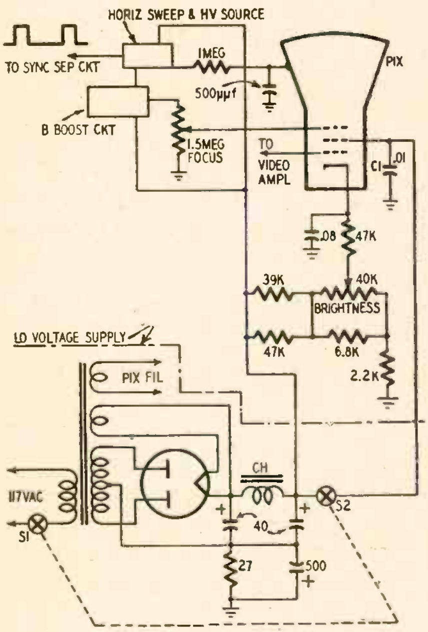
Precise Development Corp., Oceanside, L. I., N. Y., has announced the model 478 capacitance decade box, which offers four decades from 100 μμf to 1.111 μf, equivalent to 10,000 capacitors. The entire unit is pocket-size, (measuring 3¾ x 6¼ x 2 inches), and comes in a bakelite case. The model 478 is available in kit or wired. **END**

All specifications given on these pages are from manufacturers' data.

SPOT BLANKING FOR TV

In some TV receivers, particularly those using electrostatic focusing or PM focusing magnets, an intense spot of light appears on the screen when the set is first turned off. This bright spot is the result of bombardment by the residual electron beam and is the cause of brown stains on the screen which resemble ion burns.

When the set is first turned off, the charge on the low-voltage filter capacitors dissipates rapidly through bleeder resistors and tubes which are still hot enough to be conductive. The high-voltage filter capacitor—usually a 500-μμf unit or the capacitance between ground and the inner aquadag coating of the picture tube—takes a comparatively long time to discharge. It discharges only through stray leakage and through the residual electron beam. The spot of light remains on the screen until the high-voltage filter capacitor discharges to the point where its voltage is too low to attract electrons from the cathode.



The phosphor of the average TV picture tube can absorb a beam dissipation of approximately 1.5 milliwatts per square centimeter for 10 seconds without damage. However, time is an important factor in the ability of the screen to dissipate this power without damage. A beam of much lower wattage will damage the screen if it remains in one spot too long.

Robert J. Schipper and Robert A. Stacy have been issued Patent No. 2,638,562 covering a circuit designed to extinguish the residual electron beam before it has time to burn the screen.

The diagram shows the patented circuit added to the picture-tube and power-supply circuits of a typical TV set using electromagnetic deflection and electrostatic focusing. The patent consists mainly of the addition of C1 and switch S2.

B plus for the first anode of the picture tube is supplied through switch

S2 which is ganged to the on-off control S1. C1 is a storage capacitor connected between the first anode and ground. When S1 and S2 are closed, C1 is charged to the operating voltage on the first anode. As soon as the switches are opened, the B plus filter capacitors begin to discharge through the horizontal sweep and voltage-boost circuits and are soon drained of their charge. C1 has a decay time-constant longer than that of the high-voltage filter. It can discharge only through the first anode circuit, leakage in the picture-tube socket and S2. The decay time of this capacitor holds the first anode at normal operating potential. This permits beam current to flow heavily until the high-voltage filter capacitor has discharged beyond the point where it attracts sufficient electrons to the screen to damage it. The screen can take the concentrated electron bombardment for the short period that the high-voltage filter capacitor is discharging through the electron beam. It would be burned if the first anode voltage were allowed to decay rapidly and thus increase the time required for the high-voltage filter capacitor to discharge.

VIDEO PEAKING COILS

Many constructors of TV receivers, scopes, and other equipment often waste a lot of time calculating winding data for r.f. chokes and coils used in resonant and peaking circuits when suitable coils or winding data for them already may be on hand. Usually, the problem is one of recognizing a suitable coil and adapting it to fit the circuit. When the required inductance is known, it is easy to find winding data.

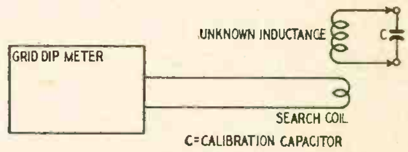


Fig. 1

For inductances of about 100 microhenries, iron-cored broadcast antenna and oscillator coils may be used. When the inductance range of broadcast coils is exceeded, various i.f. transformers and stripped-down r.f. chokes are suitable Short-wave coils and broadcast coils with some turns removed are suitable for many circuits requiring low inductance values. Slug-tuned forms permit varying the inductance over a wide range.

Since most available coil data is prepared to cover a definite frequency range with a capacitor of a given size, we usually have to calculate the inductance to determine whether the coil satisfies our needs. This calculation time can be minimized by referring to the table. It lists frequencies to which inductances from 1 to 1,000 μh resonate when tuned by a 100-μμf capacitor. For example, assume that we need a 45-μh coil for high-frequency peaking in a TV set or scope. The table shows that a 45-μh coil tunes to 2,370 kc with a 100-μμf capacitor. We immediately recognize this as a simple short-wave coil for which we probably have winding data on hand.

L (μh)	f (kc)	L (μh)	f (kc)	L (μh)	f (kc)
1	15,900	60	2,053	280	950
2	11,243	65	1,972	290	934
3	9,180	70	1,900	300	920
4	7,950	75	1,836	310	904
5	7,111	80	1,778	320	888
6	6,491	85	1,725	330	875
7	6,010	90	1,676	340	862
8	5,622	95	1,631	350	850
9	5,300	100	1,590	360	838
10	5,025	110	1,516	380	816
12.5	4,497	120	1,451	400	795
15	4,105	130	1,394	420	776
17.5	3,801	140	1,344	440	758
20	3,563	150	1,328	460	741
22.5	3,352	160	1,257	480	726
25	3,180	170	1,248	500	713
27.5	3,032	180	1,185	550	678
30	2,903	190	1,154	600	649
32.5	2,789	200	1,143	650	624
35	2,688	210	1,097	700	601
37.5	2,597	220	1,070	750	581
40	2,514	230	1,048	800	562
42.5	2,439	240	1,026	850	545
45	2,370	250	1,005	900	530
47.5	2,307	260	986	950	516
50	2,249	270	968	1,000	502
55	2,144				

$$\frac{159{,}000}{\sqrt{L \times C}} = f \text{ in kc}$$

L in microhenries (μh)
C in micromicrofarads (μμf)

There are several ways to measure the inductance of a coil without a bridge. One is to tune the coil with a known capacitor and measure the resonant frequency of the combination with a grid-dip meter as shown in Fig. 1. The second method is to tune the coil with a known capacitance and make it oscillate and then measure the frequency on a receiver or an absorption wavemeter. Fig. 2 shows how a Meissner oscillator may be used for the purpose. The grid and plate coils should

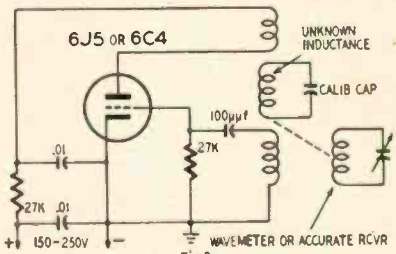
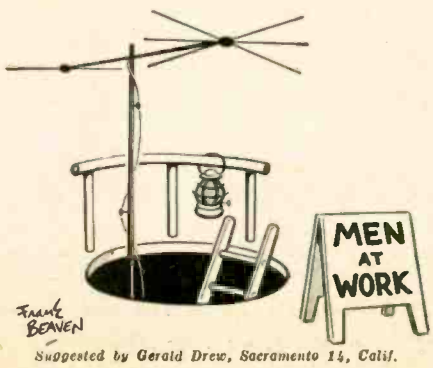


Fig. 2

each have approximately one-fourth the number of turns in the coil being checked This method is subject to error caused by reflected capacitance, stray inductance, resistance in the oscillator circuit, and inaccuracy of the measuring device. When a grid-dip meter is used as in Fig. 1, the accuracy is limited only by the sensitivity and calibration accuracy of the grid-dip meter.—*L. H. Trent*

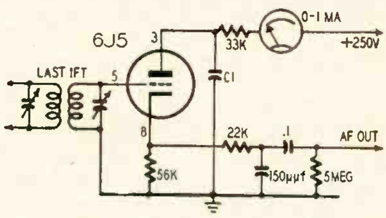


Suggested by Gerald Drew, Sacramento 14, Calif.

NOVEL TUNING METER

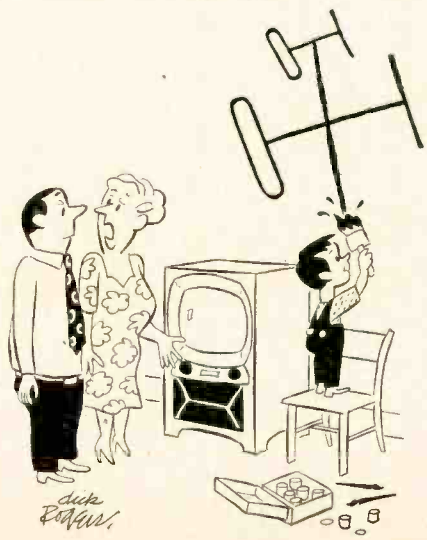
Simple tuning and signal-strength meters in superheterodyne receivers often consist of a milliammeter connected in series with the B plus lead to one or more of the i.f. stages connected to the a.v.c. line. In a circuit of this type the meter reading decreases as the signal strength increases. Three rather clumsy tricks are often used to make the meter swing upward with increasing signal strength. One is to connect the plate-current meter in a delicate bridge circuit; another is to mount the meter upside down; and the third is to use a v.t.v.m. to measure the x.v.c. voltage.

