10TH ANNUAL TELEVISION ISSUE

RADIO-ELECTRONICS

JANUARY 1957

TELEVISION • SERVICING • HIGH FIDELITY

HUGO GERNSBACK, *Editor*

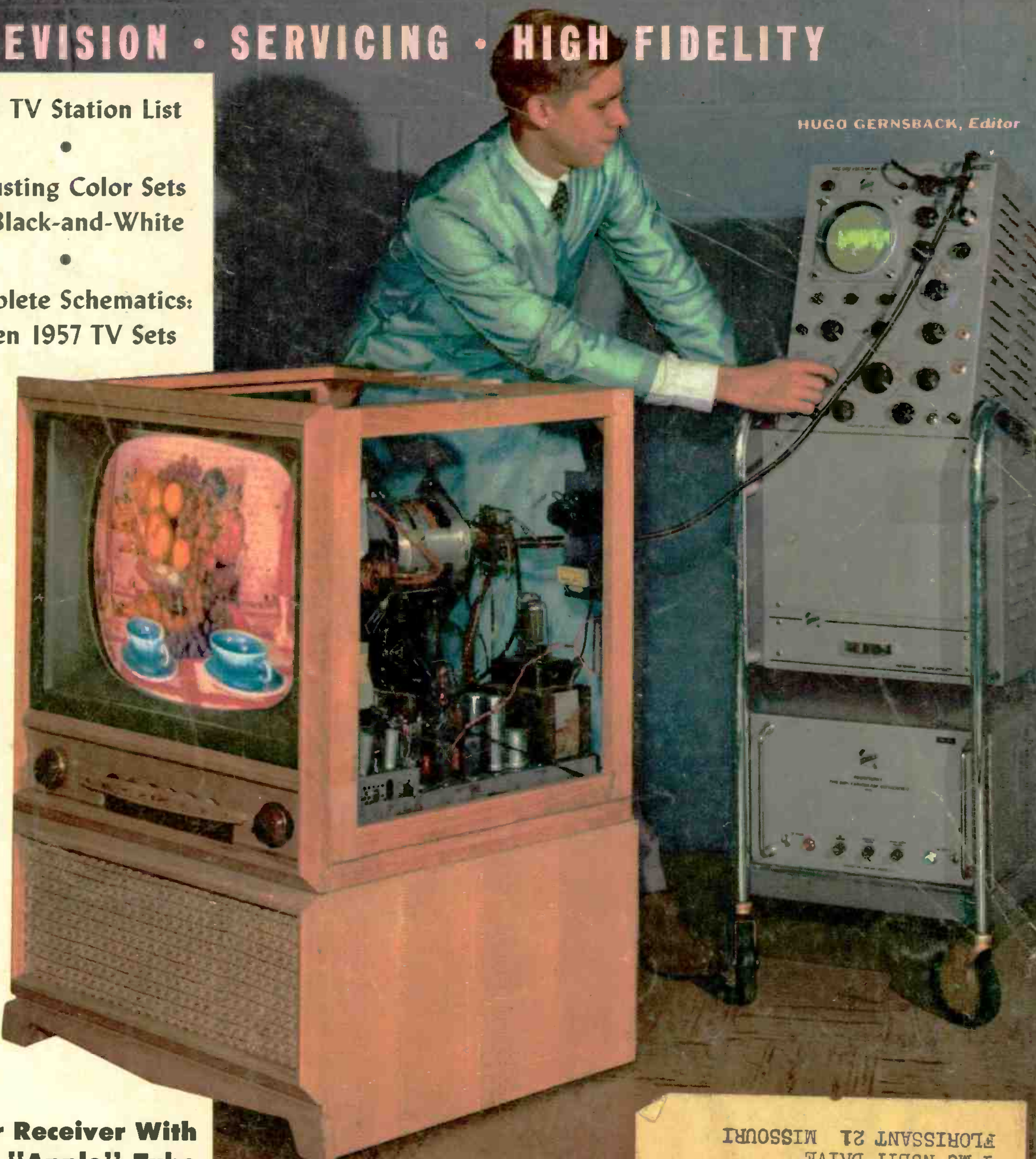
New TV Station List

•

Adjusting Color Sets for Black-and-White

•

Complete Schematics: Seven 1957 TV Sets



Color Receiver With New "Apple" Tube

See page 40

R NYFLOT 12-57
4 MC NULTY DRIVE
FLORISSANT 21 MISSOURI


Does the picture tube you buy have these built-in features?
Specialized Engineers and Scientists, highly trained and skilled to devise and develop the best components and processes for manufacturing high quality picture tubes.
DU MONT
TWIN-SCREEN HI-LITE Picture Tube
The very latest and up to date manufacturing techniques backed up by modern mass production equipment as illustrated by this mechanized aluminization rack.
Extremely stringent quality control inspections and tests to assure adherance to the tightest specifications and performance qualifications. Every Du Mont picture tube is thoroughly tested on the most modern equipment as shown here.
YOU CAN STAKE YOUR REPUTATION ONLY ON A MANUFACTURER THAT HAS THESE.
IT'S DEALERS CHOICE
make it... DU MONT
Cathode-ray Tube Division, ALLEN B. DU MONT LABORATORIES, Inc., 750 Bloomfield Avenue, Clifton, N. J.

Radio-Electronics

Formerly RADIO CRAFT ■ Incorporating SHORT WAVE CRAFT ■ TELEVISION NEWS ■ RADIO & TELEVISION*

TENTH ANNUAL TELEVISION ISSUE

EDITORIAL

TELEVISION

TEST INSTRUMENTS

RADIO

WHAT'S NEW

AUDIO—HIGH FIDELITY

ON THE COVER

(Story on page 40)

An experimental color TV receiver using Philco's new "Apple" tube. Harold B. Collins, senior engineer, is making a few checks with the scope.

NEXT MONTH: TWO NEW TV REMOTE CONTROLS • SIGNAL TRACING PROBES IN B & W AND COLOR SERVICING • TRANSISTORIZED CAPACITANCE BRIDGE

Associate Member Institute of High Fidelity Mfrs., Inc.

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RAYTHEON

Answers Independent Service Dealers' Questions About "Captive Service"

What is "Captive Service"?

It is the repair work done by service companies owned by set manufacturers — companies established by them to handle the profitable TV and radio set maintenance on receivers of their own manufacture — work that otherwise would be handled by Independent Service Dealers.

Will "Captive Service" affect my volume of business as an Independent Service Dealer?

A conservative estimate by service association spokesmen indicates that in 1957 Captive Service Companies could do close to $250,000,000 worth of TV and radio repair work.

Does Raytheon compete with me through a "Captive Service" organization?

No, indeed! Raytheon does not have a captive TV-Radio service organization — does not now manufacture TV or radio receivers.

Raytheon *believes service is your business — serving you is Raytheon's.*

How can I compete with the "Captive Service" organizations of big national companies?

Raytheon helps you do this. If you can qualify as a RAYTHEON Bonded ELECTRONIC TECHNICIAN, your service and parts guarantee is backed by a bond — a bond issued through Continental Casualty Company, one of the country's largest insurance companies. Here is real prestige for you. What's more, your work on all makes and models of sets is *bonded.*

Will becoming a Raytheon Bonded Dealer mean I'll lose my "independence"?

Not at all. You become one of a group of TV-radio technicians known from coast-to-coast as the best in the business, yet you retain your own "independence." The Raytheon Bonded Program is nothing new. It's a proven program Raytheon has provided for more than 11 years — that has successfully helped build premium customer business for Independent "Bonded" Service Dealers. It's Raytheon's investment in your future.

How does being a Raytheon Bonded Dealer help me compete with "Captive Service" companies?

(1) Your TV-radio repair service is nationally advertised by Raytheon in TV Guide Magazine.

(2) Western Union "Operator 25" is retained in 23,000 cities and towns by Raytheon to send customers to Raytheon Bonded Dealers.

(3) You are *bonded* to service *all* makes and models of sets — a big advantage.

Will I have other advantages over "Captive Service" organizations?

Yes, you'll be using Raytheon TV and Radio Tubes. They are perfect for your replacement work because Raytheon Tubes are designed to give quality performance in all Television and Radio sets.

How do I get the whole story on the Raytheon Bonded Program?

Ask your nearest Raytheon Sponsoring Bonded Tube Distributor.

RAYTHEON MANUFACTURING COMPANY

Receiving and Cathode Ray Tube Operations

Newton, Mass. • Chicago, Ill. • Atlanta, Ga. • Los Angeles, Calif.

Raytheon makes all these: Receiving and Picture Tubes, Reliable Subminiature and Miniature Tubes, Semiconductor Diodes and Transistors, Nucleonic Tubes, Microwave Tubes.

RAYTHEON®
Excellence in Electronics

A SENSATIONAL NEW OFFER FROM THE COLUMBIA (LP) RECORD CLUB

Free... Any 3

OF THESE SUPERB HIGH-FIDELITY
12" COLUMBIA (LP) RECORDS

If you join the Columbia (LP) Record Club now—and agree to accept as few as 4 selections during the coming 12 months

YES! You may have, FREE, ANY 3 of these best-selling 12" Columbia (LP) records. We make this unique offer to introduce you to the money-saving program of the Columbia (LP) Record Club . . . a program that selects for you each month the greatest works in every field of music—performed by the world's finest artists and brilliantly reproduced on Columbia (LP) records.

HOW THE CLUB OPERATES

To enjoy the benefits of the Club's program and to receive your 3 records free—mail the coupon, indicating which of the four Club divisions best suits your musical taste: Classical; Jazz; Listening and Dancing; Broadway, Movies, Television and Musical Comedies.

Each month you will receive free the Club Magazine which describes the current selections in all four divisions. You may accept or reject the monthly selection for your division. You may also take records from the other Club divisions. This unique advantage assures you the widest possible choice of recorded entertainment. Or you may tell us to send you NO record in any month. Your only obligation is to accept as few as 4 selections from the almost 100 that will be offered during the next 12 months, and you may cancel membership at any time thereafter. The records you want are mailed and billed to you at only $3.98 (original cast Broadway Shows somewhat higher) plus a small mailing charge.

FREE BONUS RECORDS GIVEN REGULARLY

The 3 records sent to you now represent an "advance" of the Club's bonus system—given to you at once. After you have fulfilled your membership obligation by purchasing four records, you will receive an additional free Bonus record of your choice for every two additional Club selections you accept. Bonus records are superb 12" Columbia (LP) records—the very best of the world-famous Columbia (LP) catalog—just like those shown here. Because you are given a Columbia (LP) record free for each two records you purchase from the Club, your membership provides the best buy in records—anywhere.

Indicate on the coupon which 3 records you want free, and the division you prefer. Then mail the coupon at once. You must be delighted with membership or you may cancel without obligation by returning the free records within 10 days.

COLUMBIA (LP) RECORD CLUB
165 West 46th Street, New York 36, N. Y.

MAIL ENTIRE COUPON NOW!

COLUMBIA (LP) RECORD CLUB,
Dept. 684, 165 West 46th St.,
New York 36, N. Y.

Please send me as my FREE gift the 3 records indicated here: (Select the records you want by checking the 3 boxes in the list at the right)
. . . and enroll me in the following Division of the Club:

(check one box only)

☐ Classical ☐ Listening and Dancing
☐ Broadway, Movies, Television and Musical Comedies ☐ Jazz

Each month you will send me the Columbia (LP) Record Club Magazine which describes the records offered in all four Club divisions. I have the privilege of accepting the monthly selection in the division checked above, or any other selection described, or none at all. My only obligation is to accept a minimum of four records in the next 12 months at the regular list price plus a small mailing charge. After accepting 4 records, I will receive a free Bonus record for every two additional records I purchase. If not delighted with membership, I may cancel within 10 days by returning all records.

Name...
(Please Print)

Address...

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

CANADA: Prices slightly higher.
Address 11-13 Soho St., Toronto 2B

If you wish to have this membership credited to an established Columbia Records dealer, authorized to accept subscriptions, please fill in the dealer's name and address also.

Dealer's Name...

Dealer's Address... 45-3

CHECK THE 3 RECORDS YOU WANT:

☐ Tchaikovsky: Nutcracker Suite; The Sleeping Beauty Ballet
Philadelphia Orchestra, Ormandy, cond.

☐ Day Dreams
Doris Day sings 12 popular songs—including *Sometimes I'm Happy, You Go To My Head*, etc.

☐ King of Swing; Vol. 1
Benny Goodman and Original Orch., Trio Quartet. *Ridin' High, Moonglow*—9 more.

☐ My Fair Lady
Percy Faith and his Orchestra play music from this hit show.

☐ Brahms: Double Concerto; Variations on a Theme by Haydn; Tragic Overture
Stern, violin; Rose, 'cello; N. Y. Philharmonic, Walter, cond.

☐ Songs from Walt Disney's Magic Kingdom
12 happy songs from famous Disney films.

☐ Concert by the Sea
Erroll Garner — recorded in an actual performance at Carmel, Calif.—playing 11 numbers — *Red Top, Where or When*, etc.

☐ Levant Plays Gershwin
3 works—Rhapsody In Blue; Concerto in F; An American in Paris.

☐ The Voice
Frank Sinatra in 12 songs that first made him famous — *Lover, Fools Rush In*, etc.

☐ Rimsky-Korsakov: Scheherazade
Philadelphia Orch., Ormandy, conductor. A superb performance of this exotic score.

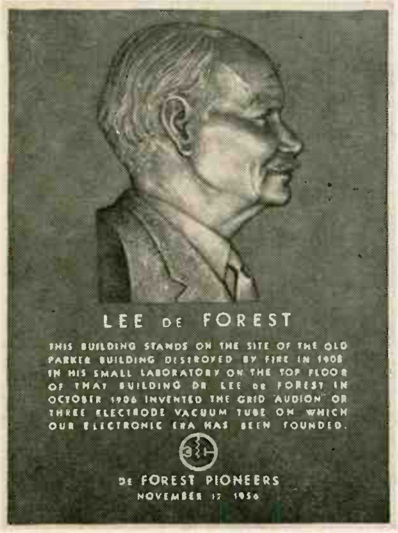
☐ Music of Jerome Kern
Andre Kostelanetz and his Orchestra play 20 Kern favorites.

☐ Jazz: Red Hot & Cool
Dave Brubeck Quartet in *Love Walked In, The Duke*—5 more.

News Briefs

de FOREST COMMEMORATION on the 50th anniversary of the invention of the three-element vacuum tube was made Nov. 12, 1956, at 229 Fourth Ave., New York City, scene of the de Forest laboratory in 1906. In honor of the occasion a plaque (see photo) was dedicated by the de Forest Pioneers.

The ceremonies were presided over by Rear Admiral Ellery W. Stone, president of the de Forest Pioneers



and of the American Cable & Radio Corp. Brig. Gen. David Sarnoff, RCA board chairman, spoke at the dedication. Scheduled to speak and unveil the plaque, Fleet Admiral William F. Halsey (Ret.), board chairman of All America Cables & Radio, Inc., was unable to attend and his speech was read. The program closed with a talk by Dr. Lee de Forest.

PRICE OF TRANSISTORS will drop to that of vacuum tubes by 1961 and their use in television receivers and other electronic equipment will be equal to vacuum tubes by 1963. Speaking at a meeting of the Institute of Radio Engineers, Dr. William Shockley, father of the transistor, made this prediction, adding the two-year lag would be due to technical design changes.

Joining Dr. Shockley in predicting the future was Dr. W. R. G. Baker, vice president of G-E and president of the Radio-Electronics-Television Manufacturers Association, who predicted that transistorized, truly portable television sets will be on the market within two years. At a joint meeting of the IRE and RETMA, Dr. Baker, in a report delivered for him, said that hold-

(*Continued on page* 14)

FCC Commercial Operator License Exams

An FCC License can be your Guarantee of Success in Electronics

in a Minimum of Time

mail coupon Now!

here's proof...

Name and Address	*License*	*Time*
Walter Eggers, Pacific Grove	1st	12 weeks
Paul Reichert, West Salem, Ohio	2nd	10 weeks
Harold Phipps, La Porte, Indiana	1st	28 weeks
John H. Johnson, Boise City, Okla.	2nd	12 weeks
James Faint, Johnstown, Pa.	1st	26 weeks

Bob Thompson:

In a year and a half, he received his first class FCC License. He is continuing his training with Cleveland Institute. His goal is much higher than his present position with Eastern Airlines, so he is adding technical "know-how" to his practical experience.

Bob Thompson
2935 Ironwood Drive
Nashville 14, Tennessee

James Glen:

When Jim enrolled, he was a temporary employee of the City of Tacoma, Washington. In the space of 14 months, he completed the Master Course and received his first class license. He is now installing and maintaining mobile and microwave equipment.

James S. Glen, Jr.
2920 Knob Hill Road
Tacoma, Washington

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- ☐ Manufacturing
- ☐ Amateur Radio
- ☐ Broadcasting
- ☐ Home Experimenting
- ☐ Telephone Company
- ☐ Other________

In what kind of work are you now engaged?________

In what branch of Electronics are you interested?________

Name________ Age____

Address________

City________ Zone____ State______

Special Tuition Rates to Members of Armed Forces

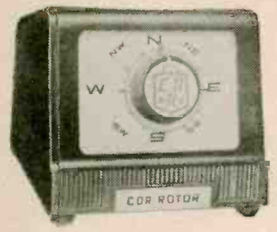
5-star feature...

★ 1 **the best color TV picture**

the growth of color TV means an even greater demand for CDR Rotors for pin-point accuracy of antenna direction.

★ 2 **a better picture on more stations**

CDR Rotors add to the pleasure of TV viewing because they line up the antenna perfectly with the transmitted TV signal giving a BETTER picture . . . and making it possible to bring in MORE stations.

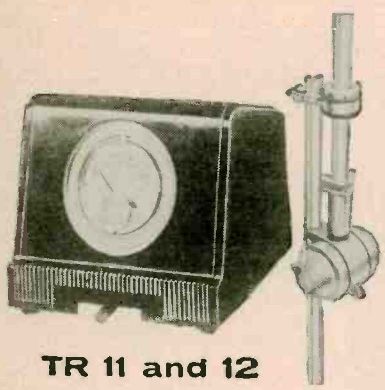


AR-22

TR-2

TR-4

CDR ROTORS



TR 11 and 12

AR 1 and 2

★ 3 **tested and proven dependable**

thousands and thousands of CDR Rotors have proven their dependability over years of unfailing performance in installations everywhere in the nation. Quality and engineering you know you can count on.

★ 4 **pre-sold to your customers**

the greatest coverage and concentration of full minute spot announcements on leading TV stations is working for YOU . . . pre-selling your customers.

★ 5 **the complete line**

a model for every need . . . for every application. CDR Rotors make it possible for you to give your customer exactly what is needed . . . the right CDR Rotor for the right job.

CORNELL-DUBILIER
SOUTH PLAINFIELD, N. J

THE RADIART CORP.
CLEVELAND 13, OHIO

for the expanding independent service-dealer

More and more independent service-dealers are strengthening their competitive position by broadening their activities. They are adding to radio and television service: Marine, mobile and citizen radio . . . sound systems . . . industrial equipment . . . special electronic devices . . . etc.

These forward-looking independent service-dealers are discovering expanded lines of CBS industrial tubes and semiconductors ready to help them in their profitable new fields. New PA-5 and PA-17 reference guides describe respectively over 200 CBS industrial receiving, power and special-purpose tubes . . . and a wide line of CBS crystal diodes, transistors and silicon power rectifiers.

Both guides are free . . . from CBS Tube distributors or direct. Just ask for Bulletins PA-5 and PA-17.

CBS tubes • semiconductors

Reliable products through Advanced-Engineering

CBS-HYTRON
Danvers, Massachusetts
A Division of Columbia Broadcasting System, Inc.

NEWS BRIEFS (Continued from page 10)

ing up commercial production of transistorized TV receivers is the problem of getting enough power from the battery-operated transistors to obtain full-contrast pictures.

COLOR TV TAPE RECORDING is at a point considerably short of perfection. The first public demonstration of a color TV program recorded on magnetic tape given over WRCA-TV, New York, recently, indicated the huge potential of this process. The broadcast was an experiment and was advertised as such. TV critics stated there was a discernible flicker in parts of the show, and colors lacked their customary vividness. On the credit side, the colors had good stability and did not blur. The demonstration was brief, lasting approximately 2 minutes.

NOBEL PRIZE IN PHYSICS for 1956 has been awarded to Dr. William Shockley of the Shockley Semiconductor Labs of Beckman Instruments, Dr. Walter H. Brattain of Bell Labs' Physical Research Department and Dr. John Bardeen of the University of Illinois. The Swedish Royal Academy of Sciences announced the award on Nov. 1, 1956, stating that it was given for "investigations on semiconductors and the discovery of the transistor effect." At the time of their invention and development of the transistor, the three men were with Bell Laboratories.

Winners of the 1956 Nobel Prize in Physics: Left to right, Dr. William Shockley, Dr. Walter H. Brattain, Dr. John Bardeen.

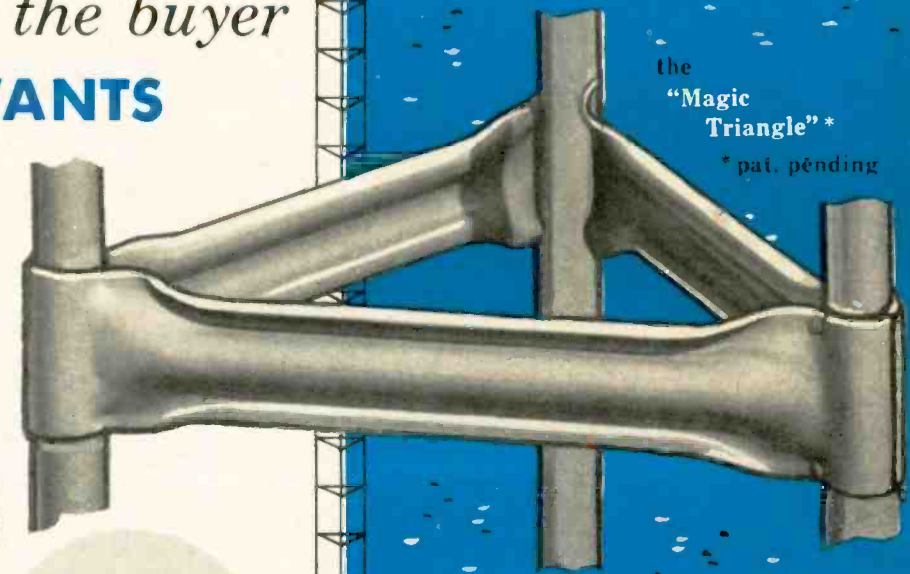
Drs. Shockley and Brattain are considered co-inventors of the transistor; Dr. Bardeen did basic physical research leading to the transistor's development. Each of the three winners (see photo) received a gold medal and a share of the $38,633 prize money. The prize-winning development was made by the three scientists eight years ago.

TRANSISTOR REPLACEMENT in portable radios and other electronic equipment may never be necessary if they are used within the limits set by the manufacturer. Speaking to a transistor reliability symposium, sponsored by a Department of Defense advisory group, C. H. Zierdt, Jr., engineering consultant in G-E's Semiconductors Products Dept., reported that life tests started in 1954 on transistors picked at random from regular manufacturing lots show no failures after 18,000 working hours at full output. This is equal

ROHN towers

Give what the buyer

WANTS



HOT DIPPED GALVANIZED

UNEQUALLED DESIGN!

LIFETIME OF DEPENDABLE PERFORMANCE

The popular ROHN No. 6 Tower (and ROHN Package Towers) feature the exclusive "Magic Triangle" . . the machine produced triangular tower bracing that adds ruggedness, sturdiness and dependability far above any other similar tower!

And, speaking of "similar" towers, there are NONE in existence. ROHN "Superior Design" Towers are far ahead with more exclusive features . . . with more research . . . with greater acceptance than any other tower!

See a ROHN Representative or Authorized Distributor for the FULL Rohn Story . . . it's one you should know!

All models of Rohn Towers are suitable for home TV installations . . makes possible elimination of guy wires to give a self-supporting installation of gleaming galvanized steel!

Communication towers, heavy duty towers, fold-over towers are also available. The Rohn catalog shows a *complete* line including all types installation equipment, bases, roof towers, tubing and dozens of accessories.

PROUDLY DISPLAY THE NEW DECAL

Colorful, new Rohn window decals are available to authorized Rohn Distributors, Dealers and Servicemen. Get yours today and display it proudly

These 3 BIG sales features are ROHN Exclusives . . . features that have been proved positively. Sell—recommend—install ROHN . . . the world's largest manufacturer of this type of tower . . . you have the BEST by far!

ROHN *Manufacturing Co.*

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Rohn Manufacturing Company
116 Limestone, Bellevue
Peoria, Illinois

Gentlemen: Please rush me complete details on the full line of Rohn Towers and Accessories.

Firm____________________

Name_______________ Title_________

Address____________________

City_______________ State_________

to maximum load on the units 8 hours a day for 6 years. He stated further that it is now impossible to tell if the transistors will ever fail because they look and act like new transistors.

Calendar of Events

Fifth Annual Canadian Audio Show, Jan. 10–12, Windsor Hotel, Montreal, Canada.
Minneapolis High Fidelity Music Show, Jan. 11–13, Dyckmann Hotel, Minneapolis, Minn.
Third National Symposium on Reliability and Quality Control in Electronics, Jan. 14–16, Hotel Statler, Washington, D. C.
Very Low Frequency Symposium, Jan. 23–25, NBS Laboratories, Boulder, Colo.
Detroit High Fidelity Music Show, Feb. 1–3, Statler Hotel, Detroit, Mich.
Los Angeles High Fidelity Show, Feb. 6–9, Ambassador Hotel, Los Angeles. The West Coast Convention of the Audio Engineering Society will be held in conjunction with the Show, Feb. 7–8.
1957 Transistor and Solid State Circuits Conference, Feb. 14–15, University of Pennsylvania, Philadelphia, Pa.
San Francisco High Fidelity Show, Feb. 15–18, Hotel Whitcomb, San Francisco, Calif.
Cleveland High Fidelity Music Show, Feb. 22–24, Hollenden Hotel, Cleveland.
Note: The Milwaukee High Fidelity Music Show reported here last month as scheduled for January has been canceled because of lack of available facilities. Dates of the Minneapolis Hi-Fi Show were changed from Jan. 18–20 to those listed above.

FCC COOLS ELECTRONIC COOKER in the 915-mc range. The General Electric bid for authority to operate its proposed electronic cooker in that portion of the spectrum received what appears to be a setback when the FCC recently announced that it will review all service allocations above 890 mc.

An FCC spokesman said that while there is no law prohibiting the commission from assigning a frequency in this range to G-E or anyone else for electronic-oven purposes now, it is unlikely that it would be done while the subject is under general investigation.

The FCC assigned this portion of the spectrum to industrial, scientific and medical services in 1947, with telephone communications given a secondary right to share the band. Industrial users showed little interest in the band but telephone companies moved in on an extensive scale. Thus, when in March, 1955, G-E petitioned the FCC to establish standards for industrial operations on the 915-mc band, the telephone users claimed squatters rights and demanded that the 890–940-mc band be assigned exclusively to communications.

TWO NEW TV STATIONS have gone on the air since our last report:

KGW-TV, Portland, Ore.	8
WHYY-TV, Philadelphia, Pa.	35

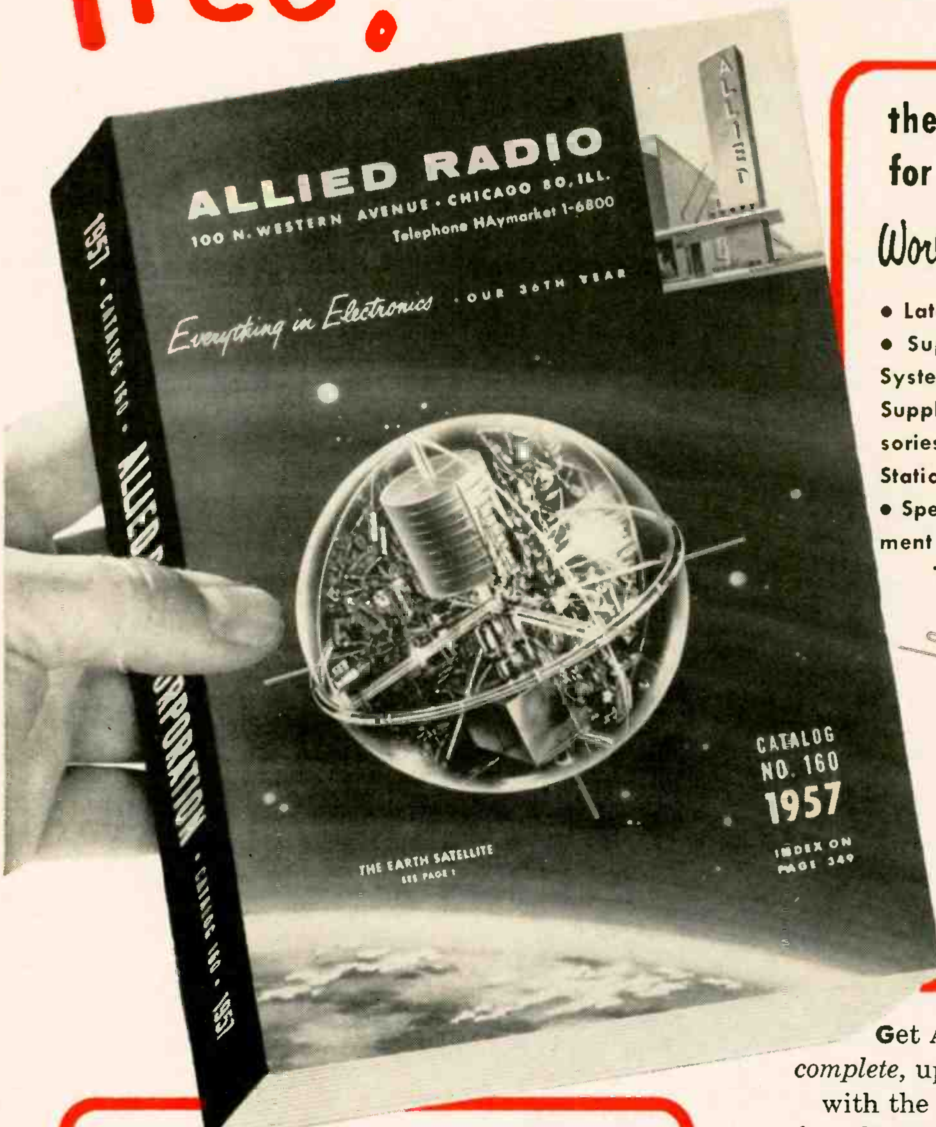
WHYY-TV is the 23d noncommercial outlet and the 6th uhf of this group.

The following TV stations have changed their call letters: WJNO-TV, Palm Beach, Fla., channel 5, to WPTV; WPTV, Ashland, Ky., channel 59, to WALN-TV.

The total of TV stations now operating in the U. S. and its territories is 491 (394 vhf, 96 uhf), including 23 noncommercial of which 6 are uhf. END

free! ALLIED'S 1957

value-packed 356-page CATALOG



the only COMPLETE catalog for everything in electronics

World's Most Complete Stocks

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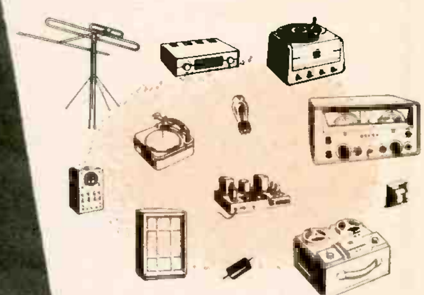

Get ALLIED's 1957 Catalog—it's *complete*, up-to-date—356 pages packed with the world's largest selection of quality electronic equipment at lowest, money-saving prices. Get *every* buying advantage at ALLIED: fastest shipment, expert personal help, lowest prices, guaranteed satisfaction...

FEATURING

SUPER-VALUE knight-kits: Finest electronic equipment in money-saving Kit form—Test Instruments, Hi-Fi kits, Hobbyist kits, Ham kits. Easiest to build and you SAVE MORE.

EVERYTHING IN HI-FI: World's largest selection of quality Hi-Fi components and complete music systems—available for immediate shipment from stock. Own the best in Hi-Fi for less!

EASY-PAY TERMS: Only 10% down, up to 18 months to pay. Available on orders over $45. Fast handling—no red tape.

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World's Largest Electronic Supply House

You Can Train at Home for Good Pay Jobs in

RADIO-TELEVISION

Fast Growing Industry Offers Good Pay, Security, Bright Future

Training PLUS OPPORTUNITY is the ideal combination for success. Today's OPPORTUNITY field is Radio-Television. Over 125 million home Radios plus 30 million sets in cars and 40,000,000 Television sets mean big money, opportunity for trained Radio-Television Technicians. More than 4,000 Radio and TV Broadcasting stations offer interesting and important positions for technicians, operators. Color Television, portable TV sets, Hi-Fi, other developments assure future growth. Radio, Television are both growing. Need for trained technicians is increasing!

J. E. SMITH
Founder

Find Out What Oldest and Largest Home Study Radio-Television School Offers You

Since 1914—for more than 40 years—N.R.I. has been training ambitious men at home in spare time for Radio-TV. Thousands of successful graduates say N.R.I.'s 50-50 training method is a fast, easy, effective way to higher earnings, desirable jobs. Carefully planned experiments and practice with equipment supplied free of extra charge, bring basic principles, techniques to life right in your own home. Find out what dependable training can do for you.

Add to Your Income Starting Soon

Make $10-$15 a Week Extra Fixing Sets in Your Spare Time

Soon after enrolling, many N.R.I. students start earning extra money fixing neighbors' radio sets. Many earn enough extra to pay entire cost of course and provide capital to start their own full time Radio-TV business after getting N.R.I. Diploma. If you want a job with a future, find out how you can train at home for Radio-Television. Mail Postage Free postcard for Sample Lesson. See how practical it is to learn at home. Get 64-Page Catalog, too. See equipment you get, outlines of courses, facts about opportunities in this growing field. Prices of N.R.I. Courses are low, terms easy.

You Learn by Doing—Get Practical Experience with Kits N.R.I. Sends

Nothing takes the place of practical experience. As part of N.R.I. Servicing Course you build AC-DC Radio Receiver and Vacuum Tube Voltmeter shown below. Use them to make tests, conduct experiments, get practical experience. All equipment yours to keep.

See Other Side

N.R.I. Training leads to good pay jobs like these. BROADCASTING: Chief Technician, Chief Operator, Remote Control Operator. **SERVICING:** Home and Auto Radios, P. A. Systems, Television Receivers, Electronic Controls, FM Radios, Hi-Fi. **SHIP AND HARBOR RADIO:** Chief Operator, Assistant Operator, Radiotelephone Operator. **POLICE RADIO:** Transmitter Operator, Receiver Serviceman. **GOVERNMENT RADIO:** Operator in Army, Navy, Marine Corps, Coast Guard, Forestry Service Dispatcher, Airways Radio Operator. **IN RADIO PLANTS:** Design Assistant, Transmitter Design Technician . . . **AND MANY OTHERS.**

N.R.I. TRAINED THESE MEN

Thanks N.R.I. for Good Start

"Right now I am doing spare-time repairs on Radios and Television. Going into full time servicing soon." C. HIGGINS, Waltham, Mass.

Quit Job to Start Business

"I decided to quit my job and do TV work full time. I love my work and am doing all right financially." W. F. KLINE, Cincinnati, Ohio

Engineer with Station WHPE

"I operated a successful Radio repair shop. Then I got a job with WPAQ and now I am an engineer for WHPE." VAN W. WORKMAN, High Point, N. C.

N.R.I. Started His Way up

"I was a cab driver earning $35 a week. Then I enrolled with N.R.I. Now tester with TV maker." J. H. SHEPHERD, Bloomington, Ind.

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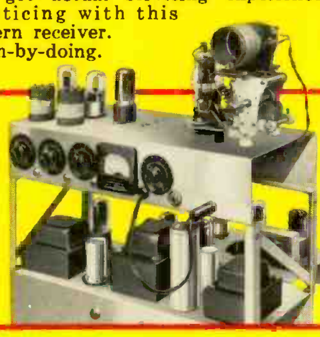

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Paid for Instruments out of Earnings

"I am doing very well in spare time TV and Radio. Sometimes have three TV jobs waiting and also fix car Radios for garages. I paid for instruments out of earnings." G. F. SEAMAN, New York, N. Y.

Has Own Radio-TV Business

"We have an appliance store with our Radio and TV servicing and get TV repairs. During my Army service, N.R.I. training helped get me a top rated job." W. M. WEIDNER, Fairfax, S. D.

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Correspondence

SERVICING BY MANUFACTURERS

Dear Editor:

It has become increasingly evident that Admiral, G-E and Philco now wish to join our old competitor, RCA, in an all-out drive to capture the consumers' service business and take it out of the hands of the independent neighborhood service technician and service dealer. This presents an incentive for the independent dealers and technicians of America to *unite and fight* as they have never done before.

Unity is necessary to preserve their independence, to preserve their security, to preserve their investment in a $2 billion a year industry, to preserve their future which holds forth a potential of technological advancement in a consumer and industrial application the likes of which the world has never before seen.

We should not stand idly by while big set manufacturers gobble up our investment along with our many years of experience and our customers whom we have spent so many years getting.

BILL MATTINGLY
Television Service Association of Michigan, Inc.
Detroit, Mich.

TRANSISTOR REGENERATOR

Dear Editor:

Since my article, "Transistor Shortwave Regenerator," August, 1956, appeared I have received numerous queries as to how the high-frequency range of this unit could be extended and what circuit changes were necessary. I am happy to say that the 2N137 transistor used in the regenerator can be replaced with a 2N144 with no circuit modifications necessary and with increased high-frequency performance.

EDWIN BOHR
Huntsville, Ala.

NOTES ON SPEECH–MUSIC

Dear Editor:

Correspondence with readers who constructed my speech–music discriminator from details in the September issue brought out a number of points that I'd like to pass on to others.

1. The input voltage (1–3 volts peak) was measured on a scope. Higher voltages are clipped and the unit does not work as well as it does when the error is on the low side.

2. The plus and minus voltages delivered by the power supply need not be exactly 200 but they should be as nearly equal as you can make them.

3. The table shows socket voltages as measured on the 3- and 300-volt dc ranges of a 20,000-ohms-per-volt meter. Supply voltages are +205 and −210.

DC VOLTAGE READINGS

Socket terminals	V1	V2	V3	V4	V5
Pin 1	0	0.15	84†	178	0
Pin 2	0.66	0	0	0	−125
Pin 3			0.45	2.15	−105
Pin 5	45	.07*			
Pin 6	20		−0.08	110	−85
Pin 7	0.66	0	−0.08	−0.2	−105
Pin 8			0.03		−105

*10 volts with signal applied. Measured on 300-volt scale.

†Averages around 70 with signal applied. May drop as low as 65.

4. If the unit does not work, check the voltage across the 2-μf capacitor. It should be less than 2.8 for music and more than 2.8 volts for speech when the circuits between the input and the capacitor are operating correctly.

EDWARD E. PREDMORE
New York, N. Y.

A VOICE FROM THE PAST

Dear Editor:

While reading some back issues of RADIO-ELECTRONICS I came across the Communications column in the December, 1949, issue. In it a Mr. Robert O. Barg stated:

> You have published many good articles in the past year which have been useful to me in part-time servicing and construction. However, material like the "Electronics in Medicine" series, Geiger counters, and microwaves merely wastes space that could be used for something more suitable for the average technician.
>
> I suppose you must publish a certain amount of TV material to keep up to date, but I personally believe TV picture quality and program material are an insult to anyone's intelligence. How anyone can gaze at those blurred black and white blobs that jump and flicker like the old-time movies is beyond me. I've seen all the best receivers, and they're all stinkeroos. Until a high scanning rate and higher frequencies are developed, TV will amount to nothing. It's little better today than it was 10 years ago.

I could not help but wonder if Mr. Barg is still in the radio-television business. If he is, he is probably sadly lacking in the theory of uhf because he seemed to think that material on microwaves "merely wastes space."

Particularly amusing was his statement: "TV will amount to nothing". How does he feel about it now?

A really good technician is interested in all phases of electronics and appreciates reading occasional articles on equipment which he has not yet come in contact with but may have to service at some later date.

I wonder if the skeptic Mr. Barg disapproves of the current material on transistors.

KENNETH MAUS
Reading, Pa.

TV SERVICE KIT

Dear Editor:

Letters reaching me concerning my article *Universal TV Service Kit* indicate that some additional data should have been included.

The carrying case is an inexpensive suitcase measuring about 14 x 26 inches (a larger one might be advisable in view of the flood of new tubes today). The sockets to receive the tubes are on two pieces of ¼-inch plywood, one for the body or bottom and the other for the lid. It's necessary of course to drill a hole beneath each socket, large enough to allow the tube pins to go through.

After the top and bottom plywood assemblies are completed, they may be bolted through the case with ordinary machine screws and washers.

The tubes in the list below pretty well cover the makes of sets most popular in my area. Additions may be needed elsewhere.

MINIATURES

1X2	6AN8	6C4
1B3	6AQ5	6CL6
3AL5	6AS5	6CS6
3BC5	6AU6	6J6
3BN6	6AU8	6S4
3BZ6	6AV6	6T8
3CB6	6AW8	6U8
3CS6	6BA6	6X8
4BQ7A	6BC5	12AT7
5J6	6BC8	12AU7
5AM8	6BE6	12AV7
5AN8	6BH6	12AX7
5U8	6BH8	12AZ7
5BK7A	6BK7	12BA6
6AB4	6BN6	12BE6
6AH6	6BQ7	12B4
6AL5	6BY6	12BH7
6AT6	6BZ6	12BK5
6AT8	6BZ7	12BZ7
6AM8	6CB6	12BY7

GT TYPES

5Y3	6SN7
6AC7	6SQ7
6AG7	6V3
6AQ7	6W4
6AU4	6W6
6AU5	6X5
6AX4	12AX4
6AX5	12L6
6BL7	12SN7
6BQ6	25AV5
6J5	25BQ6
6K6	25L6
6SL7	25W4

LARGE TYPES

5U4
6BG6
6CD6
12CU6
6AU5
6AV5
6CU6
6BY5

H. A. HIGHSTONE
Santa Rosa, Calif.

SYMBOL CONTROVERSY

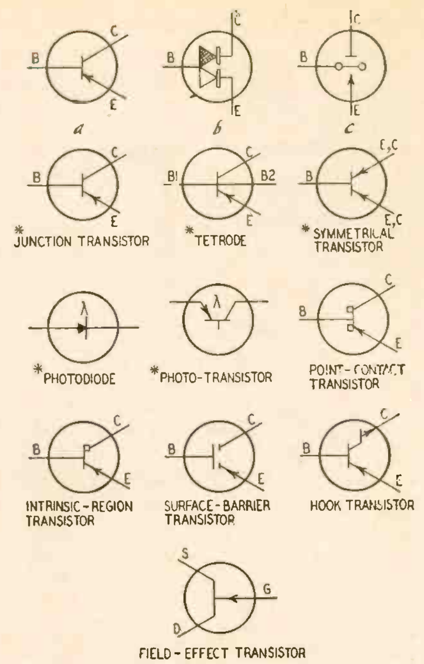
Dear Editor:

I read with interest the letters about transistor symbols in your magazine. This healthy controversy is going on all over the trade.

Persons proposing new symbols should keep two things in mind: First, the symbol should be easy to spot in a complex diagram. That's why the common symbol at *a* has a circle—to keep it from looking like just three wires at first glance.

Second, it should be simple and easy to draw. Draftsmen's time is valuable, and fewer mistakes are made with simpler symbols. Thus, cross-hatching of electrodes *b* (from a letter in the November issue) and extra circles to draw *c* (from a recent transistor book) are impractical.

One feature of present symbols is good. The emitter arrow *always* gives the polarity of the transistor (p-n-p or n-p-n) by pointing from a p to an n region. This is the direction of easy current flow at the junction. Diode symbols also use this convention. It is so useful it should be kept in any future symbols.



I don't feel any radical departures from present symbols will gain acceptance. My personal preference is with the symbols in the diagram. The asterisks indicate symbols in common use now.

The point-contact and intrinsic-region symbols stress the actual material, while the others stress the physical action involved.

PAUL PENFIELD, JR.
Birmingham, Mich.

LIVE AND LET LIVE

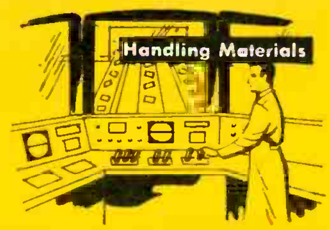
Dear Editor:

Mr. Mulford's letter, in the October issue, presents a sad situation. With industry veritably crying for electronic engineers and offering fabulous enticements to qualified men, we find Mr. Mulford, a "college grad" who "majored in electronics," forced to poach in the TV servicing preserve, and crying bitterly because the servicing fraternity resents that kind of unfair competition.