Experimeters desiring to include a tuning indicator or S-meter in a sensitive superheterodyne receiver may consider using this combination S-meter and second detector described in *The Radio Constructor* (London, England). The meter reads forward and the audio



quality is good. This circuit does not depend on a.v.c. voltage for its indications, so it can be used for tuning in c.w. signals with the a.v.c. turned off. The circuit (see diagram) consists of a 6J5 or equivalent triode connected as an infinite impedance detector with a 0–1-ma meter in the plate circuit.

The infinite impedance detector requires a comparatively husky input signal for good audio quality and wide meter deflection, so the receiver in which it is used should have two high-gain i.f. amplifier stages. The plate filter capacitor C1 should be just large enough to bypass the r.f. and audio signals but should not be so large that its charging current may damage the meter. Use the smallest value that will not cause the meter to deflect on audio peaks. A value of about 0.1 μf is about the largest that can be used. END



"Now he's experimenting with painted circuits"

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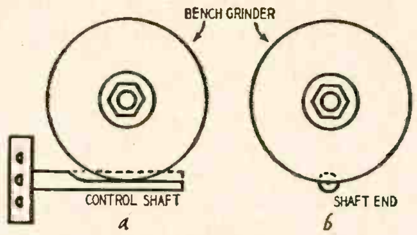
TRY THIS ONE

FLATS ON CONTROL SHAFT

When a flat is necessary on a radio control shaft to facilitate using a spring-type or a set-screw-type knob on a stiff moving control, a file and a vise is usually used, but the finished job is often uneven and inaccurate despite the hard work that went into it.

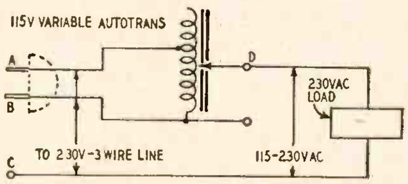
If you have access to a motor-driven bench grinder or even a hand-cranked



type, you can turn out neat, factory-looking flats on any type of shaft. See drawings. Grinding lengthwise as at *a* provides a common flat surface; grinding across the end view of the shaft as shown at *b* leaves a slight concave which further aids in holding the knob firm.—*W. F. Woychoski*

VARYING A 230-VOLT LINE

The diagrams show a way of using a 115-volt adjustable autotransformer to vary the voltage of a 230-volt a.c. line for shop-testing motors and other equipment. Variable autotransformers are commonly used for adjusting 115-volt lines, and may be obtained from radio and electrical supply houses.



Lines A and B in the sketch must be properly identified with a series test lamp or meter. Connect B to the neutral or ground side of the 230-volt 3-wire supply line. Connect A to one side and C (an extra conductor) to the other. The circuit through the load is completed by D which connects to the side of the output receptacle connected directly to the movable arm. Lead D may be connected to one lug of a standard male plug to facilitate plugging it into the autotransformer output terminal.—*Hugh Lineback*

(Several variations of this circuit designed to permit varying the output of a 115-volt autotransformer continuously from 0 to 245 volts appeared in the November, 1952, issue of *General Radio Experimenter.—Editor*)

SIMPLIFIED U.H.F. CHANNEL FREQUENCY CALCULATIONS

In an article on page 31 of the August, 1953, issue, A. G. Hatfield presents the formula

$$F = 800 - 6(69 - N)$$

for finding the low end of u.h.f. TV channels below channel 69 and

$$F = 800 + 6(N - 69)$$

for channels above 69 where F is the

frequency in megacycles and N is the channel number.

I have found that both of the above formulas can be reduced to the simpler form

$$F = 386 + 6N.$$

Using Hatfield's examples, we find the low-frequency end of channel 22 as

$$F = 386 + 6(22)$$
$$F = 386 + 132$$
$$F = 518 \text{ mc}$$

and the low end of channel 82 is

$$F = 386 + 6(82)$$
$$F = 386 + 492$$
$$F = 878 \text{ mc.}$$

The frequencies of the video and sound carriers and the high-frequency end can be found as described before or by adding 1.25, 5.75, and 6 mc to the low-end frequency to find the video carrier, sound carrier, and high-end frequencies, respectively.

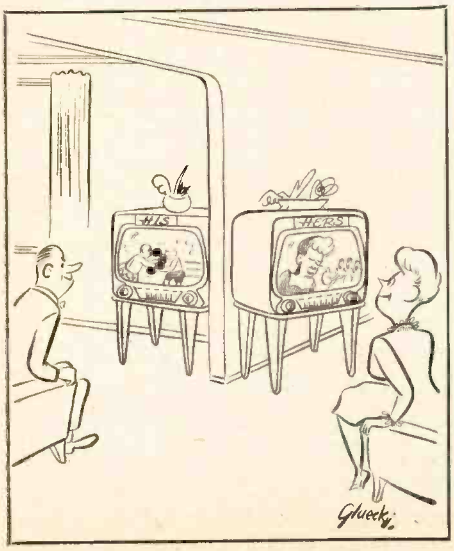
This new formula is easier to remember and to use than the two given previously.—*J. C. Galbraith*

HANDY FUSE CHEST

You'll hardly ever lose or mislay one of the several boxes of fuses that you carry in your TV or auto-radio service kit if you modify a few old fuse boxes to make a chest-of-drawers assembly like that shown in the photo.

You need one box for each size fuse

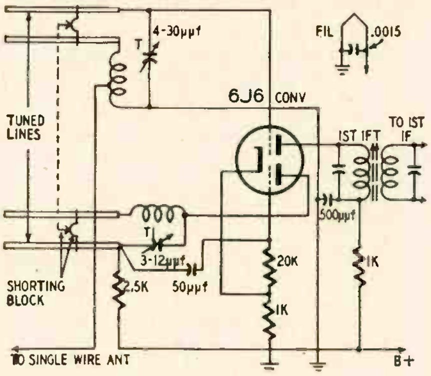
that you use. Remove the covers from all except one box and flatten the bottom flanges so they parallel the sides. Stack the boxes and solder the sides together where they overlay to complete the assembly.—*John M. Macgowan* END



FIDELOTUNER ON 156-MC BAND

? *I have an Edwards Fidelotuner 88–108-mc FM tuner that I want to convert to cover the 156-mc police band. Can you tell me how to make the conversion?—V. B. J., Indianapolis, Ind.*

A. Parallel-wire transmission lines with movable shorting bars are used to tune the antenna and oscillator circuits in this tuner. These circuits are shown in the illustration. The lowest frequency is determined by the length of the effective lines and the highest is determined by the trimmer capacitor and coil shunting the open end of each line. The oscillator inductance padder is a small coil with 3 or 4 turns. The antenna padding inductance is a U-shaped loop with the antenna lead tapped onto it.



The frequency of the circuits must be increased, so you must decrease the inductance of the padding coils. To cover the 152–162-mc band, the oscillator must tune from 141.3 to 151.3 mc or from 162.7 to 172.7 mc. Short out the oscillator padding inductance with short, heavy leads and measure the oscillator tuning range with a grid-dip meter. If the highest frequency is above 151 and below 172 mc, the best bet is to operate the oscillator below the signal frequency. Vary the oscillator trimmer capacitor so the lowest frequency is about 141 mc. Now check the high-frequency end of the range. It should be about 152 mc. If it is not, install a trimmer inductance of about half the number of turns in the original one. Now, juggle the settings of the trimmer capacitor and the turns and spacing of the inductance padder until the oscillator covers the required range.

Set the tuner to the lowest frequency and adjust the antenna trimmer so the meter indicates resonance at 152 mc. If the circuit does not tune this high, reduce the padding inductance. One way is to replace the padder inductor with one made of flat copper strip about ½ inch wide or soft copper tubing about ¼ inch in diameter. Another way is to connect a coil across the present padder inductor. Try about 35 turns of No. 28 enameled wire close-wound on a ¼-inch polystyrene form and note the effect on the tuning range. Adjust the L and C values in the antenna circuit for best performance across the band or peak the circuits at the frequency of the local police transmitter.

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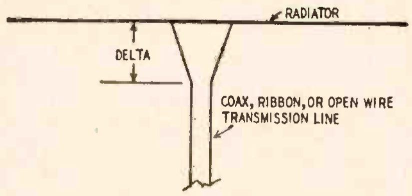
You will have to move the tap on the antenna coil. Connect a good antenna to the input terminal and solder the tap to the point of maximum signal and minimum noise. A vertical J (page 96 of the December, 1951, issue) or ground-plane antenna will provide the omnidirectional pickup required for reception of mobile stations. For increased gain, try a vertical collinear array like that shown on page 99 of the August, 1953, issue.

DELTA MATCH SYSTEM

? *Where can I get information on using a delta-match system for connecting an antenna to a transmission line. I would like to know how to compute the impedance of the antenna and the dimensions for the matching section.—C. P. J., Athens, Pa.*

A. A delta-match is a tapered-line impedance transformer used to match a dipole radiator to a transmission line having a higher impedance. It is often used to match a 72-ohm transmitting dipole to a high-impedance open-wire transmission line or the radiator of a multielement array—such as a Yagi —to a 72-ohm transmission line. In each case, the feed-point impedance of the antenna is much lower than the characteristic impedance of the transmission line. The diagram of a delta matching system is shown.



The dimensions of the delta depend on the impedance of the antenna at its center, the diameter and spacing of the transmission line, and the reactance which the matching section presents to the transmission line. Design formulas including all of these variables are not available, so a delta is hardly ever used in homemade receiving antennas.

Antenna manufacturers sometimes use a delta-matching system instead of a folded dipole to step up the impedance to an antenna to match the transmission line. They usually excite a model antenna with a signal generator or grid-dip meter and then measure the standing-wave ratio on a bridge. The dimensions of the delta are then adjusted for a minimum standing-wave ratio. The delta is set up for one type of transmission line. Substituting a line of a different impedance increases the losses in the antenna system.

POWER TRANSFORMER QUERY

? *I am constructing an audio amplifier in which the center-tapped filament winding is connected to a tap on a B plus voltage divider. My power transformer does not have a center-tapped filament winding. Can I get the same results by installing a separate filament transformer with a tapped secondary? Why is the tap connected to a low B plus voltage?—J. C. M., Nyack, N. Y.*

A. The filament winding on your transformer need not be center-tapped. All you need do is connect a 50–100-ohm wire-wound potentiometer across the untapped winding and connect the movable arm to the B plus point. Adjust the arm of the potentiometer for minimum hum in the amplifier output.

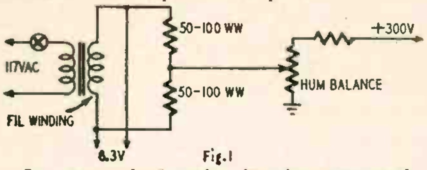


Fig. 1

In some electronic circuits, the cathode of a tube may be a hundred volts or so above ground. If the heater is grounded, the tube is likely to be damaged by a short or flashover between heater and cathode. The maximum voltage between heater and cathode is 90 volts for most receiving-type amplifier tubes. So, if the cathode must be operated more than 90 volts positive, the heater is usually biased positive to reduce the voltage between these two elements.

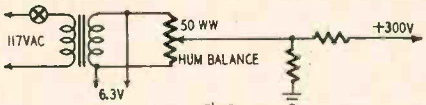


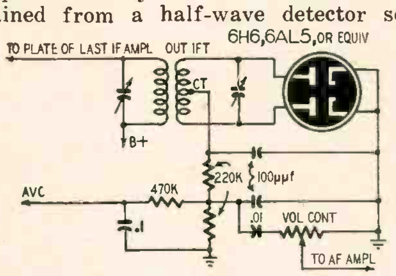
Fig. 2

In high-gain circuits, hum may occur when a heater emits electrons to the cathode or when there is leakage between the heater and cathode. In either case, hum can be greatly reduced or eliminated by using Fig. 1 or Fig. 2. Typical circuits use about 150,000 ohms for the series element and around 50,000 ohms for the control in Fig. 1 and grounded resistor in Fig. 2. The heater bias voltage should be limited to about 90 and the bleeder current to 2 ma or less.

FULL-WAVE DETECTOR CIRCUIT

? *I have an i.f. output transformer which has a center-tapped secondary for feeding a full-wave detector. I would like to use this as a replacement for a half-wave output transformer in my receiver. Please publish a diagram of a full-wave detector using this transformer.—P. W., Viola, Kansas*

A. A full-wave detector is shown in the diagram. The audio and a.v.c. voltages developed for a given i.f. signal input are only about half those obtained from a half-wave detector so



you may find that your set does not have enough gain to operate properly. Sets which use full-wave detectors usually have two or more high-gain i.f. amplifiers and two a.f. amplifier stages ahead of the output stage to make up for the decreased detector output. It will probably be better to use a half-wave i.f. output transformer as the replacement in your set. END

ADMIRAL 82-CHANNEL TV SETS

Poor performance of Admiral all-channel sets on u.h.f. may be caused by the u.h.f. antenna lead from the u.h.f. antenna terminals to the tuner being too close to or touching the metal brackets on the rear-picture tube mount. This lead is purposely long and acts as a quarter-wavelength trap at the mean frequency of the low-band channels and as a three-quarter wavelength trap at the mean frequency of the high band.

Remove the back of the cabinet and check this lead to be sure that it is not close to any metal, and straighten it out if it is looped or doubled up.

While the back is off the set, check this lead at the point where it is soldered to the u.h.f. tuner. Remove the metal bracket (if any) that covers the u.h.f. antenna connections. This bracket was used on the production line and is not required after the set is installed in the cabinet.—*Admiral Radio & TV Service Bulletin*

MECK XB-702 TV SET

When the set was first turned on it would not sync vertically until the hold control was to the extreme low-resistance end of its range. After a warmup, the vertical oscillator would drift until sync was lost and could not be restored with the hold control.

The vertical drifting was remedied by replacing the .01-μf paper capacitor in the grid circuit of the 12SN7-GT with a .01-μf ceramic unit. The oscillator still locked in at the low-resistance end of the hold control, so we substituted a 100,000-ohm resistor for the 390,000-ohm unit in series with the control. This increases the vertical hold range and permits the oscillator to lock-in in the center of the control range.—*Charles Erwin Cohn*

HUM IN MOTOROLA 17T8

The complaint was a loud hum at all settings of the volume control. A normal picture ruled out filter troubles. A check with a v.t.v.m. showed a grid-to-cathode short in the 25L6-GT audio output tube. Replacing this tube cleared the trouble. A neon short indicator showed barely a flicker when the old tube was tested.—*Raymond H. Leeson*

ZENITH 28T925R

The set came in with the complaint that the picture had shrunken to a thick horizontal line. We plugged it in and it operated normally about two hours before the trouble occurred. The picture returned to normal as a test prod was touched to a tube pin to measure the vertical supply voltage. The resistances of the primary and secondary of the vertical output transformer agreed with manufacturer's data, so we did not suspect the transformer until we happened to check the resistance between the windings and found that it was only 1,600 ohms.

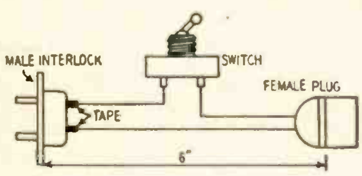
A new transformer eliminated the trouble.—*W. S. Ross*

WESTINGHOUSE ABC CIRCUIT

A handy incandescent light source is necessary when adjusting the a.b.c. (automatic brightness control) circuit on the Westinghouse V2233-4 TV chassis. Furthermore, you must be able to turn this light on and off at intervals to see if the control is working as it should. The a.b.c. adjustment control is on the rear of the chassis. This makes it inconvenient to turn the light on and off as needed.

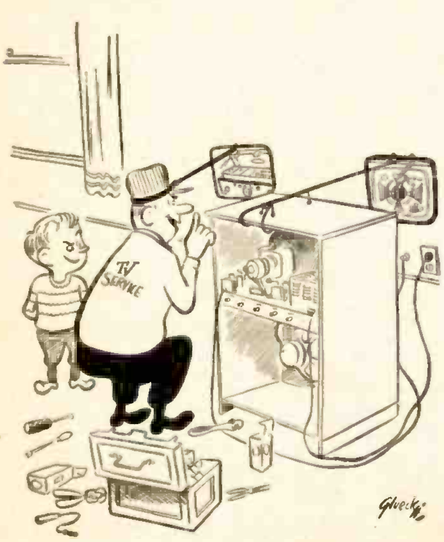
This little gadget is a great help in adjusting the control and it will serve a lot of steps if you service many of these sets. The unit consists of a 6-inch length of line cord with a small push or rotary switch in the center of one lead, a male interlock plug on one end, and a female line plug on the other.

Set up a small table or bridge lamp about 5 feet in front of the receiver—you can probably borrow one from the set owner. Plug its cord into the female plug of your adapter and then plug the male interlock into your cheater cord. This puts the light switch at your fingertips.



Follow these steps when adjusting the controls:

1. Set the ABC switch on the back of the chassis to OFF.
2. Adjust the brightness and picture controls for normal picture contrast under normal operating conditions. Do not block or obscure the phototube while making these adjustments.
3. Move the ABC switch to ON. Turn on the lamp and make sure that its rays illuminate the front of the set.
4. Start with the ABC control in its counterclockwise position. Rotate it slowly clockwise while switching the lamp on and off until you find the setting where brightness and contrast vary in proportion to changes in lighting.—*H. L. Matsinger* END



"I use that one to keep an eye on my tools"

JANUARY, 1954

REAL SALE TUBE

ADVERTISING INDEX

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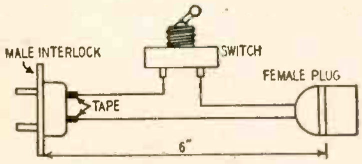

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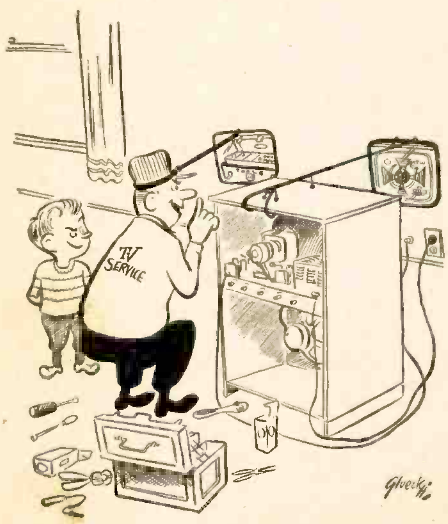

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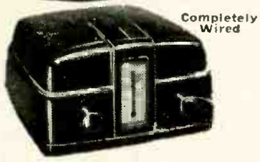

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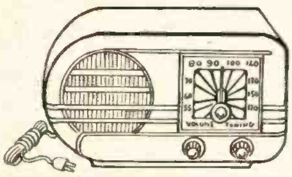


5 TUBE AC-DC SUPERHET KIT

Kit #1—Five Tube superheterodyne kit, A.C.-D.C. contains all components required to construct this latest design, highly sensitive superheterodyne broadcast receiver, complete with black bakelite cabinet (excludes wire and solder) ....Only **$7.95**

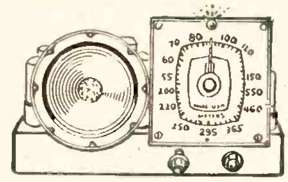
Kit of 5 tubes (12AT6, 12BA6, 12BE6, 35W4, 50C5). Only $3.25.