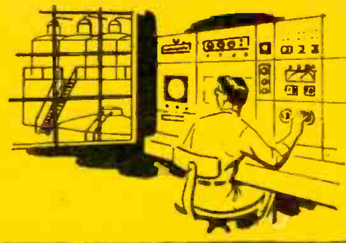
Would Mr. Mulford be a law unto himself? Are ethics to be only for his poor relations in the electronic field? My advice to Mr. Mulford is to picture himself as a full-time service technician, paying rent for a shop and all the other expenses involved in independent service operation, and struggling to make a decent living for himself and family. How would he feel then about someone operating part-time from his basement, cutting prices and often libeling his honest endeavor? Don't be greedy, Mr. Mulford; live and let live. And don't throw up road blocks to the attempt of TV service technicians to raise their calling to an honorable, decent way of life.

H. M. LAYDEN
Chief Technician
Judd-Bennett Co.
New York, N.Y.

END



Handling Materials



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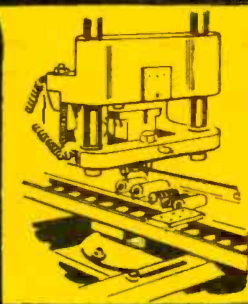

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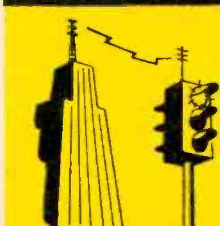

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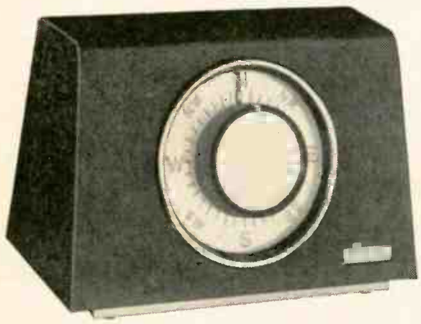

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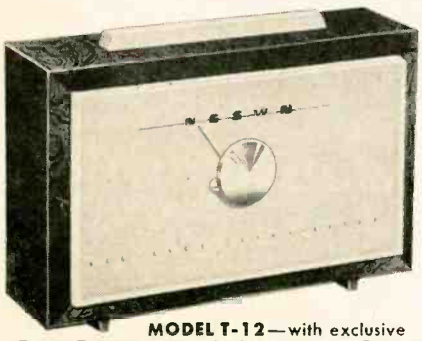

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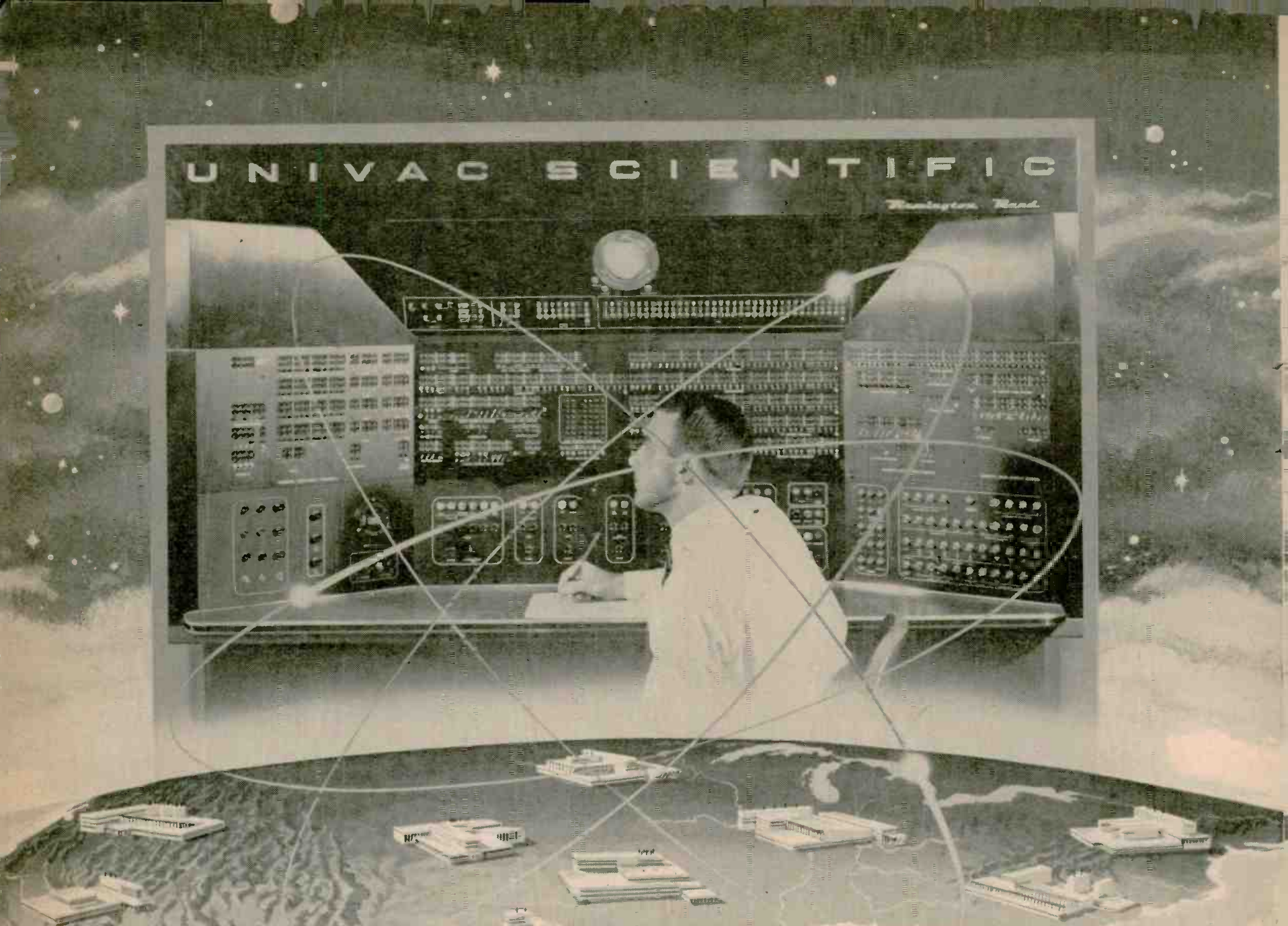

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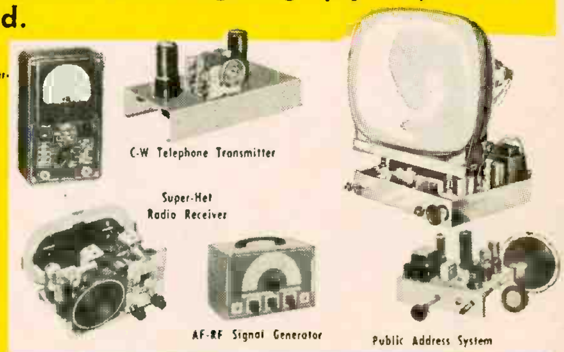

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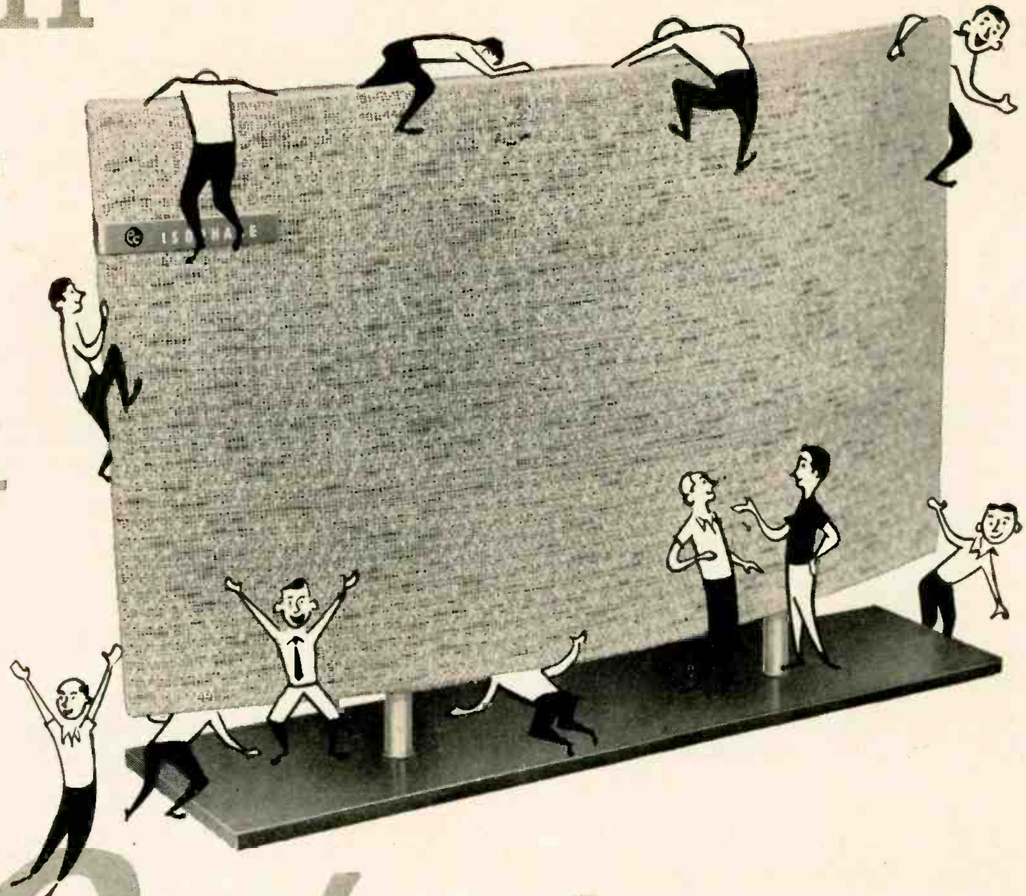

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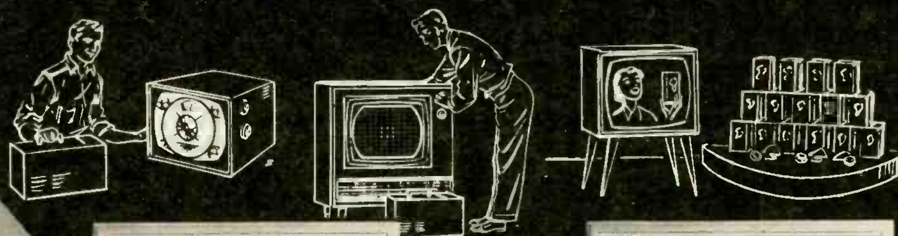

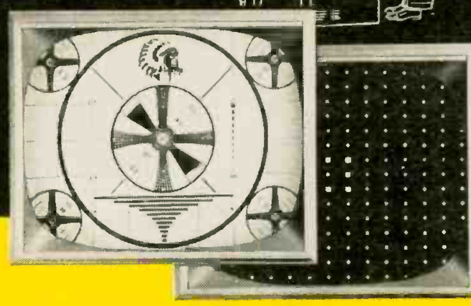

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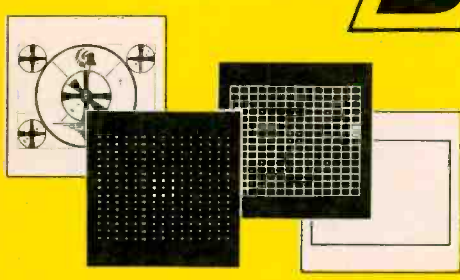

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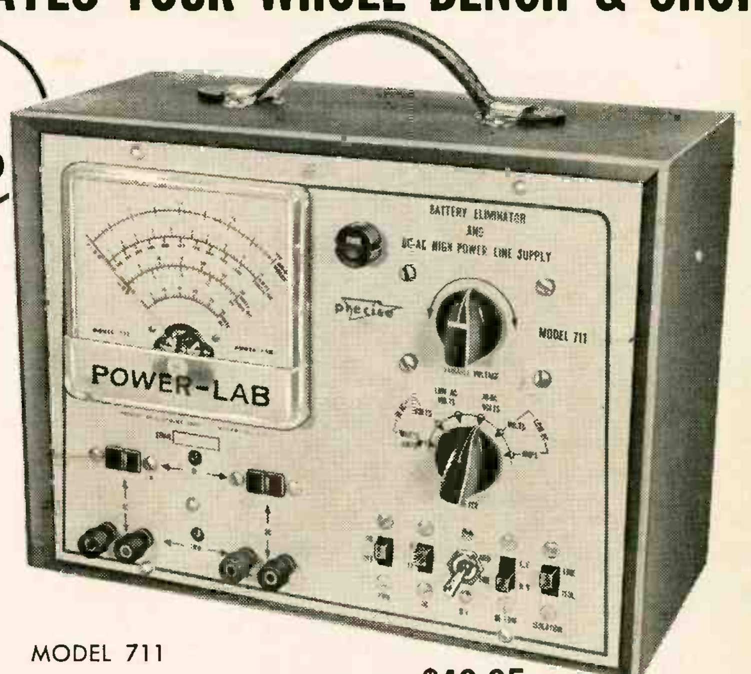

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High Voltage AC	No Isolation 90-140 volts	20 amps 2000 watts	10 amps 1000 watts
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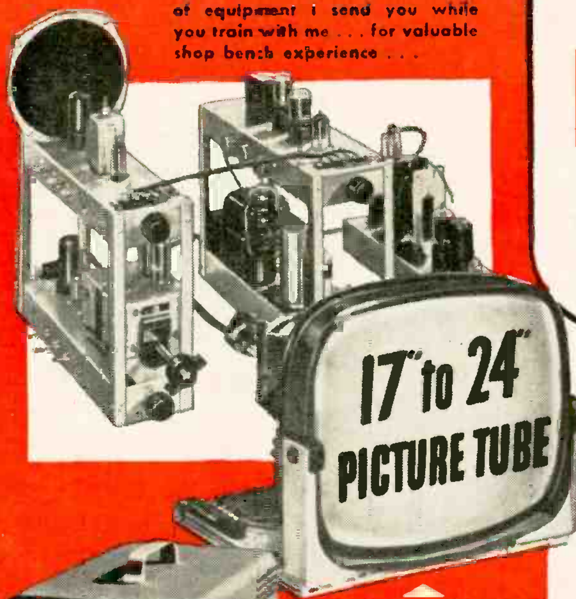

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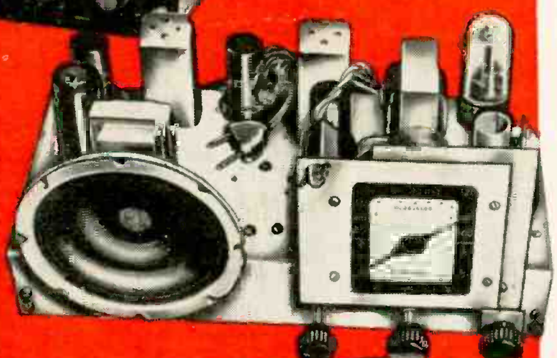

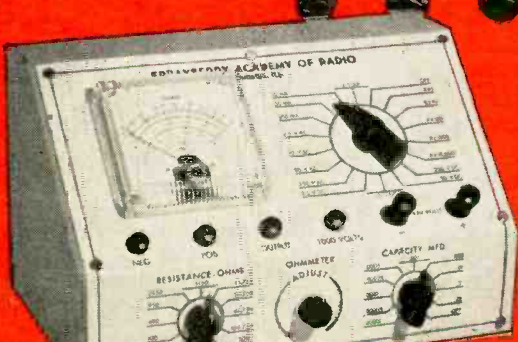

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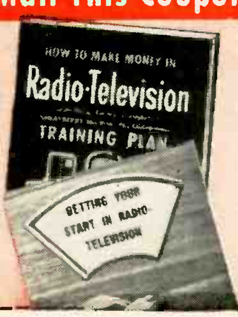

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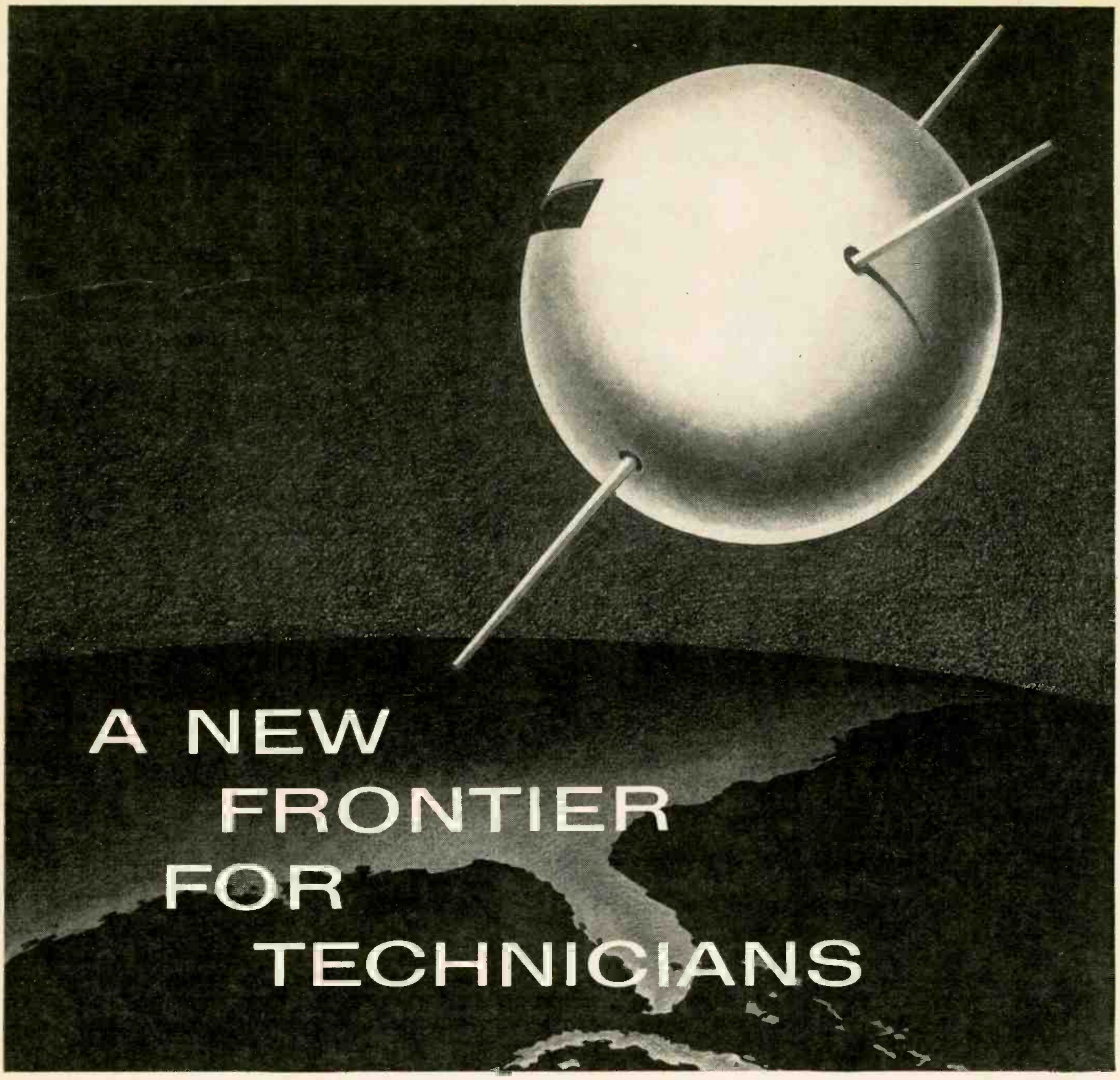

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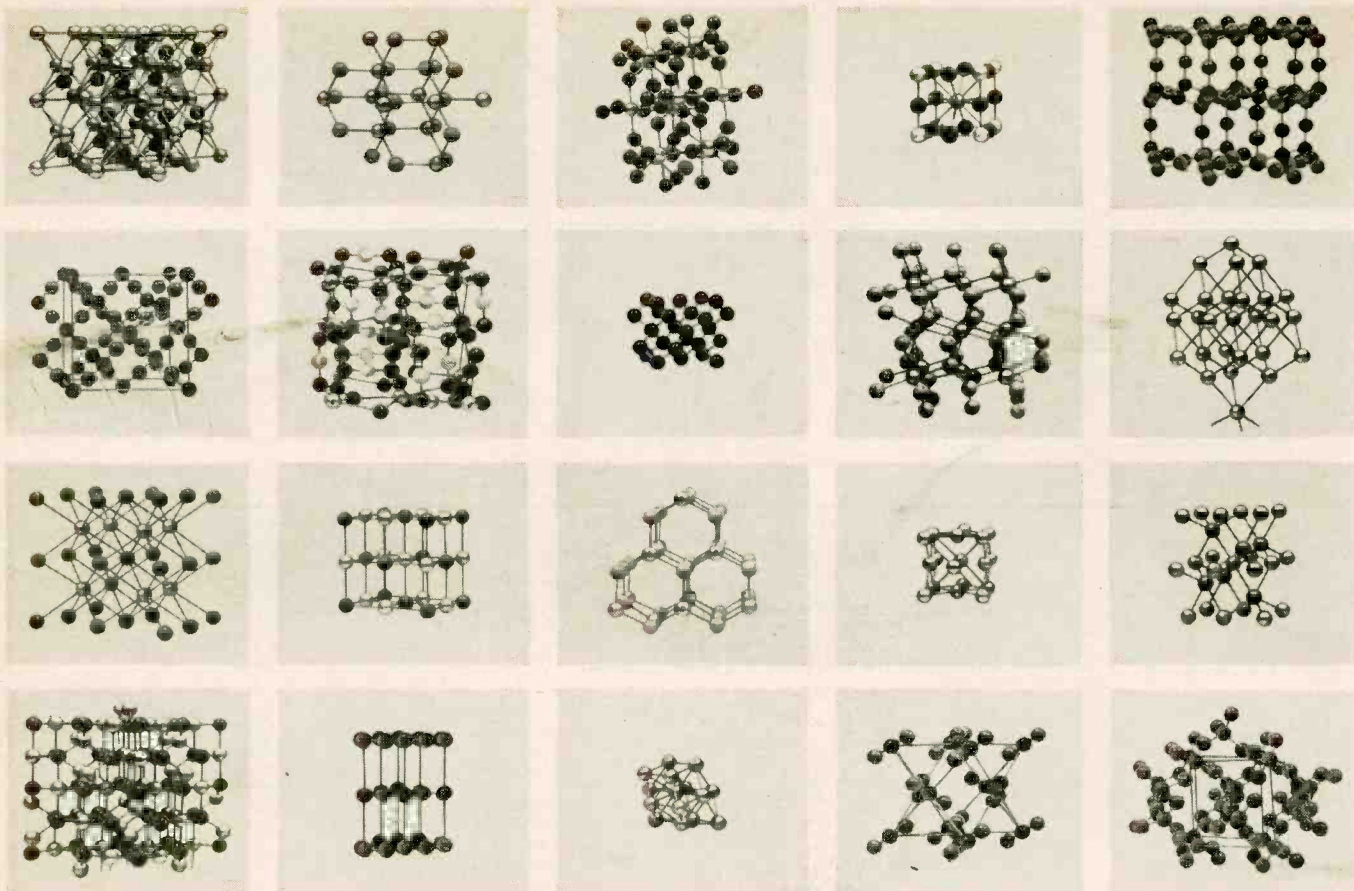

Crystal structure models. Top row, left to right: cuprite, zincblende, rutile, perovskite, tridymite. Second row: cristobalite, potassium dihydrogen phosphate, diamond, pyrites, arsenic. Third row: caesium chloride, sodium chloride, wurtzite, copper, niccolite. Fourth row: spinel, graphite, beryllium, carbon dioxide, alpha-quartz.

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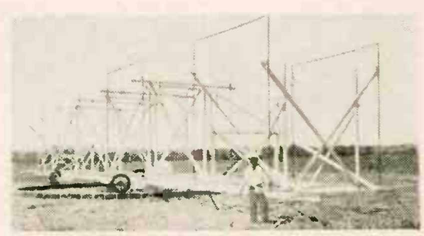

Directional antenna used by Karl G. Jansky in discovery of stellar radio signals at Bell Telephone Laboratories in 1932.

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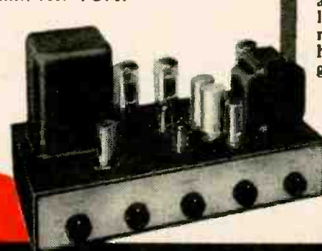

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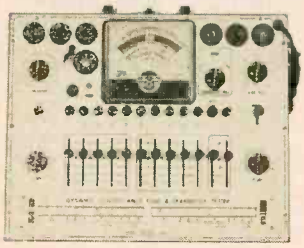

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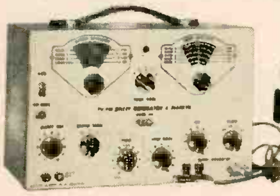

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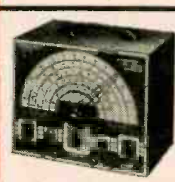

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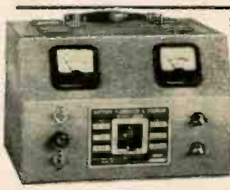

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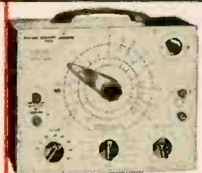

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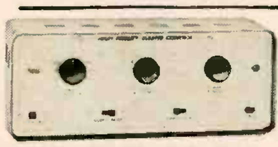

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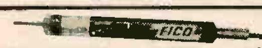

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RADIO-ELECTRONICS

Hugo Gernsback, Editor

TELEVISION OF THE FUTURE

... *Future Progress Will Effect Vast Changes in TV* ...

WHILE television has been with us for a long time—the writer wrote the first technical article, "Television and the Telephot," in the December, 1909, issue of *Modern Electrics*—it was also very crude in those early days. Television as we know it today did not become a practical reality until the years immediately following World War II.

Up to very recently we had only monocolor television. Today we have full-color receivers and we can look forward to the immediate future when multicolor sets will become as common as the present black-and-white receivers.

What of the more distant future? In what direction will television travel? From today's technical viewpoint we can forecast a number of developments which are certain to come.

Yet it is necessary to understand that in technical forecasting it is never safe to predict exactly how long it will take industry to catch up with the forecasts. There are too many imponderables, too many obstacles in research, in finances and in manufacturing. There is aways a long and weary road between prediction and reality.

Three-dimensional TV has long been predicted by the writer and others. Much research has been done in this branch and many patents have been granted. It is a certainty of the future.

Picture-on-the-wall TV, first predicted by the writer in 1954,* is also a certainty in the not-too-distant future. The heavy cumbersome TV sets of today are doomed to extinction, chiefly because they take up too much room in the modern and future home. Most TV set manufacturers are working intensely on this problem now.

Electronoptics is a new concept of which you may hear a great deal in the future. It will be linked intimately with a radical re-evaluation of all present-day TV. For over three decades now the writer has been speaking of *scanless* TV. The animal eye, as we have reiterated constantly, is still by far the best TV receiver. It is also the smallest, the most compact, the most efficient and the lightest. The eye does not scan—it requires no huge cathode-ray picture tube. It works by chemico-electronoptics. Now we know that the electromagnetic spectrum has radio waves in one section, which then gradually merge into a high-frequency region where the electro-radio waves become light rays—the optical part of the spectrum.

It is the writer's contention that the cumbersome instrumentation now used in our TV sets will be replaced with much simpler electronoptical means in the future. Why? Let us see how TV sets work today:

First we receive the waves (impulses) from the transmitter. We then amplify these impulses and convert them into modulated cathode rays. These rays then influence certain chemicals (phosphors) on the TV tube's screen, giving us light impulses which we require to perceive the pictures.

This roundabout system can be enormously simplified once we have mastered the intricacies of electronoptics. The cathode-ray tube will not prevail in the future. It is far too cumbersome and too complicated. Exactly how will electronoptics solve the problem? There may be scores of methods. Let us hint at only one:

Semiconductors of the future, combined with atomic luminescence, look attractive. Remember, transistors are still in their earliest infancy—you can expect great and astonishing, as well as revolutionary, advances from them in TV.

The Television-phone, long predicted, already exists in laboratory models. It will be universal in the not too distant future. You may wish to call an important customer abroad, but you can't speak, let us say, Turkish, nor he English. The telephone company's language rectifier—now also in the laboratory stage—will translate both voices *instantly* by electronics. You may—after you read this—have some doubts as to the verisimilitude of your voice and if it will sound like you. Your doubts are justified. Your voice will *not* sound exactly like yours after electronic translation. Yet after a lapse of many years, it is certain that improvements will in due time make it possible to recognize voices of your friends even if rectified.

Automatic channeler. One of the nuisance chores of television is switching channels, particularly if you are comfortably seated 10 feet from your receiver. This deficiency has occupied many engineers and set designers in recent years. Good progress has been made in this direction. One firm brought out a flashlight device which, when trained on a photoelectric cell on the receiver, changes the channel. Another device was a miniature radio transmitter which fits your hand. By pressing a button, you change the channel.

Good as these devices are, they are still cumbersome in that you must keep pressing the button successively until you obtain the correct channel.

A simpler system would be in the so-called "click-clack," such as is used by elevator starters. This 10¢ device gives two distinct and sharp signals. In the TV receiver, we will have two special microphones which are tuned exactly to the two distinct sounds. If you press down on the gadget, the picture starts "rolling" slowly from one channel to the next one. If you see the desired channel, you release the pressure on the click-clack and it now gives the second sound, the "clack." This stops the "rolling" of the channels. The advantage of the click-clack is its great simplicity and diminutive size—you can put six of them into your vestpocket.

Pocket and mini-TV sets are a distinct possibility for the immediate future. Even today such an overcoat pocket set could be built. People *do* want small, portable receivers as is best shown by the boom of our "small" portable TV sets. While these are still fairly large, measuring about 10 x 9 x 12 inches and weighing 22 pounds, the trend is unmistakable. People *do* want desk and night table receivers that can also be put in your overnight bag when traveling. If the present vogue of real pocket radios is a sign, we may be sure that handy pocket TV sets of the future will be even more popular.

Still smaller minitelevision receivers are certain to be built in the future—just as will such tiny ones as television wristwatches, forecast by the writer in 1945. While still impracticable today, because of the necessary bulky cathode-ray tube, the problem is not insoluble in the future with improved electronic techniques. —*H.G.*

*See RADIO-ELECTRONICS, January, 1954, issue, page 33.

COVER FEATURE

The Apple (left), a standard black-and-white and a shadow-mask color tube.

how the apple tube works

By H. R. COLGATE*

THE Philco Apple† tube is a 21-inch single-gun rectangular color picture tube. The face on which the picture is viewed is coated with a repeating array of red, blue and green stripes arranged vertically. Each stripe is .010 inch wide and is separated from the next color by .010 inch so that in every inch across the face of the picture tube there are about 17 red stripes and an equal number of blue and green ones. The chemicals used in each of the stripes are selected so that when all three stripes are lighted at once, the resultant color is white. When each stripe is lighted separately, the resultant colors are red, blue or green. When red and blue are lighted together, the color is magenta. Blue and green produce cyan and red plus green makes yellow.

The magenta, yellow and cyan secondaries could be produced by lighting up the appropriate primary colors either in rapid sequence or simultaneously by making the spot hit the required color stripes at the same time. Secondary colors are produced on the Philco tube by making the spot hit the required color stripes at the same time. Colors in between primaries and secondaries are made by carefully controlling the amount of each color that is illuminated.

This type of colorimetry requires that the circuits which are processing the incoming broadcast signal information always know *exactly* where the picture writing beam is as it scans across each color stripe. If beam position is known to a high degree of precision, the beam can be modulated as it crosses a red stripe when there is red in the broadcast picture. When there is yellow in the broadcast picture, the beam can be turned on as it crosses the red and green stripe. For white, the beam is left on while it crosses all three stripes. It is possible with this tube, then, to make any color that can be produced by mixing appropriate amounts of red, blue and green light. Each color that can be produced may be reproduced 17 times per linear inch or 550 times per square inch.

The Apple tube provides the color processing circuitry with exact beam-position information by producing a marker signal every time a green stripe is crossed. Thus the circuits know when the beam is crossing green and that shortly thereafter it will cross the blue, then red. Obviously some time is required to receive the marker signal from the tube and some time is required to process the broadcast signal, so the marker signal is fed into circuits that predict where the beam will be a short time later and then makes use of this information to modulate the beam correctly.

Fig. 1 is a cutaway of the picture tube, as viewed from above. The red, blue and green phosphor stripes are printed directly on the glass faceplate. The phosphor stripes are backed with an aluminum coating. On the gun side of the aluminum coating and behind each green stripe is the marker, or index stripe, This marker stripe is made of a material that produces a signal every time it is crossed by an electron beam.

The marker stripe produces a signal only if it is being scanned. Since picture content is sometimes black or minus green, the beam that is producing the color picture cannot be depended on to produce a continuous signal from the marker stripe. A second beam produces marker signal only.

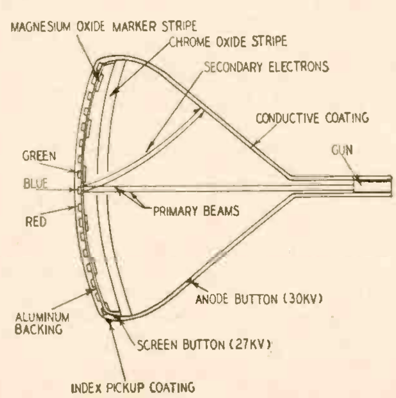


Fig. 1—Cross-section of the Apple tube, as viewed from above.

One beam, then, is used for "writing" the color picture and the second only for obtaining the beam-position information. The marker beam is so aligned that it always strikes the same color stripe as the picture writing beam.

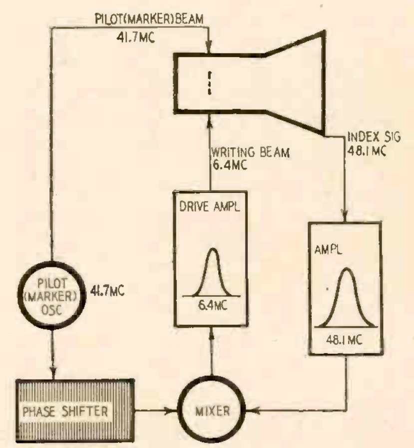


Fig. 2—How the marker signal is produced and processed.

It is modulated at a frequency—the "pilot carrier frequency"—which is above the video and color frequency range so that frequency-separation techniques can be used to separate marker-beam information from picture-beam signal.

The marker beam is always on and operates at a very low current level. It is also advantageous to operate the marker beam so that it produces a signal that is easy to distinguish from the miscellaneous signal produced by the picture writing beam as it hits the marker stripe during the course of picture writing.

The marker-signal production and processing are shown in the block diagram of Fig. 2. The marker signal from the screen of the picture tube must be amplified, combined with instructions from the transmitter and restored to picture writing frequency;

* Lansdale Tube Co., Lansdale, Pa.
† The term "Apple" does not refer to any characteristic of the tube—was simply the secret code name of the Philco color tube development project.

that is, the frequency at which the beams cross phosphor stripes, are amplified and fed to the electron-gun writing beam grid to produce color. An oscillator at 41.7 mc drives the marker-beam grid. This, plus the 6.4-mc scanning frequency (the rate at which both beams cross the marker stripes), produces a signal from the marker stripe whose frequency at 48.1 mc is easy to separate cleanly from writing signal. The output at 48.1 mc is amplified and then goes to a mixer. In the mixer it it heterodyned with the pilot oscillator output, producing the necessary 6.4-mc signal for the writing grid.

To change color, it is necessary only to change the time relationship between receipt of marker information and time that the writing grid is pulsed on. This time relationship between receipt of marker information and writing grid conduction is known as phase; thus, to produce blue the phase shift required would be 120° (since the marker stripe is behind green) and for red 240°.

To make the system of Fig. 2 show complete color pictures instead of a solid field of color, it is necessary to vary dynamically the phase and amplitude of the pilot oscillator signal entering the mixer.

To make use of the system chosen in Fig. 2, the 3.58-mc color signal must be converted to a 6.4-mc writing signal. Fig. 3 shows how this is done. The 3.58-mc color signal and a 3.58-mc reference signal are fed into mixers, each of which is hooked to the output of a 38.1-mc oscillator. The 41.7-mc signal from the mixer containing color information at 3.58 mc and the 38.1-mc pilot carrier are filtered and mixed with a 48.1-mc output from the index signal amplifier. The resultant 6.4-mc signal is used to drive the writing beam of the picture tube. The output of the mixer that has been fed 3.58-mc reference and 38.1 pilot carrier is used for marker beam at 41.7 mc.

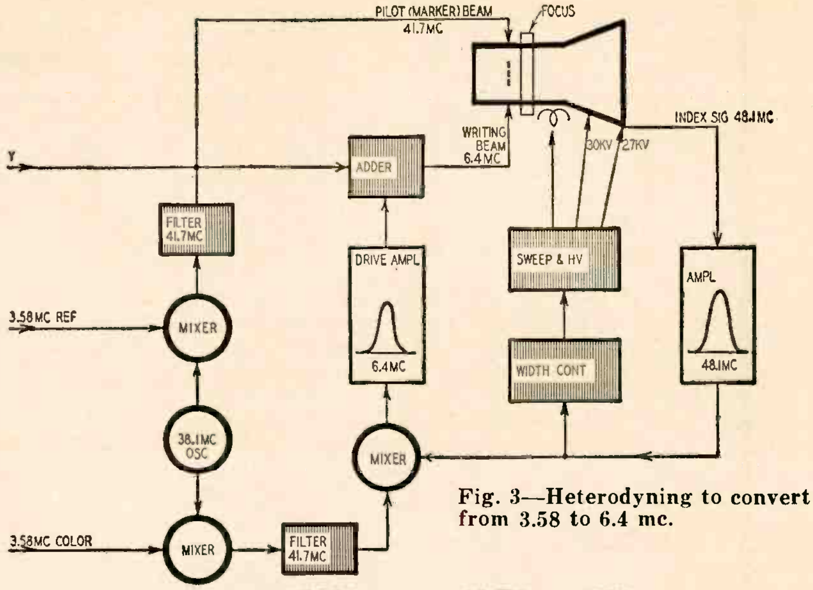


Fig. 3—Heterodyning to convert from 3.58 to 6.4 mc.

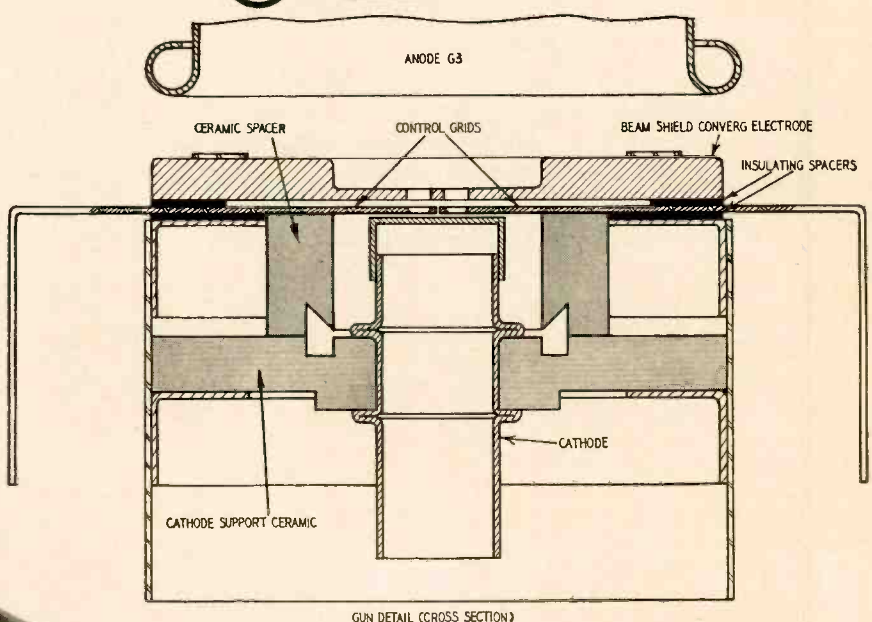
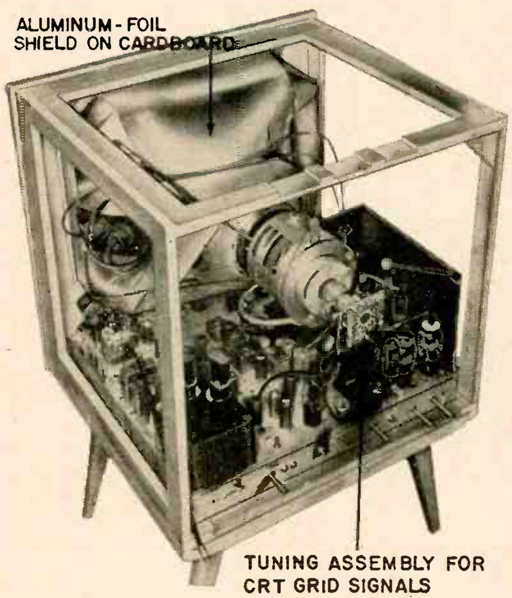


Fig. 4—Apple tube's "double-barreled" gun.



An experimental color receiver using the Apple tube.

The tube's construction

The picture tube, then, must meet several specific requirements. There must be a phosphor structure that, when selectively illuminated, will reproduce the color picture the camera sees. There must be a marker structure that produces a signal that will allow the circuitry to know exactly where the beam is at any instant. There must be an electron gun that has a picture writing beam and a marker beam.

Fig. 1 shows that there are three major components in each picture tube. There is the gun that produces the marker and picture writing beams, the screen structure composed of the aluminum-backed phosphor stripes and the graphite-coated glass that is the collector of the secondary electron signal.

The screen structure is operated at 27 kv. The anode or collector operates at 30 kv and is electrically separated from the screen by a stripe of chrome oxide. The 3-kv difference between the screen and the anode makes it possible to collect the secondary electron signal from the marker stripe and thus obtain beam-position information once that signal has been processed.

The electron gun that produces the picture writing and marker beam has only one more element than a conventional black-and-white picture-tube electron gun; it has two control grids instead of one. However, the requirements that this electron gun must meet are quite different from a black-and-white gun, hence the quite different design shown in Fig. 4.

Spot size must be small, there must be no cross-talk between the beams and the beams must track; that is, always have a known relationship to each other since one beam is used to tell where the other is.

The tracking requirement is met by designing the gun so that the two beams originate very close together and then cross each other at the center of deflection. Center-to-center separation of the two beams at the control grid plane is .029 inch, and they are made to cross each other at the center of deflection by the action of the field lens produced by the convergence electrode. This lens bends the beams toward each other slightly.

Small spot size at high beam currents is obtained with small countersunk grid apertures, close grid-to-cathode spacing and careful assembly of parts so as to not introduce any electrostatic lenses into the system. At typical operating voltages, the cutoff of the marker beam is 50 volts.

Cross-talk between beams is prevented by a beam-shield-convergence electrode that provides a simple shield between the two beams in the region just above the grid apertures and effectively reduces the cross-talk between the beams to a level low enough not to be a limitation on the system.

Fig. 5 shows a complete receiver. The circuits outside the dotted lines are similar to conventional color receiver practice. The horizontal-sweep–high-voltage section is very similar to monochrome practice. A pair of 6CD6 tubes have been used for the drive and a special high-perveance diode, the L1379, is the damper. The 30-kv supply is obtained by a voltage doubler of 1B3's. Width control, for the close but long-time-constant control of the average color writing rate, is obtained by controlling the average bias on the drive tube grids with the output of a writing frequency discriminator. Sweep width modulation is required at the vertical scanning rate to match the raster pincushion to the color-line pincushion. This is provided by a small amount of drive-tube bias variation with vertical parabola and sawtooth components derived from the vertical output stage. To aid in maintaining horizontal sweep linearity (it changes with line voltage) and to maintain a nearly constant picture height, the plate supply voltage for the horizontal and vertical oscillators is derived from the regulated energy in the horizontal system. The 6X4 shown provides a 400-volt supply for this purpose. An antiringing damper, the L1373, is used to suppress transients of the output transformer. Vertical dynamic focus only is used in this receiver and for this vertical frequency parabola is applied to a focus control tube. Regulated high voltage for maintaining optimum focus, horizontal sweep operation and index is provided by the L1359 and L1360 all-glass gas regulators. The requirements for stability of width, linearity and high-voltage regulation can be met by these circuits.

The mixer unit consists of two tubes whose triode sections do nearly all the color signal processing required by the receiver. The functions of this section are to generate an unmodulated pilot frequency carrier and to transfer the chrominance modulation to a second pilot frequency carrier. To supply the unmodulated pilot carrier signal, a pentode is used as a 38.1-mc oscillator. Oscillator output is mixed with 3.58 reference signal and the sum frequency of 41.7 mc is selected, amplified and applied to the C-R tube pilot signal grid where about 40 volts peak to peak are required. The pilot carrier bias control previously mentioned is a dc bias control on this C-R tube control grid. Pilot oscillator output is also mixed with the receiver chrominance signal and again the sum derived to form the chrominance modulated signal of 41.7 mc.