D 1273 INSULATED RESISTOR KIT

Contains 100 resistors ⅓, ½, 1 & 2 watts from 5% to 20% tolerance. Housed in a transparent plastic box. Price complete **$1.65**

D 1278 PAPER TUBULAR BY-PASS CONDENSER KIT

Contains 50 by-pass condensers ranging in capacity from .005 mfd. to .5 mfd. and at voltages from 200 to 1600, housed in a plastic transparent cabinet, size 7" x 3½" x 1⅛". Price $2.95 per kit.



6-TUBE RADIO KIT

Kit #2—A low-priced **6 TUBE KIT** designed for high sensitivity, excellent selectivity and good tone quality. Uses 25L6, 25Z6, 6SQ7, 6SA7, 6SK7, 6SK7 in an easily constructed circuit. The 6 Tube Kit is shipped with all parts, including punched chassis, resistors, condensers, coils, sockets, PM Speaker, hardware, etc.

And at a closeout price of only (less tubes and cabinet) **$6.95**

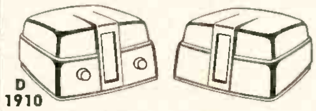
Matched set of six tubes for kit **$3.25**

PHONO OSCILLATOR

Not a Kit!

Wireless phono oscillator transmits recording for crystal pickups or voice from carbon mike through radio without wires. Can also be used as an intercomm by using P.M. speaker as mike. Price (excluding tubes) **$2.95**

With Complete Set of Tubes....$3.95



SUPERSENSITIVE TWO STATION INTERCOMMUNICATION SYSTEM.

The unit is suitable for use in home, office, factory, nursery or sick room. So sensitive it will pick up a baby's cry at a reasonable distance. Operates from 115 volts AC/DC. Both stations housed in compact plastic cabinets (6"x6"x3½"), and requires only 2 wires to connect. Furnished with 50 ft. of twin conductor wire. Price $16.95

D 1279 DISC CONDENSER KIT

Contains an assortment of 50 Erie type disc ceramicons, includes the following capacities 001, 2 x .001, .0015, 2 x .0015, 2 x .004, .0047, .005, 2 x .005, .01, 2 x .01 and 10 assorted printed circuited capacitors, housed in a transparent plastic box. Price $2.95 per kit.

Electronic Code Practice Oscillator & Blinker Kit

AC/DC or Battery Operated!

Kit #3—One of the most practical Code Practice Oscillators ever designed, yet one of the simplest to build and operate. Can be used with any number of headphones. Adjustable Pitch Control—Any type of headphone can be used.

No warmup time—ready to operate instantly.

Simple and safe to operate.

Operates anywhere—with AC or DC power, or from a 90 volt Miniature Battery.

Learn Blinker Code with flashing light.

Blinker can be used as signaling device.

International Morse Code included.

Kit each **$1.95** Assembled **$2.95**

3-TUBE PHONO AMPLIFIER

Not a Kit!

An assembled unit ready for installation using tone and volume control and six feet of rubber cord (Not including Tubes) **$2.95**

With Complete Set of Tubes .. **$3.95**

D 1274 PRECISION RESISTOR KIT

This kit consists of 50 1% Wilkor carbofilm resistors of 50 different ohmages, housed in a transparent plastic box. These can be combined in series or parallel to produce almost any desired ohmage. Each resistor retails at about .85. Price for kit $2.45.

Terms: All merchandise shipped F.O.B. New York City, prices are subject to change without notice. Include 20% deposit for C.O.D.'s.

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BAKELITE TUBING .... 12" Lengths

Type	O.D.	Wall	Per Ft.
Natural	3/8"	3/32"	$0.25
Natural	1/2"	1/16"	.29
Natural	5/8"	5/32"	.35
Black	3/4"	7/32"	.45
Black	1-1/4"	1/2"	.59
Black	1-3/8"	1/16"	.49
Black	1-1/2"	1/2"	.98
Natural	2"	1/16"	.39
Natural	3"	1/8"	1.15
Natural	3-1/4"	1/16"	.69

60 MIN. TIMING SWITCH & BELL . . . adjusts 12 sec. to 1 hour. 3" calib. face (12 sec. divisions). S.P. 8A/115V. contacts. Closed during timing. Bell signals end. Spring wound. 1¼" ptr. knob. 2" deep....$2.49
#32 P.E. MAGNET WIRE...12 oz. spool 98¢, 6/5.00
115V. THERMOSTAT . . . SPST 10A. contacts norm. Closed. Opens at 115°F. O.D. ⅝" x 3¾"....... .98
IMMERSION HEATER...27V., 54W. ⅜" x 2⅜" .49
"OUNCER" TRANSFORMERS...S.B. Carbon Mike Input .... .98
OUTPUTS . . . matching 50L6, 50B5 etc. ..... .98
HI-FI CRYSTAL HAND MIKE . . . moulded black bakelite case. 5½ ft. cable 3.95
HAND MIKE CASE only—as above (2" I.D.) ea 49¢ 12/5.00
PERMEABILITY TUNER . . . STD. BROADCAST .98

!! SUPER $ $ $ SAVINGS !! . . . with the NEW **"JUMBO RADIO-ELECTRONIC PARTS KIT"...** Chock-full of: COILS, CONTROLS, SWITCHES, RESISTORS, CONDENSERS, WIRE, SOCKETS, PHOTOFACTS, TV PARTS & DIAGRAMS PLUS MUCH, MUCH MORE (Shpg. wt. 20 lbs.) **$3.95**

HEARING AID AMPLIFIER CHASSIS (2 tube) . . . **MAKE A REAL VEST POCKET RADIO or AMPLIFIER** (½" x 2" x 5") adding only simple tuner & phone. **WITH SCHEMATICS FOR 2 or 3 TUBE SET.** Less tubes & case $2.49
SET OF 2 SUB-MIN. TUBES for above........ 2.98
HEAR AID BONE CONDUCTOR RCVR . . . (½" x ¾" x 1½") . . . Excel. for **MUSICAL CONTACT MIKE, DETECTOPHONE.** Low impedance magnetic type 1.98
115V. AC ELECTROMAGNET . . . 6 oz. pull. cont. duty. O.D. 1" x ⅞" ....ea 98¢ 6/5.00
T-44A MAGNETIC MIKE . . . complete, orig. carton .98
19 FT. WHIP ANTENNA...6 screw sects......3.49
RADIO HARDWARE TREASURE . . . **FULL LB. CAN of:** Nuts, Screws, Washers, Lugs, etc...ea 89¢ 3 lbs./2.49
MOULDED BAKELITE CONDENSERS . . . 50mmf to .2mfd, 200-600V. Micamold. 50 asstd $1.98 100/2.98
CARBON RESISTORS, ⅓-2 watt. 100 asstd 1.98
ROTARY SELECTOR SWITCHES . . . incl. multi-deck. All with ¼" shafts. Kit of 6 asstd. 1.75

"DIRECT FACTORY SPEAKER REPAIRS SINCE 1927"
Min. order $3.00. 20% deposit req. on all C.O.D.'s. Full remittance with foreign orders. Please add sufficient postage—excess refunded.

LEOTONE RADIO CORP. 67 Dey Street New York 7, N. Y.

New! All Latest Developments. UHF . . . Transistors . . . Color!

TELEVISION SERVICING

by Walter H. Buchsbaum

All New! 2nd Revised Edition TRANSISTORS COLOR UHF and LATEST TV CIRCUITS

Get this brand-new, complete handbook for sure-fire working knowledge of TV installation, maintenance and trouble-shooting. Tells you step-by-step procedures for audio IF alignment, video IF alignment, aligning RF amplifiers, mixers, oscillators, etc. All possible defects classified for ready reference, thoroughly analyzed to show what is wrong and why . . . and what to do to correct the defect. No mathematical knowledge needed!

Part I—Principles of TV receivers, including all new 82 channels. Latest data and illustrations on UHF tuners, converters and antennae. Separate chapter covers the new, all electronic color TV system, explains for the first time all the standards, circuits and color picture tubes. Transistors, theatre TV, industrial TV, etc.

Part II—covers latest installation and alignment techniques for all receivers. Both UHF and VHF alignment data for the newest TV models are given. Antenna installation, fringe area reception and apartment house installations are described.

Part III—the trouble-shooting section. Defects are classified according to symptoms and a detailed step-by-step procedure is given for locating and repairing all possible trouble.

USE IT 10 DAYS FREE—Coupon below brings you "Television Servicing" on FREE trial for 10 days, without obligation. Mail it NOW.

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70 Fifth Ave., New York 11, N. Y.
Send me, for 10 DAYS' FREE TRIAL, "Television Servicing" I will return it in ten days and pay nothing—or keep it and send $5.95 (plus few pennies postage) in full payment.

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SAVE! Send $5.95 with this coupon, and we'll pay postage and packing.

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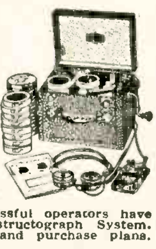

It is easy to learn or increase speed with an Instructograph Code Teacher. Affords the quickest and most practical method yet developed. For beginners or advanced students. Available tapes for beginner's alphabet to typical messages on all subjects. Speed ranges 5 to 40 WPM. Always ready—no QRM.

ENDORSED BY THOUSANDS!

The Instructograph Code Teacher literally takes the place of an operator-instructor and enables anyone to learn and master code without further assistance. Thousands of successful operators have "acquired the code" with the Instructograph System. Write today for convenient rental and purchase plans.

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4701 Sheridan Rd., Dept. RC, Chicago 40, Ill.