The functions of the video amplifier are normal. The luminance signal from the detector is amplified and applied to the C-R tube writing grid. The chrominance signal from the sideband unit is amplified by the last two stages of the video amplifier and with the luminance makes a composite video signal for the C-R tube writing grid. About 150 volts of peak-to-peak signal, including the sync pulse, achieve 40-foot-lambert highlight-brightness pictures.

A band of silver paint near the tube face is used to make a capacitive couple tuned to resonance at index sideband frequency for index signal takeoff.

The pilot carrier signal is coupled from the chassis by coaxial lead. Writing frequency signals are carried by open wire leads. END

References

H. R. Colgate, P. D. Payne, G. W. Pratt and G. R. Spencer, *The Philco Color Tube, A Secondary-Emission Beam Indexing Color Tube*, Philco Corp. Philadelphia, Pa. Professional Group on Electron Devices IRE, N. Y. Chapter. May, 1956.

J. S. Bryan, R. G. Clapp, E. M. Creamer, S. W. Moulton and M. E. Partin, *A New Color Television Display—The Apple System*, Philco Corp., Philadelphia, Pa. IRE National Convention, N. Y. March, 1956.

R. A. Bloomsburgh, G. A. Feddi, W. P. Boothroyd and R. C. Moore, *The Current Status of Apple Receiver Circuits and Components*, Philco Corp., Philadelphia, Pa. IRE National Convention, N. Y. March, 1956.

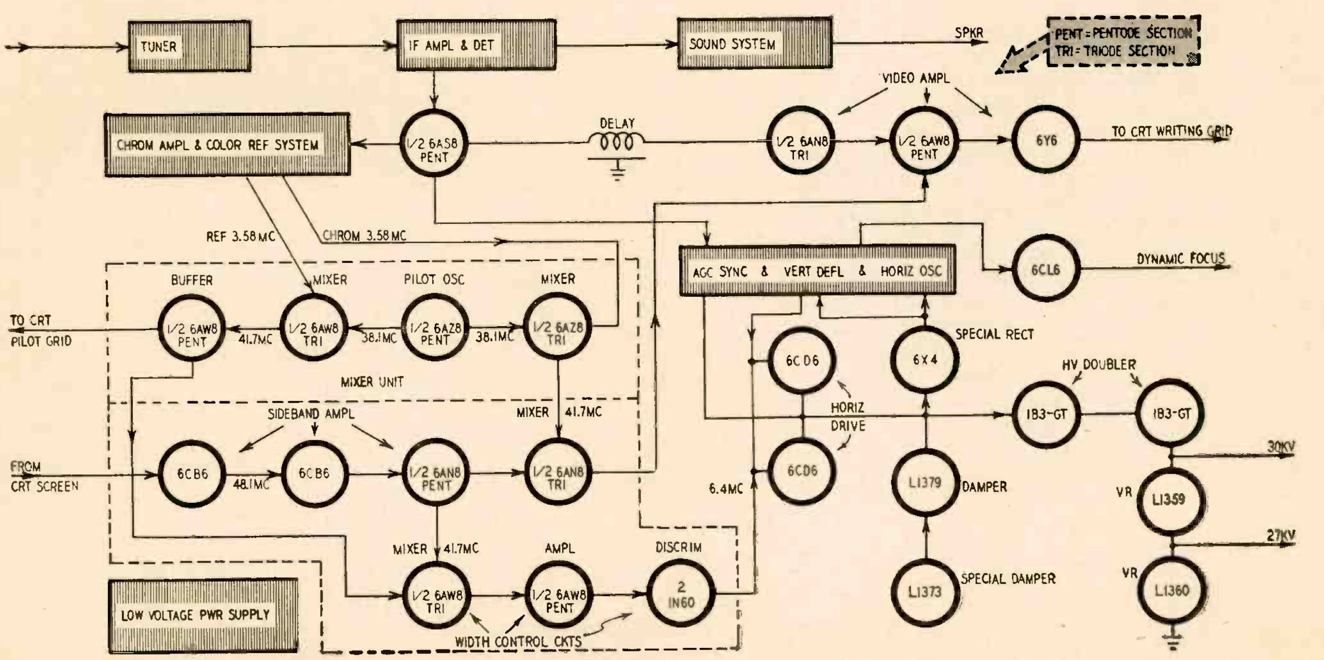


Fig. 5—Functional diagram of the Apple receiver, with special detail on color circuits.

BLACK and WHITE adjustments in COLOR TV

Techniques for removing color from monochrome pictures

By MATTHEW MANDL*

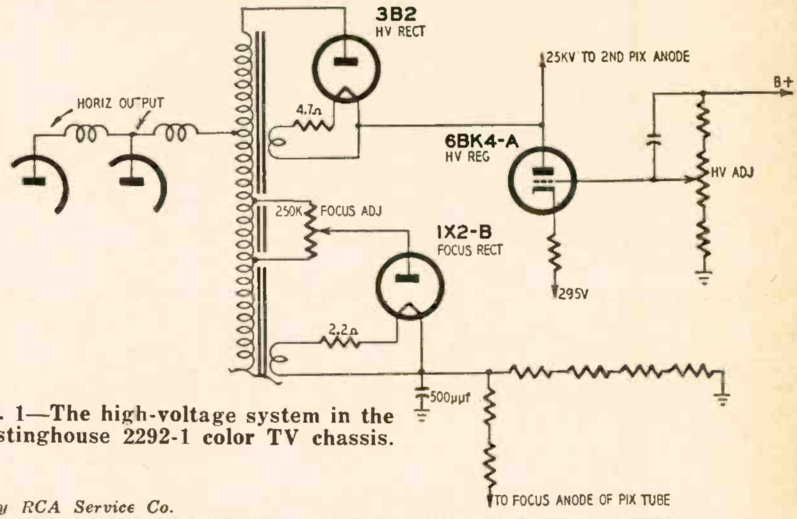


Fig. 1—The high-voltage system in the Westinghouse 2292-1 color TV chassis.

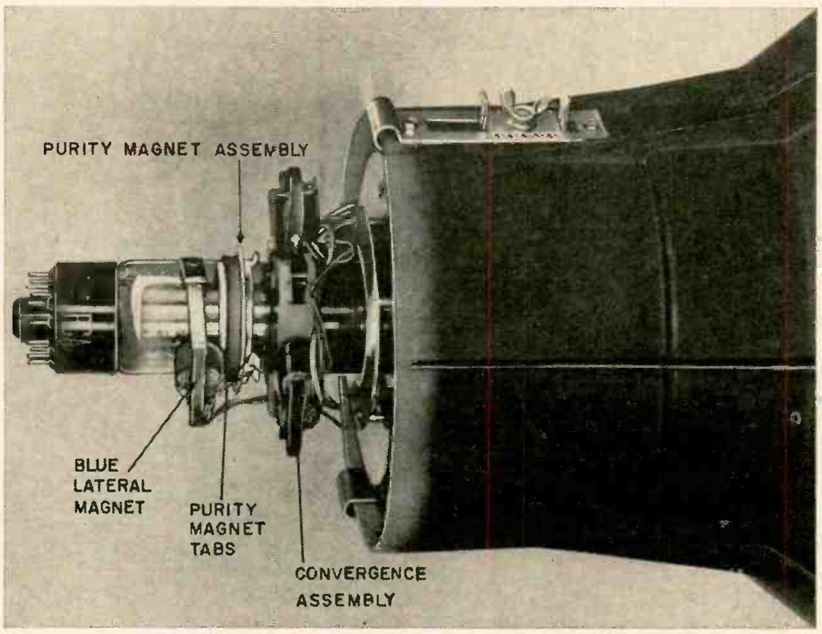
MANY technicians, when first servicing color television receivers, are surprised to find that getting a good black-and-white picture from a color TV receiver is not a simple matter. Yet most customers will complain more when black-and-white reception is color-contaminated than if color reception is not exactly up to par. The reason is that *nearly* true colors will appear good to the viewer (particularly during the first few weeks of set ownership) but a black-and-white picture tinged with color is sure to raise some vigorous protests.

In a three-gun color tube each beam must strike its respective color phosphor during the scanning process to produce the proper colors in a color program. During black-and-white reception the three beams must still be utilized since the operation of only a single beam would mean that a screen would be either red, blue or green, depending on which beam is in operation and which two are cut off. Thus the three beams must have proper amplitudes so the red, blue and green blend together to produce a white image.

Corresponding proportional decreases in the intensity of the three beams should not affect the monochrome purity, but should only modify its intensity. A gradual decrease in brilliancy gives the appearance of a progressively darker scene until finally the complete absence of white at any portion of the screen gives the illusion of black. Remember that any black object appearing on a television screen appears black only because of the *lack of illumination*. This is the reason black disappears when a light source illuminates the screen or when the receiver is operated in a well-lighted room.

If, during the scanning process, any beam does not remain in register with its particular color dots, a portion of the screen will appear in color during black-and-white transmission. If, for instance, the beam which strikes the blue phosphor dots is off registry at the lower right-hand corner of the screen, this portion of the screen will no longer have the proper proportions of red, blue and green for the production of *white* since part of the blue is missing. In consequence, any object in this section of the scene which should be white, or some degree of a lower white value such as light or dark gray, will appear in color.

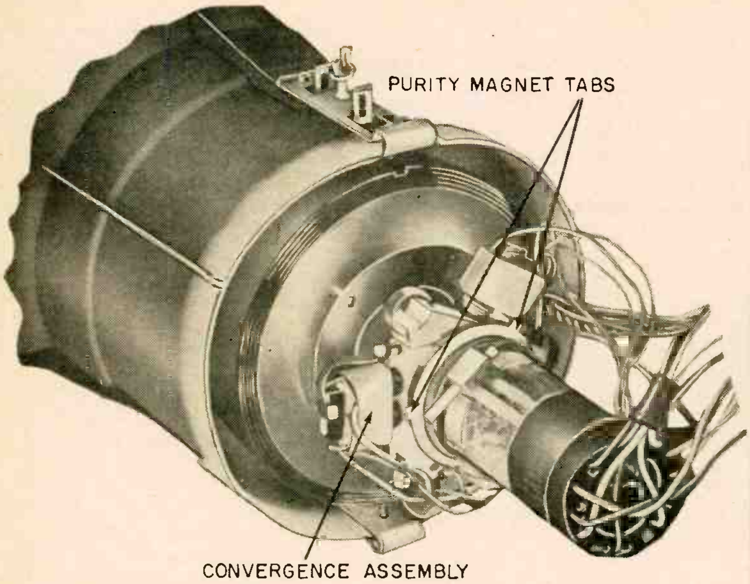
Photos Courtesy RCA Service Co.



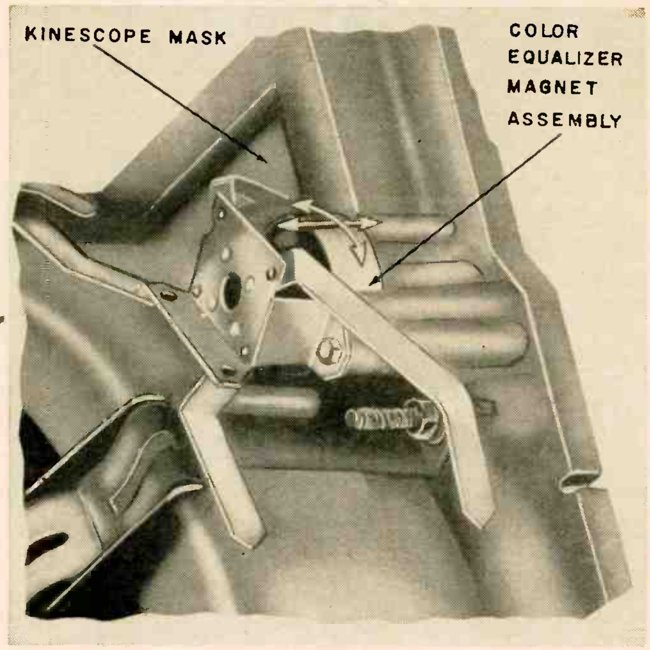
Side view of neck assembly on a typical three-gun color TV picture tube. The tube is not in operating position—blue beam magnet is normally on top.

Even after the receiver has been adjusted to produce a satisfactory black-and-white picture, the results will be disturbed if the viewer adjusts the contrast, brightness or fine tuning controls too far beyond the settings which were established when the receiver was initially set up. Hence, the technician should spend a little time with the customer and brief him regarding the effects of improper adjustment. The customer should also be warned not to tamper with any rear-panel controls or any of the various color and gain controls which may be accessible from the front of the receiver. If it appears that such controls require adjustment, the technician should be called. Maladjust-

*Author *Mandl's Television Servicing*



Above—Closeup shows purity magnet tabs.



Right—Closeup of color equalizing magnet assembly mounted on periphery of the kinescope face—six are used, as indicated in Fig. 2.

ments of such controls by the viewer may necessitate a complete readjustment and realignment by the technician.

During the initial receiver setup when the set is first installed, extensive high-voltage, purity and convergence adjustments may be necessary. After the set has been in service for some time, however, only minor adjustments of these controls may be necessary to reset and re-establish proper color and monochrome reception. Such resetting may be necessary because of tube aging or slight changes in component part values, even though no major fault which would require tube or parts replacements has developed in the receiver. The sequence of the initial setup procedures should still be followed when subsequent readjustments are necessary even though they involve only the checking of such adjustments rather than going through step by step processes. The general sequence is given herein as a reference check.

High-voltage adjustment

A 21-inch three-gun color TV tube requires from about 19,000 to 25,000 volts on the second anode to obtain adequate beam velocity. The purity and convergence adjustments depend on this second-anode voltage, and any change in it affects purity and convergence. A decline in the emission of the high-voltage rectifier or a change in the characteristics of the regulator tube alters the voltage from the value originally established during initial adjustments. Thus, proper color as well as black-and-white reception will be affected.

If the technician finds that the high voltage is below normal in a receiver which has been in use for some time, the high-voltage control must be adjusted to bring the voltage back to normal. The focus control may have to be readjusted slightly and a check should also be made of the static convergence. Re-establishing the high voltage at the level which prevailed during the initial setup should again restore proper color and monochrome reception.

If the high-voltage adjusting potentiometer (Fig. 1) is unable to bring the voltage up to the proper level, try new tubes. Not only should a new high-voltage regulator, high-voltage rectifier and damper tube be substituted, but horizontal output and horizontal sweep oscillator tubes may have to be replaced. Since the high voltage developed depends on the amplitude of the flyback pulse, defective tubes in the horizontal sweep output section as well as in the oscillator section can cause a decline in high voltage.

Convergence

The static convergence control can be adjusted while viewing the screen. Misconvergence will be noticed in the edges of objects by the double or triple image which appears. The displaced images appear in color even though a black-and-white picture is being received. This gives a rough check of whether the convergence control is severely misadjusted. If it appears that the convergence should be reset, it is necessary that a dot pattern generator be brought into the home so that the dynamic convergence at the sides of the screen can be checked with the dot pattern on the screen. Failure to obtain good convergence of the entire screen area necessitates a check of the color purity.

Convergence adjustments influence the three beams so that they have a proper crossover through the small holes of the aperture mask. Purity adjustments affect the alignment of each beam so that the beam travels in a path substantially parallel to the tube-neck axis. If the beam is not angled properly, it will be impossible to converge it correctly at the aperture mask, and both black-and-white and color reception will be impaired. Even though the beam is aligned properly (correct purity) proper colors cannot be obtained so long as the static convergence (center of screen) and dynamic convergence (as beam travels across the tube face) are not correct.

Purity

During the initial setup of the color television receiver the purity adjustment procedures usually involve a more complex sequence of steps than would be necessary when the purity is readjusted subsequently. Initially, all the magnets of the field-neutralizing assembly are set so they are at a maximum distance from the picture tube. (See Fig. 2.) The contrast control is turned down, the brightness control turned up. The red screen control is then advanced fully; the green and blue screen controls are turned down.

The rings of the purity magnet are then rotated (Fig. 3) or the entire assembly is rotated until a pure red raster is obtained. In some service notes it is recommended that the yoke be moved back from the picture tube. This sometimes facilitates purity adjustments because the smaller raster thus obtained permits better inspection of the sides of the scan.

A continuation of the purity adjustment check would be to turn the red and blue screen controls down and the green screen control up, to check for green purity. The process is then repeated for blue. In most instances if the red purity adjustment is satisfactory, the green and blue give little trouble. If they do, convergence will have to be rechecked, as well as the value of the high voltage.

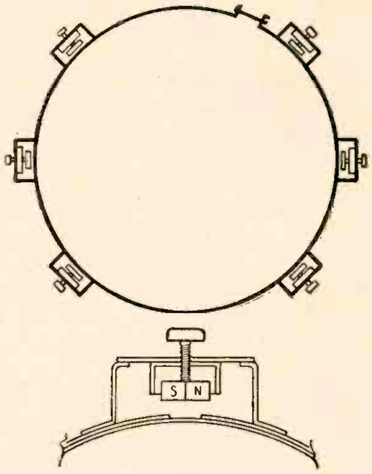


Fig. 2—A typical arrangement of the field neutralizing assembly.

If all efforts fail to produce uniform single-color fields for the three primary colors, a compromise adjustment may be necessary. When service notes mention a compromise adjustment, however, it should only mean that a very small amount of color contamination is present. If, for instance, a blue field is seriously contaminated over more than approximately one-eighth the screen area, convergence and high voltage should be checked to ascertain *why* good purity cannot be obtained. Lack of proper purity adjustments will invariably result in some portions of the screen being colored during reception of a black-and-white signal. (In many early color TV receivers it may not be possible to obtain perfect purity and convergence, however.)

When rechecking purity after the receiver has been in operation for some time, the yoke need not be moved nor should it be necessary to reset the magnets of the field-neutralizing assembly. A simple check should consist merely of turning down the blue and green screen controls and advancing the red screen control. The contrast can be turned down and the brilliancy up for a quick check of red purity. It is even better to disable each of the other guns temporarily by shorting each grid to ground through a 100,000-ohm resistor. If slight contamination occurs, the rings of the purifying magnet or the entire assembly can be readjusted slightly to make the correction.

Once proper red purity has been obtained the green and blue screen controls are turned up until a bright white screen is obtained. If the field-neutralizing magnets are not properly adjusted, some color may be visible around the edges of the screen. In such a case the individual magnets near the area where color appears must be adjusted until the entire screen is uniformly white.

If any trouble is experienced with color purity or the lack of a clear white picture, the technician should ascertain from the customer whether the receiver has been moved from the position it was in when the initial adjustments were made. Purity adjustments can be upset if the receiver is moved to another location in the room because stray magnetic fields influence it differently when in another part of the room. Even the magnetic field of the Earth has considerable effect on purity. If the receiver has been relocated, purity readjustment is definitely in order.

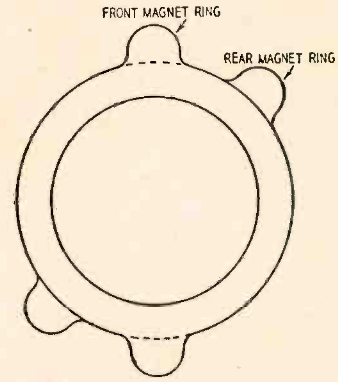


Fig. 3—Purity magnet—rings can be rotated individually.

White adjustment

Continue the procedure for obtaining a good black-and-white picture by adjusting the blue and green background controls, as well as the brightness control, around the approximate center of their ranges. The contrast control should be turned down and the three screen controls readjusted slightly to produce a low-intensity gray screen. According to the RCA service notes, the correct setting for their model 21-CT-661U series receivers is for an 8,200° Kelvin bluish-white screen (about the same as modern TV picture-tube phospors.)

With a black-and-white picture tuned in, advance the contrast control while observing the picture. When this is done, one or more colors appear on the screen. These should be reduced by readjusting the screen and background controls. Once a pure low-light screen has been obtained without color contamination, make a recheck for the type of picture obtained with a slight increase in the brightness control. It is preferable to get a pure picture which is not contaminated over a good range of that control.

Once the receiver has been adjusted so that a good black-and-white picture is obtained, the technician can check to see how well is is maintained with changes of the contrast and brilliancy controls. The extreme ranges of both the contrast and brilliancy controls which still maintain a good black-and-white picture can then be demonstrated to the customer. If this is not done, a misadjustment of the contrast or brilliancy control by the customer will result in contaminating the black-and-white picture. The customer may then attempt to correct the trouble by turning some of the screen and background controls. Soon he will have the set so far out of proper adjustment that it will be virtually impossible to obtain any black-and-white picture not seriously contaminated by color.

Bar generator

For readjustments in the customer's home it should not be necessary to take along a color bar generator. The color bar generator is useful for troubleshooting serious defects in the demodulator or in the matrix circuits but, for slight readjustments of the receiver to obtain a pure black-and-white picture, it can be dispensed with the reliance placed on the foregoing procedures.

Too often the results obtained with the color bar generator for proper color depend on the interpretation of the particular technician using the instrument. A color such as magenta or cyan is difficult to interpret correctly with respect to proper saturation, hue and intensity, within the narrow ranges necessary. The sequence of colors obtained is useful for troubleshooting, particularly when one demodulator is not functioning properly, when defects occur in the matrix or the phasing is incorrect in the 3.58-mc oscillator.

Invariably, however, an attempt to use the color bar generator for proper color intensities leaves much to be desired when a black-and-white picture is turned on after the instrument is disconnected.

If the circuits are not defective, adjustments of purity, convergence and high- and low-level gray backgrounds will provide the proper color levels where both a good color picture as well as a black-and-white picture is obtained.

If receiver faults cannot be corrected by adjusting of the field-neutralizing magnets, the purity assembly and the convergence controls, a color bar generator can be used to localize the particular stages at fault. In such cases, however, it is preferable to take the receiver to the shop since correcting the trouble will usually require chassis removal.

When a set has been repaired at the shop the technician has to make slight readjustments of purity and of the field neutralizing magnets when the receiver is returned to the customer. Stray magnetic fields around the workbench at the shop may be considerably different than those in the customer's home. END

TV shop on wheels

Mobile chassis and test equipment make for rapid and effortless servicing

By H. A. HIGHSTONE

Fig. 1—The hard way to do things.

DOING things the hard way is asking for bankruptcy in any business. The one-man TV shop is particularly sensitive here. When one man must be manager, technician, buyer, salesman and deliveryman, he has to perform each of his jobs with maximum efficiency. This means in the least possible time and with the least amount of energy. The only way to do that is to spare neither expense nor thought in making everything easy.

One particular item, which probably 19 out of 20 shops do the hard way, is picking up a TV set for shop repair and later returning it to the customer. Actually, a one-man operator in my vicinity frequently backs out of pickup and delivery jobs because the hard and potentially dangerous method of Fig. 1 is the only way he knows. Oddly enough, the largest shop in my area handles these jobs the same grunting way—sending two men on such errands.

Investing only $55 in a standard furniture dolly (Fig. 2) could put both the aforementioned shops out of the horse-and-buggy category to their considerable advantage. In just 60 seconds flat a TV set—either table or console (Fig. 3)—can be attached to the dolly as securely as though bolted on. Padding on the topside of the dolly makes protecting blankets unnecessary and crawler belts on its underside let it slide down stairways without the slightest bumping. Even a high-school boy of average strength can single-handed take a set down flights of steps and load it in a delivery truck. When loading aboard the truck (Fig. 4), the deliveryman never lifts more than half the weight of the TV set. One minute after the set has been readied for loading, as in Fig. 4, the truck can be scooting for the shop, no roping or stays required.

A secondary but important factor is the customer confidence inspired by the dolly. Needless to say, there is a vast difference between a man groaning and grunting a TV set into a truck the hard way and another man whipping it out of the house in one-third the time, quickly, efficiently and without strain.

Fig. 5 shows another time-saving gadget, of which I use half a dozen. It minimizes equally the chances of dropped chassis and hernias. These dollies are constructed of ¼-inch plywood, 2 feet on a side with a 2 x 4 framework holding the bottom together. Four casters on the bottom make them mobile.

I specialize in bring-your-TV-to-me-I-repair-it-while-you-wait service and the dolly was originally contrived to be rolled out on the sidewalk and receive the TV set directly from the customer's car. Very shortly however, the usefulness of the dollies in expediting shopwork became apparent. To cite one good example, consider a case when your TV repairman has several intermittents in his shop. Ordinarily, these would be lined up side by side, fired up and let to run until trouble developed. When it does develop, likely enough it is in a chassis wedged in between two others, requiring a lot of sweating, lifting and rearranging to get test gear into play.

However, when such sets are each on its individual dolly, the story is different. Let one little pet start turning handsprings and it can be rolled over to a workbench or test instrument center in mere seconds. Moreover, if another chassis chances to be in the way at the test center, it can likewise be rolled elsewhere in seconds. A group of these dollies enables the technician to shuffle TV sets around his shop every bit as easily as though they were table radios; the number of lost hours salvaged reaches an impressive figure.

With so much gear already on wheels, the idea of making test gear also mobile was a natural development. A scope, vtvm, etc. mounted over a bench may be impressive to certain customers but such a rigid layout is definitely unhandy when, for instance, one is operating on a big console with a cabinet-mounted pix tube. Another dolly, for test gear alone, is the answer to that one. If a chassis is half-disemboweled at my work center and not easily movable even on a dolly, I can still run all my test gear to the other end of the shop for a quick look at another chassis. Also worthy of mention—the various instruments are all firmly attached to the dolly, ending once and for all that spine-chilling *kerash* when a vtvm—or worse—is dragged off a bench.

As a final step in making mine a shop on wheels, one of my dollies is reserved exclusively for tools. Hand tools of all sorts are always thrown back onto the tool dolly (a low rim keeps them from falling off) instead of onto a bench. This ends the familiar messy scene of a chassis surrounded by a clutter of small tools intertwined with test leads and mixed up with odd parts. It also ends the business of hunting for mislaid tools—no tool not in immediate use is allowed to remain anywhere except on the tool dolly.

The 4 x 8-foot sign in Fig. 6 is my reaction to the so-called peril of drugstore automatic tube testers. Trying to cook up ways and means of thwarting this sort of competition seemed to have only one good answer—"If you can't beat 'em, join 'em!" This checker isn't used for my own work, naturally, but it supplies a satisfactory and *rapid* means of checking a bagful of tubes brought in by customers. By briefly doubling the heater voltage for each tube one can with little practice run through a bag of tubes at least four times as fast as he could with a conventional tester. And in what other department of a one-man shop, it must be asked, can you make more than you do selling $10 worth of replacement tubes in 5 or 10 minutes? Interestingly, not 1 customer in 20 attempts to do his own testing.

"I know it's nothing but a little tube." "This bill for $15 labor looks pretty high to me." "I don't have any picture, which tube do I buy?" All but the most phlegmatic among TV repairmen immediately run their blood pressure up 30 or 40 points each time they run into such familiar remarks and queries. I have found that a prize argument-stopper and educational device is a junk chassis stood on end. It should be prominently in the forefront in every TV repair shop. I keep mine where I can refer to it easily in discussions with customers. It is a dandy object lesson in making them realize there's more to a TV set than tubes—that maybe a bill showing $15 labor and $2 worth of parts isn't too expensive, after all. Time and again customers have gawked briefly at the

Fig. 2—TV chassis is attached to dolly by webbed strap looped over picture tube.

jumble of wires and parts, then remarked: "You can have it, if that's the way you want to make a living!" It's a cheap way of making customers happier and saving much time otherwise lost in argument and explanation.

One of the prize time wasters in any one-man shop is the onerous task of keeping books, as mandatory in these days as meeting the rent. The ordinary method is always costly in time and usually in money inasmuch as the too-busy proprietor inevitably forgets to enter a lot of expenses legally chargeable in his income tax statement; or because he doesn't know they're even allowable.

Available today are several tax-and-business record systems which are simple, automatic and foolproof, not the slightest knowledge of bookkeeping being required. Mine comes in the shape of a heavy binder filled with printed forms covering a period of 2 calendar years. Cost: $90.

About 5 minutes' work daily keeps every item completely up-to-date and in every respect. How much have I collected in sales taxes to date? I can tell you in 30 seconds, any time you wish to know. Am I getting ahead or going back? Give me time to take inventory at the end of any month and I can tell you in a couple of minutes just how I'm doing. And I, incidentally, not only hate bookkeeping but find ordinary systems much beyond my understanding.

In my tax-and-business record system are numerous places for entering charges which reduce my income tax considerably. Some of these I never knew existed; even if I had, how to be sure they were legal deductions? Finally, and here is a real added attraction, at the end of the business year I spend 15 minutes copying figures from my constantly running totals of income, expenditure and depreciation on a printed form. My agent figures my tax and returns me completely filled-out forms for both income tax and social security, requiring nothing but my signature to complete them. END

Fig. 3—Deliveryman can negotiate stairways without the slightest bumping.

Fig. 4—Ready to load. Lift dolly to horizontal position and slide forward. Close door. Drive off.

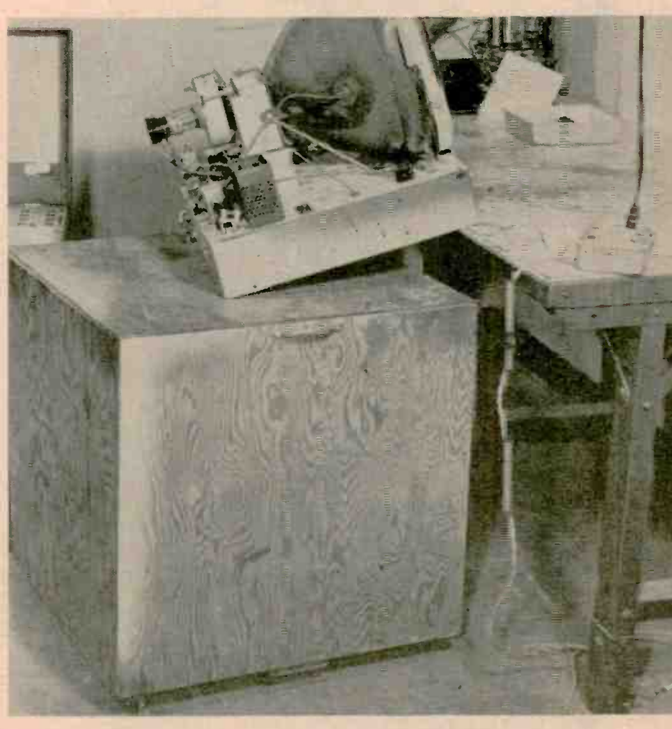
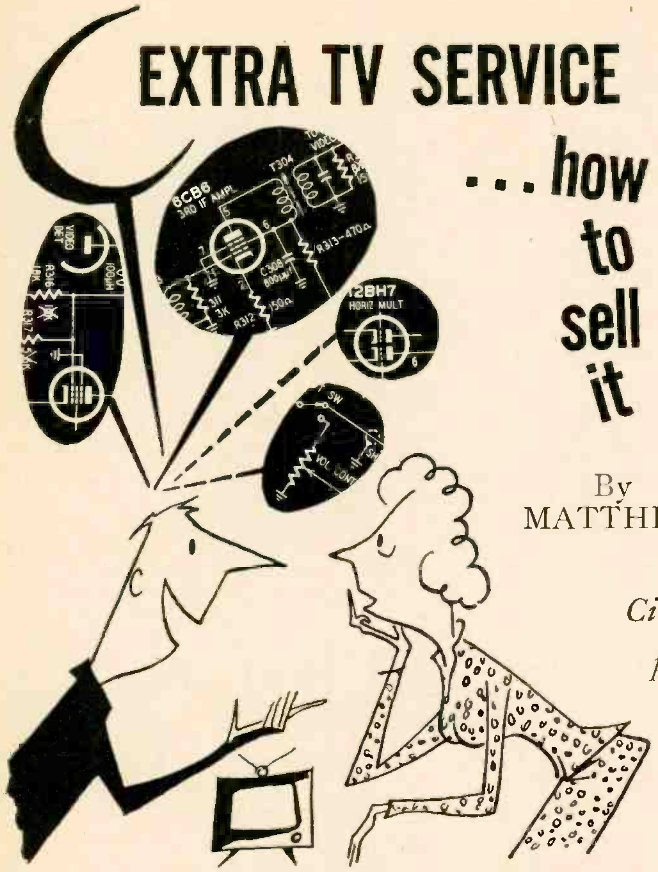


Fig. 5 — An easy and safe way to shift chassis from one part of the shop to another.

Fig. 6 — If you can't beat 'em, join 'em!

EXTRA TV SERVICE

...how to sell it



By MATTHEW MANDL

Circuit modifications provide additional revenue

DURING slack seasons or whenever there is a lull in TV service, the wide-awake shop can stimulate business by "selling" its customers receiver improvements. This is particularly worth while when the service call involves only a tube replacement or other minor repair. The customer can often be convinced that by paying a little more he can get an improved receiver in terms of picture or audio reproduction. The only difficulty is that it takes a little *selling*, either by the technician making the call, or over the phone by the shop owner when the set has been brought in.

A variety of services can be suggested to a customer. When one or more of these have been sold, a notation of what has been done should be included on the service card index file for the customer. Thus, when a service call is again made to the customer, other improvements can be recommended.

Circuit improvements

The performance of any television receiver a year or more old can generally be improved by replacing some tubes. Even though most of the tubes may check fairly good in a tube checker, the cumulative effect in emission decline of a number of tubes takes its toll in picture quality.

Customers usually balk at wholesale tube replacement. But if only a half dozen or less are involved they can usually be sold on the idea, provided they are convinced it will improve quality and perhaps avert a serious breakdown in the near future. For a general improvement it is a good idea to replace the tubes in the tuner and horizontal output amplifier, plus the low-voltage rectifier.

The tuner tubes restore sensitivity, while the horizontal output tube will improve brightness and picture width. New low-voltage rectifiers (vacuum tube or selenium) help restore picture size if inadequate. By restoring the rated voltage output of the power supply, they also "tone up" all the other circuits. Since defective horizontal output tubes and low-voltage rectifiers can damage other circuit components (in the absence of a fuse or failure of a fuse to blow) such tube replacement also reduces callbacks and saves the customer service-call charges.

If the customer can also be sold a new vertical output tube, damper and high-voltage rectifier, so much the better. The remainder of the tubes in the receiver need not be replaced unless definitely found weak or defective.

Focus, linearity and proper picture positioning adjustments should be made as a matter of routine during a service call. If picture quality can't be improved with the focus control, however, an overhaul job should be recommended on the tuner, the video if stages, the video detector and the video amplifier. This would include a complete check of tubes and parts (including the peaking coils in the video amplifier) to find out what is causing the poor definition. Since such a complete checkup may also involve tuner tracking and video if alignment, the customer should be given an estimate of the approximate price before the work is started.

The final touch in tuner tracking should consist of adjusting the oscillator slugs. This should be done so that each station will be tuned in properly when the station selector is turned, without having to bother with the fine tuning control. While this procedure adds a little more time to the service work, the results impress the customers to a considerable degree.

A word of caution to newcomers in the service field: Don't attempt tuner tracking and video if alignment without a good marker and sweep generator and an oscilloscope. Inaccurate or poor equipment may make picture quality worse instead of better. Always refer to the service notes for the particular receiver and follow the step-by-step procedures carefully.

Manufacturers' service notes are also an excellent source of information for selling service to customers. Most service notes and supplements contain numerous suggestions for improving circuit performance. Virtually all receivers exhibit some weaknesses which show up only after they have been in the field for some time. As these are checked by the manufacturer, circuit corrections are detailed in new service notes or in supplements to the original notes. When business is slack, a little time can be taken to investigate service notes and supplements so that the improvements recommended by the manu-

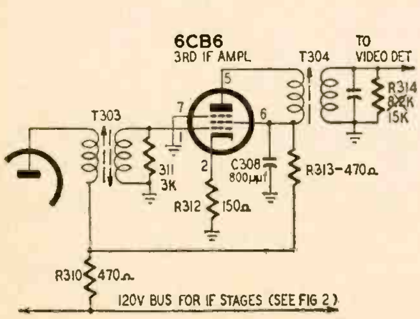
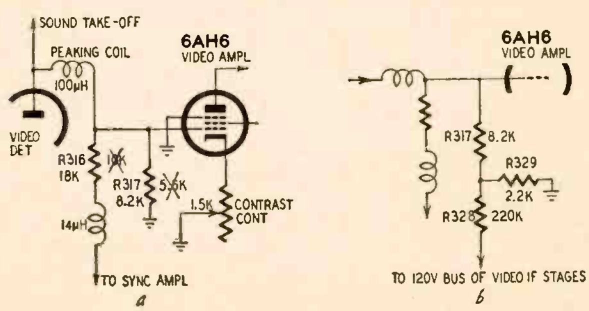


Fig. 1 (left)—Schematic of the third if stage in the Westinghouse V-2192-1 chassis.

Fig. 2 (right)—Changes made to improve contrast range in Westinghouse chassis.



facturer can be suggested to customers when their sets are serviced for some other trouble.

To illustrate, consider some of the production changes recommended for the old Westinghouse television receivers chassis Nos. V-2192 and V-2192-1. The manufacturer's supplement 3 tells how the contrast range of the receiver may be increased by making some changes in both the last video if stage and the video amplifier. As shown in Fig. 1, an 8,200-ohm resistor (R314) is across the secondary of the last if stage. This is changed to 15,000 ohms.

Besides this, R316, connected to the grid of the video amplifier (Fig. 2-a) is changed from 10,000 to 18,000 ohms. Grid resistor R317 is also changed, from 5,600 ohms to 8,200, and its lower end removed from ground and connected to a voltage divider as shown in Fig. 2-b. The voltage divider must be added, consisting of a 220,000-ohm resistor (R328) and a 2,200-ohm resistor (R329) wired in series. One side of the 220,000-ohm resistor connects to the 120-volt bus used for the if stages as shown in Fig. 1.

Focus in this receiver can be improved by increasing the voltage at the first anode (pin 10) of the picture tube. This is done by disconnecting pin 10 from the 310-volt output of the power supply and connecting it to the junction of resistors R438 and R455 in the plate supply circuit (pin 6) of the horizontal multivibrator as shown in Fig. 3.

While additional modifications are listed in the supplement, the changes shown illustrate recommendations that can be made for improving reception. All need not be made—the extent of the changes depending on how much the customer wants to spend and the degree to which they are required—in some localities weak signals contribute to troubles.

Antenna systems

Another item which deteriorates considerably within a few years is the antenna system. Offer to inspect the antenna without charge on each service call. Determine its condition and recommend repair or replacement whereever justified. Some technicians use binoculars to inspect the antenna from the ground. With binoculars the condition of the antenna elements, U-bolts and brackets, and turnbuckles can be determined. Inspect the lead-in. Cracks may develop in the plastic insulation as it ages. Repairs to the antenna elements or lead-in replacement may help reception, while new guy wires, turnbuckles and other mounting brackets minimize the danger of the antenna being damaged during windstorms.

The condition of the lightning arrester should be determined and the connections to the grounding wire and rod inspected. If no lightning arrester or grounding wire is used the customer should be informed and an installation recommended. The ground wire is an added protection since it is used to ground the mast. No. 6 wire (solid or stranded) can be used and should have a straight run from the antenna mast to a ground rod. An excellent ground rod can be made with an 8-foot length of ⅝-inch pipe driven into the ground.

The antenna installation should also be evaluated with reference to new stations which may have gone on the air since the antenna was installed. Service can thus sometimes be sold in terms of reorientation even though the antenna system is in good working order and mechanically sound.

Since the advent of high-gain cascode tuners many customers have found that fair reception is possible with an indoor antenna. In such instances an outdoor installation can be recommended to improve reception of the more distant stations.

If new uhf stations have gone on the air since the antenna was installed, or if uhf stations are in prospect for the area, it also opens the possibility of a uhf converter sale as well as the addition of a uhf antenna array.

Improving tone quality

Since hum in the audio is always objectionable, impairing sound quality, its presence is another indication that additional services can be sold. The power supply filter capacitors should be checked and replaced if leaky or otherwise defective. In some receivers a filter resistor is used instead of a filter choke and the hum level can be reduced considerably by substituting a filter choke. When this is done the ohmic value of the filter resistor should be measured and the replacement choke should have the same dc resistance. This will assure the same voltage drop so that the output of the power supply will not be changed. The value of the choke can range between 5 to 15 henries since this is not as critical as the dc resistance.

A new rectifier may also help in hum reduction. Again the service notes and their supplements should be consulted. In some receivers the hum level may be higher than normal because of improper lead dress in the audio circuits or due to poor parts placement. Occasionally the service notes for the receiver recommend specific changes for hum reduction.

Many console television receivers use small speakers. Where room is available a larger speaker can be installed for better frequency range as well as more power output. Find the voice coil impedance of the existing speaker by consulting the service notes and replace with a speaker of the same impedance. Changing a PM speaker is simple and requires only removing the speaker mounting board and cutting a larger hole to accommodate the larger speaker. When a dynamic speaker is employed the replacement speaker must have a field coil electrically identical to the old unit. Again the service notes give information on inductance and resistance.

The popularity of high-fidelity audio provides another means for selling improvements to the customer. Since the sound transmission which accompanies television is frequency-modulated, its audio-frequency range is far superior to that of AM radio. Thus, adding a high-fidelity audio amplifier and speaker will improve the sound transmissions.

The high-fidelity amplifier can be attached to the television receiver by using a spdt switch as shown in Fig. 4. This permits selecting either the high-fidelity audio output or the audio system of the television receiver, by throwing the switch. A jack must be installed on the rear apron of the TV chassis for the plug to the external amplifier. If the amplifier does not have a volume control the switch can be placed after the volume control on the television receiver, in the grid lead of the audio amplifier. Volume can then be controlled from the front panel for both the high-fidelity amplifier and the TV receiver's audio system.

Since many television receivers do not have a tone control, this item can be suggested to the customer. It may consist of a simple capacitor and potentiometer arrangement such as shown in Fig. 5. The .004-μf capacitor and the 1-megohm tone control (a lower value may be better in some circuits) shunt the volume control of the receiver. While this circuit is simple and effective, it requires an additional knob for which room must be found either on the front panel or on the side.

Remember, *service* can be sold as well as *merchandise*. END

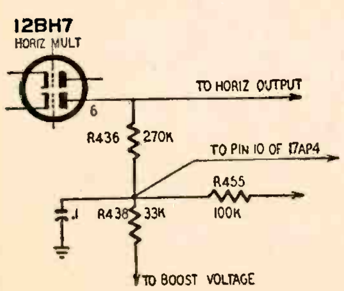


Fig. 3—Diagram shows voltage source for pin 10 of the picture tube.

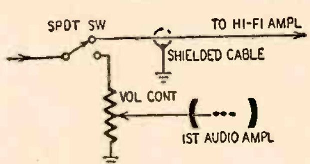


Fig. 4—Connections for adding a high-fidelity amplifier to TV set.

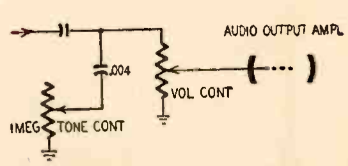
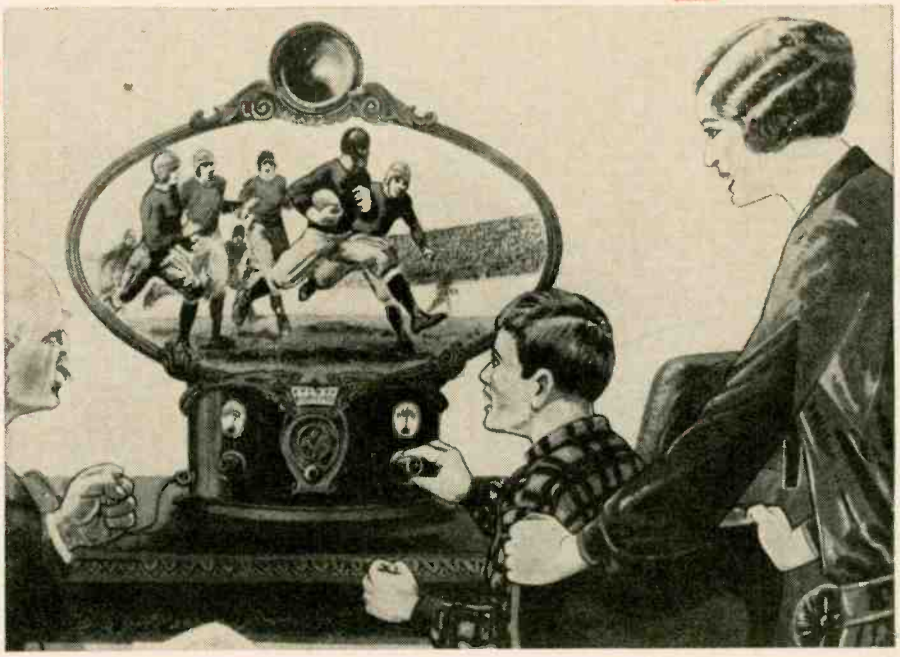


Fig. 5—Simple tone control circuit.

30 YEARS of Television

TV was first demonstrated in this country in 1927. Since that time, the public has never been entirely without some form of television

By FRED SHUNAMAN
MANAGING EDITOR



Future home televiser, as envisioned on the front cover of *Television*, 1927.