PRES-PROBE CONDENSER TESTER

Finds Intermittent Condensers Instantly

Pres-probe's sliding tip with variable resistance prevents condenser healing. Tests with power on. Requires no adjustment. Stops guesswork. Saves time. Convenient probe size (7⅛" long). *Satisfaction guaranteed.*

NET **7.95** Postpaid U.S.A.

See Your Dist. or Order Direct

PRES-PROBE CO.
4034 N. Sixth St., Milwaukee 12, Wisc.

Lawrence S. Thees, former general sales manager of the RCA Tube Department, Harrison, N. J., was elevated to the top-level post of general commercial manager on the staff of Richard T. Orth, vice-president in charge of the RCA Tube Department, in an organizational change which established four new marketing divisions within the department. In the change, Douglas Y. Smith, former manager of sales operations, was advanced to the new post of

L. S. Thees

D. Y. Smith

general marketing manager with administrative responsibility for the four new marketing divisions, a separate sales division, and two sales-service divisions.

Others promoted in the reorganization include: **Kenneth Bucklin,** to manager of the new Receiving Tube and Transistor Marketing Division; **Michael J. Carroll,** to manager of the Cathode-Ray and Power Tube Marketing Division; **Harry B. Wilson,** to manager of the Electronics Components Marketing Division; **Leonard J. Battaglia,** manager of the Parts and Equipment Marketing Division; **Lee F. Holleran,** to manager of the new separate Sales Division; **Harold F. Bersche,** manager of the Renewal Sales Activity; **Lawrence D. Kimmel,** manager of the Equipment Sales Section; **Gene R. Rivers,** manager of the Government Sales Section; and **Charles B. Swope,** to manager of the Planning and Control Division.

Dr. O. G. Haywood, Jr., was named manager of Engineering Planning of Sylvania Electric Products Inc., New York City. Dr. Haywood was formerly a colonel in the U.S. Air Force, where he organized and headed the Office of Scientific Research and Development Command in Baltimore, Md. In his new position, Dr. Haywood will co-ordinate Sylvania's engineering planning in the fields of lighting, radio, electronics and television.

O. G. Haywood, Jr.

Brig. Gen. Thomas C. Rives (ret.) was promoted to the position of manager of the newly organized Laboratories Department of the General Electric Electronics Division, Syracuse, N. Y. General

T. C. Rives

Rives was formerly manager of Technical Military Liaison for G-E.

John E. Martin was named director of research for the Gabriel Co., Cleveland, Ohio. He was previously a senior staff member of the company. He will make his headquarters at the Gabriel Laboratories Division in Needham Heights, Mass., where he will supervise electronic research and development of various Gabriel products.

J. E. Martin

Harold Blumenthal, sales manager of the Manufacturer Division of Shure Bros., Inc., Chicago microphone manufacturer, was given added responsibilities as export manager.

H. Blumenthal

R. N. Stoddard, former Midwestern regional manager of the Westinghouse Electronic Tube Division, was appointed to the newly created post of headquarters assistant to the general sales manager at Elmira, N. Y. John G. Thompson, former product manager of cathode-ray tubes at Elmira, succeeds Stoddard as Midwestern regional manager.

C. G. Barker, former vice president of Magnecord, Inc., joined the National Co., Malden, Mass., as distribution manager. In his new position he will co-ordinate and direct activities of the company's representatives and establish basic distribution policies. The National Co. designs and manufactures communications receivers and transmitters and electronic components for government, industry and amateurs.

C. G. Barker

Obituaries

Joseph A. Burstein, president of Burstein-Applebee, Kansas City distributing firm, died in Menorah Hospital recently at the age of 58.

Paul Hetenyi, retired head of Solar Manufacturing Corp., and a consulting engineer for Aerovox Manufacturing Co., New Bedford, Mass., died in his home in New York City recently.

Personnel Notes

. . . **William C. Brown,** manager of the Raytheon Magnetron Research and Development Laboratories, Waltham, Mass.; **Gordon S. Humphrey**, executive assistant to the general manager of the Equipment Division; and **William T. Welsh**, sales manager of the Power Tube Division, were named assistant vice-presidents of Raytheon.

. . . **William A. Patterson,** president of United Air Lines, was elected to the Westinghouse Board of Directors.

. . . **J. J. Kahn** and **H. J. Hoffman,** Machlett Laboratories, were named co-chairmen of the RETMA Membership Promotion Committee. **J. B. Elliott,** RCA, was reappointed chairman of the Sports Committee, and **Fred D. Wilson,** DuKane Corp., was reappointed chairman of the School Equipment Committee.

. . . **J. E. Schlener** was appointed merchandising manager for the Electronics Division of Sylvania, with headquarters in Woburn, Mass. He was formerly sales engineering supervisor.

. . . **Robert C. Sprague,** chairman of the Board of Sprague Electric Co., North Adams, Mass., was appointed by the Senate Armed Forces Subcommittee on Preparedness, to direct a full-scale study of hydrogen and atomic bomb defense.

. . . **J. A. Frabutt** was named general sales manager of Federal Telephone and Radio Co., a division of International Telephone and Telegraph Corp. He was formerly manager of sales to Government agencies.

. . . **James J. Shallow,** sales manager of Philco Distributors, Inc., of Philadelphia, was appointed general manager of the Accessory Division of Philco Corp.

. . . **William H. Kelley** was appointed to the newly created office of vice-president in charge of marketing for Allen B. DuMont Laboratories, Clifton, N. J. He was formerly a vice-president of Motorola.

. . . **Alexander Nepo** joined the electrical engineering staff of Littelfuse, Inc., Des Plaines, Ill. He was formerly with the Argonne National Laboratories.

. . . **H. G. Boehm** was appointed director of the International Division of P. R. Mallory & Co., Indianapolis.

. . . **Ronald W. Argenta** joined La Pointe Electronics, Rockville, Conn., manufacturer of Vee-D-X antennas and accessories, as art director and assistant advertising manager.

. . . **Stanley W. Cramer** was appointed acting manager of the Special Apparatus Division of Radio Condensor Co., Camden, N. J., succeeding **Frank A. Cowgill** who resigned because of ill health. Other Radio Condensor personnel appointments include **Joseph S. Robb,** director of engineering; **Melvin V. Weiss,** chief engineer of special apparatus and TV; and **Jack Teaf,** chief engineer of the Auto Tuner Division of the company.

. . . **Virgil M. Graham,** director of technical relations of Sylvania Electric Products, was elected a vice-president and member of the Executive Committee of the U.S. National Committee of the International Electrotechnical Commission.

END

TUBE FAILURES

Dear Editor:

The information contained in "Tube Failures in TV Receivers" (November R-E) contains numerous inaccuracies. I run my own shop, and take on anything from Admirals to Zeniths. My experience has brought me in contact with about every TV set and brand of tube in common use.

In section 1 of the article, among tubes most likely to burn out, are listed the 5U4-G and 5Y3-GT. For every 20 of these tubes replaced in my shop, 19 are *not* burned out, but have failed due to dwindling emission. The other one will be an actual burnout.

Similarly, I can't recall seeing even one burned-out 6W4-GT anywhere, although I have replaced many gassy, short circuited or low-emitting 6W4-GT's.

In section 2, tubes most likely to become weak, my experience again conflicts with that of the author. I replace at least 20 low-emission 6SN7-GT's for each 6CD6-G; at least 30 low-emission 6SN7-GT's for each 6BG6-G.

Looking at section 2 from another angle, I find 6BQ6-GT tubes becoming "weak" just about 20 times more often than 6BG6-G's or 6CD6-G's. Likewise, "weak" 1B3-GT's and 1X2-A's are scarce as hen's teeth in these parts. The 1X2-A's I replace are almost invariably either burned out or short-circuited. Most 1B3-GT failures are burnouts, with rare cases of short-circuiting or gas. And how about the 12AU7? There's a tube which is right up with the worst of them in the matter of getting weak.

The author's failure to list the 6AU6 and 6AL5 among tubes most likely to burn out is astounding. I have no exact figures on these tubes, but I venture to say that out of every 100 burned-out (open heaters) tubes replaced in my shop, at least 75 or 80 are either 6AL5's or 6AU6's.

I write more in sorrow than in anger. Your magazine has consistently published useful, authentic information in the past, which I have used much to my advantage. What's the idea of printing this misinformation on what makes up just about 98% of tube failures in TV receivers?

H. A. HIGHSTONE
Santa Rosa, Calif.

"Now?"

LIE DETECTOR

Dear Editor:

I recently read your article "Electro Psychometer" in the May 1953 issue of RADIO-ELECTRONICS. I would like to call attention to the following:

If a sensitive galvanometer is connected in series with the hands, it will indicate a current flow. The current flow will increase, if through an effort of will—not quality of thought—the experimenter exerts pressure on the electrodes. It will also increase, if the human body becomes a center of EMF.

This can be verified by a simple experiment. Hold the prods of a sensitive a.c.-d.c. voltmeter—one against a radio chassis ground, and the uninsulated end of the other, with the fingers. The d.c. reading will be small, but I have read about 5½ volts a.c.

The voltage is under the control of the subject. Wearing of rubber, insulated soles decreases the voltage.

It thus becomes apparent that electronic devices used as lie detectors are subject to error.

What Humanity needs, is not a lie detector—lying is a virtue today—but an eradicator for the causes that lead man to crime and the necessity for hiding his offense—first against himself, and then against his fellow man.