TELEVISION has been with us for 30 years. In 1927 Baird, American Telegraph & Telephone (AT&T), Westinghouse and others demonstrated publicly that sight as well as sound could be transmitted by radio. That year also saw the first issue of *Television*, probably the world's first TV magazine. The cover of that first issue pictured a set that looked like one of our coming mural receivers—an oval screen mounted above the set much as cone speakers were in those days. Its speaker—a 4-inch job that was an all-too-accurate prediction of much present-day practice—is perched at the top of the screen. There are three main controls, and two meters give the set a highly scientific appearance.

The issue referred at some length to experiments then being made by Baird, Jenkins, Alexanderson (General Electric Co.) and others. There was some confusion between TV and facsimile, and a long chapter describes the transmission of photos by wireless. The scanning disc used in the Bell system is shown in enough detail for experimenters to duplicate. Photocell "transmitters" are also shown; the experimenter had to supply his own TV signals in those days!

The preface by editor Hugo Gernsback states, "At the present time, most of the television arrangements necessitate revolving discs or other more or less cumbersome devices. This is not the final solution of television; the final device will have no cumbersome moving apparatus, but will be greatly simplified. This is theoretically possible, and a number of experiments made along these lines point to the final completion of this phase."

It was not at all clear whether the first issue of *Television* was intended as a book or a periodical—probably it was a trial balloon. A magazine in format, it avoided carefully any date or reference to coming issues. But the second *Television* (dated July, 1928) was called Vol. 1, No. 2, making the first issue No. 1 in what was starting out to be a series of annuals. However, nothing further was seen till the first issue of *Television News*, March–April, 1931.

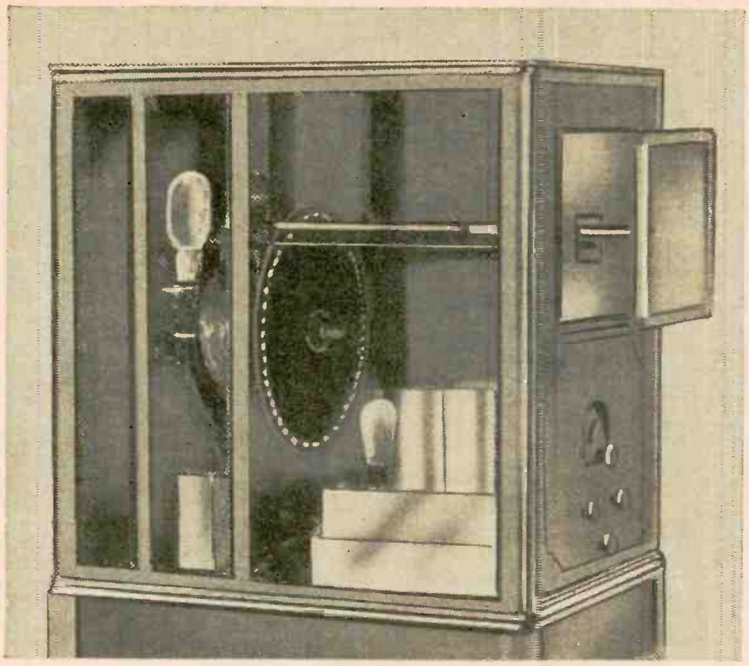
In its first issue *Television News* makes known the "new method" of television reception that would replace the "cumbersome devices" then in use. Though all the practical kits and parts offered in the advertisements or described in the articles are for the familiar scanning disc, either with perforations or lenses, or for the Jenkins–de Forest drum, the cathode-ray tube is hailed as the final solution of the scanning problem. There was much progress in practice as well as theory. In 1928 only two manufacturers offered the necessary phototubes and receiving neon tubes for TV experiments. In 1931 there is a plethora of parts and even complete TV kits.

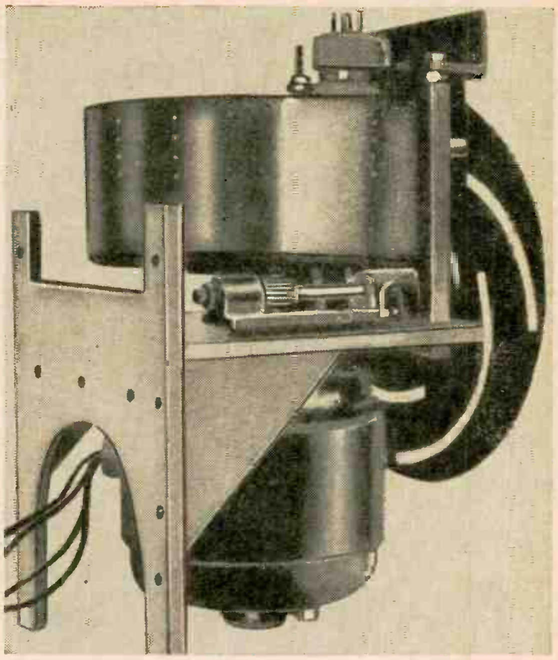
Articles by Baron Manfred von Ardenne state that "Europe Sees With Cathode-Ray Tubes" and a photograph in one of his articles is possibly the first published picture of a TV image on a C-R tube screen. The Baron's outfit seems to be closed-circuit: he says that sync pulses as well as modulation are transmitted by wire.

We even have TV dx, with English amateurs receiving German TV images (probably transmitted on the broadcast band) at a distance of 900 miles.

No longer does the experimenter have to produce his own TV signals. The November–December issue of 1931 prints a list of 28 telecasters. Most of these operate around 2000 to 3000 kc (100 to 150 meters) though one is on 660 kc and two—apparently mobile—on 43 mc. Automatic synchronization is becoming common and we hear of interlaced scanning—then simply referred to as the Sanabria system.

But the shadow of the C-R tube on the horizon put an end to this early period. Experimenters became dissatisfied with their 2-inch, 80-line pictures and withdrew to their basements and garages to experiment with the new tubes and pictures of 3 or even 5 inches, with detail exceeding 200 lines! *Television News* disappears with





Two early Jenkins televiewers. One at left used a scanning disc—at right is the more sophisticated drum projector.

the January–February, 1932, issue. Little more is heard of the new art till 1936, when Hugo Gernsback devotes his editorial in the August issue of *Short Wave Craft* to "Television on the Short Waves." From that time TV is mentioned in every issue and in January, 1937, the magazine becomes *Short Wave & Television.* But not until March, 1938, was a "how-to-build" article printed, though 5- and even 9-inch tubes were advertised a month earlier. All articles—and even picture pages—carried the warning:

> Television is still in the experimental stage. This article gives the latest technical information on the subject. Home television will not be realized for some time to come.

Yet Britain began to televise for the London area public in August, 1936, using their present 405-line standard. Transmissions were experimental, using two systems—Baird's and the all-electronic EMI system. In February, 1937, the EMI was adopted as standard and regular scheduled broadcasting commenced.

The United States was promised regular TV "in the spring" of 1939. Experimental stations multiplied and, though there are no formal announcements, it becomes clear that more and more people are looking in on the experimental broadcasts of NBC and CBS on the East Coast and on Don Lee's W6XAO in California. The 441-line standard was most in use.

In April, 1940, Dr. Alfred Norton, NBC's television head, stated that there were no less than 2,000 sets in use, 88% in homes. The average audience was 8,000 persons and program production was already costing $10,000 and $15,000 per week. Commercial TV did not come till July, 1941, however, with a set of standards based on our present 525-line system. Articles on "building your own televiser" multiplied, a few commercial receivers were sold and those in existence were modified to operate on the new standards. TV was under way, this time apparently for real. But in December, 1941, only a few months after the first station was licensed, war again put a stop to the spread of this new science. Sets and parts quickly became unobtainable, though four TV stations continued to broadcast on a token basis throughout the war period.

The third renaissance of TV seemed the most difficult of all. Telecasting picked up after the end of hostilities, but few sets were to be seen in homes even in 1947. The situation was much like the one that later affected color TV—there were programs, the sets were in the stores but people would not buy.

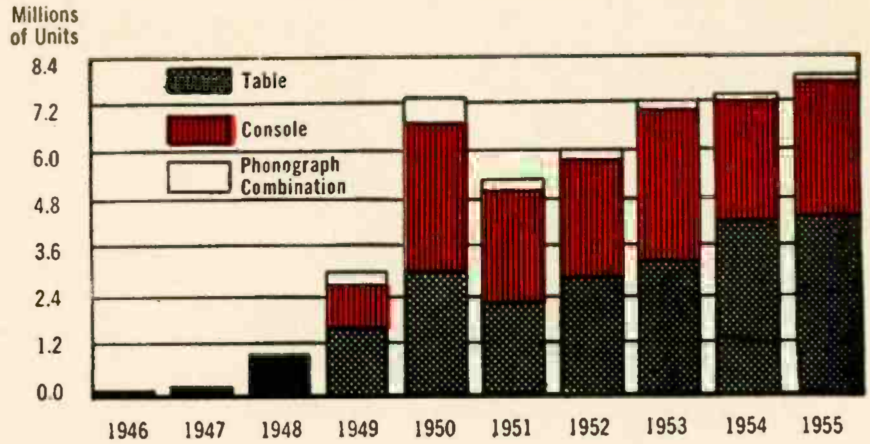
The reason? According to a survey

The F.A.D. Andrea receiver, a set (also put out as a kit) of the late '30's.

made of 800 dealers who attended the Television Institute in New York in the summer of 1947, people were not prepared to pay the prices asked. Prices for a simple TV receiver ranged—theoretically—from $300 to $400, but the receivers on department store or radio dealers' floors were vastly more expensive, often on the wrong side of $1,000. Even the cheapest sets were usually boxed into a cabinet with an AM–FM radio receiver and a record player. Most of us remember 1947 as the year TV was on view in store windows—more often than not on a 5-inch *Viewtone* receiver.

Yet things were already looking up. Early in 1947 Transvision started advertising a kit, first with a 5-inch and later a 12-inch tube. Readers of RADIO-CRAFT were told how to build their own (if they could get a picture tube) in a two-part article in the January and February issues. Toward the end of the year, sets at lower prices began to appear—and be sold—in the stores.

According to RETMA, no less than 136,000 TV receivers were sold in 1947, a large number of them probably during the Christmas season. The stage was being set for 1948, which should have been called "Television's Year." The first of this magazines 10 Annual Television Issues appeared in January. We now find 16 brands of TV receivers. The mode was a 52-square-inch picture



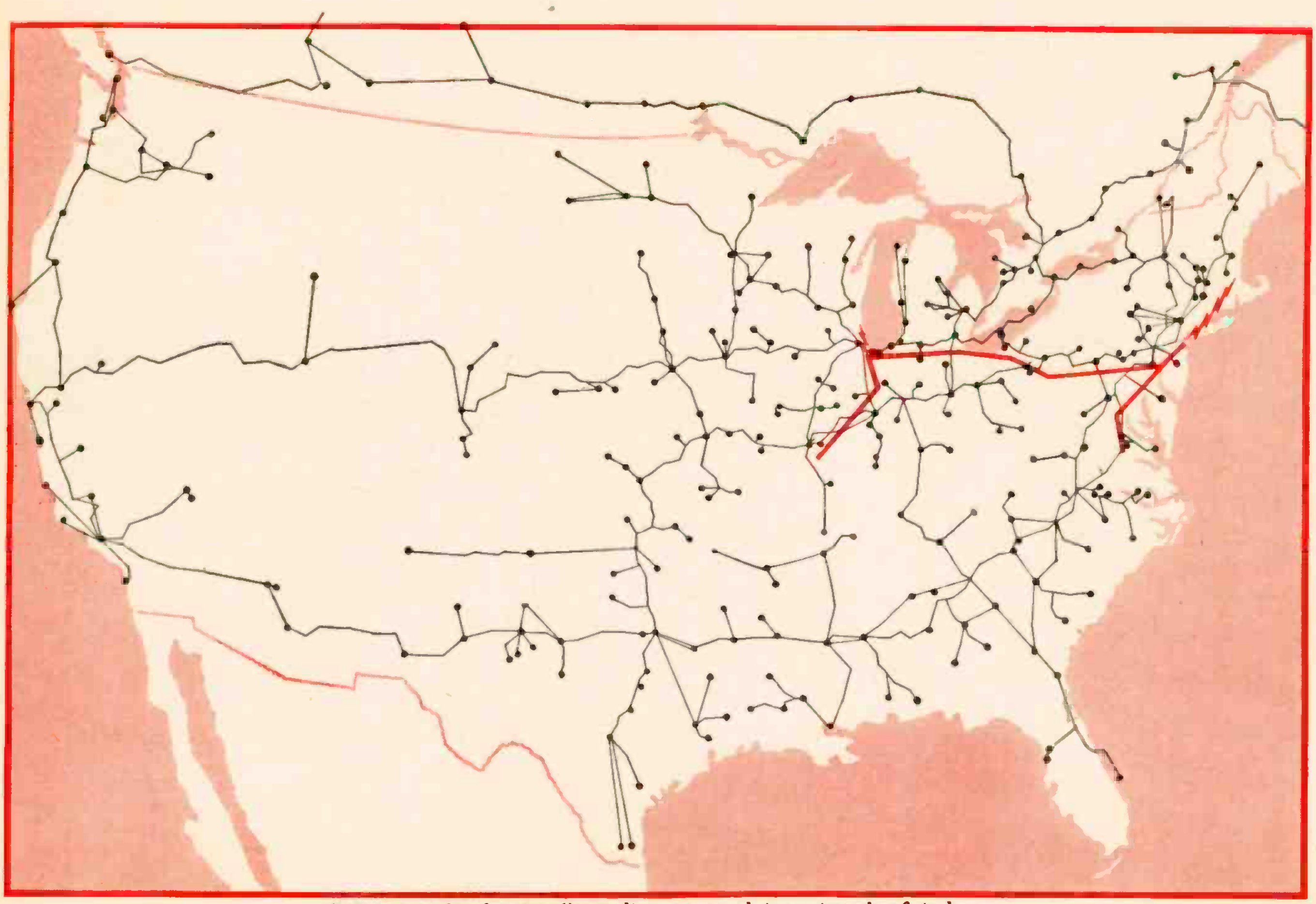
Growth of TV set production in U.S.A. 1946-1955. The solid black bars in 1946-1948 indicate total production of all types. Later years are sub-divided.

(10-inch tube) though some were smaller and there was one projection set with a 19 x 25-inch screen.

Little real information on TV was as yet available, and the bulk of the magazine was filled with historical or prophetic articles by such persons as Allen B. Du Mont, Valdimir Zworykin, T. T. Goldsmith Jr., George Clark, Will Baltin and Louis Pacent.

There was one article on FM–TV antennas and one on ghost elimination, plus a special article on the new kickback power supply. Servicing stories were attempted, with one rather general article and a TV trouble chart (still useful). The "most useful circuit" of the year was the 630-TS, which appeared with a descriptive article. A TV station list of 18 telecasters also appeared. Networking was just beginning, with a New York–Washington hookup and experimental transmissions from New York to Boston.

An article on the Transvision kit—with complete schematic—appeared in the February, 1948, issue but for the next few months no down-to-earth TV



TV network of 1950 (in red) compared to network of today.

items. In July the Philips projection unit was reported, and from that month there was at least one practical article in each issue. Technotes began to appear occasionally, indicating that sets were getting into the technicians' hands and that they were able to repair them. By the time the second Television Issue appeared in March, 1949, TV had been accepted by the service technician.

By 1949, TV manufacturers had joined the Over Fifty Club, 55 being listed in the TV set directory which was a feature of that issue. Test equipment had appeared, sweep generators alone being made by no less than eight manufacturers. Marker generators and field-strength meters were also mentioned. Boosters, remote controls and remote (slave) viewing units had also made their appearance. Network facilities had expanded greatly and the East Coast TV cities were linked to Chicago and St. Louis by a coaxial cable that also linked in Pittsburgh, Buffalo, Cleveland and Toledo, with microwave relays adding Detroit and Milwaukee to the circuit. Television seemed to be settling down but still capable of making great progress.

In January, 1950, intercarrier sets were already being discussed and there was an article on revamping and improving the already "old" 630 receiver. The "electronic magnification" fad, in which the center of the picture was enlarged to fill the whole screen, was being taken very seriously, and color was the subject of two articles. Dr. Du Mont discussed industrial applications. An article "Curing Unusual TV Troubles" indicated that at least some troubles were now a matter of routine.

By 1951 color was (fleetingly) with us, as the FCC approved the CBS color system, which by means of a "color wheel" made it possible to get color TV with black-and-white tubes. Readers of the fourth Television Issue were told how to convert their sets for color, including instructions for synchronizing the color wheel and changing sweep circuits to 144 cycles for vertical and 29,160 cycles for horizontal deflection. Big-tube conversions are current, and the first of a series of TV tube-replacement lists appears "as an aid in converting to bigger tubes." An illustrated station list indicates that 107 TV broadcasters were on the air.

In 1952 that trend to bigger tubes—both in new and converted sets—was still strong. The Picture Tube Replacement Guide is much longer and contains tubes up to 24 inches. Transcontinental TV was now a reality, with east-west and west-east channels on a 3,000-mile network of 107 relay towers. Europe's first network, linking six stations and three television systems (441, 819 and 405 lines) in France and Britain, also came into being that year. With the imminent lifting of FCC's "freeze" which had stopped TV station construction since late 1948, uhf television was immediately in prospect and converter circuits were described. There was also a listing of boosters, which were still very popular.

The RCA 630, earliest of the modern TV receivers.

1953 was uhf's year. Wild activity had started among would-be broadcasters with the lifting of the freeze and though only a handful of uhf stations were on the air by January, 1953, dozens were being rushed to completion and optimism was unlimited. One authority expected to see 50 new stations by the end of 1953, over 600 in 1955 and "possibly 1,000 or more" by 1957. Though the few uhf stations on the air demonstrated the technical possibilities and limitations of the new spectrum (and the equipment newly designed to work in it) the real economic difficulties and the superstitions that were to cut so deeply into the new stations' opportunities for advertising income had not yet been discovered. Two articles described uhf converters and their circuitry.

A number of tables and charts covering replacement and repair components appeared in the 1953 Television Issue for the benefit of the technician who was now apparently quite at home with TV circuitry and ready for information on details. These tables were found useful and numbers of them were reprinted by commercial concerns as promotional material. The first Canadian TV station, CBFT of Montreal, was operating (since September, 1952) and a three-city network (Toronto–Ottawa–Montreal) was due in June, 1953.

Color transmission and reception by the new compatible system was accepted as a development of the near future by the time the 1954 Television Issue was printed. (The CBS system had run afoul of parts shortages at the beginning of the Korean conflict and had quietly disappeared, to the relief of manufacturers and engineers alike.) A series of lessons on color TV was started. Uhf was still up in front and uhf converter characteristics were listed, together with three articles on uhf equipment and servicing. The number of uhf stations had reached a peak and was due for an actual decrease during 1954. The total number of TV stations was 330, of which 110 were uhf.

In 1955 one of the leading articles was "What's Happening to Uhf?" It was not at all clear whether the new band could survive. Color had actually arrived—sets were available at $1,000 or so—and a token amount of color broadcasting was being carried on. So it is not surprising that seven articles dealt with color and two with color test equipment. 1956 continued the trend, recognizing color as something now with us and to be serviced. Uhf was recognized as a necessity and therefore something that would survive, though it was equally recognized that it could not compete with established TV stations.

And that brings us to 1957 and the present TV issue. It is evident that TV is no longer a special subject or extraordinary problem. It is established, and may be expected to progress in a steady manner in the future. Even such striking variations as widespread introduction of transistors or flat picture tubes will simply be important details. Such drastic upheavals as the foray into sequential color TV are less likely in the future. Television is established and is now prevailing, with 490 United States and 36 Canadian stations on the air, and the number increasing steadily. For the last two years, the absolute number of TV sets entering American homes has been greater than that of radios. This brings to mind the last sentence of that 1927 editorial mentioned at the beginning of this article: ". . . this new art will far surpass the art of radio itself in the immediate future . . ." END

PEAKING in color TV bandpass amplifiers

Circuit response and causes of color smear

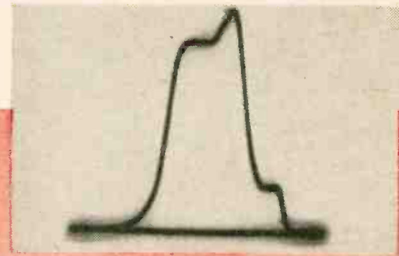


Photo A—Relatively flat bandpass amplifier response—minimizes edge distortion in reproduction of color bars.

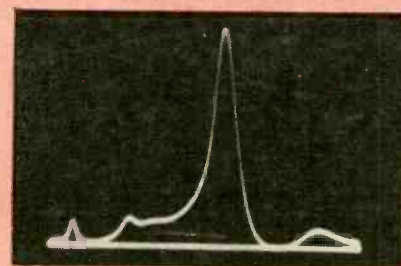


Photo B—Peaked response of bandpass amplifier—helps maintain chrominance signal level after if attenuation.

By ROBERT G. CENTERVILLE

EARLY designs of color TV receivers utilized a bandpass amplifier response (Photo A) which was relatively flat. In 1956 sets the trend was to moderate peaking of the bandpass amplifier high-frequency response.

A highly peaked bandpass response is shown for comparison in Photo B. In general, the bandpass circuit is usually aligned with high-frequency peaking intermediate to Photos A and B. There seems to be a tendency to go back to the flat response in 1957, but meanwhile many of the sets in the field have peaked amplifiers.

A certain amount of high-frequency peaking is required in most cases to compensate for attenuation of the color signal in the if amplifier. If the response of the if amplifier could be maintained flat from 3.58 to 4.1 mc, then the bandpass amplifier could be aligned also with a flat response. But since there is usually some attenuation of the color signal in this region (Fig. 1), the bandpass amplifier must be aligned with rising response here.

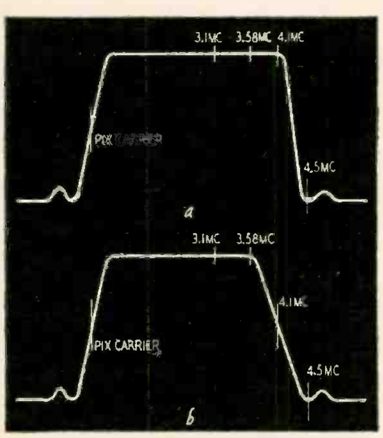


Fig. 1—If passband: a, flat response through color signal region (3.1–4.1 mc); b, falling response from color subcarrier to 4.1 mc.

Much can be learned by observing the result of *excessive* high-frequency peaking in aligning the bandpass amplifier. Moderate peaking is tolerable and scarcely discernible to the viewer. However, extreme peaking causes *overshoot* and *ringing* of the color signal.

Checking the bandpass

The test setup of Fig. 2 is used to check bandpass amplifier response. Exact details of connection points are usually provided in the service notes for the color TV receiver and should be consulted. If the response of Photo B is observed, it may be expected that this signal section of the receiver will introduce certain transient irregularities in the reproduction of a color bar signal.

Observe the output provided by a color bar generator (Photo C). Good waveform is apparent and, if no distortion is introduced by the signal circuits in the receiver, a replica of it will be seen at the output of the bandpass amplifier. To check this waveform it is necessary to use a wide-band scope having full response at 3.58 mc. A narrow-band scope will attenuate and distort the waveform, causing the technician to arrive at false conclusions.

Some may feel that a narrow-band scope can be used to obtain the frequency response curve of Photo B and that a wide-band scope is not required to observe the bar-signal response of the bandpass amplifier. This basic distinction should be carefully noted:

1. *The frequency response curve of the bandpass amplifier is obtained with the use of a demodulator probe. The scope is required to reproduce only the envelope of the bandpass amplifier signal.*
2. *The bandpass amplifier signal itself is viewed without the use of a demodulator probe. The scope must reproduce frequencies up to 4.1 mc.*

We shall return to this matter but for the present let it be taken that display of the undemodulated responses requires wide-band scope response. The good waveform seen in Photo C, after passage through the rf, if and chrominance bandpass circuits, emerges as shown in Photo D. Substantial distortion is now apparent, contributed chiefly by the peaked circuit response. The sharp corners, flat tops and perpendicular rises and falls of the original waveform are all affected.

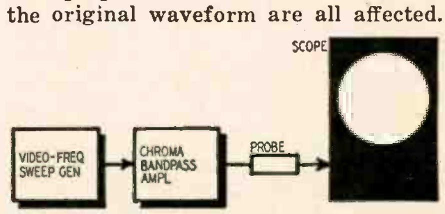


Fig. 2—Test setup for Photo B curve.

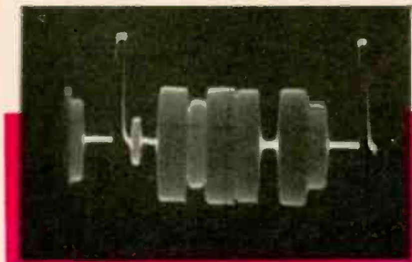


Photo C—Color bar generator output.

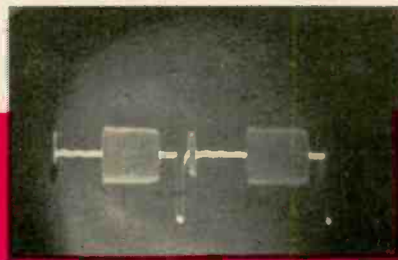


Photo E—An R—Y signal for checking bandpass amplifier square-wave response.

Photo G — Overshoots produce vertical lines.

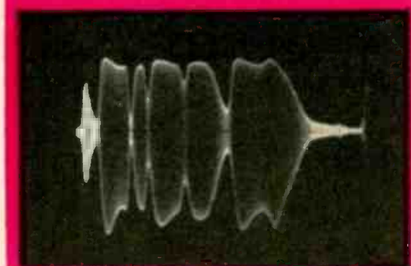


Photo D—Color bar signal after passing through peaked bandpass amplifier.

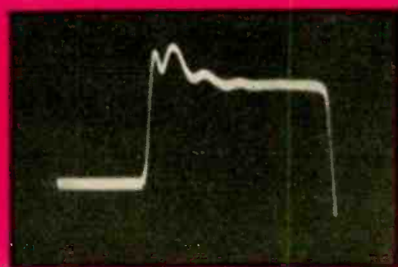


Photo F—Ringing and overshoot of demodulated color bar signal at color detector output, following peaked bandpass amplifier.

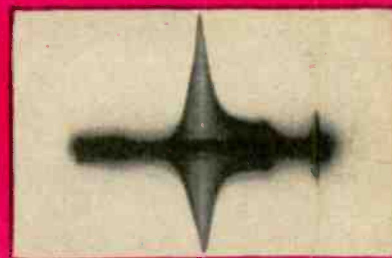


Photo H—Response of bandpass amplifier, obtained with sweep generator and direct application of a wide-band scope.

Now, corners are rounded, tops show overshoot with subsequent tilt and curvature, and rises and falls are so slowed that the color bar signals tend to run into and blend with one another. The black bar (horizontal gap, fifth bar from left) shows that the slow decay of the chrominance bar signal causes the black bar to acquire a substantial contamination from the trailing chrominance signal.

Color bandpass characteristics

Note that the horizontal sync pulse has been stripped from the waveform of Photo C, after passage through the bandpass amplifier (Photo D). The horizontal sync pulse is eliminated by the bandpass amplifier because it has a fundamental frequency of 15,750 cycles (plus harmonics up to approximately the fifteenth). Since the bandpass amplifier cuts off below 2 mc, passing only the frequencies from 2 to 4 mc, the sync pulse cannot get through the bandpass amplifier. This is a normal feature of bandpass amplifier operation in which luminance information is largely separated from chrominance information. The horizontal sync pulse, although not strictly luminance information, falls in this general category.

Next, let us see what peaked response in the bandpass amplifier does to the color bar signal applied to the grid of the color picture tube. When the color receiver is energized by an R − Y signal (Photo E), this signal passes through the bandpass amplifier and through the R − Y detector circuit. The R − Y bar signal is demodulated by the R − Y detector and its envelope can be viewed on the scope screen at the output of the R − Y detector. Because of the peaked response of the bandpass amplifier, the output from the R − Y detector does not show a true square-wave response, as might be suspected. Instead, a distorted square waveform is observed (Photo F). Overshoot and ringing of the leading edge are prominent.

Such overshoots produce vertical lines of spurious color in the pattern (Photo G) seen on the screen of the color picture tube. A certain three-dimensional effect is introduced at the edges of the bars, also evident in the photo. The three-dimensional effect is spurious and does not correspond to the desired signal reception.

Wide-band scope method

There is an alternative method of viewing the frequency response of the bandpass amplifier with a wide-band scope, which is preferred by some technicians. This is the *undemodulated* type of response obtained when the test setup of Fig. 2 is utilized, *omitting the demodulator probe*. The undemodulated response shown in Photo H is for the same bandpass amplifier whose demodulated response is illustrated in Photo B.

This is a useful cross-check inasmuch as distortions which might be introduced by an unsuitable demodulator probe will show up in a comparison of the two types of display. Of course, the scope must be really *flat* in the region from 2 to 4 mc or the display of Photo H will not be valid.

Returning now to demodulator probe characteristics, the technician might well ask why a demodulator probe could not be used in testing the bar signal output from the bandpass amplifier (Photo D). The answer is that the demodulating capability of service type demodulator probes is limited. Although frequency response curves can be satisfactorily reproduced with a demodulator probe, this is a test situation which concerns basically the reproduction of a 60-cycle square wave. (A demodulated response curve belongs to the generic family of 60-cycle square waves.) On the other hand, an ordinary demodulator probe fails when called upon to process wave envelopes of higher frequencies, such as color bar signal envelopes. A color bar envelope has a typical fundamental frequency of 150,000 cycles, far beyond the capability of conventional demodulator probes.

There are very important considerations in practical color TV service work. The beginner often assumes that he can view a color burst, for example, with a narrow-band scope and a service-type demodulator probe. The assumption is incorrect because the probe is unable to follow the rapid rise and fall of the burst envelope. Burst should be viewed by direct application of a 4-mc scope at suitable points in the receiver circuit, such as at the output of the picture detector. In such a case, the burden of demodulation falls upon the picture detector circuits which have the necessary demodulating capability for the operation. END

TALL TOWER TECHNIQUES

By JACK DARR

Part I: Assembling the tower; sizes and location of guy wires; selecting the tower location

THE basic reasoning behind the design of any TV antenna installation can be stated simply: Get the antenna a certain distance into the air and keep it up there. To do this many installations can be made much easier and simpler by using triangular metal towers instead of the more common tubular masts. This is especially true when extremely high antennas—from 40–50 feet on upward—are needed. If a fringe-area type antenna is being erected, using a large antenna rotator and a heavy dual array similar to the kind shown in Fig. 1, the tower will make a much better and stronger installation.

In areas with a high average wind velocity the towers are almost a must for high installations. It is often very difficult to design and erect a tubular mast installation capable of carrying a heavy antenna and of withstanding high wind velocities. Due to the much greater rigidity of the triangular tower it can be guyed to ride out almost any wind encountered. Many instances have been known of these towers riding out winds of almost hurricane velocity, when properly installed.

Another desirable feature of towers is that they can be climbed with ease. Many makes have steps built into them as a part of the bracing. (See Fig. 2.) By using these steps, making repairs to the antenna, lead-in, rotator, etc. becomes almost as easy as climbing a flight of stairs. Antenna changes or replacements may be made with ease.

About the only undesirable feature of a tower installation is the increase in cost over the tubular mast. However, recent developments in tower construction, including the building of towers from sheet iron or steel, have brought the cost of these units well below what they originally were. The first towers on the market were made of aluminum. Due to its light weight and good structural strength this material is still used extensively.

Commercial home type towers are made in two sizes, 9 and 11 inches. This refers to the horizontal measurement; each side of the triangular cross-section is of the dimensions given. Most of the towers are made in 6-foot sections and shipped in bundles of six pieces, making a 36-foot tower when assembled. Other types are available including some made of tubular steel as well as crank-up or telescoping units. But we'll deal mainly with the more common varieties made of stamped sheet steel or aluminum.

As a rule, the sections are assembled on the job, although many shops prefer to preassemble their towers in 12-foot lengths, installing bottom and top kits in the shop. These sections may be easily transported to the job atop the ladder racks of the antenna truck.

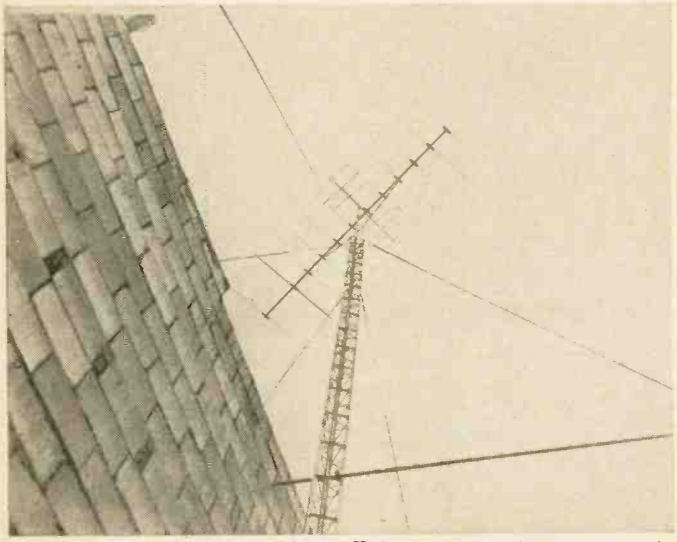


Fig. 1, left—Fringe-area antennas mounted on tower. Horizontal boom is made of mast section and supports the right side of tower where no guy wires could be erected Fig. 2, right—Tower steps permit climbing, facilitating adjustments, replacements or repairs.

The overall height of the finished tower should be a guide to the size needed. For the average residential installation, with heights up to about 50 feet, the smaller 9-inch tower is satisfactory. For heights up to about 100 feet, the 11-inch ones should be used because of their greater strength.

Each complete tower requires two "kits"—a top and a bottom kit. The top kit comprises all parts needed to hold the mast section (which holds the antenna itself) and finish up the top of the tower. It includes three pieces of angle iron, made of sheet steel, which are bolted to the exposed ends of the three legs of the tower, and six odd-shaped bolts which are hooked together in the center, passing through the legs, to hold the piece of masting. (See Fig. 3.) As can be seen from the photo, three bolts are hooked together to form a triangle; the tighter the bolts are pulled, the more firmly the mast is held. As a rule these bolts must be pulled down very tightly to keep the antenna or rotator from turning under wind pressure.

If a rotator is used, it is a good idea to furnish a little extra help by tying the anchor lugs of the rotator to the corners of the tower, using scraps of guy wire. This is necessary because of the tremendous pressure exerted on the antenna by a stiff crosswind. Most of the antennas used in this type of installation are large, and the sidewise pressure a stiff wind exerts on the long tail of the antenna can cause the rotator to twist in the mounts unless it is very tightly held. This throws the direction indicator off at the control box and invariably results in another trip up the tower! Take the necessary precautions when installing and save unnecessary climbing!

The average antenna–rotator installation uses a short piece of tubing, about 3–4 feet long, to hold the rotator, while the antenna itself is mounted on another piece, not over 6 feet long, above the rotator. Always use the shortest possible mast above the rotator to lessen the leverage of the antenna on it. This mast may be of 1-inch stock, while the lower piece may be of any size which will fasten to the rotator mast clamps. When setting the rotator always set it as close to the top of the tower as possible for greater strength. For some makes special base plates are available which can be installed in the tower itself to hold the rotator. This eliminates the necessity for using the short piece of mast and makes a much stronger installation. In some cases ball-bearing thrust bearings are installed in the top of the mast itself, with the actual rotator located several feet down, inside the tower.

The bottom kit consists of two heavy angle irons and a long bolt, threaded on each end, of about ⅝-inch diameter. The angle irons are bolted to the ends of the tower legs, and the bolt passed through holes in the end of the angle irons, secured with large nuts. On the bolt, two loops of heavy iron, with holes, are placed. These can be fastened to a flat surface, making a "hinge" for the tower base so it can be raised and lowered. Whether these hinges are used depends upon the type of installation being made. In any case they can be used to anchor the base of the tower, after installation is completed, by driving lag screws through them into a wooden base or by slipping them over bolts set in a prepared cement base.

In some cases tower installations must be made on flat roofs, such as business buildings, apartment houses, hotels, etc. For the safest installations of this type, make up a heavy base, using 2 x 12-inch timbers. This should be at least 4 feet square, using three crossmembers; it is *not* fastened to the roof in any way. The weight of the tower will hold it in place, especially after a few hot days; it will sink into the tar of the roof, holding itself firmly. In any case, the transverse strain on the base of a properly installed tower is almost negligible if the guy wires are properly located and tight.

This platform is used to spread the weight of the tower over a larger area of the roof surface and is left unfastened to prevent the possibility of making leaks in the roof. (A point which some customers seem to prize highly.) As a final precaution, after all installation work is completed, give the whole platform a good coat of liquid roof coating or tar. Be sure to work this well down inside the framework. When softened by the sun on a hot day this will seal the base to the roof.

For anchoring the tower base on a residential installation, on the ground, a small base of cement is best. A shallow hole may be dug several days previous to the installation and filled to ground level with a mixture of standard 3:1 concrete. A flat surface is necessary and two ½-inch bolts, at least 8 inches long, may be embedded in the concrete at the appropriate location. (Pass the threaded ends of the bolts through two holes bored in a piece of scrap wood and then simply push the heads down into the concrete till the board touches the surface, and allow to set.) If the tower is standing alone, away from the house, this type of base is essential. If it is alongside the house where is may be anchored to the eaves, the base may even be left sitting on the ground or on a flat surface. Brackets are available which may be used to fasten the lower end of the tower to the side of the house if it is of frame construction.

For this house-side installation, which is the most common, very little support is needed for the base. A pair of cement blocks sunk into the ground or even a piece of heavy timber, 2 x 12 oak, etc., is all that is needed. If a wooden base is used, cover it with tar to prevent rotting from contact with the soil. Actually, all that is necessary is something to keep the base of the tower from sinking into the ground. If the soil is firm or rocky, no support at

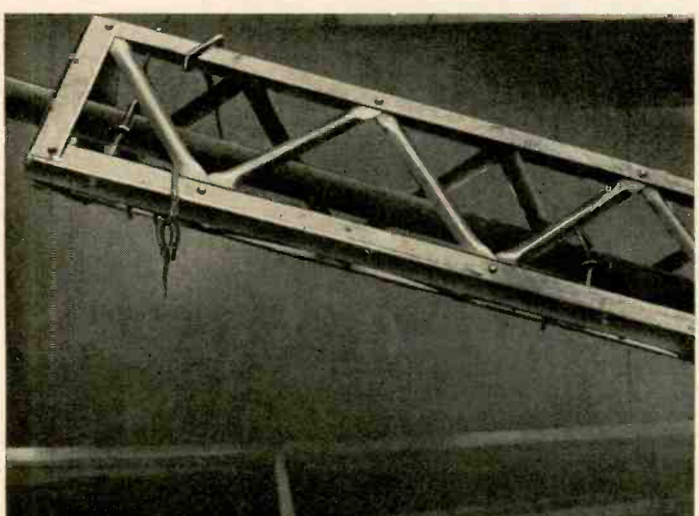


Fig. 3—Top section installed on tower. Hook bolts interlock to hold mast in center of tower.

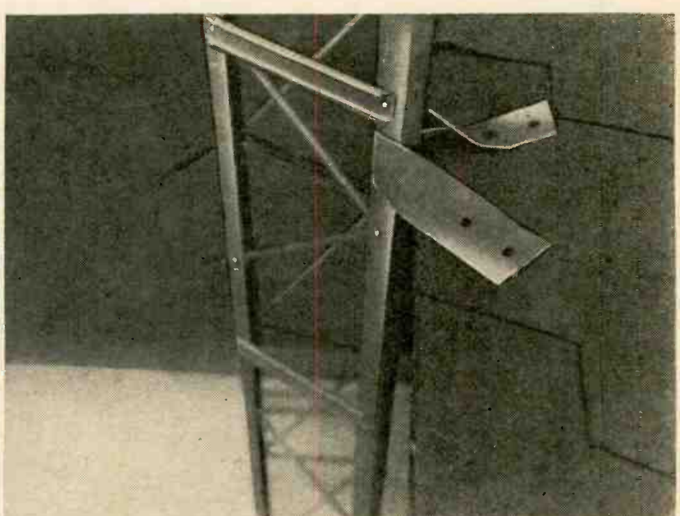


Fig. 4—A sheet-metal strap is used to fasten tower to eaves of house, using heavy brass screws or lag screws.

all is needed. Many installations have been made this way and no trouble encountered.

The strength needed to keep the tower up is furnished by anchoring the tower to the eaves of the house. This takes away all laterial stress on the tower base, if the tower is properly guyed. The easiest way to do this is to wrap a short piece of sheet steel around each of the two legs of the tower which are against the house and fasten them to the surface of the roof

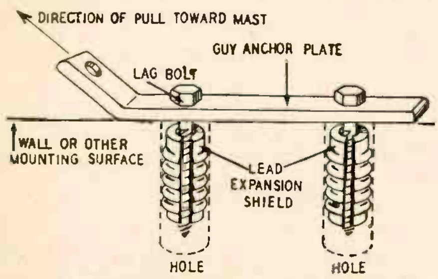


Fig. 5—Typical guy anchor plate for anchoring guy wire to masonry or brick wall.

with 1-inch No. 10 brass screws or lag screws. (See Fig. 4.)

If the building wall is brick, stone or other types of masonry, this brings up another problem in making anchorages. To anchor a tower to a vertical masonry surface, special brackets are available and are about the only means of making anchorages of sufficient strength. V-shaped of heavy steel, they are bolted to the tower legs, with extensions going on past to contact the wall surface. The extensions are fastened to the wall by lead expansion shields with lag screws, in holes drilled in the masonry.

Drilling holes into masonry walls used to be a time-consuming tedious job, but the development of carbide-tipped special masonry bits has speeded up the task immensely. Designed for use in the standard ¼-inch electric drill, they are available in several sizes. The ½-inch size is the one most used in this work as it makes a hole large enough to take a No. 8 shield, using a ¼-inch lag screw which is needed to carry the load. Be very careful when selecting the location for the holes so that the bolts will have a good solid hold. If the wall is old and the mortar crumbled out of most of the joints, drill in the center of a good solid brick. Don't set a hole close to the edge of a brick—there will be a chance of the edge breaking.

The same techniques may be used to fasten anchors to solid cement walls although these are usually much harder to drill if the cement is as solid as it should be. Special guy anchor plates are used for this. They are made of heavy sheet steel about 8 inches in length, with three holes for the bolts and one end turned up slightly, and another hole for the guy wire. Be sure to use eyes or thimbles in these holes to prevent cutting of the guy wire by the sharp edges.

When locating the anchors be sure to set them so that the direction of pull is at right angles to the bolts. Never set an anchor plate so that the strain is pulling directly away from the wall surface; this is its weakest position. Always make the pull come in the direction of the long axis of the plate, at right angles to the bolts or lag screws (Fig. 5). This may necessitate placing anchors on the sides of parapets, walls, etc., rather than on the tops, when working on a masonry building. Guy wires may also be anchored to the sides of chimneys in the same manner. However, if the chimney is small enough, it would be quicker and stronger to simply go all the way around the chimney. If the chimney is old and the mortar shows signs of crumbling, be sure to set the guy wire as low as possible to get maximum strength. Never tie to the top two or three courses of any chimney: this is its weakest point and a pull may break the chimney.

As to roof mounting of towers on residences with sloping conventional roofs, we don't recommend that at all! It is far better and just as cheap to add an extra two sections of tower to compensate for the height loss as to spend the extra time and trouble necessary to make a roof mount on this type of roof. The added loading of the roof structure may give trouble in any case. This, together with the possibility of causing leaks in the roof, will usually be enough to convince the customer of the desirability of the side mount! The actual difference in cash is somewhat in favor of the ground mounting, after you figure the cost of the special base bracket and the added time necessary to set the tower up.

Assembling the towers

The typical commercial tower, of the stamped variety, is fastened together with aircraft type bolts and stop nuts, two in each leg, making six to each joint. The top ends of each section are expanded to fit over the straight ends of the other section (Fig. 6). To assemble two sections, the expanded ends are slipped over the straight ends of the other section and the holes lined up. In some cases you will have to insert bolts in one section and use them as a fulcrum to line up the remaining bolt holes. Run the lock nuts finger-tight on each bolt and be sure that all bolts are installed before tightening any of them. The diagonal braces are slipped over the ends of the bolts; most of them will have two braces on some bolts while others have none. The bolts themselves are ⅛ inch, with a ⅜-inch hex head, as are the nuts. Two socket wrenches, with 4-inch shafts, are very handy for tightening as they may be slipped past the legs of the tower with ease.