JEAN G. LAMOTHE

Charlotte Amalie
Saint Thomas, U. S. Virgin Islands

(While we have not made any experiments with self-generated electricity in the human body, we fell short in not pointing out that devices like the "Electro Psychometer" which measure the body's resistance are not reliable indicators of the subject's veracity. They measure emotion, not guilt, and a nervous but innocent subject may run a higher score than a callous but guilty one. But the devices are fine for entertainment at a party!—*Editor*) END

CORRECTIONS

The Geiger Counter article referred to in our correction notice on page 132 of the November, 1953, issue should have read "page 119 of our September issue." Instead, it was erroneously stated to have appeared in October. The corrected notice follows:

We have been informed by Amperex Electronic Corp. that the 1N tube recommended for the simple Geiger counter described on page 119 of our September issue is no longer obtainable. A tube with closely parallel characteristics is the 75N. It is slightly larger than the 1N, and is rated at 700 volts instead of the 1N's 600.

The 75NB3 is electrically identical with the 75N, but uses a pee-wee 3-pin base. If construction details are slightly modified, this might be a more convenient tube.

The 6V6 cathode biasing resistor in the Junior Golden Ear Amplifier (page 55 of the November, 1953, issue) was erroneously given as 470 ohms in the diagram and parts list. The correct value for the 6V6 cathode resistor should be 250 ohms to develop the 19 or 20 volts of bias required for proper operation. The resistor should be rated at 5 watts or more. We thank the author, Joseph Marshall, for this correction.

$3.00 FOR CARTOON IDEAS

RADIO-ELECTRONICS prints several radio cartoons every month. Readers are invited to contribute humorous radio ideas which can be used in cartoon form. It is not necessary that you draw a sketch, unless you wish.

Address
RADIO-CARTOONS, RADIO-ELECTRONICS
25 West Broadway, New York 7, N. Y.

> Any or all of these catalogs, bulletins, or periodicals are available to you on request direct to the manufacturers, whose addresses are listed at the end of each item. Use your letterhead—do not use postcards. To facilitate identification, mention the issue and page of RADIO-ELECTRONICS on which the item appears. All literature offers void after six months.

ANTENNA BOOKLET

LaPointe's new 30-page well-illustrated pocket-sized booklet describes their entire Vee-D-X line of u.h.f. and v.h.f. antennas and accessories, including 36 products, headed by the company's new antenna rotator.

Free on request to LaPointe Electronics, Inc., Rockville, Conn.

RELAY DATA

Davis Electric's *Decohm* products are described in a 3-color booklet recently issued by that company. Complete technical data on various molded-coil type open relays, hermetically sealed canister-type relays, and television deflection yokes is given.

Available free from the Davis Electric Co., 230 N. Spring St., Cape Girardeau, Mo.

TV ACCESSORIES

Tele-Matic has issued a 28-page catalog describing their TV accessory and antenna line. Included on the illustrated loose-leaf sheets are wave traps, filters, switches, transformers, antenna couplers, u.h.f. and v.h.f. antennas, a TVI analyzer, and a u.h.f. booster.

Gratis from Tele-Matic Industries, Inc., 1 Joralemon St., Brooklyn 1, N. Y.

HIGH FIDELITY

Admiral's *What You Should Know About High-Fidelity* is an attractively illustrated 12-page booklet discussing the how, why, and what of high quality reproduction in nontechnical language.

10¢ in stamps or coin from the Advertising Dept., Admiral Corp., 3800 Cortland St., Chicago 47, Ill.

VIDICON BOOKLET

Technical information on RCA deflection-circuit components for use with the small television camera tube, the 6198 vidicon, is supplied in a new 14-page booklet. Recommended circuits are shown in a 6-page application section.

Single copies available free on request to RCA Tube Department, Commercial Engineering, Harrison, N. J.

GENERAL CEMENT CATALOG

G-C's 64-page, 2-color catalog gives detailed descriptions, specifications, and prices of their complete line of radio, TV, and electronic products. All products are listed by types in an index for quick reference. More than 3,000 items in over 150 classifications are included.

Request Catalog No. 156 from General Cement Mfg. Co., 904 Taylor St., Rockford, Ill.

CORRECTION

Temples of Tone, the high fidelity brochure described last month, is not available direct from Electro-Voice, Inc. as stated, but may be obtained from local Electro-Voice distributors.

TUBE MANUAL

Tung-Sol has issued the 19th edition of its *Electronic Tube Characteristics Manual.* The first 166 pages contain all the technical information about receiving and cathode-ray tubes required by engineers and service technicians for everyday use. Six different colored pages are used to separate the many charts, diagrams, and technical data for easy reference.

The manual is distributed through Tung-Sol tube wholesalers.

TRANSISTOR MANUAL

CBS-Hytron has issued an 8-page illustrated booklet as an introduction to transistor theory, data, and applications. Both point-contact and junction transistor operation are explained by vacuum-tube analogy.

Among the nine basic transistor applications are hearing-aid and radio receiving circuits, and a circuit for use in switching applications.

Gratis from CBS-Hytron, Danvers, Mass.

SOUND CATALOG

Hudson's new 56 page 1954 high-fidelity catalog has a 3-page introduction on the meaning and methods of achieving high-quality sound. The booklet itself includes tuners, amplifiers, speakers, record changers, tape recorders, and cabinets, and is of interest to both music lovers and professional sound men.

Free on request from Hudson Radio & Television Corp., 48 W. 48th St., New York 36, N. Y.

AUDIO EQUIPMENT

Sun Radio's 1954 high-fidelity catalog is a 93-page, profusely illustrated booklet which features a compatability chart of radio tuner and amplifier components and a 5,000-word article on the subject of planning a home music system. Phono equipment, tape recorders, tuners, amplifiers, loudspeakers, cabinets, and binaural equipment are described and illustrated.

Gratis from Sun Radio & Electronics Co., 650 Sixth Ave., New York 11, N. Y.

ANTENNA FOLDER

Wells and Winegard has issued a folder describing its complete antenna line. V.h.f. and u.h.f. antennas are included.

Free on request to Wells and Winegard, Burlington, Iowa.

ANTENNA MANUAL

A newly revised, 1954 edition of *TV 'Tenna Tips*, by Mandl and Noll, has been issued by Snyder. The 44-page pocket reference manual now includes an "Antenna Selector" section, with first, second, and third choices for each area.

Also included in the subject matter are the latest u.h.f. and v.h.f. data, Directronic antennas, Yagis, installation do's and don'ts, dimension guide, channel frequencies, helpful hints, and many other subjects relating to television antennas.

Free copies may be obtained by writing to Snyder Mfg Co., Philadelphia 40, Pa. END

HOW TO UNDERSTAND AND USE TV TEST INSTRUMENTS, by Milton S. Kiver. Published by Howard W. Sams & Co., Inc., Indianapolis 5, Ind. 8½ x 11 inches, 147 pages. Price $3.00.

Realizing that a craftsman's workmanship and efficiency may be considered a direct reflection of his knowledge and ability with the tools of the trade, the author has dedicated this book to a better understanding by the technician of TV servicing instruments.

Five chapters are devoted to detailed discussions of vacuum-tube voltmeters; AM, FM, marker, and cross-bar generators, oscilloscopes, special-purpose probes, voltage calibrators, field-strength meters, and other TV test equipment. The author shows schematics of typical test instruments and goes into considerable detail on each device, explaining each control and showing how and why it is used.

The sixth chapter discusses the use of the various instruments in aligning FM and TV receivers, and the seventh chapter describes the use of test instruments in solving difficult TV receiver servicing problems.—*RFS*

TELEVISION TUBE LOCATION GUIDE (TGL-4) Compiled and published by Howard W. Sams & Co., Indianapolis 5, Ind. 5½ x 8½ inches. Approximately 190 unnumbered pages. Price $2.00.

This is the fourth volume of *Television Tube Location Guide*. It brings to the TV service technician drawings showing the location of each tube in relation to the others and the major above-chassis components in 173 different chassis used in a far greater number of models. These charts enable the technician to locate, remove, and replace tubes which cannot be seen without pulling the chassis. Each socket diagram shows the location of the blank pin or key to simplify replacing tubes in sockets that cannot be seen from outside the cabinet.

Each layout shows the location of the fuse or fuses and lists the rating and data on the circuits which they protect. This enables the technician to determine if the defective circuit is protected by a fuse—information that can be exceedingly helpful in isolating the source of trouble.

Also included with each layout chart is a listing of typical circuit-failure symptoms and the tubes that are likely to cause circuit failure. This aids in making a preliminary diagnosis of the trouble without removing the chassis. —*RFS*

MOST-OFTEN-NEEDED 1953 RADIO DIAGRAMS AND SERVICING INFORMATION. Compiled by M. N. Beitman. Published by Supreme Publications, 1760 Balsam, Highland Park, Ill. 8½ x 10¾ inches, 192 pages. Price $2.50.

Volume 13, the 1953 edition of the *Most-Often-Needed Radio Diagrams* series, is an inexpensive source of original manufacturers' schematics, alignment data, dial-stringing diagrams, voltage measurements, and trouble-shooting hints covering about 400 different AM, AM-FM receiver models, and record players and record changers made by leading manufacturers. Although this compilation cannot possibly have the coverage and detailed data of larger service manuals, its low cost and small size give it a place on the work-bench of small shops and part-time service technicians.—*RFS*

TELEVISION INTERFERENCE (Third edition). Compiled and edited by Philip S. Rand. Published by Remington Rand, Inc., New York, N. Y. 8½ x 11 inches, 107 pages. Single copies obtainable for 25¢ each from Anne Smith, Remington Rand, Inc., 315 Fourth Avenue, New York 10, N. Y.

This third edition is a complete anthology on TVI containing reprints of full-length articles on the subject which appeared in many trade and technical publications. Readers will find this edition consists almost entirely of material published since the printing of the second edition. Of the 30 articles, 8 were published originally during 1953, 13 during 1952, and the remaining 9 between November, 1951, and December, 1948.

In addition to the articles, there is a bibliography listing 100 articles and short items on TVI which appeared in *QST* magazine. Instead of outlining the contents of each article, this reviewer feels that it is sufficient to state that this book should be read by every amateur radio operator, TV service technician, broadcast station engineer, and operator of diathermy and radio-frequency heating apparatus.—*RFS*

SMALL TRANSFORMERS AND INDUCTORS, by K. A. MacFadyen. Published by Chapman & Hall, Ltd., London, England. 6 x 8½ inches, 237 pages. Price $8.25.

Of all the components in radio or TV, transformers seem the most mysterious. There are so many different types and they appear to have so little in common. This book shows that all kinds of transformers, whether audio, power, r.f., instrument, pulse, or h.f., are based on the same principles. Charts, tables, and formulas show how to design and use coils and cores.

The book begins with circuit theory, both electric and magnetic. The author discusses the essentials of an ideal transformer: one with no losses, no leakage. From this hypothetical standard, he proceeds to describe "imperfections" that are always present—distributed capacitance, copper and core losses, leakage reactance, and so on. We find that each imperfection has the same result as a hypothetical network added to the ideal standard.

Other chapters describe the measurement of inductance, the design of power and h.f. transformers, and the principles of pulse transformers. The last chapter contains much data on iron cores and coils.—*IQ* END

ADVERTISING INDEX
JANUARY ISSUE

Radio-Electronics does not assume responsibility for errors appearing in following index.

RADIO SCHOOL DIRECTORY

PAGE 195

RADIO SCHOOL DIRECTORY

AUDIO AMPLIFIERS READY-TO GO

MODEL AMP 5 Hi-Fi 5 watt AC Amplifier plus built in PreAmp GE V.R. pickup 60 to 18000 Cps/1DB/down 2 DB 40 cys. hum level-55 db. mike & phono volume. continuous bass treble controls 6SJ7, 6SC7, 6V6, 6x5 "TAB" Hi-Fi special to your door PREPAID $21.39. Same unit less GE PreAmp PREPAID $15.98
Model 302PA 3 Tube Phono Ampl. Ideal for Custom Building Your Phonograph..$ 4.98

GROMMES HI-FI AMPLIFIERS

LJ2 Pre & Pwr Amp 8 Watt 20-20Kc. $35.77
503GP Pre & Pwr Amp 10 watt 20-20 Kc 53.90
215BA Williamson Pre & Pwr Amplifier 15 watt 10 to 100 Kc.. 97.51
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Hi-Torque (powerful) UL appvd. 2400 RPM 115V AC/DC motor. Jacobs geared chuck and key. Self aligning — oilless — ball thrust bearing. Light weight and easy to handle. Treat yourself to this workhorse drill. Plus 9 drill bits $14.95
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29PCS CHROME VANADIUM SPEED STEEL. Top Quality for Machinists or all purpose use. Standard Full Length 1/16" to ½" by 64th's $7.98
12 PCS SET 1/16" to ½" Less Index $3.49
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The servicemans workshop, kit includes 200J Jacobs chuck ¼" drill, asst drill bits and accessories for grinding, polishing, paint stirer, buffing, sanding and many other uses. 55 pieces in all. As shown, special Model 200JK $19.25

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YOU PICK THEM **39¢** lots of 10

Cracked base or broken key electrically perfect
TESTED & 90 DAY GUARANTEED
ORDER NOW, WHILE THEY LAST
5U4G — 6SN7 — 25L6GT — 35Z5
5Y3GT — 6K6GT — 12SA7GT — 6H6
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GE RPX050 Triple Play Cart 4.98
Electrovoice Triple Play.. 1.98
Pickup Arm & Xtal Hi-Outpt 2.39
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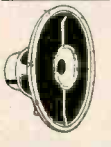

All 8 ohm. V.C., Alnico V Magnets, Inbuilt Network, 2 wires needed for HF & LF Response. Famous HI-FI Speaker Mfgrs.
15" Coaxial PM & 5" Tweeter, 25 watt/20-17500 cy, shpg wgt 13 lbs special P25CO....$23.75
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8" Coaxial PM & 2½" Tweeter, 8 watt/70-15000 cy, Ideal for Home Hi-Fi TV, Radio & Phono Replacement Special P8CO $8.95

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POPULAR VALUES **25¢ ea.** lots of 15
Here is a handy assortment of 15 condensers for the serviceman. Only......$3.75

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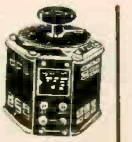

Standard Elect (Staco) Variable Voltage Transformer
TYPE 20/0-135V/3 Amp/N $11.98
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2 ohm 50W Model J..2.25; 5 for 10.00
6 ohm 25W Model LH ..1.49; 2 for 2.49
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350. 500. 5000 ohm Slotted shaft. 25 watt ....79¢; 3 for 2.00

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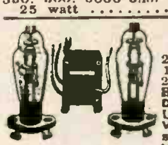

2 Tubes, Sckts, xmfr, 115v60cyc Inpt, outpt 2.5vct/10A/ Hivins $4.98
DIODE PROBE TUBE Unexcelled for No-Loss VHF testing. Ultra-sensitive subminiature-envelope. .New. w/data VR92 ....25¢; 5 for $1.

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7JP4 ....$17.95
10BP4 .... 10.00
12" Glass 12.00
14" Rectangular .. 14.00
16" Glass 16.00
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19" Round 19.00
20" Rectangular .. 20.00
21" Rectangular .. 21.00
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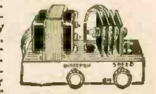

0 to 12 VDC/2 Amp. variable DC supply, uncased and completely built—inpt. 115v/60 cy. Usable LAB supply. filament D. C. plating, battery charging, model railroad, includes voltage or speed control and center off reversing sw. Ideal for two "HO" locomotives Prepaid USA. $10.95; 2 for $20.00

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10-0-10V (CT) 100 Amp., fan cooled. Replace your old inefficient sulfide rectifier w/new selenium type. SPECIAL...$11.98

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Current (Cont.)	List Price	"TAB" Price	Qty 12 For
65MA @ 130V	$1.50	$0.59	$6.48
75MA @ 130V	1.85	.69	7.58
100MA @ 130V	2.05	.79	8.68
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4 Amp ....$ 8.75
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Current (cont.)	18/14 Volts	36/28 Volts	54/40 Volts	130/100 Volts
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2AMP	2.20	3.60	5.40	10.50
4AMP	4.25	7.95	12.95	25.25
6AMP	4.75	9.00	13.50	33.00
10AMP	6.75	12.75	20.00	44.95
12AMP	8.50	16.25	25.50	49.00
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115V/60 cy inputs.
up to 14DVC at 12 amps.......$ 19.98
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*From This Special List We Ship $10.00 and Up Tube Orders At Our Expense (Postpaid) Within Continental Limits of U.S.A.
90 Day Gtd. When ordering mention 1RE

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0A3/VR75	1.04
0B2	1.37
0B3/VR90	.98
0C3/VR105	.92
0D3/VR150	.92
1B3/8016	.80
1L4	.48
1L6	1.35
1LD5	.98
1LN5	.78
1P5	.78
1U4	.52
1U5	.54
1X2A	.98
2A4G	1.18
2X2	.42
2X2A	1.53
5R4GY	1.20
5R4GYW	1.75
5T4	1.48
5U4G	.55
5Y3GT	.43
6AC7	.80
6AG5	.71
6AG7	1.14
6AH6	1.22
6AJ5	1.40
6AK5	.77
6AK6	.92
6AL5	.48
6AL7GT	.98
6AN5	2.90
6AQ5	.52

6AQ6	.81
6AQ7GT	1.29
6AR6	2.98
6AS5	.79
6AS6	2.22
6AS7G	3.48
6AT6	.54
6AU5GT	1.10
6AU6	.63
6AV5GT	.98
6AV6	.49
6AX4/6U4	.74
6B4G	1.18
6BA6	.54
6BA7	1.09
6BC5	.63
6BC7	1.23
6BD6	.83
6BE6	.54
6BF5	.98
6BG6G	1.58
6BH6	.63
6BJ6	.69
6BK7	1.58
6BL7GT	1.19
6BN7	1.98
6BQ6GT	1.20
6BQ7	1.65
6C4	.52
6C5	.68
6CB6	.59
6D4	2.70
6F6GT	.79

6H6	.60
6J4	6.66
6J5	.54
6J6	.58
6J7	.72
6K6	.54
6K7	.58
6K4A	3.69
6K6GT	.54
6L6	1.48
6L6G	1.08
6L6GA	1.08
6L6GAY	1.98
6SA7GT	.66
6SC7	.90
6SF5	.78
6SF7	.73
6SG7	.64
6SH7	.61
6SJ7	.58
6SK7GT	.56
6SL7GT	.64
6SN7GT	.68
6SQ7GT	.62
6SR7	.62
6SS7	.88
6T8	.96
6U4	.74
6U8	.99
6V6	1.39
6V6GT	.59
6W4GT	.52
6X4	.49

6X5	.54
6Y6G	.88
7A8	.68
7C7	.76
7F7	.92
7F8	1.24
7H7	.72
7N7	.92
7V7	1.06
7Y4	.68
12A6	.48
12AH7GT	1.45
12AL5	.54
12AT6	.54
12AT7	.89
12AU6	.72
12AU7	.69
12AV6	.52
12AV7	.94
12AW6	1.18
12AX7	.98
12AY7	1.69
12BA6	.59
12BA7	.94
12BD6	.59
12BE6	.59
12BF6	.85
12BH7	1.29
12C8	.62
12H6	.64
12J5	.52
12K8	.68
12Q7GT	.55
12SA7GT	.88