The bolts are usually of two sizes, long and short. The longer bolts are used in holes which must hold the two diagonal braces in addition to the legs, the shorter bolts are used where only the two legs are fastened. Be sure to get the right-size bolt in the right holes. When putting the sections together if

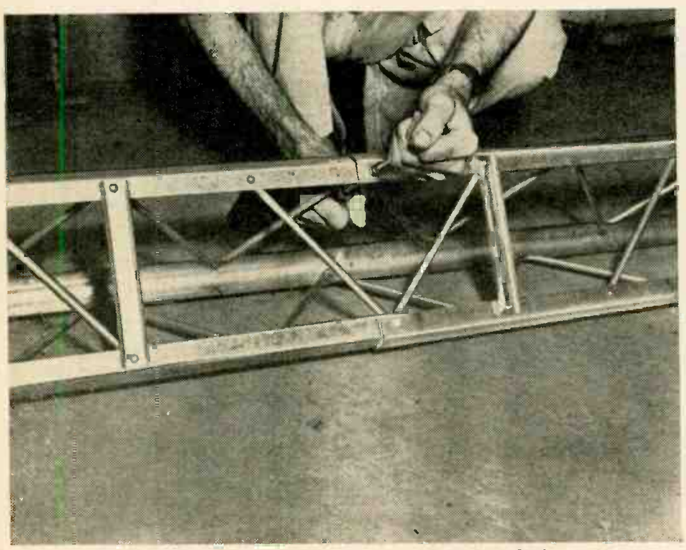


Fig. 6—Two sections of steel tower being assembled in shop—expanded ends of one section fit over straight ends of other.

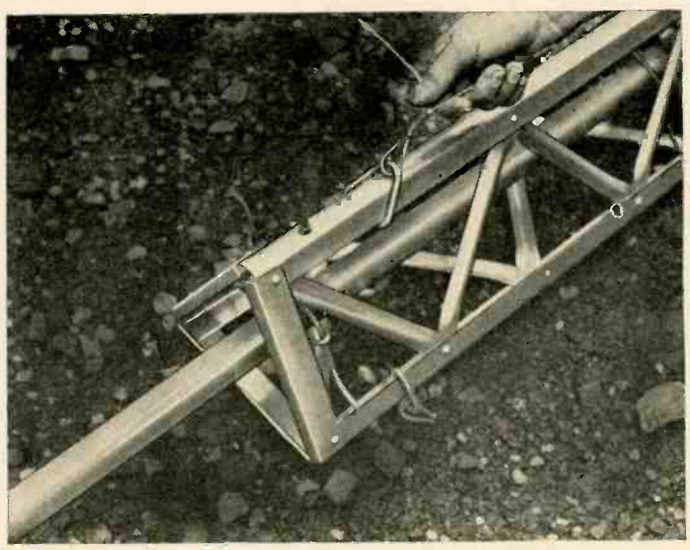


Fig. 7—Triangular guy ring, eye and guy wire attached to top of tower. Thimbles and rings protect guy wire.

the tower has built-in steps, as many do, be very sure that the steps are all on the same side of the tower, all the way up! With all of the bolts set and all braces fastened, tighten up all bolts as much as possible.

When putting the sections together, the triangular guy rings must be slipped over the tower legs *before* the joint is assembled. Once there they slide down the legs until stopped by a diagonal brace. For conventional guying, the rings are installed in sets of three, every 12 feet. This begins at the top where a set of guy rings must be installed when the top kit is assembled. From there on down the guys are set every two sections, as far down as necessary. For instance, a 48-foot tower would need at least three sets of guys —top, down 12 and down 24 feet. From this point on the tower would be supported by the eaves of the house. For a free-standing tower, unsupported by a house, another set at 12 feet up from the ground might be used, if the average wind velocity was fairly high.

Sizes and location of guy wires

For medium-height towers up to 48 feet, standard 6/20 guy wires used on ordinary installations are sufficient. For high towers from 54 feet on up, it would be better to use a somewhat heavier guy wire, 6/18 or its equivalent, especially for the two top sets of guys. The 6/20 could be used for the lower and shorter wires. For the top, where the maximum wind loading is found, the heavier wires are necessary to give the installation sufficient strength.

When fastening guy wires to the tower, the special guy rings mentioned above must always be used. The small metal eyes or thimbles must also be used to prevent the wires from taking too sharp a bend and breaking (Fig. 7). Never wrap guy wires around the legs of the tower itself; the sharp edges of the stamped legs will cut and weaken the wire which might cause breakage at the wrong time and the loss of the whole installation!

To make the proper twist joint around the eyes, pass about 5 inches of the guy wire through the eye, settling it firmly in the groove. Pull the two ends together and cross them as close to the eye as possible. Now wrap the loose end around the guy wire at least eight times, making the turns as near to a right angle with the guy wire as possible. This type of wrapping leaves no possibility of joint slippage, always a danger with a loose-wrapped joint. Clip the loose end off with cutters to make the joint neat.

Selecting the tower location

The first step in choosing a location for the tower should be the location and angles of the guy wires. The actual site of the tower should depend upon this more than any other single factor. Never use a location merely because it is convenient, if it does not offer the proper guy anchorages! One disadvantage of the house-side type of installation is the fact that one set of guys must be run out into the yard, away from the house. If there is a nearby shed or garage, the yard guys may be anchored to its roof, near the eaves. This takes care of the worst objection, the presence of guy wires in a traffic area. Always place these guys as high as possible to avoid accidents.

If no outbuildings are available, large trees may be used. To make a proper anchorage to a tree, drive a large screweye into the trunk about 6 feet from the ground. This will give a good anchorage and, if the tree is large enough, will cause no trouble from the tree's swaying in the wind. Never, under any circumstances, anchor a guy wire to a tree by wrapping it around a limb or the trunk. This will rapidly kill the tree. The screweye will do absolutely no harm to the tree and, within a few days, the tree will have grown around the shank until it is impossible to remove it! The guy wire slanting upward and away from the tree will keep it out of the way of persons walking in the yard. Drive the screweye into the trunk until all of the threads are covered by the bark.

If there is no tree, the anchorage must be made of pipes driven into the ground or from a regular "dead man" anchor, as used by the telephone company. These are driven or screwed into the ground until only the head is seen. An anchorage may be made by digging a hole and pouring cement into it, setting eye bolts in the cement or by driving iron pipes or rods into the ground. If the rods or pipes are used, always use at least three, placed in a triangle with the wires tied to all of them. To protect passersby from running into the wire, place a guard made of sheet metal over the wires near the ground, or small planks bolted to the wires. These are similar to the guards seen on guy wires used by telephone and power-line men. Their main purpose is to make the guys readily visible to keep people from stumbling over them.

When laying out the guy system always plan for a four-guy arrangement, instead of the common three, if it is at all possible. While the three-guy system may be used at the lower levels, the two top sets of guys, at least, must be four-guyed for maximum strength. This distributes the strain between four wires instead of three, lessening the loading on any given wire. A four-guy system is actually easier to lay out—two wires can go along the house wall, one over the house, leaving only one guy to go out into the yard. For convenience, the two along the wall are called the side guys, the one going over the house the back guy, the one in the yard the front guy.

The four-guy system is always set up so that the wires are exactly at right angles to each other for maximum strength. If the three-guy system is used, they must always be set at exactly 120° apart to equalize the pull. Never deviate from this, especially if the side which would have the widest angle (included angle) would be toward the direction of the prevailing wind. In almost every locality the majority of storms arrive from almost the same direction. Take advantage of this by placing one set of guys into the teeth of the wind for maximum strength.

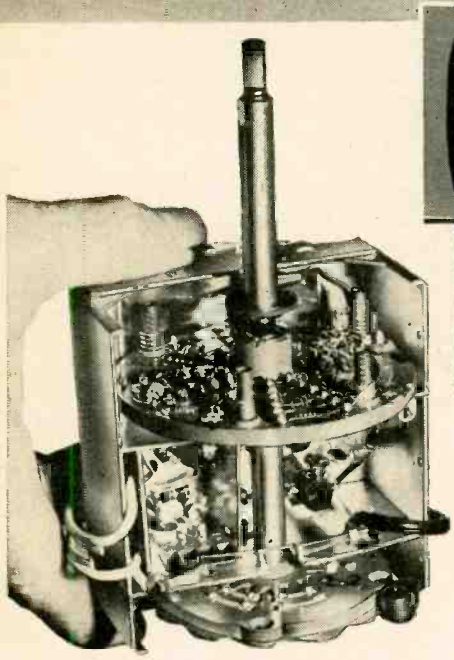
TO BE CONTINUED

(Many localities require that before a tower can be erected a construction permit be obtained on the basis of engineering data supplied by the contractor or person making the installation.

Also, building codes in many localities do not permit using chimneys or vent pipes as antenna supports or guy anchors, even for ordinary TV masts, and specify that masonry anchors shall be inserted into the brick, block, tile or other material; not in the mortar joints.

Check your local building codes and find out if permits are needed before starting an installation. In the event of damage due to tower failure or other accidents, insurance companies are likely to think a long time before paying for damages caused by an unapproved installation.—*Editor*)

trends in 1956-57 TV receivers



Interior view of Admiral's new disc type vhf television tuner.

By ROBERT F. SCOTT
TECHNICAL EDITOR

New circuitry features may be prototypes of future design

THE last few months of 1956 saw the introduction of a number of new lightweight portable TV sets. This forms 1956's most significant trend and most important source of new and interesting circuits. Many of these use multipurpose tubes, novel circuitry and unusual arrangement of components to reduce weight, size and cost. At least one new circuit arrangement can be found in most portables but the RCA KCS100B 11-tube chassis will probably be the most-often-copied in 1957.

The KCS100B chassis shown in Fig. 1 has dual-purpose tubes in all except the horizontal output, high-voltage rectifier and damper circuits. The switch-tuned front end with incremental inductors uses a pair of 6U8 triode–pentodes. The triode section of V1 is a grounded-grid rf amplifier with the incoming signal fed to the cathode through an antenna-matching network and FM and 41.25- and 47.0-mc traps. The output of this stage goes to the grid circuit of pentode V2-b used as the mixer. The triode section of V2 is the high-frequency oscillator. The signal at the mixer plate goes to the grid of pentode V1-b operating as the *first if amplifier*.

The output of V1-b appears across L47, tuned to 45.5 mc, and is capacitance-coupled to the second if amplifier. A parallel-tuned network consisting of L48 and C25 is in series between B plus and the low end of L47. The adjustable slug of L48 is the SOUND BOOST control, adjusted for optimum sound when good sound and picture cannot be obtained simultaneously with the fine-tuning control.

Rf amplifier V1-a and if amplifier V1-b are in series for dc across the B supply. The cathode of V1-b is connected to the plate of V1-a through the coils on S1-c and L8. Similarly, the halves of V2 are in series across the B supply. In this case the plate of the pentode mixer is connected to the cathode of the oscillator through L49.

The second picture if amplifier is conventional and uses the pentode section of another 6U8. This stage feeds a germanium diode video detector and agc source. Video, sound if and sync are taken from a common takeoff point in the plate circuit of video amplifier V103-a. The two-stage sync circuit (V103-b and V102-b) feeds the two 6CG7's in the vertical and horizontal sweep circuits.

Agc voltage from the video detector is applied directly to the grids of the second if amplifier and the rf amplifier and indirectly to the first if amplifier. The rf and first if amplifiers are in series for dc so the plate current through both can be controlled by varying the bias on either one.

The sound if signal from the plate of V103-a is fed to the grid of sound if amplifier V101-a. The 4.5-mc sound takeoff coil in the grid circuit is shunted by a 1N367 diode operating as a dynamic limiter. The clipping level is set by a positive cathode bias taken from a voltage divider in the cathode circuit of the second pix if amplifier. This limiter bias varies with the agc level to provide optimum limiting.

The 4.5-mc output of the sound if amplifier is fed to a ratio detector using two 1N367's. The dc voltage at the output of the detector is fed to the sound if amplifier grid through a 1-megohm resistor and used for sound avc.

The af output of the detector is fed back across R102 in the grid circuit of the sound if amplifier. The amplified signal appears across R104 in the plate circuit and is then fed to the volume control. The audio output stage is the triode section of 6U8 V101.

The horizontal sweep circuit is conventional and uses a 6CG7 oscillator and control tube and a 6BQ6-GTB output. The picture tube operates with only 5,800 volts on the second anode, obtained by rectifying the pulses at the plate of the 6BQ6. A stepup type flyback transformer is not needed.

Triode sound if's

Emerson introduced the triode sound if amplifier several years ago and other manufacturers are gradually adapting this arrangement as a means of saving tubes when the triode section of a multipurpose tube is available. Triode sound if amplifiers used in Zenith, Sylvania and Capehart sets were described in "Trends in 1955–56 Receivers" in the January, 1956, issue.

Fig. 2 shows the sound if amplifier and a reflex amplifier common to the sound and picture if circuits in the 11-tube sets in the Muntz 600 series. The second video if and first sound if amplifier are the pentode section of a 6BA8 triode-pentode. The sound and video signals are amplified in the two-stage video if circuit and then fed to the video detector. The 4.5-mc sound if signal is fed from the detector to the reflex amplifier through L6. The amplified 4.5-mc signal is developed across L14 in the plate circuit and applied to the triode sound if amplifier. The plate coil of this stage is the primary of the sound discriminator transformer.

Oscillations, normally caused by feedback through the grid–plate capacitance of the triode, are prevented by feeding an equal out-of-phase voltage from the bottom end of the plate coil to the grid through a *gimmick* with a capacitance of approximately 7.5 $\mu\mu f$.

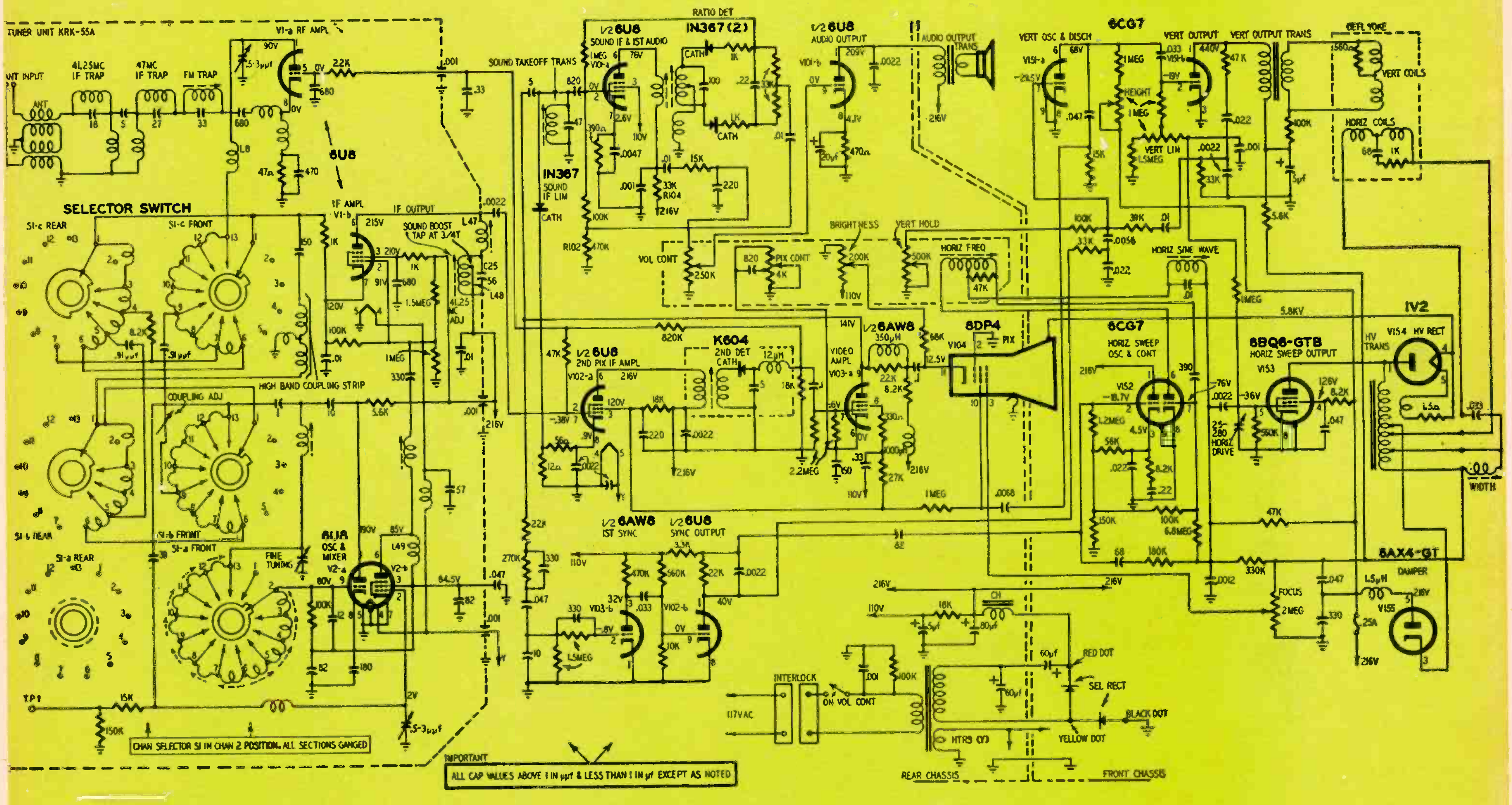


Fig. 1—The RCA portable chassis KCS100B. This circuit is used in models 8-PT-7030, -1, -4.

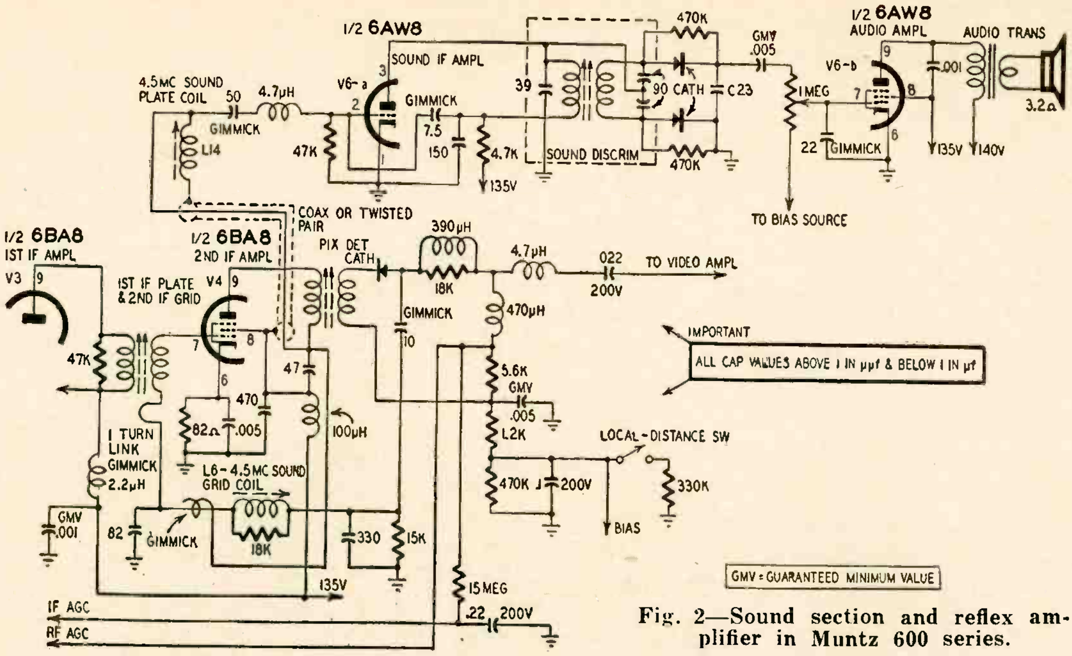


Fig. 2—Sound section and reflex amplifier in Muntz 600 series.

The Muntz receiver is the only one of the simplified type that we have seen using a Foster-Seeley discriminator instead of a ratio detector. The discriminator uses germanium diodes shunted by 470,000-ohm resistors to equalize the impedances in the halves of the circuit. The discriminator output goes directly to the 6AW8 audio output stage without intermediate voltage amplification.

The Du Mont RA-392 Sportsman portable uses the triode half of a 6AU8 as the sound if amplifier and limiter. This circuit, not shown, is transformer-coupled to a 6BN6 gated-beam discriminator. The stage is neutralized by a 2.4-μμf capacitor between the grids of the 6AU8 and 6BN6.

B-plus distribution

It is now common practice for TV receiver engineers to use the audio output stage as a voltage source or B-plus voltage-dropping resistor to supply other stages in the set. And we have seen how tubes in the front end are in series across the B supply in the RCA KCS100B. Fig. 3 shows a similar arrangement used in the Admiral 14YP3B 14-inch portable. B plus (about 115 volts) for the 3BC5 rf amplifier is taken from the cathode of the 3CB6 first if amplifier. Agc voltage is applied directly to the rf amplifier. The cathode bias, and thus the gain of the first if amplifier, varies with the agc voltage applied to the tuner.

New disc type tuner

The tuner shown in Fig. 3 and the photograph is a new type with antenna,

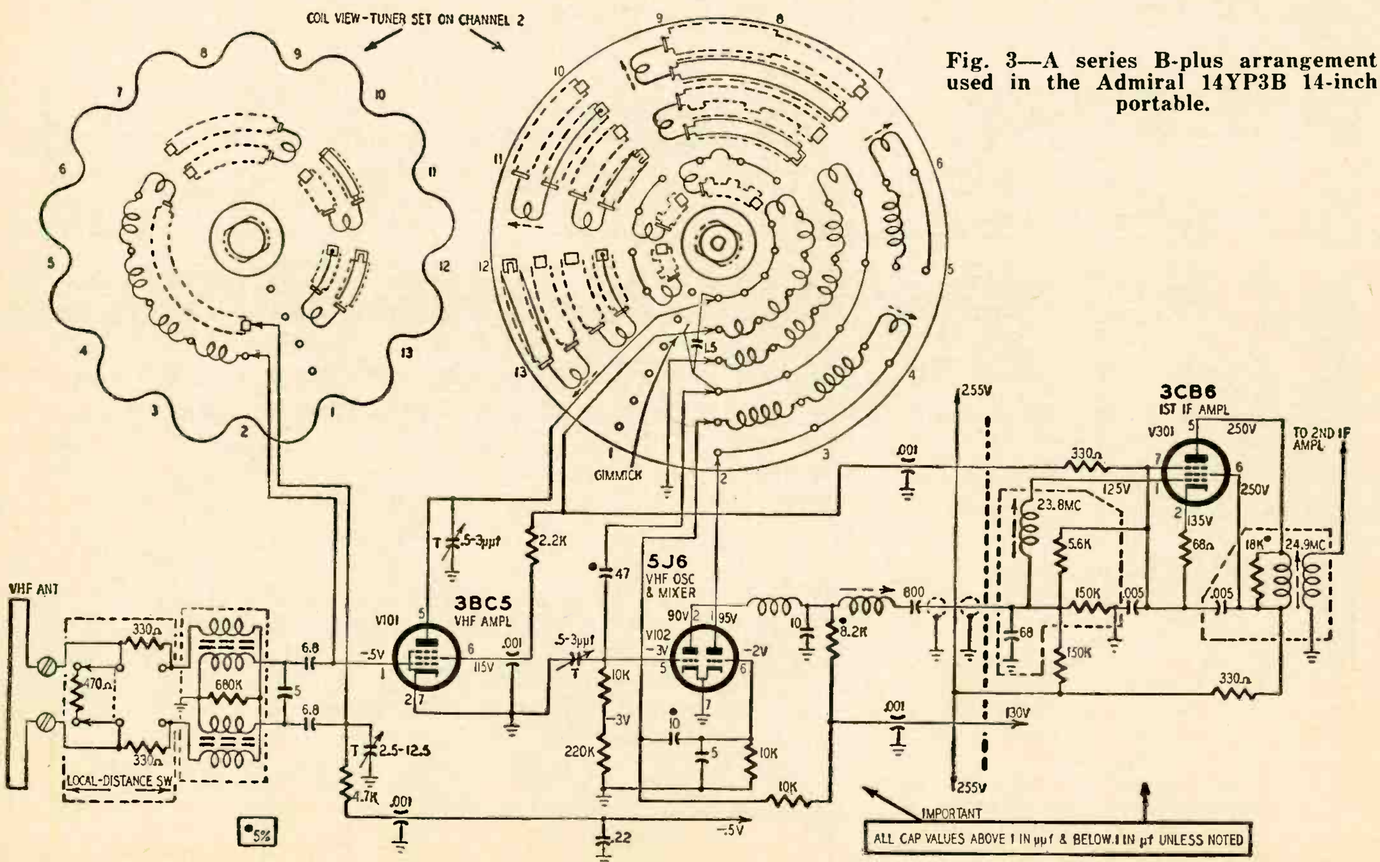


Fig. 3—A series B-plus arrangement used in the Admiral 14YP3B 14-inch portable.

oscillator and mixer coils mounted on two discs or rotors instead of turret strips or switch wafers. It is 20% smaller and more sensitive than the conventional turret tuners used in previous Admiral TV sets.

It is now being used in the 10- and 14-inch portables and plans are being made to use it in the 17-inch portable and other black-and-white models. The tuner's components are readily accessible and the unit can be disassembled quickly by removing three retainer and index springs.

Agc from sync clipper

In the July, 1956, issue we discussed two circuits devised for obtaining agc voltage from the sync circuit. The Du Mont Sportsman portable uses the sync clipper as the agc source. The circuit (Fig. 4) is similar to the Philco circuit described in the above-mentioned article.

Composite video with negative-going sync is taken from the video detector and applied directly to grid 3 through R1 and R2 and to grid 1 through R1 and C1. Amplified composite video with positive-going sync is applied to grid 3. The positive-going pulses cause grid current to flow and develop a negative voltage across R1 and R2 and charge C2. The charge on C2 is proportional to the peak amplitude of the sync tips and is used as the source of agc voltage.

A delay bias of plus 30 volts is applied to the agc network. The resistors in the network have been selected so the if agc voltage increases and the rf (tuner) agc voltage decreases as video modulation decreases. Thus, the overall gain of the receiver does not vary with video modulation level.

When the LOCAL–DISTANCE switch is set to *local*, the positive delay bias is applied to the agc line through R3 (8.2 megohms) and the sync clipper (grid 3) is biased to clip high up on the sync pulses.

Throwing the switch to *distance* reduces the resistance in series with the bucking or delay voltage to 5.6 megohms (R4), thus increasing the agc delay. Simultaneously, the bias on grid 3 is reduced so the circuit clips the sync pulses closer to the blanking level, thus providing more sync on weak signals. The bias on grid 1 is increased to improve noise rejection in weak-signal and noisy areas.

At all times, the bias on grid 1 is set so the tube cuts off on noise pulses exceeding the level of the sync pulses.

Motorola uhf tuner

Most all-channel uhf tuners are designed around the Inductuner or a series of capacitance-tuned coaxial lines. The new Motorola type TT-81, VTT-81 and WTT-81 uhf tuners use coaxial-line tuning elements resonated to the desired frequencies by varying the length of the center element. As Fig. 5 shows, there are three shorted quarter-wave lines—two in the antenna circuit and one for the oscillator.

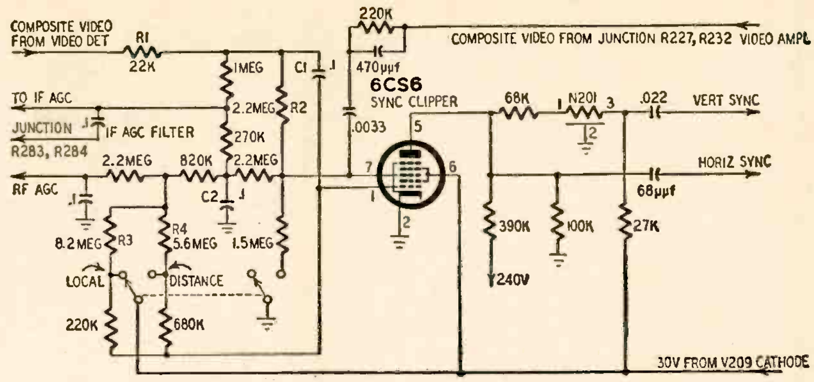


Fig. 4—The Du Mont RA-380/381 agc and sync clipper circuit.

The tuner housing and the metal internal shields or partitions form the outer conductor of the coaxial line. The center conductor is made in two parts. The fixed portion is a metallic cylinder plated on the outer surface of an insulating tube. The variable portion is a metal slug that moves in and out of the cylinder to vary the effective line length. The fixed and moveable sections are coupled by the capacitance between their surfaces.

The tuning slugs are ganged to a drive mechanism so they can be moved in and out to cover the range between channels 14 and 83. The cylindrical ends of the housing are tapered to increase the distributed capacitance and inductance as the cores are moved out of the housing. The taper provides a straight-line relationship between core length and resonant frequency. Four screws on each tapered housing section are adjusted for tracking and alignment.

The balanced antenna coupling coils L1 and L2 are arranged so they are located at a point on the central conductor where the impedance is 300 ohms. (The impedance of a shorted quarter-wave stub is zero at the shorted end and reaches a maximum at the open end.) The first and second antenna tuning lines are coupled by slots in the wall of their common shield or outer conductor. L3 couples the output of the second antenna tuning section to the crystal mixer.

The oscillator is a modified Colpitts type using coaxial-line tuning elements and operating above the signal frequency. The tube socket is a part of the inside wall of the outer conductor. Two 27-μμf capacitors couple the plate leads to the outer conductor. The plate supply lead is filtered by the .001-μf feedthrough capacitor and the inductance of the lead between plate pin 7 and the capacitor.

The oscillator signal is picked up by L4 and fed to the mixer crystal. Oscillator injection is controlled by varying the distance between the takeoff loop and the center conductor. The crystal is in series with the oscillator takeoff coil so its impedance minimizes oscillator radiation through the antenna tuning sections or the if output lead.

This tuner is a single-superheterodyne type with output in the band of 40 to 46 mc. END

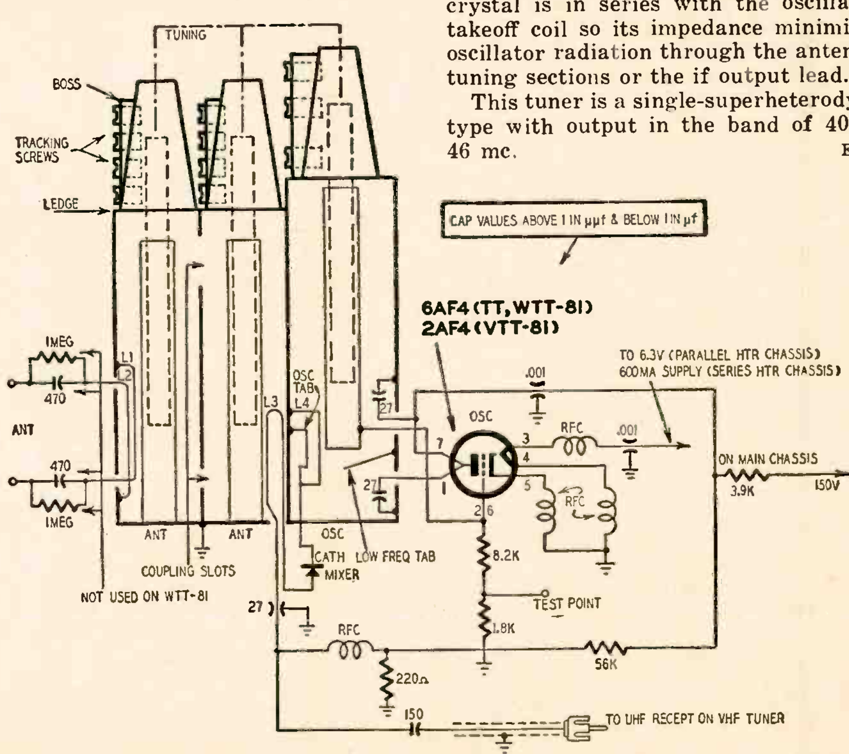


Fig. 5—Diagram of Motorola uhf tuner using coaxial-line tuning elements.

HINTS ...on TV tube troubles

Probabilities and possibilities in making initial checks

By CYRUS GLICKSTEIN*

PRACTICALLY everybody knows that most TV troubles are caused by defective tubes. Every experienced service technician substitutes good tubes for suspected bad ones as one of the first steps in troubleshooting. Yet almost every technician has at some time substituted tubes in a set and, when this didn't cure the trouble, pulled the chassis for more detailed troubleshooting in the shop. Some time later he finds the trouble was caused by a tube which he had overlooked.

The usual practice in TV troubleshooting is to examine the symptoms on the screen and listen to the sound carefully, then check the effect of adjusting various controls in an attempt to localize the trouble. The next step is to change tubes in all sections where the trouble may possibly be located. If tube changes do not cure the fault, then more extended troubleshooting procedures are required. Tube changes are usually made in home service calls. More extended troubleshooting is commonly done in the shop.

The following troubleshooting procedures and precautions are recommended when looking for defective tubes or replacing tubes:

1. If the receiver has a filament or power transformer (all tube heaters in parallel), open the rear. Using a cheater cord, and with the power switch turned on, note if one or more tubes has an unlighted heater. If so, replace the tube. If all filaments are lit, replace tubes in the suspected sections as outlined later.

2. In series-filament receivers be extremely careful to minimize the possibility of shock. In many of these sets one side of the line is connected to the chassis when the power switch is on. To avoid shock, make the following check before starting to service the set: Turn the power on and with an ac voltmeter (or neon tester with a clip lead attached to one prod), measure the voltage (Fig. 1) from the chassis to any convenient external ground. The metal face plate on the ac outlet may be used as the ground point. If a plastic face plate is used, use the screw head attaching the face plate to the outlet assembly. If line voltage is read on the meter (or neon tester lights), reverse the line plug from the TV set

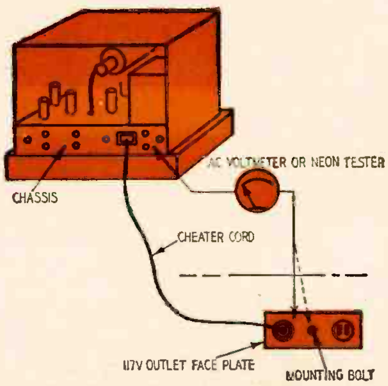


Fig. 1—Checking for shock hazards

in the outlet. In any event, avoid touching any external ground and the chassis at the same time while power is on.

3. If all tubes are unlighted in a series-string receiver, at least one is probably open. To locate it in a hurry, a neon tester may be used to make top-chassis checks. Take out the last tube

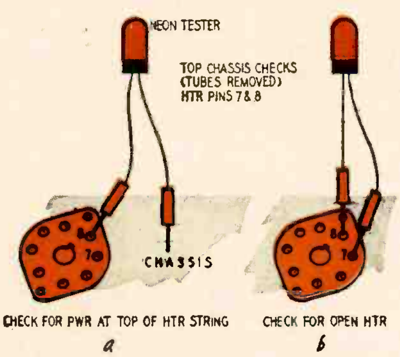


Fig. 2—Checking series-string tubes.

in the string next to the hot side of the line. Most recent receiver diagrams provide heater connection charts. Place one prod of the tester in the pin connected to the hot side of the line and the other prod to the chassis (Fig. 2-a). If the tester lights, power is being applied to the top of the string. Now put the tester prods on the heater pins of the socket with the tube still out (Fig. 2-b). If the tester lights, the tube which is out of the socket has the open heater—the tester must complete the circuit to light. If the tester doesn't light, there is an open heater between this socket and ground.

Next replace the tube and take out the middle tube in the string to determine which half of the line is open. Make the same two checks as before, first from the heater pin connected to the hot side of the line to ground and then across the heater pins.

If the tester lights on the first check, the string is OK from the hot side of the line to this point. The open is therefore either in the tube which has been taken out or in the ground half of the string. The second check across the heater pins will tell the story; a lighted tester shows this tube has the open heater. If the tester doesn't light, the open is in the ground half of the string. If the tester doesn't light on the first check, the open is in the half of the string from the tested point to the hot side of the line.

If necessary, continue the procedure of removing the middle tube in the remaining portion of the heater string which checks defective and repeating the two tester checks. If there is any doubt which heater pin goes to the hot side of the line, touch the tester to each pin in turn, while the other prod of the tester is applied to the chassis.

An alternate method is to make similar checks with an ac voltmeter. A reading of 117 volts on the meter corresponds to the tester lighting, zero to the tester not lighting. A number of receiver models provide heater test points at intervals in the heater string to simplify such checking.

A heater-to-cathode short in a series string (Fig. 3) may cause a complex trouble. The defective tube may short out a large part of the filament string and full line voltage is thrown across only a few tube filaments. One or more heaters in this part of the string may open. After replacing a tube with an open heater in any series string, turn the set on and observe whether all tubes light. If only some tubes light and

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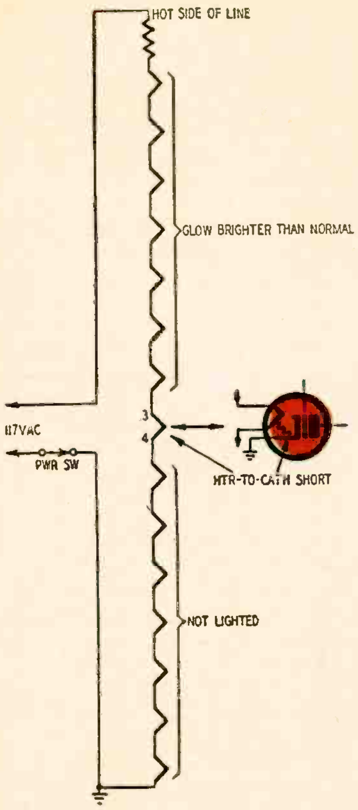

Fig. 3—Diagram shows effect of heater–cathode short in series-string line.

glow brighter than normal, turn the set off immediately and check for a tube with a heater–cathode short. Refer to the heater layout chart and check the last unlighted or the first lighted tube (going from the chassis to the hot side of the line) for a possible short. (Whether defective tube lights depends on which side of the heater is grounded.)

4. In replacing one of two parallel tubes (for example, two parallel 5U4-G rectifiers) let the remaining tube cool before the receiver is turned on. If not, the load is not evenly distributed and the new tube may be damaged by drawing excessive current.

5. If a bad tube is found and the fault is not an open filament (gassy tube, short between elements, etc.), check for other possible faults which may have been caused by or resulted from the defective tube. This is especially important if all defective tubes are replaced and the set's operation is improved but not completely restored to normal.

6. Before substituting a new low-voltage rectifier tube for one with an open filament, make a top-chassis check with an ohmmeter to determine if a filter capacitor is shorted (Fig. 4). In many sets with resistive voltage dividers from B plus to ground, a low resistance is normal—as low as 5,000 ohms in some cases. Where a shorted capacitor is found it should be replaced before substituting a new tube.

7. Always replace a suspected tube with a *known* good tube. The only way to be certain the replacement tube will function correctly is to try it first in a normal set before placing it in a tube caddy.

As mentioned, it is essential to check all tubes which may possibly cause the trouble. This is not always as simple as it may seem. In many instances, symptoms which point to a fault in one section of a receiver may be caused by a tube in some other section. Three general rules should be followed in making tube checks: First, change the tubes which usually cause the type of trouble observed. Second, change all other tubes which may possibly cause this trouble, going from the most likely to the least likely. Third, be certain every possible tube which can cause the trouble is checked.

Many signal troubles (sound, video or sync) may be caused by a faulty tube *anywhere* between the antenna terminals and the usual section which causes the symptom—that is, by any tube through which the particular signal passes. Also, any trouble (signal, sweep or raster) may arise when a faulty tube in a different section than the one usually suspected upsets normal dc voltage distribution in various sections. When several seemingly unrelated symptoms appear, check for a tube which may be shorting out part of the B supply by a fault such as a cathode–heater short.

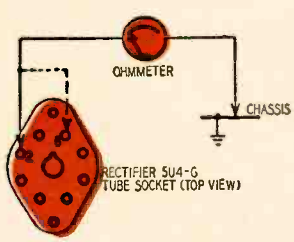

Fig. 4—Checking filter capacitor

A summary of various troubles follows, indicating in each case tubes which should be checked. However, in some models, other tubes may cause a given symptom due to circuit peculiarities. To avoid overlooking possible culprits when servicing an unfamiliar model in the home, check the schematic diagram of the receiver to make certain all possible suspects are eliminated.

Video–sound troubles

a. *No picture, no sound. Raster normal.* The most common causes for this trouble are the tubes through which both the video and sound signals pass. First change the rf amplifier, oscillator and mixer tubes in the front end; video (common) if tubes and other common video–sound stages such as the video detector and, in some intercarrier sets, the video amplifier. Less common possibilities which should not be overlooked are: last video amplifier stage (Fig. 5), sound output tube and agc tube (Fig. 6).

A defective last video amplifier in some types of *split-sound* receivers may cause no pix and no sound by applying

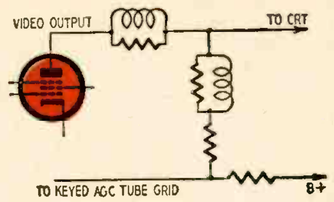

Fig. 5—Defective video amplifier changes grid potential of agc tube.

too large a dc voltage to the grid of the agc keyer tube. This causes excessive agc bias at the if and rf amplifier stages, causing loss of both picture and sound. In the same way, a defective agc tube may cause excessive agc bias and loss of both picture and sound.

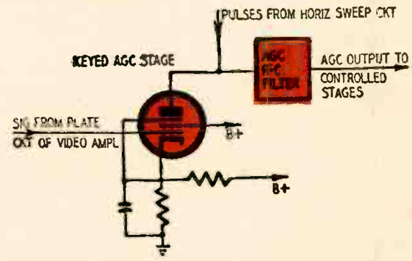

Fig. 6—Agc stage—when defective may develop excessive agc voltage.

Many sets have the sound output stage wired in dc series (Fig. 7) with a number of other stages—video if's and possibly one or two others. An open heater in the sound output stage or similar defect removes dc from one or more of the video if stages, killing both the picture and sound.

b. *Best pix and best sound not together.* Rf amplifier.

c. *Weak and distorted pix and sound, but the sound is from a different channel.* Rf amplifier, oscillator.

Sync troubles

a. *Picture out of sync both horizontally and vertically. Video apparently normal, sound and raster normal.* The most common possibilities are: sync amplifier, sync clipper. Other possibilities are: video if amplifiers (especially the last), video detector and amplifier, noise limiter and the sync clamping diode (this last may be overlooked, if used, because it usually is a diode section of a multiple tube such as a ratio

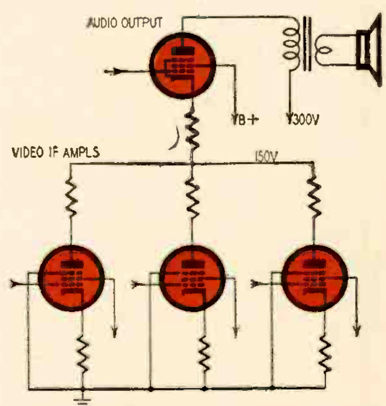

Fig. 7—Sound output stage forms voltage divider with various if stages.

detector–first audio, etc.). If the out-of-sync condition is not too bad horizontally or vertically or both, with or without sound distortion, check the rf amplifier tube.

b. *Horizontal bend or loss of horizontal sync. Sound and raster normal.* Change the horizontal afc and oscillator tubes first, in addition to the tubes mentioned in a. If video is abnormally overcontrasty, check agc tube.

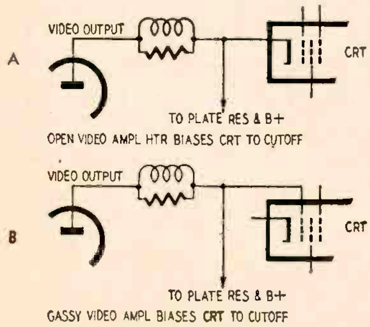

Fig. 8—In direct-coupled stages, defective video amplifier affects bias applied to the picture tube.

c. *Critical vertical hold or roll. Picture, sound and raster otherwise normal.* The most common possibilities are vertical oscillator, sync amplifier and sync clipper. Another possible cause is a defective rf amplifier tube (heater-to-cathode leakage which may not be great enough to show up in the picture as a 60-cycle hum bar). If horizontal hold is not completely normal, check the other tubes listed under a.

Sweep troubles

a. *Insufficient width. Picture, raster and sound otherwise normal.* The most common possibilities are: horizontal output and low-voltage rectifier. Also the horizontal oscillator and damper.

b. *Frequent replacement of horizontal output tube.* Check drive to tube (setting of horizontal drive control) and setting of horizontal linearity control before making a detailed check around the horizontal output and horizontal oscillator circuits.

c. *Vertical foldover or decreased height.* Vertical oscillator, vertical output and low-voltage rectifier tubes.

Raster troubles

a. *Blank screen. Sound normal.* The most common causes are: defective horizontal oscillator, horizontal output, damper and high-voltage rectifier tubes. Other tube possibilities are: open filament in picture tube (or misplaced ion-trap magnet), defective output video amplifier or agc tube.

A defective output video amplifier can cause higher-than-normal plate voltage (low emission, open filament) or lower-than-normal plate voltage (gassy). Depending on the connections to the C-R tube, bias to the picture tube may be increased sufficiently to cut it off (Fig. 8). A defective agc tube may result in excessive video applied to the grid of the video amplifier stage, thereby cutting off this stage and raising the plate voltage sufficiently to bias the CRT to cutoff (Fig. 8-a).

b. *Poor focus.* Low-voltage rectifier, audio output tubes and C-R tube.

c. *Excessively long warmup time before raster comes on.* Defective damper tube. Check for poor or oxidized connection to the plate cap of the horizontal output tube.

Manufacturers' notes

Defective tubes should be replaced by the same type. However, manufacturers may suggest in their field service notes other tube types to improve operation. The following pointers are taken from makers' field service notes and tube manufacturers' bulletins.

1. Be careful about interchanging 600-ma tubes with their prototypes. (A prototype is the original tube after which the 600-ma type is patterned.) For example, the 5T8 (600-ma type) and the 6T8 (prototype) differ considerably in required heater voltage—4.7 volts compared to 6.3—and are not interchangeable.

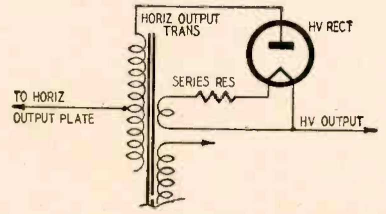

Fig. 9—Current-limiting resistor is in series with filament of rectifier.

The 6SN7-GTB (600-ma type) and the 6SN7-GTA (prototype) are identical except for the heater current tolerance and the controlled heater-warmup time. These characteristics are carefully controlled in the 600-ma types. The 6SN7-GTA cannot be used in series-strings because it does not have the required heater current tolerance and the built-in thermal characteristics to safeguard the series-string during the warmup period. However, the 6SN7-GTB can be used in other types of sets as well as those with series heaters. When replacing tubes, note carefully the complete number including the suffix (last letter). While 6.3-volt 600-ma tubes may be used in transformer type sets, the reverse is not true. *Use only 600-ma tubes in series-heater strings, not their prototypes.*

2. In cascode rf amplifier stages, a 6BZ7 or 6BQ7-A may be used to replace a 6BQ7. A 6BK7 is not recommended for replacement purposes.

3. Some 6CB6 video if tubes develop a high-resistance short between grid and cathode which can be measured cold with a vtvm. Other 6CB6's used in the last video if stage may cause limiting because of insufficient linear range, thereby compressing sync and causing sync instability. Try another 6CB6.

4. In weak signal areas sync may be improved by replacing a 12AU7 (low-mu) sync amplifier with a 12AT7 (medium-mu) sync amplifier. No wiring change is necessary.

5. The 25BQ6-GT and 6BQ6-GT may be replaced respectively by the 25BQ6-GA and 6BQ6-GA. The suggested replacements do not run as hot as the older tube types.

6. Abnormal failure of high-voltage rectifier tubes may be caused by overdrive of the horizontal output stage or by abnormal high-voltage rectifier filament voltage resulting from incorrect value of series resistance (Fig. 9).

(a) Filament failure of a 1X2 due to arc-over can often be solved by replacement with a 1X2-A or 1X2-B tube.

(b) A 1AX2 can be substituted for a 1X2 or 1X2-A only if the 2.2- or 3.3-ohm current-limiting resistor is removed. A 0.51-ohm resistor may be substituted.

7. All 1B3-GT tubes are not exactly uniform with regard to pin connections. Some brands have all unused tube pins (1, 3, 5 and 8) connected together internally as an anticorona shield and also connect these internally to one filament pin (7). Other brands do not have pins 1, 3, 5 and 8 connected internally.

If the internally connected type of 1B3 is used as a replacement in certain sets, no high voltage may result. For example, several models use pin 3 or pin 5 on the tube socket as a tie point for the 1B3 series-filament resistor. If the internally connected 1B3 is inserted, the filament is shorted out (Fig. 10). This would be evident during troubleshooting if the original symptoms are a dim raster or a similar fault and the replacement 1B3 causes a blank screen. Where the original trouble is a blank screen, the service technician may not realize he is using an incorrect 1B3 replacement.

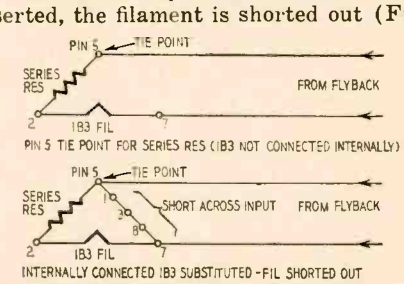

Fig. 10—Substituting an internally connected high-voltage rectifier for one that is not may short-circuit the filament winding. Numbers refer to tube pins.

When replacing a 1B3 in sets where a tube socket pin is used as a filament tie point as described above, use a new 1B3 which is not internally connected. However, if only an internally connected 1B3 is available, the tube can be used by first clipping off the blank tube pin going to the socket tie point. That is, if pin 5 on the socket is used as the tie point, clip off pin 5 on the replacement tube.

8. Some manufacturers recommend substitution of the 12DQ6 for the 12CU6 in 600-ma sets; others recommend replacement of the 12CU6 when necessary by the same brand. The variation in other brands may cause insufficient width or overscanning. END

TV Service CLINIC

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FEW controls are found in as many different circuits and in as many forms as the adjustment for varying raster width. Aside from the circuitry, the width control takes many forms—as a variable inductor, a potentiometer, a metal sleeve around the neck of the picture tube or a mechanical device that varies the air gap in the core of the horizontal output transformer. With these controls the raster may be varied in width from ¼ inch to about 1½ inches and sometimes more.

By far the most popular system of width control consists of connecting a variable inductor across a section of the horizontal output transformer. As its inductance is varied it shunts a greater or lesser amount of the horizontal deflection current generated for the horizontal coils, thus altering raster width accordingly. The width coil is usually mounted near the flyback transformer but is not inductively coupled to it. Fig. 1 shows a typical width-coil circuit, used in the Admiral 21K1.

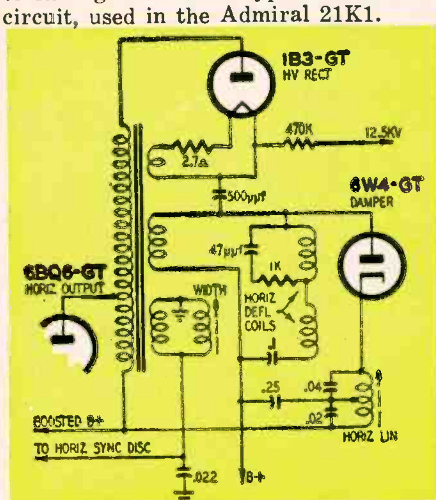


Fig. 1—Width control in Admiral 21K1.

In appearance the width coil is very much like the horizontal linearity coil, catalogs often listing them under a combined heading. There is no typical inductance range for the width coil since it will vary considerably with the type of flyback transformer. Generally, however, the inductance range of width coils falls into two categories; a low inductance of from perhaps 0.05–0.50 mh having a dc resistance of about 0.5 ohm; a high inductance of 4–28 mh having a resistance of about 32 ohms.

The low-inductance width coil must of course be connected across relatively few turns of the flyback transformer to avoid excessive shunting. Its low impedance permits it to shunt a relatively large amount of power from the flyback transformer and it will usually have a more pronounced effect on raster width than the high-inductance coil. The latter is generally connected across a larger section of the flyback transformer and provides a less critical control. Some special circuits use a combination of both high- and low-impedance width coils.

Manufacturers often couple agc and afc windings on the width coil. Thus a defect in this unit often produces extremely misleading trouble symptoms. Unfortunately, an ohmmeter check is almost useless in determining the quality of a width coil, especially in low-impedance coils where the resistance of ½ ohm or so is so low that most ohmmeters will not reveal a few shorted turns. And just a few shorted turns on the width coil can draw excessive current from the flyback transformer, producing a considerable power waste and reduction in width. Making width-coil testing still more difficult is the fact that turns often short only when the high pulse voltage is applied. Under this condition not only may turns short but there can be a breakdown from the coils to the core and ground, eventually burning out the coil and possibly even the flyback transformer.

Thus, in the absence of a special tester for flyback transformers, width and linearity coils and yokes, the best check of a width coil is replacement. Test this coil immediately when the flyback transformer overheats and when there is little or no control of width. Besides the coil, watch for a mechanical defect in the core.

In the earlier TV receivers potentiometers were frequently used to control width. Among the more common applications was the use of a pot to vary the amount of voltage on the plate of the horizontal oscillator and thus the amplitude of the driving voltage and horizontal width. The principal disadvantage of this arrangement is that the high voltage generally varies considerably with changes in horizontal oscillator output. The width-control potentiometer was connected in series with the horizontal deflection coils in some sets to vary the amount of deflection current.

The one use of a potentiometer to control raster width still found in some of the most recent TV chassis is to control the screen voltage of the horizontal output tube. Fig. 2 shows the horizontal output circuit of the Philco TV-390 chassis. A 12,500-ohm potentiometer is used as a width control. Varying this pot controls the plate current and the gain of the 6CD6-G horizontal output tube.

Fig. 3 shows the width-control setup in the G-E 21C136. The 8,200-ohm screen dropping resistor may be shorted out by the width switch. Thus this arrangement provides two positions rather than a continuous variation of width.

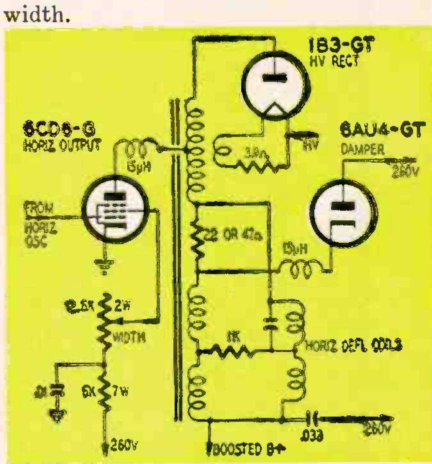


Fig. 2—Screen-grid pot varies width in Philco TV-390.

One other popular type of width control is the variable-air-gap flyback transformer. In this system the width-control shaft varies the air gap between sections of the flyback transformer core. This varies the core saturation and flyback transformer inductance which in turn affects the raster width. Fig. 4 shows schematically the width arrangement in the Motorola chassis TS-538.

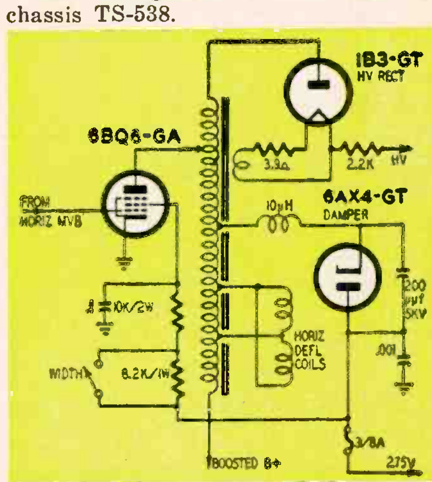


Fig. 3—A G-E version of the screen-grid width control.

The sleeve type width control, popularized by Bendix and Zenith, is now being used by several other manufacturers. It consists of an insulated cylinder of copper, brass or aluminum fitted around the neck of the picture tube and slipped between it and the deflection yoke. The amount of sleeve under the yoke determines the picture width.

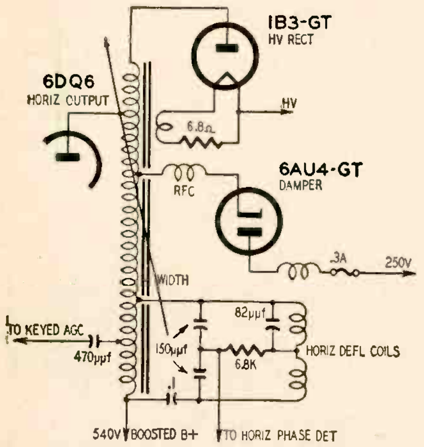


Fig. 4—Variable-gap type width control. Some diagrams use arrows on end of core as control symbol.

Horizontal sweep currents in the yoke induce eddy currents in the sleeve. These eddy currents produce a magnetic field that opposes the field produced by the yoke. Thus the effective strength of the horizontal deflection field is reduced and width decreases. Fig. 5 shows the width sleeve as used in the Zenith 19Y22 chassis.

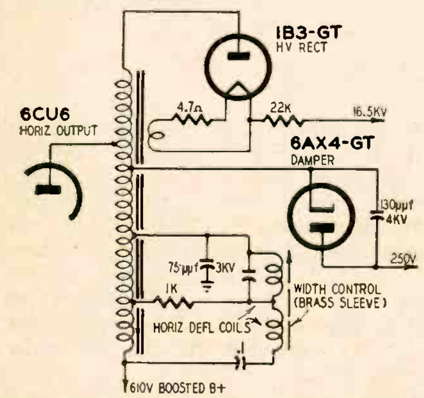


Fig. 5—Horizontal output circuit with sleeve type width control.

Height is not affected because the eddy currents produced by the 60-cycle vertical deflection currents are negligible.

Insufficient width

Having discussed the various methods of controlling raster width, the problem of insufficient width can now be considered. In so doing it is assumed that lack of width is not due to a specific circuit defect but rather to a general aging of components resulting in overall loss of efficiency. Thus, the picture and raster should be generally acceptable in all respects but for width. The methods used for increasing picture width, to be discussed next month, can also be used in cases of conversion where the new raster lacks up to 1½ inches or so in width.

Initial checks in case of insufficient width are adjustment of the ion-trap magnet, focus magnet, linearity coil and horizontal drive control. In conversions, the deflection yoke should be checked to see that it is firmly fitted as far forward as the flare of the picture tube allows. It is often necessary to go through the above adjustments twice, as varying one frequently affects the setting of the others slightly. In addition, replace the horizontal oscillator, horizontal output and damper tubes, and low-voltage rectifier (if B plus is low).

If the above fail to restore normal width, the methods to be discussed next month may be applied.

Horizontal drift

I am on my second callback with a Crosley 431-1 chassis in which the horizontal oscillator goes so far off frequency that the horizontal hold control cannot bring the picture back. Initially, I checked all components in the horizontal afc and oscillator circuits and found everything normal except for a leaky .01-μf capacitor across the horizontal waveform coil in the oscillator plate circuit. I replaced this unit and everything was fine—for a few months. Replacing this capacitor again cured the same trouble. That was about 5 months ago and now the trouble of horizontal drift has returned.

I am fairly sure now that the trouble is due to some other defect and that replacing this capacitor is only a temporary cure.—M. W., Miami Beach, Fla.

In all probability you are right on top of the basic cause of the trouble. This chassis uses the popular Synchroguide circuit and the capacitor you replaced has a long history of causing oscillator drift. In the 431-1 this capacitor is connected between lugs 1 and 4 of the horizontal oscillator transformer. As is often the case, the .01-μf unit is very sensitive to moisture and temperature changes, with some manufacturers using high-quality molded capacitors in this circuit. Thus, replace the capacitor again with a good molded unit and carefully realign the horizontal circuit as per service bulletin. If humidity is the problem, you might do well in also replacing the oscillator transformer.

Intermittent arcing

Peculiar arcing takes place in a Sylvania 1-532 chassis in which the raster shrinks in size. The arcing is very loud and appears to be in the neck of the picture tube. However, on occasion, the arcing sounds as if it is coming from beneath the chassis. I did not replace the picture tube, but I did try it in a different set and there was no arcing. I'd like some hints on where the defect might be. All tube-socket voltages measure correctly.—T. R., Fort Wayne, Ind.

Your description of the arcing indicates that the trouble is not associated with the high-voltage circuitry. The arcing in the neck of the picture tube would appear to be caused by excessive voltage on pin 6. This is probable because you state all pin voltages are normal and because pin 6, which is at approximately 260 volts, has a tie point very close to a 410-volt point on a terminal strip. Arcing is probably taking place between these points. In fact, direct shorts between these tie points have been found in this chassis.

To eliminate the arcing tape the 260-volt terminal point or remove it from the strip.

Globar resistor

On more than one occasion I have had trouble with the series filament resistor in the G-E model 17C125. This unit is connected in a series circuit with tubes having 300-ma heaters. I have noticed a wide variation in the resistance of the Globar elements and would appreciate some method of determining which units can be used in this circuit.—T. L., Richmond, Va.

The resistor used in this circuit may have a cold resistance of anywhere from 200 to 300 ohms and so this reading is meaningless. When operating properly its resistance when hot will be approximately 31 ohms. The only positive check on the Globar resistor is to read the voltage drop across it. This should be about 10 volts with the set operating on a 117-volt line. Its exact resistance can be determined by applying Ohm's law.

Vertical instability

I seem to have a real tough one on my hands, with the vertical section extremely unstable. The interlace is very poor and varies from fair to none at all. The picture constantly jitters vertically at a rapid rate, often giving the effect of a double picture. The set is a Crosley model H-17TOWH (chassis 432). Because of the complete instability of the vertical circuits I have been unable to make any conclusive tests. The tubes and dc voltages check OK but the sweep signals are completely haywire.—F. F., Cincinnati, Ohio

From your description of the defect it would be impossible to state precisely what the trouble is. However, you should try the following:

Replace all capacitors connected to the agc line. Watch the 0.25-μf unit tied to the if agc bus. This bypass capacitor often breaks loose, producing vertical jitter. Another common cause of trouble is the .005-μf capacitor across the plate winding of the vertical blocking oscillator transformer—remove it. Also, connect a capacitor of about 500 μμf from the vertical oscillator grid (pin 2) to ground.

Check to see if there is a .005-μf disc ceramic capacitor between the rear picture-tube support and chassis and if it is making good connection. This capacitor bypasses stray electrostatic fields which may seriously affect interlace.

This chassis should have a deflection-yoke shield that slips over the edge of the deflection-yoke opening and is held in place by a spring type clamp—see that this is in place. Check the lead dress of the yellow wires from the contrast and brightness controls which run under the yoke. These leads should be dressed against the chassis, away from the yoke. They can be placed under the .25-μf agc bypass capacitor. Finally, be sure the leads of the horizontal coils of the deflection yoke are dressed away from the vertical output tube.

Aside from the above, start checking all components from the plate of the sync amplifier. Check all values and signal voltages against those given on the manufacturer's schematic. The best check for components, especially capacitors, is direct substitution.

Intermittent high voltage

I have a Philco model 50T1400 set in which the high voltage comes and goes. I can draw an arc from the plate cap of the 1B3 and a very small arc from the high-voltage lead to the picture tube. I can't tell too well but it appears that, when the high voltage goes off, the filament of the 1B3-GT does not light.

I have changed the flyback transformer and all the tubes in the horizontal circuits. Voltage and resistance checks seem normal. When the high voltage comes on, it is sufficient to produce a raster on the screen. I have replaced the picture tube and the same trouble occurs. Any suggestions you can make will be greatly appreciated.—A. D., New Haven, Conn.

The general run of your checks, replacing the flyback, tubes, resistance and voltage measurements, indicate an open or shorted condition in the filament circuit of the high-voltage rectifier. Replace the 4.7-ohm resistor in the filament circuit of the 1B3. Carefully inspect the socket of the tube, replacing it if there is any sign of cracks or carbon formation. If this does not help, replace all components associated with the high voltage and damper circuits. Check all high-voltage wiring for possible arcing or leakage. Remove all sharp bends in the high-voltage wiring and dress it away from the chassis. Use high-voltage dope at all points of possible arcing.

Small horizontal size

The raster on a Stromberg-Carlson model 421 set is almost 2 inches short in horizontal size and no amount of varying the horizontal drive or width control will help. The raster has almost normal height and is extremely bright. The high voltage measures approximately 18,000, which is probably the cause of the brightness. Backing off on the drive control reduces brightness a little but the width remains about the same. I would like to know how to get the raster to fill out the screen.—P. T., Toledo, Ohio

The 18,000 volts that you measure is approximately 2,000 more than is necessary for proper operation of the picture tube. By backing off on the drive control you reduced high voltage and also horizontal drive, and thus gained very little in the horizontal size.

To reduce the high voltage to its proper value requires a little experimentation. Connect a 3,000-volt mica capacitor of about 50 or 60 μμf, in series with a resistor of about 600 ohms, between terminals 3 and 7 of the horizontal output transformer. To avoid corona, connect the resistor to terminal 3 and the capacitor to 7. For optimum results you will have to try various values of the above parts.

To reduce the high voltage further and increase width, reduce the 15,000-ohm screen dropping resistor of the 6AV5-GT horizontal output tube to about 10,000 or 12,000 ohms.

Loss of width

In a Setchell-Carlson 151 receiver there is inadequate width (only about 1½ inches). We are troubled with low line voltage in this area. Would this cause the decrease in width? Also, would it help to change the 1X2 high-voltage rectifier to a 1B3?—P. F., Oakland, Calif.

If you get sufficient height, but lack width to the extent mentioned, the trouble would not likely be low line voltage. A decrease in line voltage (and insufficient voltage from the low-voltage supply) would shrink the picture on all sides. Insufficient width can be caused by a decline in emission from the horizontal output amplifier or changes in value of the parts in the horizontal sweep output circuit. We assume that you have checked the width, drive, and centering controls for proper adjustment. Also try a new horizontal oscillator tube, and check parts and voltages against values given in the schematic for this model.

Changing the 1X2 to a 1B3 will not increase the width or high voltage unless the present 1X2 is weak. The 1B3 is capable of handling higher current than a 1X2, but cannot deliver higher voltages than are generated by the flyback system.

Defective yoke

I recently replaced a defective yoke on an RCA model 7T104B receiver with the recommended Stancor replacement unit. While it gives full deflection, there is a ripple at the left edge of each scanning line. The ripple is large at the left edge and disappears about an inch to the right. This condition did not exist before the replacement. I have made some checks around the horizontal output and damper circuits but have been unable to come up with the solution. I would appreciate your advice.—R. T., Fort Wayne, Ind.

The condition you describe indicates a defective or missing balancing capacitor across the upper half of the horizontal deflection coil. Make sure the capacitor is not connected across the lower half of the coil.

It is very possible that the replacement transformer is not an exact electrical equivalent and its characteristics are slightly different from the original. Thus, use several values of capacitors larger and smaller than the original. Also, replace the damper tube and adjust the width and linearity controls.

Vertical buzz

The complaint on a Motorola TS-216 was background buzz. The customer said that he heard the buzz for years but it never bothered him until a neighbor called it to his attention. I checked the set and found it in perfect working order except for the slight buzz, and explained to the customer that the trouble was built into the set and would be too time-consuming and expensive to remove. However, he insisted and my prediction was correct. I have spent several hours and have found only that the trouble is in the lead dress. As I move wires in the audio output circuit the buzz increases and lessens.—L. M., San Francisco, Calif.

Your chassis is one of several Motorola units that contained a noticeable amount of buzz. If you have checked the receiver thoroughly, you are correct in assuming that the trouble is built in. It is usually caused by stray coupling between the plate lead of the vertical output stage and the input to the audio circuit. Of various ways of reducing hum in this chassis, I have found only one to be thoroughly effective.

Unsolder the plate lead from pin 1 of the 12BH7 vertical output tube. Take this lead back up to the top of the chassis and run it across the top to one of the holes near the vertical output tube socket. Draw the lead through this hole and connect it to pin 1. Be very careful to keep this lead away from the audio tubes.

Reduced raster

In an RCA 2T51 receiver the raster is small even with the height and width controls at maximum. I suspect the selenium rectifiers, but would appreciate your advice.—E. N., Chickasha, Okla.

This is generally caused by a decline in output from the low-voltage supply as you surmised. If the output voltage from the selenium rectifiers is low—less than about 260 volts—check for leaky electrolytic filter capacitors. If these are normal, replace the rectifiers.

Another possibility which is sometimes overlooked is that *both* the vertical and horizontal output amplifier tubes are poor. If power supply checks don't correct the trouble, check all tubes in the vertical and horizontal system, and also component parts. END

Servicing Color TV Gating Circuits

By WALLACE WANER

A COLOR television receiver must be capable of accommodating, not only ordinary black and white signals, but also a 3.58-mc burst signal and color sideband signals as well. To secure good color and at the same time minimize the interference which would result if these various signals interacted, several gating circuits are used. Some of these circuits must *gate* or *key out* certain signals while others *gate* or *key in* specific signals. The gating-in circuits must present a "closed-door" condition to certain incoming signals and must be opened only at specific time intervals as required. The gating-out circuits must pass signals for a certain time duration and then present a "closed-gate" condition at periodic intervals to prevent signal entry into the system.

In a color television set the 3.58-mc burst is needed to lock in the 3.58-mc oscillator. But the presence of the burst signal in other circuits can cause trouble. When the burst signal enters the color demodulators, it is detected and causes color interference. With receivers using R − Y and G − Y demodulators, for instance, the burst signal would operate the red and green grids of the three-gun tube. The combination of *red* and *green* produces *yellow*, and hence a yellow stripe would appear on the left side of the screen. The reason for the stripe appearing at the left is that the burst occurs during the end of the retrace interval.

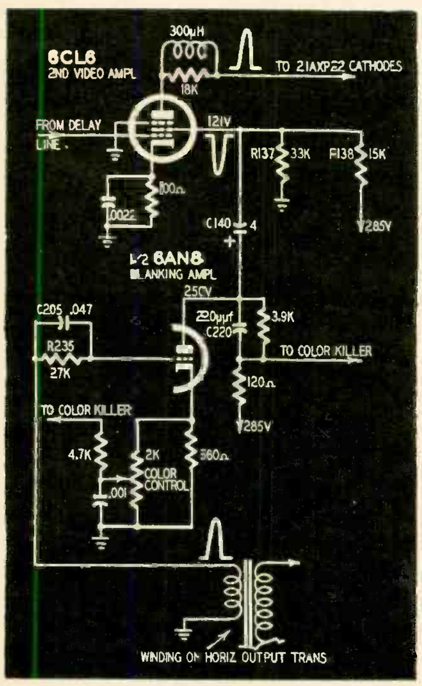


Fig. 1—Blanking amplifier in the RCA 21CT662U.

To prevent the interference stripe, a horizontal blanking amplifier is used (Fig. 1). This is the type used in the RCA 21CT662U receiver and a similar circuit is also found in the RCA CTC5 chassis. The blanking amplifier is keyed by a pulse obtained from a special winding on the horizontal output transformer. The plate circuit of the blanking amplifier is coupled to the grid of the second video amplifier by coupling capacitor C140.

When a pulse appears across the transformer winding, it presents a sharply rising grid signal to the blanking amplifier. In turn, a negative-going signal appears on the plate side. This negative pulse reduces the screen voltage of the second video amplifier, reducing the current flow through the video amplifier. Plate current drops and plate *voltage* rises, developing a positive-going pulse at the plate of the video amplifier.

The video amplifier is directly coupled to the cathodes of the color picture tube. The positive-going pulse at the cathodes of the picture tube cuts it off because a rising cathode voltage increases negative grid bias. Thus, during the time the color burst appears, the picture tube is cut off (keyed out) with respect to any signal.

Troubles occur in these circuits if screen-dropping resistor R138 changes value or if the gating-pulse amplitude drops. If the resistor should short, the voltage at the screen grid would increase beyond the point where the horizontal keying pulse is effective in producing a good anode pulse. If the pulse amplitude is insufficient because of a defective blanking amplifier, the picture tube will be inadequately blanketed. Insufficient pulse amplitude can be caused by a defective coupling capacitor C140 or a defective C205 and R235 in the network preceding the blanking amplifier.

For the circuit shown, screen voltage for the 6CL6 should be 121, blanking amplifier plate voltage 250.

Since a voltage check at the screen grid must take into consideration the possible effects of leakage in C140, this capacitor should be disconnected from the screen grid of the 6CL6. While disconnected, the capacitor can be checked for a possible short or leakage which would permit the higher plate voltage of the blanking amplifier to appear at the second video screen grid.

Resistor R137 is a power supply bleeder for the dc voltage at the video amplifier screen. The bleeding action stabilizes the voltage on the screen grid and helps improve regulation. A partial short or a decrease in value of this resistor will lower the B voltage fed to the screen grid, with the result that the entire video amplifier will be affected. When resistor R137 shorts, the excessive current through R138 may damage the latter also. Reduced screen voltage causes degeneration with a consequent decrease in color signal amplitudes and decreased contrast in black-and-white also.

If the interference stripe is still present after a check of the components has failed to disclose the trouble, use an oscilloscope to check for the presence and amplitude of the pulse at the grid and plate of the blanking amplifier and at the screen and plate of the second video amplifier.

Burst amplifier

In color transmission only the color sidebands are sent out, and the color carrier is suppressed at the transmitter. Hence, for demodulation of the color signal in the receiver it is necessary to reinsert the carrier into the color signals so that the color *video* signals can be detected. This is done with the 3.58-mc oscillator. Such a carrier-generating oscillator, however, must be synchronized very carefully and accurately with the original carrier used at the transmitter. Hence, a 3.58-mc burst signal is transmitted and, as previously mentioned, this burst occurs during the back porch of the horizontal blanking pulse. The burst is then fed to a phase detector afc system for locking in the 3.58-mc carrier oscillator of the receiver.

To prevent *video signals* from interfering with the afc system, only the 3.58-mc burst can enter it. Hence, this burst must be keyed in, with a closed-gate condition at all other times. Most receivers use a burst amplifier with a normally closed gate which prevents the entry of the composite video signal. When the burst arrives, the tube is keyed into conduction and allows the burst to enter the afc circuits.

A typical burst amplifier of this type is shown in Fig. 2. It is used in the Capehart color receiver CXC-13 series. A negative dc voltage is applied to the grid of the 6CB6 burst amplifier and holds the tube in cutoff. When the negative polarity pulse from the high-voltage transformer appears at the burst amplifier cathode, the grid is no longer as negative with respect to the cathode as it formerly was. The tube conducts and passes the 3.58-mc burst.

As with the bandpass amplifier keying previously discussed, the horizontal pulses coincide with the burst signal. Thus, the negative pulse arrives at the cathode of the burst amplifier at exactly the same time that the burst signal appears at its grid. The negative polarity pulse on the cathode cancels the negative voltage applied to the grid. The high cutoff bias is reduced and the tube assumes a *gating-in* condition. The 3.58-mc burst signal passes but all other signals are kept out.

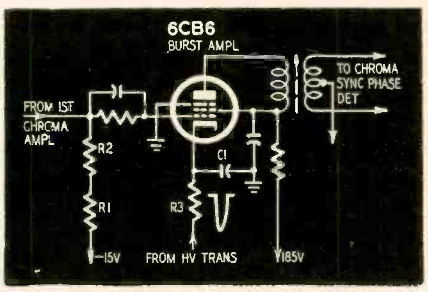


Fig. 2— Burst amplifier in the Capehart CXC-13 color chassis.

If the burst amplifier is not gated open for the burst signal, color synchronization will be lost. Incorrect colors and color breakup will appear on the screen. The synchronizing burst can be lost if the cathode resistor R3 opens or C1 shorts because the gating pulse would fail to open the burst amplifier circuit. Incorrect colors and color breakup will also occur if the burst amplifier permits the composite video signal to enter the afc system. This could occur if the voltage applied to the grid of the burst amplifier fails because of an open circuit in resistors R1 and R2. That would remove the bias from the burst amplifier and the tube would conduct continuously.

Check the tubes and the dc voltage at the burst amplifier grid, and verify the negative pulse at the cathode with a scope.

Color killer

In a color television receiver it is necessary to shut off the bandpass amplifier while receiving black-and-white signals. When a black-and-white station is tuned in, the bandpass amplifier would still accept a portion of the video signal and apply it to the demodulators. Undesired color would then appear on the screen of the television receiver and thus mar reception of the black-and-white picture. The bandpass (or chroma) amplifier is keyed out by a gating tube known as a *color killer*. A typical circuit is shown in Fig. 3.

During color reception the burst in the afc phase detector develops a negative voltage at the plate of one of the diode detector tubes. This is applied to the grid of the killer tube and holds it at cutoff. A positive pulse from the horizontal output transformer is applied to the plate of the killer tube. This pulse, however, is unable to cause tube conduction because of the negative voltage at the grid.

During black-and-white reception there is no burst in the phase detector circuit, so the negative voltage is no longer developed at the grid of the color killer tube. The tube can now conduct. Hence, the conduction of the tube is periodic, that is, it conducts every time a pulse appears at the plate. The pulsating conduction produces pulsating dc, filtered by capacitor C827 which charges for each pulse. Between pulses, C827 discharges across R832, producing a steady dc voltage across that resistor. This voltage is tapped off and applied to the grid of the chroma amplifier in the Westinghouse 2292-1 receiver. The negative voltage which now appears at the grid of the chroma amplifier shuts it off during black-and-white reception.

If the chroma control were turned all the way down, it would also prevent entry of signals into the chroma or bandpass amplifier of color receivers. The killer tube does the job automatically and eliminates the need of turning down the color control for black-and-white and turning it up for color.

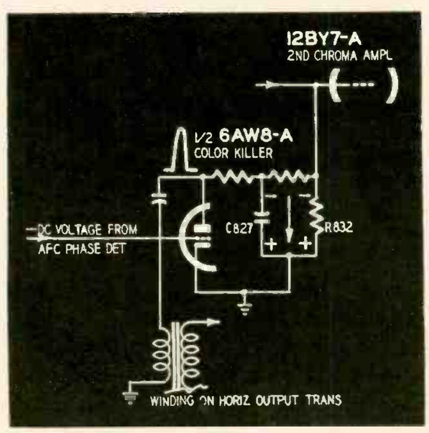


Fig. 3—The color-killer circuit in the Westinghouse 2292-1 color receiver.

Other manufacturers also use color-killer circuits which may differ slightly from the one shown in Fig. 3. Basically, however, they all serve the function of shutting off the bandpass amplifier during black-and-white reception.

Troubleshooting procedures consist of checking the tube first, then checking for the negative voltage at the color-killer grid during reception of color signals. When a black-and-white station is tuned in, the negative voltage should no longer be present at the grid of the color-killer tube. During black-and-white reception a dc voltage should be at the anode of the color-killer tube and at the grid of the bandpass amplifier. An oscilloscope can be employed for ascertaining the presence of the gating pulse at the killer tube anode.

Horizontal output

Since the gating pulses for the preceding circuits are all derived from special windings on the horizontal output transformer, insufficient pulse amplitude may be caused by troubles in the horizontal sweep output circuit. If tests on the gating circuits fail to disclose any defective tubes or component parts, the horizontal output tube should be checked and replaced if weak. The horizontal drive control should also be checked for proper adjustment. The drive control should never be advanced to the point where left-hand stretch or center compression occurs. At the same time, it must be set to give good pulse amplitudes. Too low a drive control setting will not only decrease gating pulse amplitudes but will also cause a decline in high voltage and brightness.

Since the horizontal sweep oscillator is also instrumental in establishing how much horizontal drive appears at the grid of the output tube, it should also be checked if drive amplitude appears inadequate.

Servicing the horizontal output stage of color television receivers is similar to servicing this stage in black-and-white sets. Similar tubes are employed. The Admiral 38A1A color set, for instance, uses a single 6CD6 horizontal output tube. The RCA 21CT55 uses a single 6CB5 tube, as does the Raytheon color receiver 21CT1. The Westinghouse 22-inch color receiver (2292-1 chassis) uses a pair of 25DN6 tubes in parallel in its horizontal output system. Another receiver using horizontal output tubes connected in parallel is the CBS model C-205, shown in Fig. 4.

As with the other receivers mentioned, a variable resistor is employed for the horizontal drive. The low-value resistors in the control grid and screen grid circuits are for parasitic oscillation suppression. With systems using parallel-connected horizontal output tubes it is preferable to replace both tubes even if only one checks poorly in a tube checker. If both tubes do not have similar emission characteristics one tube assumes a greater operating burden than the other and has a shorter life. Voltages can be checked at the control grids and screen grids, but should not be measured at the anodes (without special equipment) because of the high pulse voltages there. END

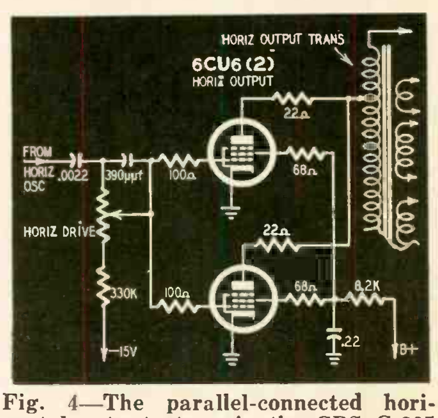
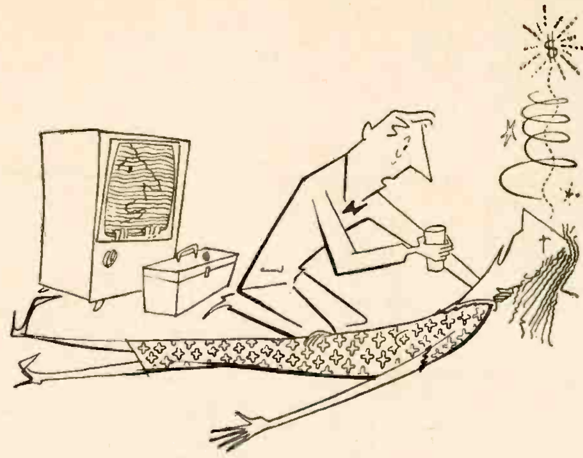


Fig. 4—The parallel-connected horizontal output stage in the CBS C-205 receiver.

How's Your Setside Manner?

By ART MARGOLIS



WHAT devil-like thoughts of destruction pass through your mind and how hard do you press your fingernails into your palm when, after you definitely ascertain a cathode-to-heater short in the C-R tube, the customer announces, "I know it's not the big picture tube because, after all, I do have sound. It's probably a loose bulb or something. Tighten them up and see what happens."

After you whisper to them the sad news, hesitatingly reveal the price of a new tube and revive the weaker customers, what happens? Do you close a profitable sale or do you collect a service charge and leave the set owner free in the open market?

The answer to the last question separates the men from the boys, the successful from the failures. For this is the point where electronic skill is no longer required—salesmanship is. TV sets are growing older and major repair jobs are becoming more frequent. It is becoming necessary to sell repairs like any other product is sold.

Several months ago we were having some trouble with a 12-inch Philco—it had intermittent loss of vertical sweep. Every time a technician would go to the customer's house it would work fine. Normally, we would have insisted on bringing the set into the shop for repair but it belonged to a widow who lived alone in an apartment house and through her personal solicitations had the entire place, containing about 40 TV sets calling us exclusively. We were of the opinion that this customer was worth while pleasing and she wanted all repairs on her set made in her apartment. So we left her instructions, "Call us as soon as it kicks off." One morning the phone buzzed and we sent an excellent bench man, Joe, armed with a trusty vtvm. An intermittently opening vertical output cathode resistor was located and changed. When Joe returned, his only remark was, "Her darn cat kept knocking the leads out of the meter." That was the first time I heard him say anything more than yes, no or thanks.

The other day she called in again for television service. Harry, who had recently finished his training, was dispatched. He wasn't too terrific a technician as yet, due to lack of experience, but he had a very pleasing salesmanlike personality. His service report told of replacing the 5U4G. It had caused the picture to shrink and the sound on channel 10 to drift.

The customer called up a bit later. "Don't ever send that Joe to fix my set, from now on I want only Harry. Joe took over an hour and Harry fixed it in about 10 minutes. I don't think that Joe knows what he is doing. Also, he took the set out and when he worked on the tuner he must have done something because I had tuner trouble again.

But Harry fixed it, and he's such a pleasant fellow too." I asked Harry whether his name wasn't really Svengali and he laughingly revealed his secret hold over our customer: a few strokes on the back of her beloved cat.

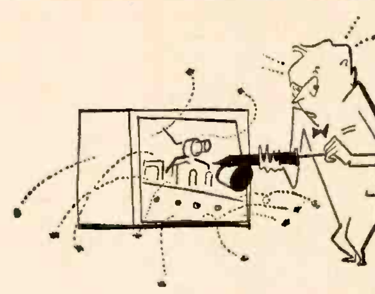
Isn't that the truth! Whether you are a hot-shot quick-as-a-wink circuit analyst capable of measuring voltage with your finger tips or a laboring beginner having trouble inserting seven-pin miniatures is of little importance to the average TV set owner. If the trainee has a smoother personality and a better line of gab, he will do better in the house than the expert.

Savoir-faire

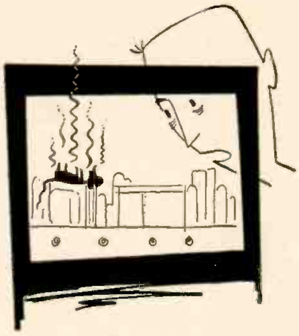
You have to use judgment in sizing up people. I was out on a call a few weeks ago. It was a 12-inch Admiral. The man of the house told me it had been smoking. Crouching behind the set, I turned it on. The low-voltage transformer began to rumble and a large cockroach jumped off the high-voltage cage onto my knee. Dumbstruck, I thought a 10-watt resistor had come alive. The man of the house, with an embarrassed smile, bent down, flipped it off onto the floor and excitedly mashed it flat.

But quick movements in the darkness of the cabinet showed many more of the same species. My host then suggested, "Let's carry it outside and we'll spray it down." This we did but I couldn't help shudder as we carried it down the stairs. Once outside, the owner of the set, master of the situation, came out with a well-used spray gun and soon all squirming ceased within the now death-laden TV. I took the set to the shop, changed the low-voltage transformer, deflection yoke, focus pot and a myriad of tubes for a substantial profit. If I had dashed out of there, as all my instincts demanded, I would have insulted a customer and lost the sale. My loss of speech at the time saved me and convinced the gentleman that this was not an unusual occurrence (ugh!). Keeping quiet in this distasteful situation was the only solution.

On the other hand, I once did a call in a suburban neighborhood. The



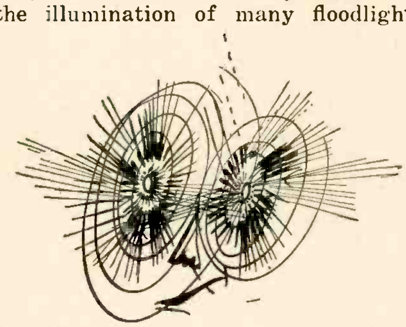
woman who admitted me was very socially conscious and tried to make me feel as if I were some lower form of life. She led me to an expensively laid out basement den and kept reminding me all the way that she had heard all about TV service technicians and the prices they charge. She assured me nothing serious was wrong with her set. It was their second set in the house, a 12-inch Westinghouse. Before I turned it on, there seemed to be a peculiar odor about the set. There was no high voltage. I opened up the cage and there, nicely fried, was a poor little mouse. In his death throes he had fractured the rf coil of the rf high-voltage power supply. I was tempted to display the mouse proudly by its tail, but I restrained the impulse and proceeded to sell the woman the service



job. She was very hard to convince and during the sales talk I almost took out the mouse a couple of times. But my better judgment won out and we had another satisfied customer.

You know customers can be very helpful. We have a nice couple nearby with a 17-inch RCA. Their set had come into the shop with some video trouble. The picture was excellent except for trailing smears. On the bench it was discovered that a .05-μf capacitor leading into the grid of the picture tube was leaky, causing a phase shift of the low-frequency components of the composite video signal. This was replaced and after checking I took the set back.

It seems they were fixing up their home in the evenings, papering and painting. I kneeled behind the set and began to put together the knobs, bolts, etc., when I was suddenly blinded by the illumination of many floodlights.



I felt I was in a police lineup. When the after-images subsided somewhat, I looked around at the pleased couple who were grinning with satisfaction. He said, "I've been using these floodlights for the painting and I knew you would be glad to work with them, too. Aren't they good and bright?"

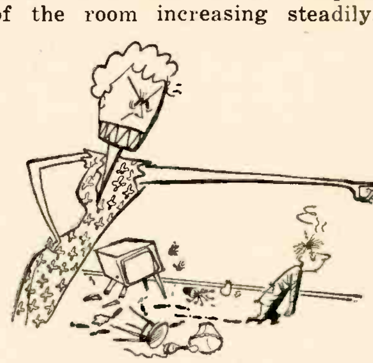
How many times have you been blinded when your well-meaning customers take the shade off a 200-watt bulb and insert it beneath your nose? How many times have you tried to explain that your flashlight is all you need and you can observe the workings of the tubes better in dimness than brilliance. But they honestly are trying to be helpful.

Sometimes they really are. On a recent call I saw the strangest thing sitting next to a 16-inch RCA. It was a toilet plunger. I figured maybe they just had kitchen sink trouble and thought nothing of it. They had no raster and plenty of sound on 3, 6 and 10, which are the three Philadelphia stations. But on 2, 5 and 9, there was a weak snowy image of the adjacent channel and no sound. Varying the manual agc control had no effect whatsoever. After changing the 6SN7, which is one-half vertical oscillator and the other half agc amplifier, the pictures and sound all returned to normal.

I started to pack up my tube caddy and the customer asked me to clean the screen. Noting the front glass came off easily I took off the snap assembly and tried to pry the glass. "Pardon me, fellow," she said, and took over. She lifted the "plumber's friend," pressed it firmly to the glass window of the set and pulled. The glass came out neatly and with open mouth I watched as she washed off the glass and the actual picture-tube face as she must have done many times before. I now carry a small toilet plunger with me and it comes in handy. No more cracking the edges of the glass while trying to pry the tight ones out with a screwdriver.