12SC7	1.08
12SF7GT	.84
12SG7	.80
12SH7	.63
12SJ7GT	.54
12SK7	.66
12SL7GT	.62
12SN7GT	.68
12SQ7GT	.54
19BG6	1.98
19V8	1.98
25BQ6GT	.98
25L6GT	.54
25Z5	.78
25Z6GT	.58
28D7	1.94
35B5	.52
35L6	.58
35Z5GT	.54
35Y4	.68
45Z3	.88
50A5	.76
50B5	.84
50C5	.54
50L6GT	.62
RK61/XFG1	2.65
80	.58
81	1.38
83	1.12
83V	1.22
84/6Z4	1.98
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117Z6GT	.96
CK502AX	1.49
CK503AX	1.49
CK505AX	1.79
CK512AX	1.45
CK531DX	1.89
CK532DX	1.89
CK533AX	1.29

CK534AX	.99
CK536AX	.99
CK538DX	.98
CK539DX	2.19
CK543DX	.99
CK544DX	.99
CK546DX	1.99
CK571AX	2.49
CK1005	.68
2050	1.48
CK5672	1.20
CK5678	1.28
5687	3.74
CK5702	2.90
CK5703	1.29
Xtal Diodes	
1N21A	1.55
1N21B	1.92
1N22	1.22
1N23	1.35
1N23A	1.98
1N23B	2.22
1N25	4.98
1N26	6.75
1N27	1.55
1N34	.64
1N34A	.90
1N35	1.65
1N38A	1.29
1N41	8.95
1N42	16.95
1N43	1.45
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1N54	.78
1N60	.60
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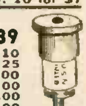

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Lead Jacketed & Boxed, Lots of 10
Smaller Quantity. Unit Price $2.25
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Case dimensions, not including insulators 4⅛H x 3¾W x 1¼"D
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1800VDC/35MA, Using Doubler Crkt. Transformer, Rectifiers, Sockets, Resistors, Capacitors and Diagram.............$6.98

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5MFD 600VDC...... 1.50; 3 for 4.00
10MFD 600VDC...... 1.98; 2 for 3.50
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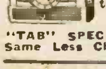

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MAROON OR IVORY
Powerful 5 tube design.
"TAB" SPECIAL Prepaid $20.98
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2 MILLION IN STOCK
GUARANTEED 1% TOLERANCE
ORDER ANY VALUE YOU NEED
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All 115 V 60 Cyc Input TV. & CR pwr Xmfr up to 20" tubes. Hi VOLTS to 20 KV (w/quadrupler ckt.) ALL tubes. PL & FIL wndgs
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700VCT/120MA, 2X6.3V/3A. 6.3V/1A Price ......$3.98; Two for ....$ 7.25
680VCT/200MA. 5V/3.5A, 6.3V/4A. 78V/1A ....$4.39; 3 for $12
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12Hy/80ma/H'Sld/3KVins 2.25
10Hy/125ma/UTC/Csd/H'Sld/1Kvins 1.98
50Hy/125ma/Csd/H'Sld .. 2.89
20 Hy/300ma or 15HY/400ma/12KVins 8.95
13.5Hy 1 amp 17 Kvins Raytheon..39.95
6 Hy/175ma, 250 ohm...1.49; 2 for 2.49
12 Hy/300ma, Hmsld 5KVins 4.95
10 Hy/85ma 550 ohm....95¢; 2 for 1.69
3 Hy/40ma UTC Hi "Q".95¢; 2 for $1.39

YOU PICK THEM **59¢** WHILE THEY LAST
LOTS OF 10
Your selection of 10 at 59¢ each or smaller quantity at indicated prices.

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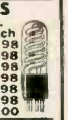
2X 20MFD/450VDC..69¢: 3 for $1.95
8X 15MFD/450VDC..98¢: 3 for 2.50
3X 20MFD/400VDC..79¢: 2 for 1.29
25MFD/450VDC ....69¢: 3 for 1.95
20MF/450V&20MF/25V ..3 for 1.95
50 mf/350vde Fp .....5 for 1.00
30-15-10 mf/250vdc .....5 for 1.00
30-2x20mf/450-25vdc .....3 for 1.00

STORAGE BATTERIES

36 Volt WILLARD Mini-BRAND NEW; 5 oz Designed Portable Equip Models.98¢; 4 for $3
(4) 36V Batteries w/acid* $3.35
2V/20AH Willard PLUS 2V. Vibrator. 2.98
2V/20AH w/vib & acid* 3.59
.v/6AH Willd NT6/BB214U 2.98
6V/6AH Battery w/acid* 3.25
6V/40AH Battery 6.98
6V/40AH Battery w/acid* 9.25
* We ship acid in bottles. R exp only

TAB PHOTOFLASH LAMPS



"Tab" No.	Replaces	Max. W-Sec.	Each
U5W	SPRG/FA104	150	$5.98
No. 1	AMGLO 5804X	100	10.98
23ST	GE FT 210	200	9.98
VA	SYLV. 4330	200	9.98
22ST	FT 110	200	9.98
V4X4	X400	200	10.98
DX	SPRGFA100	150	9.00

100 WATT SEC PHOTOFLASH KIT

Includes DX Flash Lamp Rated 150 Watt Sec. Flash Lamp Holder & 8" Reflector & Cable, Power Transf & "CD" Condensers (2) 525 MFD/450V/ 100 Watt Sec. Resistors, Capacitors, Rectifiers & Sockets $34.98
100 Watt Sec Condenser Bank .72MFD/1800V per unit. 85 units equals 61.2MFD/ 100 watt seconds ....SPECIAL $7.98
525MFD/450V "CD" condenser ..$8.00

HI-FI POWER SUPPLY

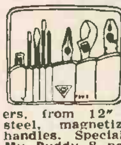
SOLA constant voltage power transformer. mounted on chassis with (2) octal rectifier sockets.
NEW MFGRD BY DUMONT
Furnishes 400VDC/250MA to filter system. 12.6VCT/6 Amp or 2X 6.3V/6 Amp (common tap) and 5V/6 Amp REGULATED With filter condensers, choke and rectifier tubes $18.98

EICO TEST EQUIPMENT

Stock #	Type	Kit Price	Built Price
221	VTVM	$25.95	$49.95
315	Sig Gen	39.95	59.95
322	Sig Gen	23.95	34.95
360	SWP Gen	34.95	49.95
377	Aud Gen	31.95	49.95
425	Scope 5"	44.95	79.95
470	Scope 7"	79.95	129.50
566	VOM	14.90	18.95
625	Tb TSTR	34.95	49.95
1171	Resist Decade		24.95

Industrials & Schools Write Qty Price

REPAIR KIT #873



All the tools needed for on the spot repair job. Includes (4) interchangeable screw driver blades and handle. electricians pliers. adjustable wrench. long nose pliers and wrap around case. Tempered tool steel $2.69
Model 3701 6 screw drivers, from 12" down, all tempered tool steel, magnetized, hammer-proof amber handles. Special ....98¢
My Buddy 8 pcs. kit. (5) interchangeable screw driver blades and handle. 3 ft. steel tape rule. diagonal cutter and case..$1.79

WAREHOUSE CLEARANCE

Antenna Mast Sections MS49 & MS50 ea/36" ....2 at 49¢; 25 at $3
Veeder Root Counter 3 diget 85¢; 3 for $2
RF Choke 2½MH/300MA 29¢; 10 for $2
RF Choke 20MH/200MA 39¢; 6 for $2
Band Pass Filters 60. 90. 150 cyc; 2 for $3

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Approved Precision Quality

The sales leader—
proved in every UHF area

Now...

The MALLORY CONVERTER Packs *ALL* Features in Half the Size!

The new Model 88 has these important Sales Advantages originated by Mallory:

Less than half as large . . . measuring only $7\frac{5}{8}''$ wide x $5\frac{9}{16}''$ high x $4\frac{5}{8}''$ deep . . . yet full Mallory quality.

It has linear tracking. Tuning is easier, more exact than ever. No bunching of channels.

The Preselector in the new 88 protects against image interference, oscillator radiation and interference at the IF frequency. It insures better selectivity.

The Mallory 88 Converter adds *all* UHF channels to *any* TV set without sacrificing a single VHF channel.

Design refinements and precision quality of the 88 assure high quality picture definition and easy tuning.

The customer has nothing more to buy, no adjustments to make for additional new channels . . . even if he moves to another area.

Installation is easy. It only takes a few minutes to connect the antenna and power leads from the Converter to the set. It can be done right in the customer's home.

***ASK YOUR MALLORY DISTRIBUTOR** for complete details of the new, handsome, compact Model 88 Converter. It can be your answer to bigger profits . . . just as all Mallory Converters have been for dealers in areas where UHF is already on the air.*

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Let's face it...

...the *best* tube you can buy *is* your best buy

When it comes to anything so important in radio and television servicing as a receiving tube, *performance* means much more than *price*.

After all, when you purchase a receiving tube, you are not buying just glass and metal. Your reputation and your profit depend on the *performance* that tube will provide!

If you try to cut corners by buying "seconds" . . . or by using "just any tube brand," you may be in for trouble. Unnecessary callbacks alone can eat up all your profit. That's why we think you'll be interested in these two facts about RCA Receiving Tubes . . .

First Fact: There is no such thing as a "second" RCA Receiving Tube that can find its way to market. If an RCA Tube fails to pass its final test, it is not only rejected *. . . it is broken up, dumped into a "meat chopper" and ground up into so much hash.*

Second Fact: The quality of RCA Receiving Tubes is continually being "upgraded." For instance, when television came, you asked for an improved 6SN7-GT. As a result, RCA's 6SN7-GT is a far better tube than the 6SN7-GT of yesterday. You see, we guard our reputation as zealously as you guard yours.

So let's face it . . . you just can't afford to buy anything less than the best in receiving tubes—and that's RCA.

To be sure you're getting unused, factory-fresh RCA Tubes, buy them only in the familiar red, white and black RCA Tube cartons through your authorized RCA Tube Distributor.

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