I was out on a call a while back on a 16-inch Zenith. I went into the house very confidently. With an experienced hand I reached down to turn on the set. Sometimes the Zenith has its off–on switch on the left and sometimes on the right. Well, I reached down and I heard the lady of the house say condescendingly, "It's the other knob."

I tried to smile, but she wasn't looking at me—she was looking at the mud I had tracked across the plush living-room rug. I try to be very careful about both of these things but somehow they escaped me this time. So I started to swing the table model set away from the wall and I felt sick as one of the spindly table legs gave a small but definite crack as it was dragged over the rug. I tried another sick smile but my customer did not seem to want to return it. I could feel the temperature of the room increasing steadily. By



then, I had the set on and I could hear sound and high voltage. A quick look showed the high-voltage lead had come out of the picture-tube well. Now I felt better, so I reached in and grabbed the lead by the rubber insulation. The solid punch of 12,000 volts dc knocked me and an entire knick-knack shelf to the floor. The mirrored back of the shelf was in tiny pieces. I got no further for the enraged housewife showed me where the door was. So, leave the "pie-throwing" to comedians.

Don't be a know-it-all

A set came into the shop a couple of weeks ago. It was a 21-inch Motorola with no high voltage. After checking the high-voltage section I discovered that by pulling out the 12BH7 vertical oscillator output tube, the brightness snapped back on but of course with no vertical sweep. The vertical size pot of 5 megohms with a 1-meg stop had opened. It was in the grid circuit of the vertical oscillator. The grid voltage being lost ran the tube wide open and the plate current drain of the tube lowered the B plus throughout the set, subsequently killing the high voltage.

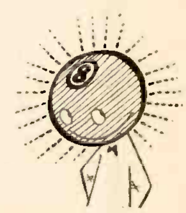
Feeling proud of myself I hustled the chassis into the truck and took it back to the house. The lady of the house seemed a bit disappointed to see me. I thought that was strange. I installed the chassis and while busy at work, reminded her a few times how lucky she was to have our expert service. Then, relaxed and confident, I switched on the set. Nothing happened. No filaments, no B plus, nothing. The lady of the house started to say something but I masterfully waved her back to her chair and silence. After about 10 minutes of checking she said in a meek but determined voice, "I think I should tell you something. My husband forgot to pay the electric bill and they turned it off this morning."

Before I close, I'd like to tell you about an incident that happened to Harold. He is an old pro at TV service, with a background of Army and civilian radio and years of TV service. He is also a great kidder. He had just finished a repair in an apartment house in West Philly on a 16-inch Admiral. The vertical output transformer was replaced for causing a 60-cycle buzz in the audio and making the picture jump like a nervous dancer in a crazy rhythm with the buzz. The job now completed and the chassis inserted into the set, Harold began to make up the bill. He asked the friendly-looking man his name. "Hoppe" was the reply.

Harold seizing on any pretense for a wisecrack, said, "Willie Hoppe?," thinking fondly of the billiard champion.

"Yes," he said, "I guess you could call me Willie although my friends call me Bill."

Harold came back, "you pretty good with a cue stick, huh?"

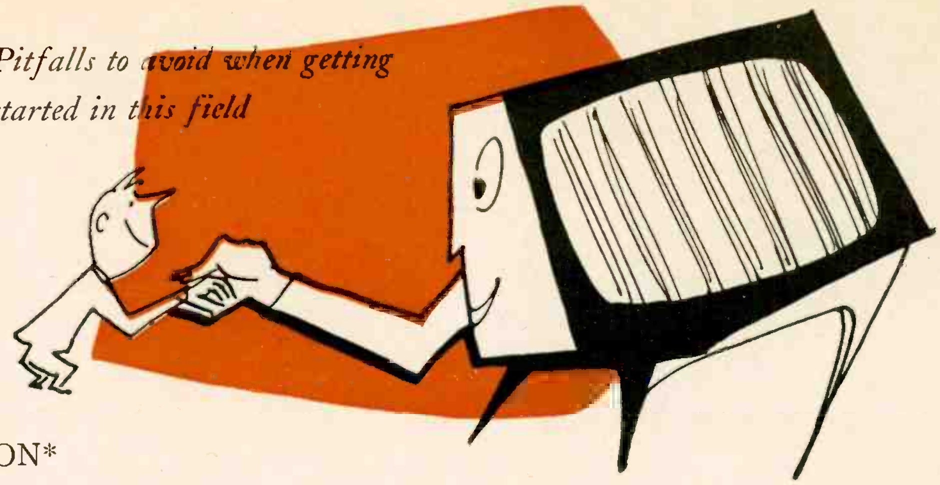


Mr. Hoppe smiled and said, "Yes," and in mock of Harold, "pretty good."

Harold laughed with the good-natured fellow and followed his beckoning finger into the next room. Those figurines were not china—they were metal and they looked like trophies. Mr. Willie Hoppe, the famous billiard champion, laughed and thought it was a great joke. END

Pitfalls to avoid when getting started in this field

getting acquainted with color TV



By ROBERT G. MIDDLETON*

THE change from black-and-white to color television is having almost as great an impact on the service technician as did the transition from broadcast radio to black-and-white TV. Getting acquainted with color TV is not easy—it requires many hours of experience *with a color receiver* to get a working knowledge of the service controls.

Pointed out in this article are particular pitfalls in the path of explorers into this new field. Perhaps the most important of these is the psychological hazard or *mental attitude* of the service technician. Not everyone has the intestinal fortitude to battle his way through the maze of technicalities.

Common convergence pitfalls

Just a sample of the difficulties: Joe Technician hooks up a white dot generator and religiously follows the instructions in the service manual. After a day or two of struggling, he finds the little color dots are farther apart than when he unpacked the receiver and he's sorry he tried to touch up the convergence.

The difficulty is partly due to the fact that the manufacturer does not talk his language and does not clearly show him what to expect when each convergence control is adjusted. He may not warn of some obvious pitfalls.

Because of incomplete discussion by the manufacturer, Joe gets to a point where the pattern apparently does not do "what the book says" and of course he's at a complete loss till he gets some help from somebody.

For example, some receivers have a shift lever to retract the convergence coils from the neck of the tube when the receiver is shipped. More than one good technician has spent hours proving that a picture tube *cannot* be converged with the convergence coils retracted. This is a treacherous pitfall for the beginner. Always remember to check the convergence assembly for a shift lever, and lower the convergence coils to the tube neck if required.

White dot patterns are the thing to use to check color convergence, of course (Fig. 1). The patterns appear simple, and they are. *But*—the horizontal sync signal from the generator *must be on frequency*. A picture tube can be converged off frequency (15,650 or 15,850 cycles) but there will be rainbow fringing on black-and-white. Be sure the generator is close to 15,750 cycles. This caution applies particularly to shop-built white dot generators.

The reason that correct frequency is important is that horizontal dynamic convergence circuits are not purely resistive but also *reactive*. When the generator sync is off frequency, the phase of the convergence waveforms is shifted. This causes the technician to *misadjust* the convergence coils to compensate for the incorrect sweep frequency. True, the TV station transmits color at 15,734 cycles. But black-and-white is at 15,750 cycles. A small amount of misconvergence can pass unnoticed in a color program, but color shows up like a sore thumb in black-and-white. Converge on 15,750 cycles!

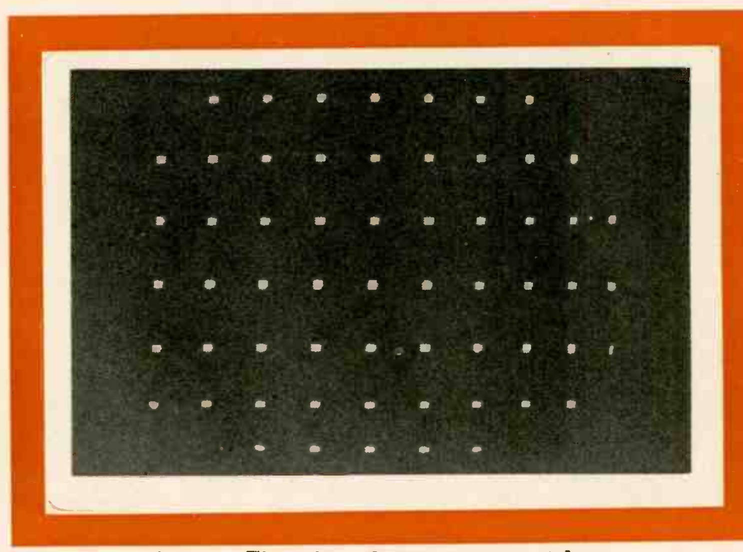


Fig. 1—The white dot pattern must be synced very close to 15,750 cycles.

The color tube can be converged best only when operating at its specified voltage—up to 30,000 for some tubes. Don't take it for granted the voltage is correct! *Measure* it with a high-voltage probe and meter, as directed in the service manual. And don't attempt convergence till width, height, linearity, centering and focus adjustments are correct!

Room-lighting effects

Another pitfall lying in wait for the unwary technician is room lighting. If the screen is balanced for color in the daytime and used chiefly under artificial light, the raster will no longer be a neutral gray but will be tinted with red, green or blue, according to the type of light used in the room. Balance the screen and background controls under the type of lighting that will be most used for viewing!

A somewhat similar pitfall is *abnormally high setting of the red screen control*. It is only too easy to set that control so high that the picture tube draws so much current that its life is shortened. Check the service manual carefully, or consult a picture-tube manual, and measure the red screen current to make sure it's within limits.

Magnetized tube shields

Another pitfall in the way of our friend Joe Technician is the scientific fact that the picture-tube shield can be magnetized when contacted by a magnetic screwdriver, pliers or other magnetic object. That screwdriver may have been very handy for recovering screws, but leave it behind when you go on a color job! If the shield is

*Chief field engineer, Simpson Electric Co.

magnetized, the only way to get good purity is to degauss the tube first.

And when using the degaussing control, remember another pitfall. Rim magnets will be weakened unless removed or retracted into their shunts during degaussing. Likewise, the magnets on the neck of the tube will be weakened if the degaussing coil is used carelessly. Even your service meters may be damaged and must be kept away from the field of a degaussing coil.

It is worth while to have a degaussing coil with you on all calls. Sometimes magnetism turns up in the tube shield for some unknown reason. Many things can cause this—the set may have been moved, for instance. Play safe and take a degaussing coil with you!

Loss of color sync

Early in his experience, every color technician will have to adjust color sync on a receiver. A set may perform perfectly at the shop but, if the signal is weaker at the installation, may lose sync. Pity the poor fellow who tries to lock in the weak color signal by turning all the slugs in the color oscillator and reactance tube coils! Instead of improving the situation, he usually winds up by bringing the set back to the shop.

If color sync is poor first check the setting of the agc threshold control, usually provided, and determine whether the station signal is being attenuated at this point. Recheck the adjustment of the fine-tuning control—this is a more critical setting than for a black-and-white receiver. Finally, adjust the color afc balance control with a vtvm, if necessary. In 99 cases out of 100 the color sync will come in OK.

If the receiver was operating satisfactorily back at the shop, it is highly unlikely that any tubes need replacing or that the coils in the color sync system need retuning. (The better color bar generators provide adjustable burst voltage as well as ample signal attenuation so that receiver operation on weak signals can be checked easily before delivery to the customer.)

Loss of color sync is sometimes the result of an unsuitable antenna characteristic which causes severe attenuation of the color burst although the black-and-white component of the signal may be relatively high. Sharply tuned high-gain antennas are particularly bad offenders. Indoor antennas can also cause color sync trouble unless suitably located.

Instruments go wrong, too

One puzzling case, which nearly resulted in sending two sets back to the manufacturer, shows up another pitfall. Chrominance circuits seemed to be out *in the same way* in both receivers. The white bar looked pink and the cyan bar green when the phasing control was adjusted to make the red bar look red. The field engineer had to call and point out that a tube in the color bar generator was going bad. The idea that the instrument might be at fault had never occurred to the two technicians who were trying to adjust the receivers.

Instruments are subject to all the ills that befall the receiver itself—tubes age and component values may eventually drift. In consequence, the proportions of the color test signal may change and the user will be misled until the trouble is corrected.

The best check of the signal output from a color bar generator is made with a wide-band scope (Fig. 2). Consult the service manual for the generator and adjust the service controls (or replace tubes) to obtain correct waveforms on all output signals. Remember, too, that *wide variations in line voltage can impair the output from a properly adjusted generator*. Check the line voltage in the customer's home.

A scope used to check the output from a color bar generator *must* have flat response up to 4 mc. The frequency response of its vertical amplifier should not be taken for granted, but should be checked with a good sweep generator. A typical sweep-frequency test of a vertical amplifier is shown in Fig. 3. Not a perfectly flat response, it is sufficiently good to make a useful check of a color bar generator signal. The test setup used to check out the scope is shown in Fig. 4.

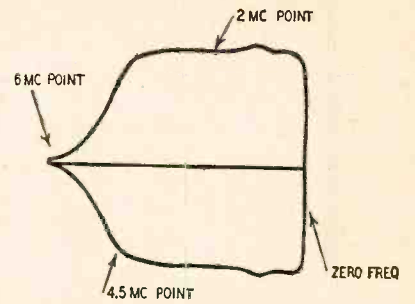


Fig. 3—Diagram hows reasonably flat vertical amplifier response to 4.5 mc.

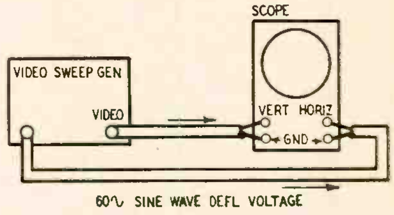


Fig. 4—Diagram shows generator and scope setup for obtaining Fig. 3.

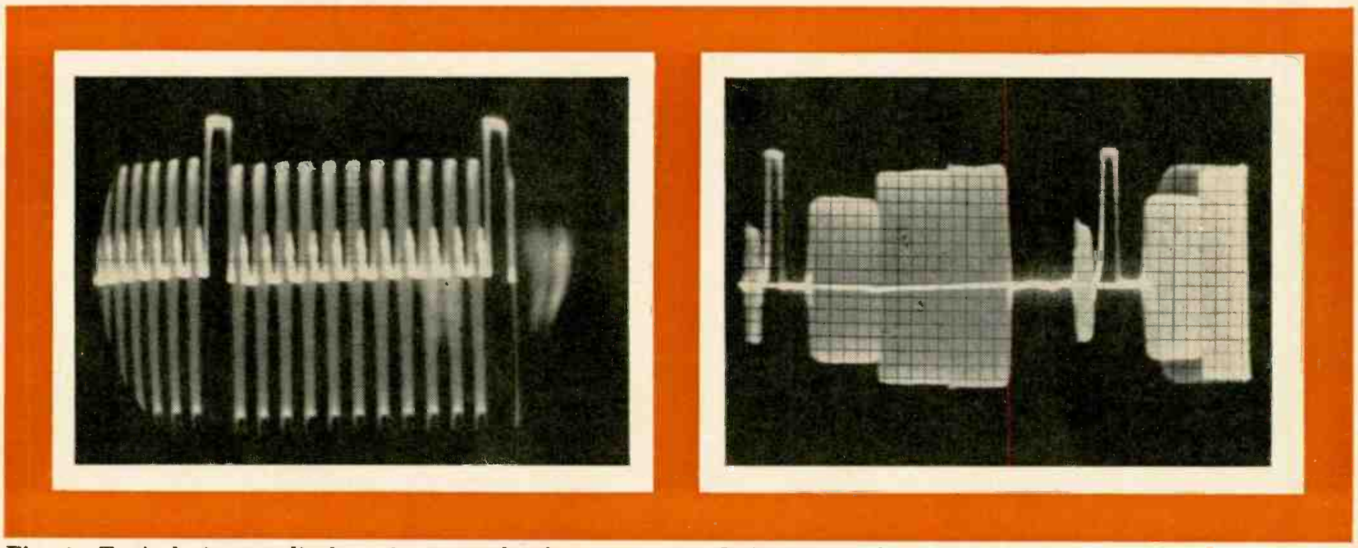
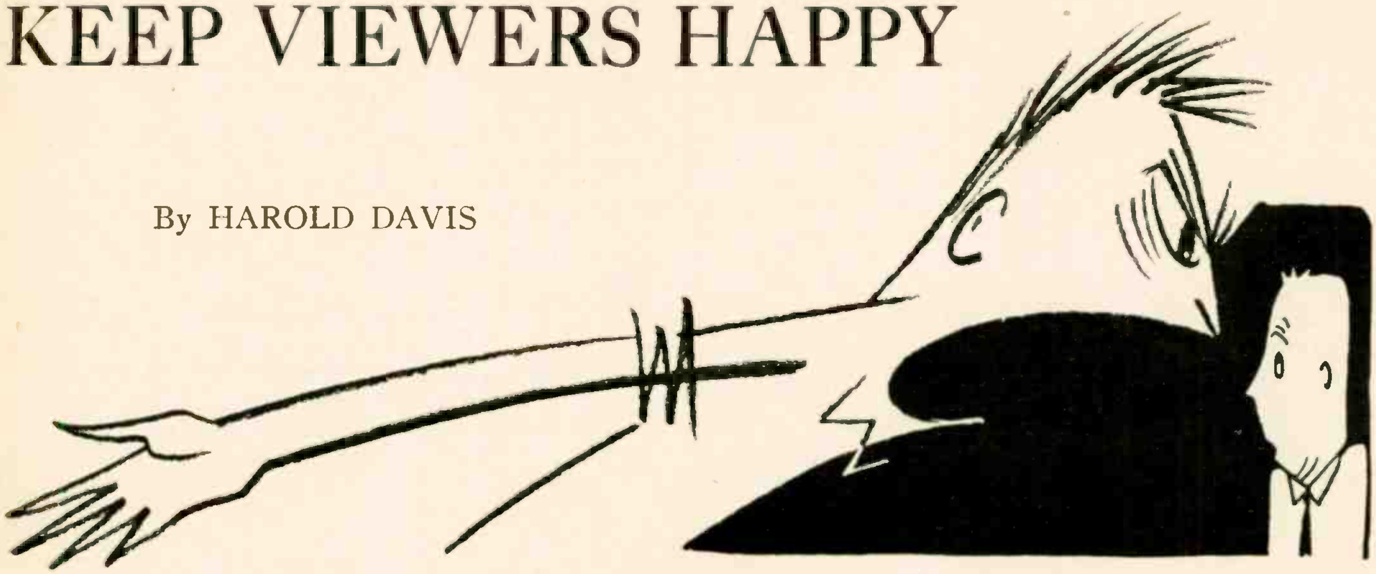


Fig. 2—Typical chroma displays from a color bar generator. Left, chroma bar signal—burst 20% subnormal. Right, linear phase sweep signal—horizontal sync subnormal.

A final word of caution concerning scope checks with conventional AM generators: Since the output from an AM generator may vary greatly from one band to another and even from end to end of a single band, the output from such instruments is usually unsuitable for scope checks. Vertical amplifiers should be checked with a known-good sweep generator having low-frequency output down to 15 or 20 kc. In case the generator has limited low-frequency output, a good audio oscillator can be used to test the low-frequency response of the scope. In case the uniformity of output from the audio oscillator is questionable, a good check can be made with an ac vtvm. END

PROPER ADJUSTMENTS KEEP VIEWERS HAPPY



By HAROLD DAVIS

"AND another thing!" his voice boomed out. "When you get the set fixed, for goodness sake's adjust it!"

It was one of my friendly competitors bawling out his service technician.

"Why can't you get technicians to adjust a set?" he asked me later.

"The biggest reason is that they don't know how," I answered.

"Don't know how!" he thundered. "I've showed them a million times." (Figure of speech of course.)

"You have to do more than show them," I ventured. "You have to *teach* them."

"Well, how do you teach them? I'd like to know."

Remembering my wartime training course, I answered calmly, "You have to *tell* them. You have to *show* them. You have to *demonstrate* to them, step by step. Then let them *tell* you and *show* you. Correct their mistakes and make them do it over and over until perfect. Check them frequently to see that they haven't picked up any bad habits."

"Here," he joked, handing me the keys. "You can have the place. I quit!"

I consider my friend above average in shop management or he wouldn't even recognize the importance of proper adjustments. Far too many service technicians run in and out houses, install tubes and leave the set out of adjustment. Many of them may not know how to adjust a set and as a result stick to the old rule of letting good enough alone.

To adjust a television set properly takes time, even when you know what you are doing. The set should be thoroughly warmed up; adjustments on a cold set won't hold. And due to the variation in the human eye, a more or less mechanical procedure should be followed.

If a service technician hasn't been to a set for a few months, check the following:

1. Tuner oscillator slugs
2. Vertical linearity and height
3. Horizontal a.f.c. and drive (phasing if necessary)
4. Ion trap
5. A.g.c., if any
6. Picture positioning
7. Brightness and contrast
8. Focus

If the fine-tuning control on a set will not produce sound bars in the picture when turned to the end, the oscillator slugs need adjusting. Sometimes it's hard to recognize which side of the carrier the sound is on. The sound is the low-frequency side and usually is the side of the carrier reached with the slug farthest in. Some sets use a single adjustment for all low channels and another for all high channels. Some sets with series-wound coils require adjusting all slugs to position the one required. This is particularly true on channels 2 and 3 on some RCA sets.

Some service technicians adjust the oscillator slug for the strongest picture. On local stations this causes a blur, greatly reducing detail. Some technicians take advantage of this situation to cover up shadows and ghosts caused by faulty antennas. The result is that the customer does *not* get good television.

When the correct position of the slug is reached, the customer should be "taught" (refer to preceding paragraphs) how to use the fine tuning. Tell him it's simple. Just roll the fine tuning until sound bars appear and roll it back until they disappear. Then show him that to continue turning will blur the picture. Let him try it while you watch.

Vertical linearity and height cause some service technicians trouble because they don't understand their functions. These controls make the picture more linear vertically—with these controls the raster lines can be spaced the same width from the bottom to the top of the screen. If the lines are widely spaced at the top, the characters will look like pygmies with long topknots.

On most sets vertical linearity spreads the top of the picture and height the bottom. However, some sets are just the reverse. It is easy to tell simply by varying each and observing the effect.

These controls can be mechanically adjusted by closing both completely, producing a small band of a raster across the screen. No picture is necessary. Turn HEIGHT until it is obvious that the bottom lines are becoming wider than the top (or vice versa). Turn VERTICAL LINEARITY until the top raster lines are the same width. Increase slightly and then increase HEIGHT. Continue this procedure until the screen is covered with raster lines all of which are the same width. Check this by tuning in a picture and with VERTICAL HOLD, roll the vertical blanking bar up and down the screen. It should stay the same width all the way.

It is often found that the raster will reach either the top or bottom of the screen and leave a blank space at the other position. When this occurs it is necessary to move the entire raster up or down with the positioning or centering ring. Don't follow the sloppy practice of deliberately distorting the raster to make it fit the screen.

The final analysis on this operation is observing it on a test pattern. But in this day of round-the-clock TV, most service technicians haven't seen a test pattern since they staggered in just ahead of the milkman on New Year's Eve.

Horizontal linearity and width require less attention than the vertical controls. However, the raster may often be spread horizontally enough to compensate for a weak tube where it is not convenient to install a new one. Also, in changing horizontal output tubes, it is often necessary to adjust the width.

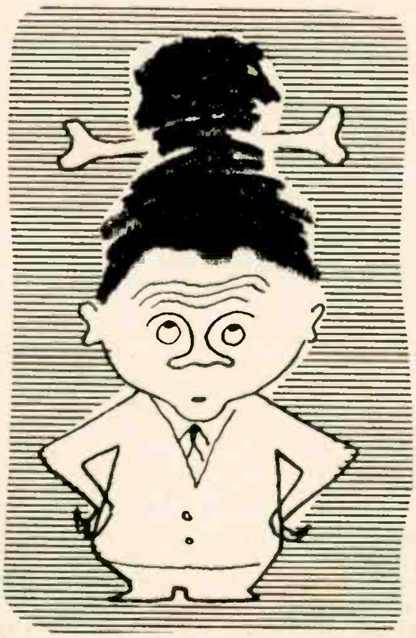
If the raster covers the screen horizontally with a little to spare, the width is usually okay. Horizontal linearity can be checked without a test pattern by observing some straight vertical lines in the edges of a picture. If these lines bulge, horizontal linearity is usually out. (Not to be confused with a wiggle that often occurs at the top of a picture.) Horizontal linearity affects the right side of the screen on most sets. On some RCA models (those using 6CD6's) maladjustment will produce excessive drive on the plate of that tube. This can be detected by pulling a spark with a screwdriver. Adjust HORIZONTAL LINEARITY for minimum sparking at the plate (top cap).

Horizontal a.f.c. should be adjusted until the set will either not fall out of sync for the full rotation of the hold control, or will fall out on each side. If white jagged lines appear as the HORIZONTAL HOLD is turned to its extreme, it is a good sign that the phasing needs adjusting. Most sets use a .01-μf capacitor across the horizontal oscillator coil. When this capacitor changes in value, HORIZONTAL PHASE, the control opposite HORIZONTAL A.F.C., needs touching up. This is particularly true with Admirals, Crosleys, Majestics and some others. Phasing can be reached on most sets without pulling the chassis by cutting the screenwire under the bottom of the cabinet. A.f.c. and phase adjustments are being turned the correct way when the bars become fewer and wider. More and narrow bars indicate farther out of sync.

HORIZONTAL DRIVE usually has more effect on the width of the raster than does the width control. On most sets, loosening the screw increases the drive because the capacitor is a bypass unit connected to the horizontal output grid.

If excessive drive is used, it will cause vertical white lines on some sets. Too little will cause black lines. This is specially true on RCA sets.

Ion-trap magnets should always be adjusted. When there is a substantial voltage change in the set or when there is an emission change in the picture tube, the ion-trap magnet position changes. It is always adjusted to the spot that gives the brightest raster. However, it is found that occasionally the raster decreases in size as the raster brightens. This is a false indication. The raster is brightening simply because it is covering less screen area. After checking the yoke to see that it is forward as far as possible, adjust the positioning ring and the focus coil, if any. Then set the ion-trap magnet to maximum brightness consistent with complete screen coverage. It will be found that each movement of FOCUS, HORIZONTAL DRIVE and CENTERING affects the ion-trap magnet position. In fact, the magnet should be rechecked the last thing before leaving the set. It *must* be adjusted when the picture tube is rejuvenated or when a brightener is installed.



"... like pygmies with long top-knots."

A.g.c. adjustments are simple. Tune the set to the strongest signal received. Turn the control until the picture pulls or blacks out; turn back until it is stable. No variation with this control indicates no or poor a.g.c. Too much a.g.c. will cause poor contrast, but border-line adjustments are dangerous because conditions may change sufficiently to cause the set to pull or black out.

The picture is positioned on magnetic sets with a lever that works like a control stick in an airplane—it moves the picture four ways. When the lever is pushed up and down, the picture moves sideways. When it is moved back and forth, the picture moves up and down. (Sometimes the lever extrudes to the side which messes up this procedure, but the movement is still there.) Failure of the picture to respond properly to lever movement can usually be traced to an improperly fitting yoke or focus magnet.

On electrostatic-focused sets, there are usually two rings with tabs that can be moved around the neck of the tube. They cause the picture or raster to follow an off-center circle pattern. Both up and down and side motion can be produced if one is patient. (This arrangement is used for purity adjustment on color sets, so practice on black-and-white is not a waste of time.)

Brightness and contrast are two controls usually available to the customer and he should be "taught" their correct use. To do this mechanically, instruct him to turn the contrast off. Turn BRIGHTNESS down until the screen is dark. Bring up BRIGHTNESS until the screen is dimly lit. Tune in a station and adjust CONTRAST until the picture tone values look like a fine photograph. If necessary, bring up brightness slightly and readjust CONTRAST to make a glossy photograph. Impress upon him that a good picture depends upon a blend of brightness and contrast.

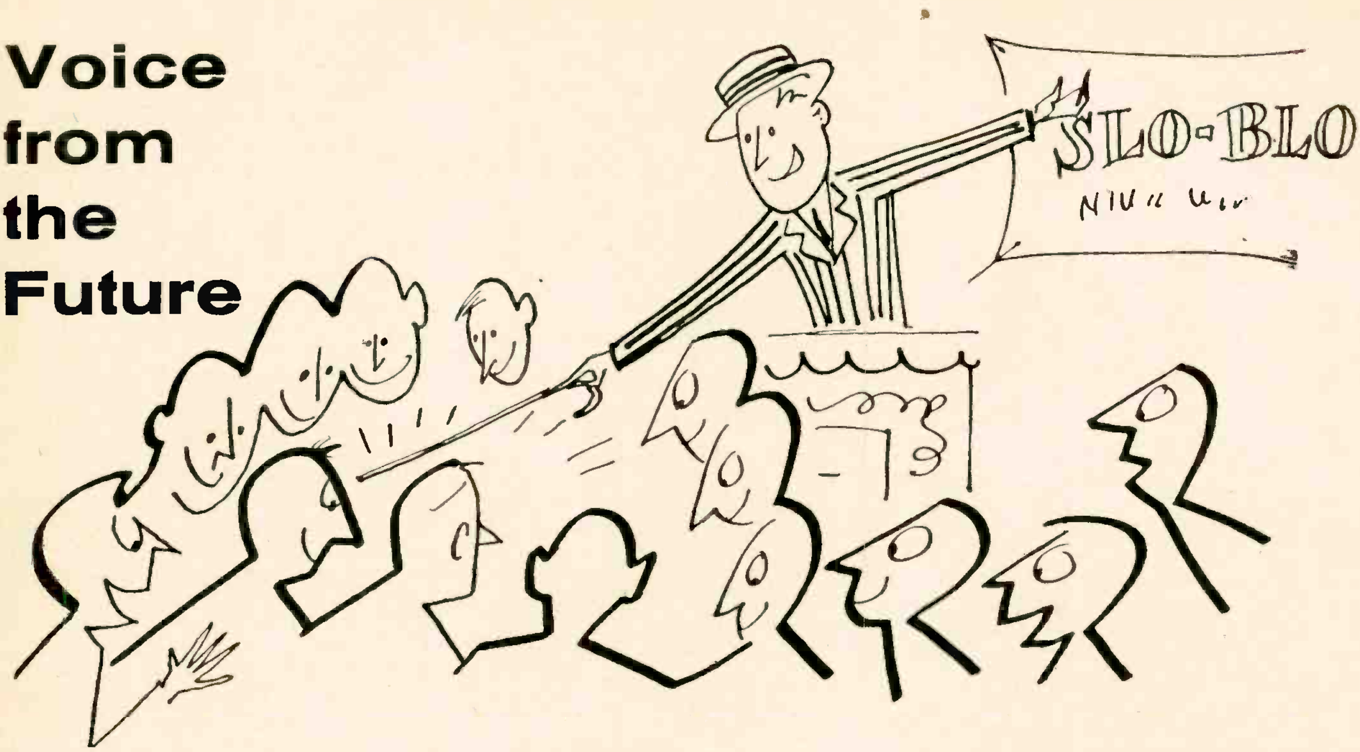
Changing from station to station will often require adjusting of both the fine tuning and contrast. Explain this to the owner.

Focus is something widely misunderstood. All you can do with FOCUS is to make the raster lines clear and distinct. It has nothing to do with the quality of the picture. If the raster lines are distinct, the set is in focus. There are two types of focus—electrostatic and magnetic. Electrostatic focus is obtained with a potentiometer or may be automatic; magnetic focus by positioning the focus magnet (on old sets by varying current through the focus coil). If the set fails to focus, it is usually due to improper positioning of the yoke, low electrostatic voltage or the picture tube. Sometimes magnetic focus can be improved by installing bolts or pieces of metal rod around the magnet, be it too strong, or an additional magnet if too weak. Installing additional ion-trap magnets close to the focus magnet has been known to help; positioning the magnetic assembly usually does the trick. Electrostatic-focused tubes can be used in magnetic sets without change (other than removing the focus coil in old sets). Magnetic-focused tubes can be used in electrostatic sets by installing a magnetic focus assembly.

Any change in supply voltage, emission of the horizontal output tube or the picture tube will vary the focus.

On sets where the focus control is available from the front, the customer should be taught to use it. I said "taught" which means "*telling* him, *showing* him, *demonstrating* to him, *watching* him do it and *correcting* his mistakes." END

Voice from the Future



Dear Editor:

You'll probably fire me for my defection but, in reporting the Electronic World Fair for 1962, I'm still stalled at the booth exhibiting the Slowblow TV chassis XX 314159—series DOG—model NUTS271828—code 4343. I've been there for three days! Just can't tear myself away!

The DOG chassis is a gold mine of all the best design features dreamed up since TV got into the living room. Slowblow's placement of *all* the tubes on the *underside* of the chassis is a fascinating development. The chassis must be completely removed from the cabinet to determine whether the heaters are even lit. True, others pioneered here, *vide* Motorola as early as 1948, where both front-end tubes plus high-voltage rectifier were cleverly buried out of sight. At a later date (1955) CBS-Columbia crudely copied the same trick. Crudely, because CBS erred in leaving a small hatch at the bottom of the cabinet. A TV repairman just *might*—after extended practice—succeed in groping up into the innards of that set and pulling tubes for checking.

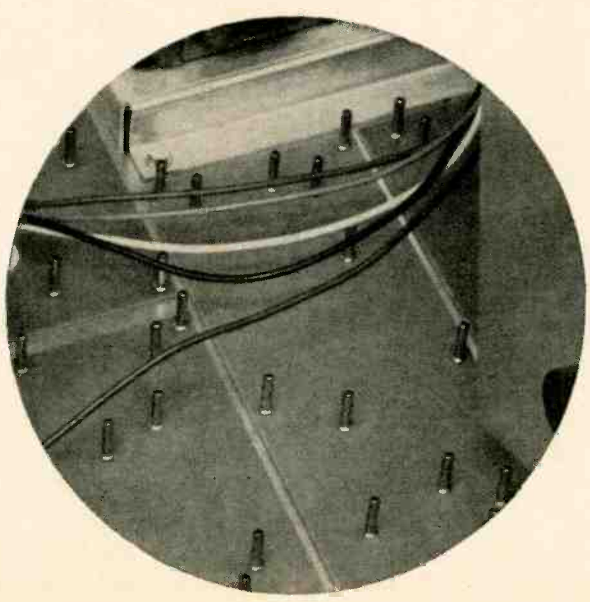
Also in 1956 RCA really scored points in their portables—it was necessary to demount the pix tube to get at the tubes in the horizontal sweep section. Slowblow has made all such clever design features seem childish, because all tubes and parts are concealed under a *riveted* cover. Of course, Motorola and others used similar covers years ago, but they were secured by merely a few dozen easily removed sheet-metal screws. Slowblow triumphs here by using a cover of boiler iron, riveted in place. Nothing less than a pneumatic jack hammer or a ½-hp electric drill will remove it.

Another daring innovation in the DOG chassis is Slowblow's clever system of locating the identification of pix tubes *inside the glass envelope*. Past years have witnessed some progress along this line, a typical example being the astute caper of putting the CRT number on its outer rim, where it was securely hidden under the mounting strap. (Thus making it impossible to quote a replacement price without pulling the set and demounting the tube.) Clever enough, of course, but feeble compared to Slowblow's tubes, which must *be broken* to discover what breed of cat they may be. Of course, the consequent implosion completely destroys all identification, which really teaches nosey repairmen a lesson, as the DOG demonstrator aptly phrased it.

A common reaction among the crowds constantly surrounding the DOG booth is amazement over Slowblow's ability in compressing his chassis to the size of a stunted cigar box. Sure, G-E did some avante-garde pioneering in this field as early as 1948. Again in 1956, G-E and a few others shared honors with their portables. Slowblow's use of a 500-ton hydraulic press makes all these earlier efforts appear less than inspired by a very wide margin. Slowblow's gigantic press jams all components into a cubage of less than 13.3 inches—and the DOG demonstrator asserts that not one part in the chassis can be replaced in less than 3.5 hours.

From Sylvania Slowblow has drawn exclusively in *soldering* his high-voltage rectifiers in place (he uses *five* 1X2's).

Also from one of their 1955 chassis he has borrowed the famous high-volt-



An enlargement showing the rivets in a small section of the latest Slowblow TV chassis.

age grounding bar. You'll recall this bar extended through the rear apron—spring-loaded—and, when tripped (usually by an owner with an investigative turn of mind), grounded the corona ring of the high-voltage rectifier, immediately burning out its filament. Slowblow's grounding bar does triple duty, however. It also short-circuits the ac input to the set (blowing the customer's house fuses) and simultaneously explodes a small demolition charge of TNT hung on the loudspeaker frame.

Borrowed from another all-time stroke of genius is the location of the PHONO switch directly behind the ON–OFF–VOLUME-CONTROL knob. You'll remember that this feature produced numberless home-service calls when televiewers inadvertently turned *both* knobs when turning on their sets—thus creating a no-raster–no-sound–no-nothing condition. Slowblow has not only copied this particular gimmick but has also added two additional PHONO switches, located directly behind the contrast and fine-tuning controls, respectively. Turning either of these controls clockwise or counterclockwise immediately puts the set on PHONO, which really teaches the customer a lesson, as the DOG demonstrator pointed out.

Borrowed from one of Philco's clever design points is Slowblow's treatment of the interlock cord. The best Philco could do here was to mount the female end of this cord on a long, springy holder, requiring usually five minutes of blind fumbling to get the cover back where it belonged. Slowblow's inspired design puts the interlock at the end of an even springier holder which has three right-angle bends in its length.

Also worthy of mention are the 48 woodscrews used to secure the back cover of the DOG cabinet. (Best total previously: a mere 28 on some Sentinel cabinets.) Moreover, instead of using the customary soft-iron Phillips screws, which could be removed at least twice before the heads were gouged out, the DOG chassis ingeniously uses screws made of solder, removable only by cutting off their heads with a pair of diagonals.

Fuses *soldered* into place and on the underside of the chassis to boot is a trick as old as TV. Packard-Bell, Sears Roebuck, Motorola, Du Mont and others have been using it for years. Slowblow has wrapped up all brilliant advances of the past in a single package by soldering all his numerous fuses *inside the deflection yoke*, where it is necessary to strip off the horizontal windings to get at them.

Packard Bell is obviously responsible for Slowblow's location of agc, height, focus and vertical linearity controls on the front of his creation, handy for customers to play with. Like many Packard Bell, Gamble-Skogmo, Sears and other chassis, the DOG horizontal hold control is hidden well out of sight in the back end of the chassis. In addition to these conveniences, the DOG chassis also makes available to the user the sound-trap, adjacent-channel picture and sound traps, together with the discriminator slug. (In the press of getting the DOG chassis into production, a control which would have permitted the customer to rotate the ion trap was reluctantly omitted.)

The less-intelligent among TV manufacturers of the 'Fifties supplied tube-function charts with their sets as an aid in service work. The smarter ones merely showed position and type without further comment, while the really topnotch engineers hid their charts behind the high-voltage cage (TravLer for one) or else pasted them on the bottom of cabinets (Philco, Admiral, et al). In another bold stroke forward, Slowblow puts his tube function chart *inside the vertical output transformer* and cleverly compounds confusion by supplying a chart which doesn't match the chassis, an ingenious innovation of Hoffman, Emerson, Tele-King and other pioneers.

In the matter of dial cords, Slowblow admittedly is not too far ahead of his competitors. True, each chassis uses slightly more than 18 yards of dial cord, 33 assorted pulleys and 17 springs of various sizes, but not a few earlier designers came rather close to this mark. Not too much to brag about, in this correspondent's opinion.

Much like certain Westinghouse chassis, Slowblow has attached a number of components to the top of the high-voltage cage, all of which must be removed and subsequently replaced by any snoopy TV technician who wishes to see what gives within.

Collapsible tube shields (which first appeared about 1955) are used throughout the DOG chassis. Slowblow has improved them chiefly by making tolerances between sections so close that they are guaranteed to jam after being extended and collapsed only twice so they must be pried off with pliers and screwdriver. The originals, remember, could be so used at least four times.

Last to be mentioned, but definitely not least is the photomodule system of assembly used in the DOG chassis. By piling approximately 30 interlocking photographic prints one on top of the other, Slowblow manages to form inductances, capacities, resistors and their connecting links.

The DOG demonstrator freely admitted that this method of construction posed certain complications in service work. For instance, after locating the particular layer in which a failure had occurred (how it was to be located is an item upon which the demonstrator refused to comment), the technician proceeds to separate the bonded layers of photographs with his pneumatic jack hammer.

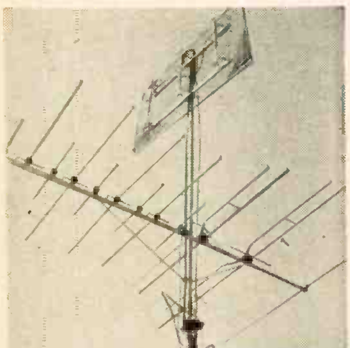
Then, after photographing and developing a new section (a complete commercial photographer's outfit, including darkroom, is required in servicing DOG receivers), he substitutes it for the failed section. He then bonds the whole mess together again with his 500-ton hydraulic press. These presses are supplied by the Slowblow Corp. at cost, plus slight charges for handling, crating, etc., together with a *free* insurance policy which provides for cut-rate psychiatric treatment when the technician finally blows his top.

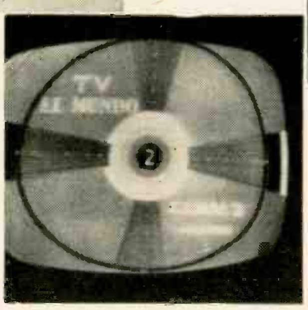
Trusting you are the same,

Yours truly,
H. A. HIGHSTONE

tv dx 1956

Summary and review of TV dx during the past year





Worm's-eye view of Bob Seybold's TV antennas (above). Havana, Cuba's channel-2 pattern (right) as received on Seybold's set in Dunkirk, N. Y.

Cuba's Television Nacional on channel 3 is often received by dxers.

By ROBERT B. COOPER, JR.

ANOTHER year of organized reporting of television dx reception has come to an end. During the past 12 months, several of our reporters managed to reach the magic number of 200 stations logged, and one dxer we know of is just under the 300-station mark! While a station total of 74 is pretty respectable, an Arkansas dxer has managed to see that many in a single 24-hour period! Reception on uhf has come into its own, especially along the Great Lakes and Gulf coast. Although the uhf trops record now stands at 750 miles, many nice loggings of 400–500 miles are reported from those areas of the country bounded by large bodies of water.

Television dxers reporting to the RADIO-ELECTRONICS TV dx column are performing a very valuable service by contributing to man's knowledge of vhf and uhf wave propagation. Your reports are carefully screened and gone over for items of general interest. They are then tabulated in order to give an idea of the scope of the dx during the past year. Your reports are then made available to interested parties and groups across the country. Several military and civil government agencies and a number of colleges have been among those studying them. Those reports from 1950 were still traveling in 1952!

During the past five years, the January issue of this magazine has carried detailed analyses of these TV dx reports, together with explanations of the various forms of dx to be encountered. Less detailed reports were carried in earlier TV issues. The August and October, 1956, TV dx columns also carried descriptions of the forms of dx reception. Anyone who finds the following article "so much Greek" is advised to look into these past issues.

Review of 1956

As TV dx seasons go, 1956 was a bit below par. As more TV fans across the country become interested in dx reception, the number of individual reports continues to grow by leaps and bounds. Careful comparison, however, has shown 1956 to be weak in both major forms of dx reception, tropospheric (extended ground wave) and sporadic-E skip.

1956 had its good points, however. Alert observers in Arkansas, Illinois, Indiana and New York report reception from station KENI, channel 2, Anchorage, Alaska. This station had been noted but once before in the States.

Noticeably lacking are reports of reception during the summer months of the Brazilian and Venezuelan low-channel stations. Robert Seybold of Dunkirk, N. Y., is the only dxer who seems to have intercepted the South Americans this year. Bob notes reception from PRF-3-TV, channel 3, Sao Paulo, and PRG-2-TV, channel 2, Rio de Janeiro, Brazil, on Aug. 7, 1956.

At least one Caribbean area station is destined to fame in the Eastern and Southern areas of our country. Of all of the letters received requesting information on identification of a single station, channel 3, Santa Clara, Cuba, far outranks all competitors. This station is part of a Cuban television network that has channel 4, Havana, as its main origination point. The network call sign—Television Nacional, TVN-3, TVN-4—frequently shows up on photographs sent to us.

Not all dx reception reported is exactly according to set patterns. Mrs. Evelyn B. Hall of Grafton, W. Va., notes reception of CFPL-TV, channel 10, London, Ont., on her receiver's channel 6. It seems that Mrs. Hall receives her television via a cabled system and the antenna in the mountains above Grafton was doing a fine job. The conversion to channel 6 was made by the cable company.

Some unconventional dx

Nor is all dxing done with elaborate antenna arrays. Bill Satterwhite of Richmond, Va., reports reception from 10 states and 3 countries with nothing more than a pair of rabbit ears on top of his receiver! Eugene Webb of Seattle, Wash., reports KNXT, channel 2, Los Angeles, and KTVR, channel 2, Denver, on his rabbit ears and portable television receiver.

Just to prove that we have no corner on the TV dx field here in the Western hemisphere, Jetterson and Sandblom of Skillingaryd, Sweden, report dx reception from Italy, Switzerland, Belgium, Czechoslovakia, Denmark, France, Germany, Great Britain, Holland and the USSR during the past couple of years.

Frank Greene of Roswell, N. M., notes reception from stations in Mexico, Canada and the United States at the same time and the same channel on May 7, 1956. How is that for international cooperation!

Although high-band reception (channels 7–13) over distances of 800 miles is not too common in areas east of the Rockies, it is all but unheard of along the Pacific coast. Cecil Murrow of Elma, Wash., reports reception from KFRE, channel 12, Fresno, Calif., and KERO, channel 10, Bakersfield, Calif. We would like to hear from others who have had similar luck with the high channels in Western areas.

Along the same line, but with the results that we have been led to expect, Paul R. Guinn of Grand Junction, Colo., notes that, after moving from equally mountainous Tennessee, his high-band tropospheric reception has fallen to zero. No high-band dx in any form has been noted in two years in Colorado.

Meteor-scatter dxing (bursts) has received a good deal of hashing over in our regular column. Several fellows are finding it fascinating to be able to sit down and log dx most any day they want to try. M. W. Degeer, Tulsa, Okla.; J. D. Burch, Hot Springs, Ark.; Collins, Buffalo, N. Y.; Schafer, Kenmore, N. Y., and Seybold, Dunkirk, N. Y., are but a few who have found MS dxing profitable toward building one's station totals.

Imagine trying to dx with seven local stations! Dan Samuels, of Mt. Vernon, N. Y., has given it the do-or-die try and his net result is 55 dx stations logged. Dan's best dx is 1,500-miler KFDX, channel 3, Wichita Falls, Tex.

Reporter Harold Glick, Yellowknife, Northwest Territory, Canada, might be classified as just the opposite of Dan Samuels. Glick not only has no local stations, he can't receive any television unless dx is in. He lives near the Arctic circle, nearly 700 miles from the nearest TV station! Harold has been at it for 2½ years, and uses a large rhombic antenna directed on the United States. He has even gone so far as to install several other TV receivers in Yellowknife for the many people who are willing to take "pot luck" on what TV dx has to offer!

As evidence that our hobby is probably not a passing fad, we are proud to announce that the American Ionospheric Propagation Association, the world's only TV dx organization, is now beginning its fourth year of operation. The AIPA monthly bulletin is currently published by Robert Seybold, RFD No. 2, Dunkirk, N. Y. Bob notes that the AIPA is always happy to have inquiries concerning membership.

Reception via the aurora

This year was a milestone for dxers in one field of dxing. Prior to April, 1956, no dxer had ever been able to identify any dx via auroral reflection. A large auroral display on the evenings of April 26 and 27 changed that. The aurora was of such brilliance that it was visible as far south as central California, Kansas, Tennessee and North Carolina. Ed Hepp, of Portland, Ore., reports audio identification only on KREM, channel 2, Spokane, Wash., and KCRA, channel 3, Sacramento, Calif. Reception was possible only when the antenna was pointed northeast from Portland. The video remained too blurred and jumbled, with broad lines, to be identified.

Paul Swartz of Gibsonburg, Ohio, also notes the effects of auroral reception on April 26, observing that just prior to the aurora display, trops was very good on the high channels. In accordance with this, Carl Lupton, of Shelbyville, Ill., notes very unusual trops reception from Kansas and Oklahoma on the evening of the 26th.

Jerry Easter of Vinton, Iowa, reports very strong aurora reception on channels 2–11 on the evening of April 26. The best antenna heading was northwest and, from some of the audio copied, the stations were in the Mountain Standard Time zone. The video cleared for a few minutes at a time, with watchable pictures as high as channel 4. Frank Hill of Gallipolis, Ohio, notes good to excellent trops reception on the evening of the 26th, to a distance of 300 miles. Frank also caught more auroral reflection on March 22 from 7:05 pm to 7:16 pm EST. Reception was on channels 2–6, with channels 2 and 5 especially strong. Easter of Iowa notes reception via aurora on both March 10 and 22.

In May, Art Collins of Buffalo, N. Y., noted auroral reception from the northwest on the 24th. WCBS, channel 2, New York, was audible on a beam heading of northwest only. Other auroral reception was noted on channels 4–6, but not strong enough to identify.

Although aurora reflection has not been too promising in the past years, it should improve markedly in the next year or so. This is a direct result of the new sunspot cycle which reaches a maximum this month, and the magnetic storms that accompany the sunspots. Observers will have the best luck with auroral reflection in the spring months. Aurora has a habit of repeating itself every 27 days, so be on the lookout for recurrence openings. Dxers north of the Mason-Dixon line will have the best luck, aiming their antenna arrays to the north, northeast and northwest from 4 pm local time on to early morning. Watch the lower channels first. Oh yes, don't forget that F2 openings are most likely to occur between the United States and South America on mornings following a large auroral display.

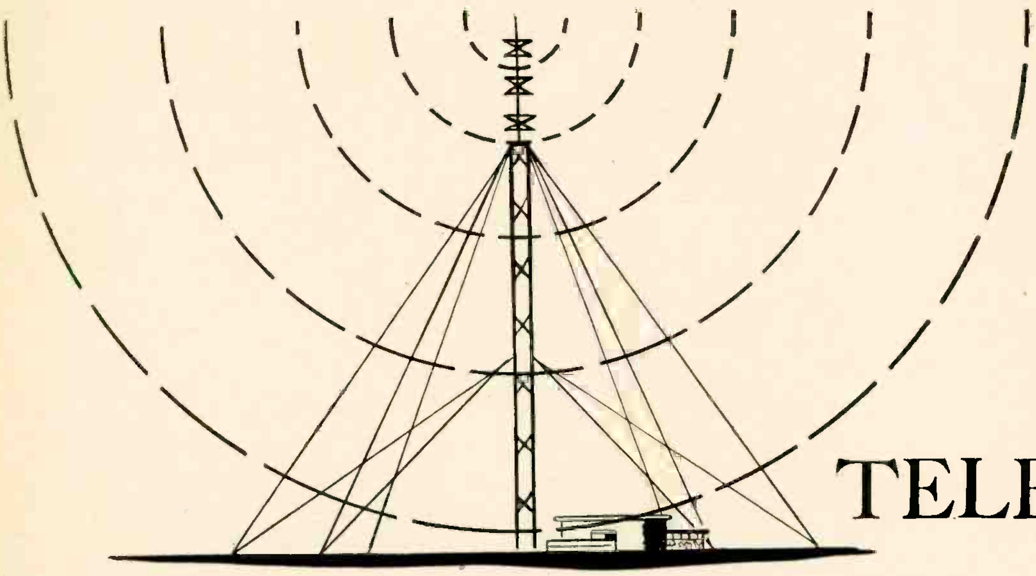
Our featured dxer for this year is Robert Seybold, of Dunkirk, N. Y. Bob began his dxing just three years ago and has amassed the amazing total of 290 stations received, with 257 of these stations verified by letter or photograph of the station identifications! These stations are in 45 states and 8 countries and include 38 foreign stations. Bob has what is far from an ideal dx location, although it does have its good points. He is just 40 miles from stations operating on channels 2 and 4, which does, of course, play havoc with low-band dx reception. Being located close to Lake Erie, his trops (ground wave) reception is very good, especially to the west. Upward of 30 stations are logged on an average day, from a location only 35 feet above sea level! Bob's antenna is an all-channel Yagi array for the vhf band and a set of 12 bowties with reflector for uhf reception. The uhf includes stations from Massachusetts to Illinois and south to West Virginia. High-band vhf dx reception includes calls from Texas, Oklahoma, Kansas and Nebraska, over 1,000 miles distant. Low-band skip includes stations from Alaska to Brazil.

OVER 50 TV DX CLUB

No. of Stations	Reporter	Location
290	Robert Seybold	Dunkirk, N. Y.
261	Bedford Brown	Hot Springs, Ark.
217	Art Collins	Buffalo, N. Y.
211	B. H. Rauch	Peoria, Ill.
196	Frank Hill	Gallipolis, Ohio
196	King Schafer	Kenmore, N. Y.
174	Carl Lupton	Shelbyville, Ill.
170	Richard Lowry	Temple, Tex.
149	Jerry Don Burch	Hot Springs, Ark.
146	Ed Sparks	Odessa, Tex.
137	R. B. Cooper	Fresno, Calif.
132	Edward Rugel	Independence, Kans.
130	Kenneth Neal	Hamlin, Tex.
128	Francis De Groat	Salamanca, N. Y.
127	Frank Greene	Roswell, N. M.
126	Raymond Sloss	Baton Rouge, La.
126	Gary Ehresman	South Bend, Ind.
115	Robert Lowden	Grindstone, Pa.
112	B. J. Bingham	Festus, Mo.
107	Paul R. Guinn	Grand Junction, Colo.
104	M. W. DeGeer	Tulsa, Okla.
103	Ray Escoffier	New Orleans, La.
98	Armand Pelland	Woonsocket, R. I.
98	Clinton T. Day	Westerly, R. I.
95	Bill Eckberg	Walnut, Ill.
94	W. T. Owen, Jr.	Springfield, Ohio
90	Norman Erint	Kenmore, N. Y.
88	Richard Kleppe	Decorah, Iowa
86	John Aldridge	Winston-Salem, N. C.
85	Larry Vehorn	Speedway, Ind.
85	Robert M. Gordon	Harrisburg, Pa.
81	B. Williams	Forest, Miss.
80	Frank Wheeler	Erie, Pa.
77	R. M. Hastings	Coventry, Conn.
76	Bob Martin	Girard, Pa.
74	David Janowiak	Milwaukee, Wis.
74	Dennis Smith	Wasco, Calif.
68	Dale Lewellyn	Scandia, Kans.
66	Wayne Blanton	High Rolls, N. M.
65	Orville Buckheister	Akron, Ind.
64	Percy Cox	Visalia, Calif.
64	Edward Bvars	Jasper, Tenn.
62	Morris Foote	Middleton, Idaho
57	Ed Hepp	Portland, Ore.
57	D. L. Barkenquast	Toledo, Ohio
55	Dan Samuels	Mt. Vernon, N. Y.
55	Leo B. Weiner	Erie, Pa.
55	Carlon Howington	Uniontown, Ohio
53	Daryl L. Kiebler	E. Lansing, Mich.
51	S/Sgt. W. J. Barney	Tarawa Terrace, B. C.
50	James Howarth	Worcester, Mass.

Membership in the Over 50 TV DX Club is automatically obtained when one reaches a total of 50 stations logged. To continue membership, however, one must keep this column informed as to his dxing activities. This is done very simply by reporting on RADIO-ELECTRONICS report forms on a monthly basis. The forms are obtain free of charge by sending a postcard with your name and address to TV DX Column, RADIO-ELECTRONICS, 154 W. 14 St., New York 11, N. Y.

The next complete listing of the members of the TV dx club will appear in the January, 1958, issue of this magazine. Additions to the club and changes in members' status will be noted from time to time during the next few months. END



TELEVISION

Alabama

WAIQ	Andalusia	2
WABT	Birmingham	13
WBIQ	Birmingham	10
WBRC-TV	Birmingham	6
WMSL-TV	Decatur	23
WTVY	Dothan	9
WALA-TV	Mobile	10
WKRG-TV	Mobile	5
WCOV-TV	Montgomery	20
WSFA-TV	Montgomery	12
WTIQ	Munford	7

Alaska

KENI-TV	Anchorage	2
KTVA	Anchorage	11
KFAR-TV	Fairbanks	2
KTVF	Fairbanks	11
KINY-TV	Juneau	8

Arizona

KVAR	Mesa (Phoenix)	12
KOOL-TV	Phoenix	10
KPHO-TV	Phoenix	5
KTVK	Phoenix	3
KDWI-TV	Tucson	9
KOPO-TV	Tucson	13
KVOA-TV	Tucson	4
KIVA	Yuma	11

Arkansas

KRBB	El Dorado	10
KFSA-TV	Fort Smith	22
KARK-TV	Little Rock	4
KTHV	Little Rock	11
KATV	Pine Bluff	7

California

KBAK-TV	Bakersfield	29
KERO-TV	Bakersfield	10
KHSL-TV	Chico	12
KIEM-TV	Eureka	3
KFRE-TV	Fresno	12
KJEO	Fresno	47
KMJ-TV	Fresno	24
KABC-TV	Los Angeles	7
KCOP	Los Angeles	13
KHJ-TV	Los Angeles	9
KNXT	Los Angeles	2
KRCA	Los Angeles	4
KTLA	Los Angeles	5
KTTV	Los Angeles	11
KVIP	Redding	7
KBET-TV	Sacramento	10
KCCC-TV	Sacramento	40
KCRA-TV	Sacramento	3
KSBW-TV	Salinas-Monterey	8
KEMB-TV	San Diego	8
KFSD-TV	San Diego	10
KGO-TV	San Francisco	7
KPIX	San Francisco	5
KQED	San Francisco	9
KRON-TV	San Francisco	4
KSAN-TV	San Francisco	32
KNTV	San Jose	11
KVEC-TV	San Luis Obispo	6
KEYT	Santa Barbara	3
KOVR	Stockton	13
KVVG	Tulare	27

Colorado

KKTV	Colorado Springs	11
KRDO-TV	Colorado Springs	13
KBTV	Denver	9
KFEL-TV	Denver	2
KLZ-TV	Denver	7
KOA-TV	Oenver	4
KRMA-TV	Denver	6
KREX-TV	Grand Junction	5
KFXJ-TV	Montrose	10
KCSJ-TV	Pueblo	5

Connecticut

WICC-TV	Bridgeport	43
WGTH-TV	Hartford	18
WKNB-TV	New Britain	30
WNHC-TV	New Haven	8
WATR-TV	Waterbury	53

Delaware

WPFH	Wilmington	12

District of Columbia

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

Florida

WESH-TV	Daytona Beach	2
WITV	Fort Lauderdale	17
WINK-TV	Fort Myers	11
WJHP-TV	Jacksonville	36
WMBR-TV	Jacksonville	4
WCKT	Miami	7
WGBS-TV	Miami	23
WTHS-TV	Miami	2
WTVJ	Miami	4
WDBO-TV	Orlando	6
WPTV	Palm Beach	5
WJDM	Panama City	7
WEAR-TV	Pensacola	3
WSUN	St. Petersburg	38
WFLA-TV	Tampa	8
WTVT	Tampa	13
WEAT-TV	W. Palm Beach	12

Georgia

WALB-TV	Albany	10
WAGA-TV	Atlanta	5
WLWA	Atlanta	11
WSB-TV	Atlanta	2
WJBF	Augusta	6
WRDW-TV	Augusta	12
WDAK-TV	Columbus	28
WRBL-TV	Columbus	4
WMAZ-TV	Macon	13
WROM-TV	Rome	9
WSAV-TV	Savannah	3
WTOC-TV	Savannah	11
WCTV	Thomasville	6

Guam

KUAM-TV	Agana	8

Hawaii

KHBC-TV	Hilo	9
KGMB-TV	Honolulu	9
KONA	Honolulu	2
KULA-TV	Honolulu	4
KMUI-TV	Maui	12
KMAU	Wailuku	3

Idaho

KIDO-TV	Boise	7
KID-TV	Idaho Falls	3
KLEW-TV	Lewiston	3
KBOI-TV	Boise	2
KLIX-TV	Twin Falls	11

Illinois

WBLN	Bloomington	15
WCIA	Champaign	3
WILL-TV	Champaign-Urbana	2
WBBM-TV	Chicago	2
WBKB	Chicago	7
WGN-TV	Chicago	9
WNBQ	Chicago	5
WTTW	Chicago	11
WDAN-TV	Danville	24
WTVP	Decatur	17
WSIL-TV	Harrisburg	22
KLEW-TV	Lewistown	3
WEEK-TV	Peoria	43
WTVH	Peoria	19
WGEM-TV	Quincy	10
WREX-TV	Rockford	13
WTVO	Rockford	39
WHBF-TV	Rock Island	4
WICS	Springfield	20

Indiana

WTTV	Bloomington	4
WSJV	Elkhart	52
WFIE	Evansville	62
WTVW	Evansville	7
WKJG-TV	Fort Wayne	33
WFBM-TV	Indianapolis	6
WISH-TV	Indianapolis	8
WFAM-TV	Lafayette	59
WLBC-TV	Muncie	49
WNDU-TV	Notre Dame-South Bend	46
WSBT-TV	South Bend	34
WTHI-TV	Terre Haute	10
WINT	Waterloo-Ft. Wayne	15

Iowa

WOI-TV	Ames	5
KCRG-TV	Cedar Rapids	9
WMT-TV	Cedar Rapids	2
WOC-TV	Davenport	6
KRNT-TV	Des Moines	8
WHO-TV	Des Moines	13
KQTV	Fort Dodge	21
KGLO-TV	Mason City	3
KTIV	Sioux City	4
KVTV	Sioux City	9
KWWL-TV	Waterloo	7

Kansas

KCKT	Great Bend	2
KTVH	Hutchinson	12
KOAM-TV	Pittsburg	7
WIBW-TV	Topeka	13
KAKE-TV	Wichita	10
KARD-TV	Wichita	3

Kentucky

WALN-TV	Ashland	59
WEHT	Henderson	50
WLEX-TV	Lexington	18
WAVE-TV	Louisville	3
WHAS-TV	Louisville	11

Louisiana

KALB-TV	Alexandria	5
WAFB-TV	Baton Rouge	28
WBRZ	Baton Rouge	2
KLFY-TV	Lafayette	10
KPLC-TV	Lake Charles	7
KTAG-TV	Lake Charles	25
KNEW-TV	Monroe	8
WDSU-TV	New Orleans	6
WJMR-TV	New Orleans	20
KSLA-TV	Shreveport	12
KTBS-TV	Shreveport	3

Maine

WABI-TV	Bangor	5
WTWO	Bangor	2
WMTW	Poland Spring	8
WCSH-TV	Portland	6
WGAN-TV	Portland	13
WAGM-TV	Presque Isle	8

Maryland

WAAM	Baltimore	13
WBAL-TV	Baltimore	11
WMAR-TV	Baltimore	2
WBOC-TV	Salisbury	16

Massachusetts

WMGT	Adams-Pittsfield	19
WBZ-TV	Boston	4
WGBH-TV	Boston	2
WNAC-TV	Boston	7
WHYN-TV	Holyoke	55
WWLP	Springfield	22

Michigan

WPAG-TV	Ann Arbor	20
WNEM-TV	Bay City-Saginaw	5
WWTV	Cadillac	13
WJBK	Detroit	2
WTVS	Detroit	56
WWJ-TV	Detroit	4
WXYZ-TV	Detroit	7
WKAR-TV	East Lansing	60
WOOD-TV	Grand Rapids	8
WKZO-TV	Kalamazoo	3
WJIM-TV	Lansing	6
WDMJ-TV	Marquette	6
WKNX-TV	Saginaw	57
WPBN-TV	Traverse City	7

Minnesota

KMMT	Austin	6
KDAL-TV	Duluth-Superior	3
WDSM-TV	Duluth-Superior	6
KEYD-TV	Minneapolis-St. Paul	9
KSTP-TV	Minneapolis-St. Paul	5
WCCO-TV	Minneapolis	4
WTCN-TV	Minneapolis	11
KROC-TV	Rochester	10

Mississippi

WCBI-TV	Columbus	4
WDAM-TV	Hattiesburg	9
WJTV	Jackson	12
WLBT	Jackson	3
WTOK-TV	Meridian	11

Missouri

KFVS-TV	Cape Girardeau	12
KOMU-TV	Columbia	8
KHQA-TV	Hannibal	7
KRCG	Jefferson City	13
KSWM-TV	Joplin	12
KCMO-TV	Kansas City	5
KMBC-TV	Kansas City	9
WDAF-TV	Kansas City	4
KTVO	Kirksville	3
KFEQ-TV	St. Joseph	2
KETC	St. Louis	9
KSD-TV	St. Louis	5
KTVI	St. Louis	36
KWK-TV	St. Louis	4
KDRO-TV	Sedalia	6
KTTS-TV	Springfield	10
KYTV	Springfield	3

Montana

KOOK-TV	Billings	2
KXLF-TV	Butte	6
KFBB-TV	Great Falls	5
KGVO-TV	Missoula	13

Nebraska

KHAS-TV	Hasting	5
KHPL-TV	Hayes Center	6
KLRJ-TV	Henderson	2
KHOL-TV	Kearney	13
KOLN-TV	Lincoln	10
KUON-TV	Lincoln	12
KMTV	Omaha	3
WOW-TV	Omaha	3
KSTF	Scottsbluff	10

This list of United States and Canadian stations has been checked and verified with all possible sources, but may still not be perfect. We will be grateful for any corrections or additions from authoritative sources.

STATION LIST

Compiled by MURIEL I. SCHILLER

Correct to Dec. 1, 1956

Nevada

KLAS-TV	Las Vegas	8
KSHO-TV	Las Vegas	13
KOLO-TV	Reno	8

New Hampshire

WMUR-TV	Manchester	9

New Jersey

WATV	Newark	13

New Mexico

KGGM-TV	Albuquerque	13
KOAT-TV	Albuquerque	7
KOB-TV	Albuquerque	4
KAVE-TV	Carlsbad	6
KSWS-TV	Roswell	8

New York

WGDA	Albany	41
WTRI	Albany-Schenectady-Troy	35
WNEF-TV	Binghamton	12
WBEN-TV	Buffalo	4
WBUF	Buffalo	17
WGR-TV	Buffalo	2
WCNY-TV	Carthage-Watertown	7
WSYE-TV	Elmira	18
WTVE	Elmira	24
WCDB	Hagaman	29
WABC-TV	New York	7
WABD	New York	5
WCBS-TV	New York	2
WOR-TV	New York	9
WPIX	New York	11
WRCA-TV	New York	4
WPTZ	Plattsburg	38
WHAM-TV	Rochester	5
WHEC-TV	Rochester	10
WVET-TV	Rochester	10
WRGB	Schenectady	6
WHEN-TV	Syracuse	8
WSYR-TV	Syracuse	3
WKTV	Utica	13

North Carolina

WISE-TV	Asheville	62
WLOS-TV	Asheville	13
WUNC-TV	Chapel Hill	4
WBTV	Charlotte	3
WTVD	Durham	11
WFLB-TV	Fayetteville	18
WFMY-TV	Greensboro	2
WNCT	Greenville	9
WNAO-TV	Raleigh	28
WITN	Washington	7
WMFD-TV	Wilmington	6
WSJS-TV	Winston-Salem	12
WTOB-TV	Winston-Salem	26

North Dakota

KBMB-TV	Bismarck	12
KFYR-TV	Bismarck	5
KDIX-TV	Dickinson	2
WDAY-TV	Fargo	6
KNOX-TV	Grand Forks	10
KCJB-TV	Minot	13
KXJB-TV	Valley City	4

Ohio

WAKR-TV	Akron	49
WCET	Cincinnati	48
WCPO-TV	Cincinnati	9
WKRC-TV	Cincinnati	12
WLWT	Cincinnati	5
WEWS	Cleveland	5
KYW-TV	Cleveland	3
WJW-TV	Cleveland	8
WBNS-TV	Columbus	10
WLWC	Columbus	4
WOSU-TV	Columbus	34
WTVN-TV	Columbus	6
WHIO-TV	Dayton	7
WLWD	Dayton	2
WIMA	Lima	35
WSTV-TV	Steubenville	9
WSPO-TV	Toledo	13
WFMJ-TV	Youngstown	21
WKBN-TV	Youngstown	27
WHIZ-TV	Zanesville	18

Oklahoma

KTEN	Ada	10
KVSO-TV	Ardmore	12
KGEO-TV	Enid	5
KSWO-TV	Lawton	7
KTVX	Muskogee	8
KETA	Oklahoma City	13
KWTV	Oklahoma City	9
WKY-TV	Oklahoma City	4
KOTV	Tulsa	6
KVOO-TV	Tulsa	2

Oregon

KVAL-TV	Eugene	13
KOTI	Klamath Falls	2
KBES-TV	Medford	5
KGW-TV	Portland	8
KLOR	Portland	12
KOIN-TV	Portland	6
KPTV	Portland	27
KPIC	Roseburg	4

Pennsylvania

WFBG-TV	Altoona	10
WLEV-TV	Bethlehem	51
WGLV	Easton	57
WICU	Erie	12
WSEE	Erie	35
WCMB-TV	Harrisburg	27
WHP-TV	Harrisburg	55
WTPA	Harrisburg	71
WARD-TV	Johnstown	56
WJAC-TV	Johnstown	6
WGAL-TV	Lancaster	8
WCAU-TV	Philadelphia	10
WFIL-TV	Philadelphia	6
WHYY-TV	Philadelphia	35
WRCV-TV	Philadelphia	3
KDKA-TV	Pittsburgh	2
WENS	Pittsburgh	16
WQED	Pittsburgh	13
WARM-TV	Scranton	16
WGBI-TV	Scranton	22
WBRE-TV	Wilkes-Barre	28
WILK-TV	Wilkes-Barre	34
WNOW-TV	York	49
WSBA-TV	York	43

Puerto Rico

WORA-TV	Mayaguez	5
WAPA-TV	San Juan	4
WKAQ-TV	San Juan	2

Rhode Island

WJAR-TV	Providence	10
WPRO-TV	Providence	12

South Carolina

WCSC-TV	Charleston	5
WUSN-TV	Charleston	2
WIS-TV	Columbia	10
WNOK-TV	Columbia	67
WBTW	Florence	8
WFBC-TV	Greenville	4
WSPA-TV	Spartanburg	7

South Dakota

KDLO-TV	Florence	3
KOTA-TV	Rapid City	3
KELO-TV	Sioux Falls	11

Tennessee

WDEF-TV	Chattanooga	12
WRGP-TV	Chattanooga	3
WDXI-TV	Jackson	7
WJHL-TV	Johnson City	11
WATE	Knoxville	6
WBIR-TV	Knoxville	10
WTVK	Knoxville	26
WHBQ-TV	Memphis	13
WKNO-TV	Memphis	10
WMCT	Memphis	5
WREC-TV	Memphis	3
WLAC-TV	Nashville	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
KFDM-TV	Beaumont	6
KBST-TV	Big Spring	4
KRIS-TV	Corpus Christi	6
KSIX-TV	Corpus Christi	10
KVDO-TV	Corpus Christi	22
KRLD-TV	Dallas	4
WFAA-TV	Dallas	8
KILT	El Paso	13
KROD-TV	El Paso	4
KTSM-TV	El Paso	9
WBAP-TV	Fort Worth	5
KFJZ-TV	Fort Worth	11
KGUL-TV	Galveston	11
KGBT-TV	Harlingen	4
KPRC-TV	Houston	2
KTRK-TV	Houston	13
KUHT	Houston	8
KHAD-TV	Laredo	8
KCBD-TV	Lubbock	11
KDUB-TV	Lubbock	13
KTRE-TV	Lufkin	9
KMID-TV	Midland	2
KOSA-TV	Odessa	7
KTXL-TV	San Angelo	8
KCOR-TV	San Antonio	41
KENS-TV	San Antonio	5
WOAI-TV	San Antonio	4
KPAR-TV	Sweetwater-Abilene	12
KCEN-TV	Temple	6
KCMC-TV	Texarkana	6
KLTV	Tyler-Longview	7
KWTX-TV	Waco	10
KRGV-TV	Weslaco	5
KFDX-TV	Wichita Falls	3
KWFT-TV	Wichita Falls	6

Utah

KSL-TV	Salt Lake City	5
KTVT	Salt Lake City	4
KUTV	Salt Lake City	2

Vermont

WCAX-TV	Burlington	3

Virginia

WCYB-TV	Bristol	5
WVEC-TV	Hampton-Norfolk	15
WSVA-TV	Harrisonburg	3
WLVA-TV	Lynchburg	13
WTAR-TV	Norfolk	3
WTOV-TV	Norfolk	27
WXEX-TV	Petersburg-Richmond	8
WRVA-TV	Richmond	12
WTVR	Richmond	6
WDBJ	Roanoke	7
WSLS-TV	Roanoke	10

Washington

KVOS-TV	Bellingham	12
KEPR-TV	Pasco	19
KCTS	Seattle	9
KING-TV	Seattle	5
KOMO-TV	Seattle	4
KHQ-TV	Spokane	6
KREM-TV	Spokane	2
KXLY-TV	Spokane	4
KTVW	Tacoma	13
KTNT-TV	Tacoma	11
KIMA-TV	Yakima	29

West Virginia

WHIS-TV	Bluefield	6
WCHS-TV	Charleston	8
WHTN-TV	Huntington	13
WSAZ-TV	Huntington	3
WOAY-TV	Oak Hill	4
WTAP	Parkersburg	15
WTRF-TV	Wheeling	7

Wisconsin

WEAU-TV	Eau Claire	13
WBAY-TV	Green Bay	2
WFRV-TV	Green Bay	5
WKBT	La Crosse	8
WHA-TV	Madison	21
WISC-TV	Madison	3
WKOW-TV	Madison	27
WMTV	Madison	33
WMBV-TV	Marinette	11
WXIX	Milwaukee	19
WTMJ-TV	Milwaukee	4
WISN-TV	Milwaukee	12
WSAU-TV	Wausau	7
WITI-TV	Whitefish Bay-Milwaukee	6

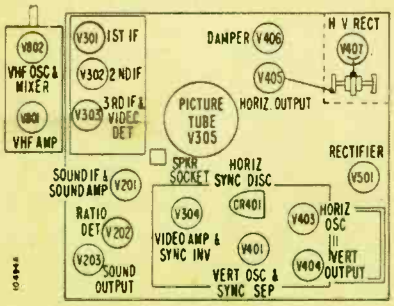
Wyoming

KFBC-TV	Cheyenne	5

Canadian

CHCT-TV	Calgary, Alta.	2
CFRN-TV	Edmonton, Alta.	3
CJLH-TV	Lethbridge, Alta.	7
CBUT	Vancouver, B.C.	2
CKX-TV	Brandon, Man.	5
CBWT	Winnipeg, Man.	4
CKCW-TV	Moncton, N. B.	2
CHSJ-TV	St. John, N. B.	4
CJON-TV	St. John's, Nfld.	6
CBHT	Halifax, N. S.	3
CJCB-TV	Sydney, N. S.	4
CKVR-TV	Barre, Ont.	3
CHCH-TV	Hamilton, Ont.	11
CKWS	Kingston, Ont.	11
CKCO-TV	Kitchener, Ont.	13
CFPL-TV	London, Ont.	10
CKGN-TV	North Bay, Ont.	10
CBOFT	Ottawa, Ont.	9
CBOT	Ottawa, Ont.	4
CHEX-TV	Peterborough, Ont.	12
CFPA-TV	Port Arthur, Ont.	2
CJIC-TV	Sault Ste. Marie, Ont.	2
CKSO-TV	Sudbury, Ont.	5
CFCL-TV	Timmins, Ont.	6
CBLT	Toronto, Ont.	6
CKLW-TV	Windsor, Ont.	9
CKNX-TV	Wingham, Ont.	8
CFCY-TV	Charlottetown, Prince Edward Island	13
CKRS-TV	Jonquière, Que.	12
CBFT	Montreal, Que.	2
CBMT	Montreal, Que.	6
CFCM-TV	Quebec City, Que.	4
CJBR-TV	Rimouski, Que.	3
CHLT-TV	Sherbrooke, Que.	7
CKCK-TV	Regina, Sask.	2
CFQC-TV	Saskatoon, Sask.	8

ADMIRAL 18Z41 CHASSIS



V801—6BZ7	V401—12AU7
V802—6J6	CR401—93A5-2 (Selenium Diode)
V201—6AU6	V403—***
V202—6AL5	V404—6S4A
V203—6DG6GT	V405—6CU6 or 6DQ6
V301—6BZ6	V406—6AU4GTA
V302—6BZ6	V407—1B3GT
V303—6AM8	V501—5U4GA or 5U4GB
V304—6AW8	
V305—21ATP4A or 21ATP4B 24DP4A in 18Z4FSA	

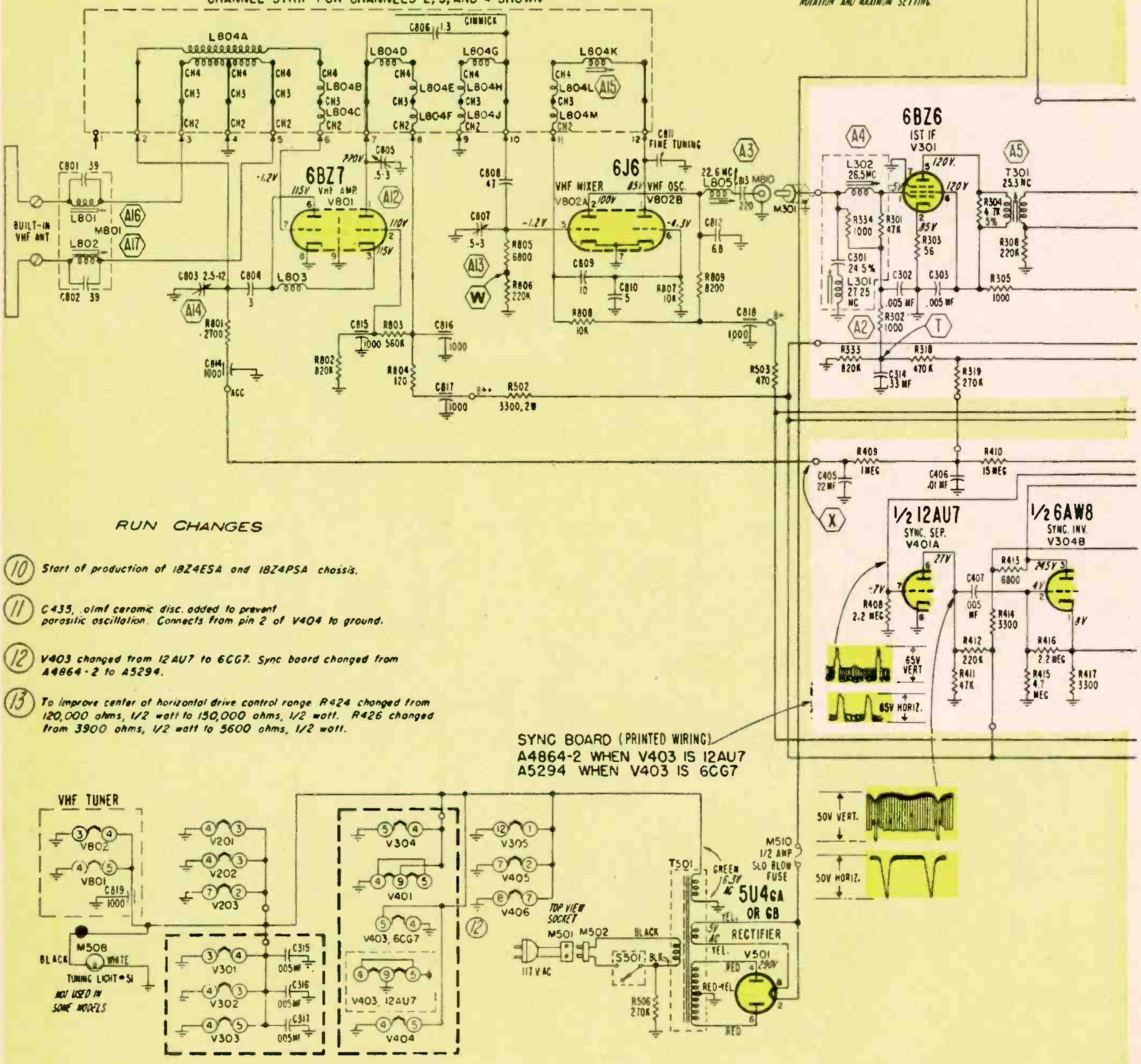
*** V403 may be 12AU7 or 6CG7. Not directly interchangeable. Replace with type used in set.

Tuner is an unusual turret type with five strips for the 12 vhf TV channels. Each strip and the fixed turret contacts

VHF TUNER 94D100-2

CHANNEL STRIP FOR CHANNELS 2, 3, AND 4 SHOWN

NOTE: ARROW THROUGH VARIABLE ARM ON CONTROLS INDICATES CLOCKWISE ROTATION AND MAXIMUM SETTING.



RUN CHANGES

(10) *Start of production of 18Z4ESA and 18Z4PSA chassis.*

(11) *C435, .01mf ceramic disc added to prevent parasitic oscillation. Connects from pin 2 of V404 to ground.*

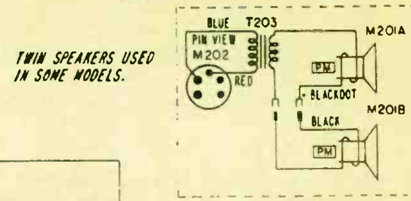
(12) *V403 changed from 12AU7 to 6CG7. Sync board changed from A4864-2 to A5294.*

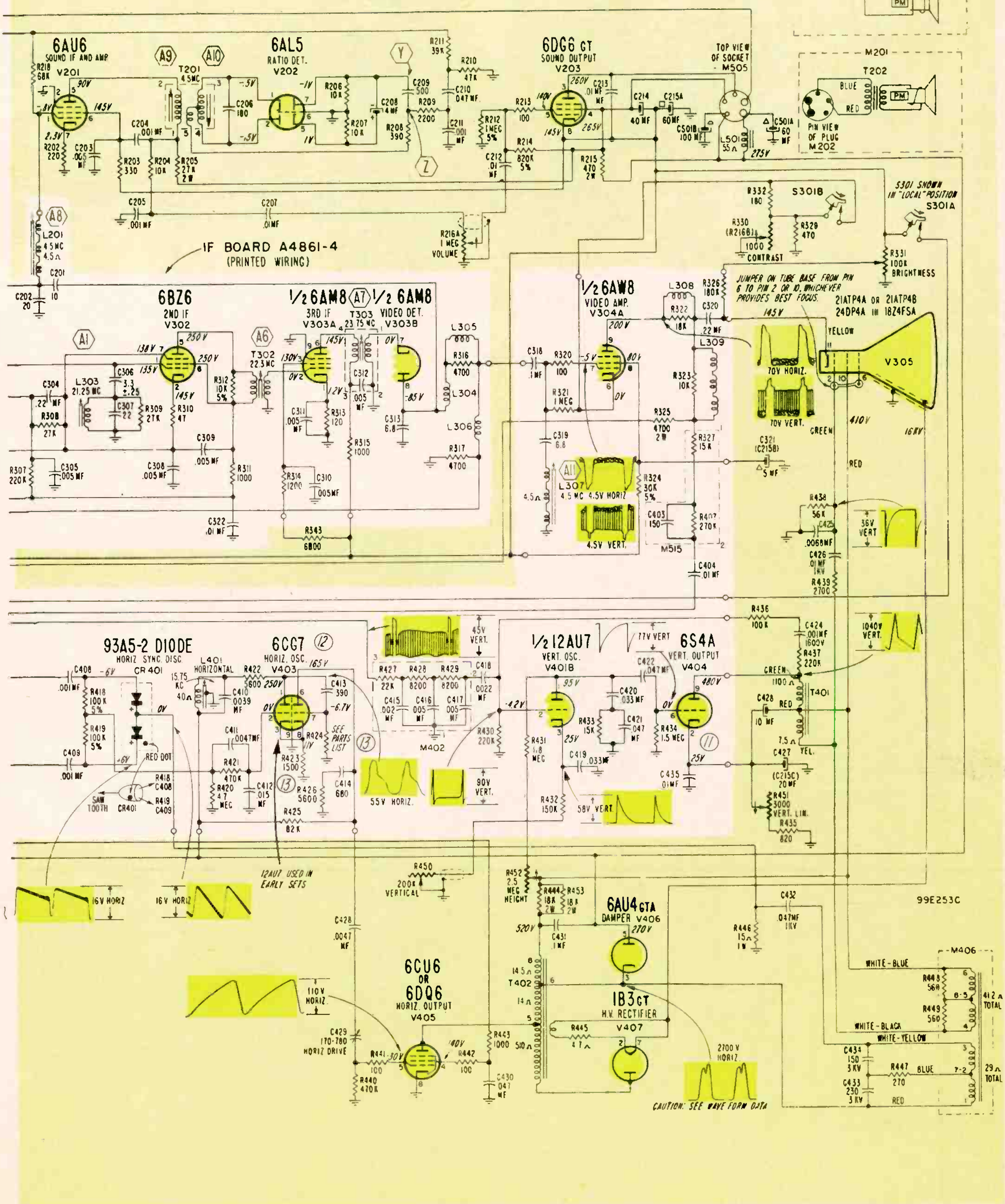
(13) *To improve center of horizontal drive control range R424 changed from 120,000 ohms, 1/2 watt to 150,000 ohms, 1/2 watt. R426 changed from 3900 ohms, 1/2 watt to 5600 ohms, 1/2 watt.*

SYNC BOARD (PRINTED WIRING)
A4864-2 WHEN V403 IS 12AU7
A5294 WHEN V403 IS 6CG7

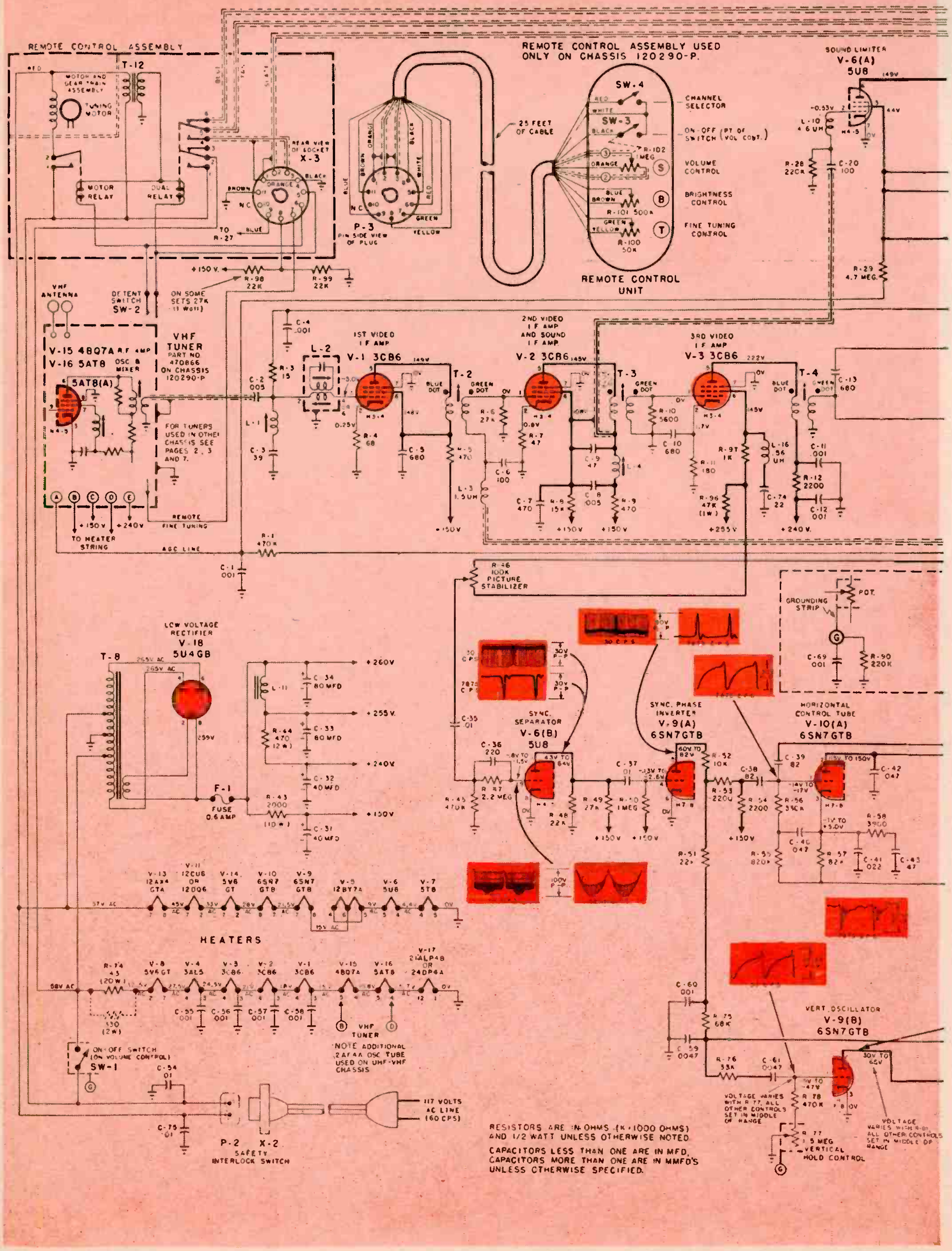
18Z4ESA, 18Z4FSA, 18Z4LSA and 18Z4PSA Chassis for runs 10 through 13

are designed to act like a switch-tuned circuit with incremental inductors. When making oscillator adjustments, always start with the lowest channel on the strip.

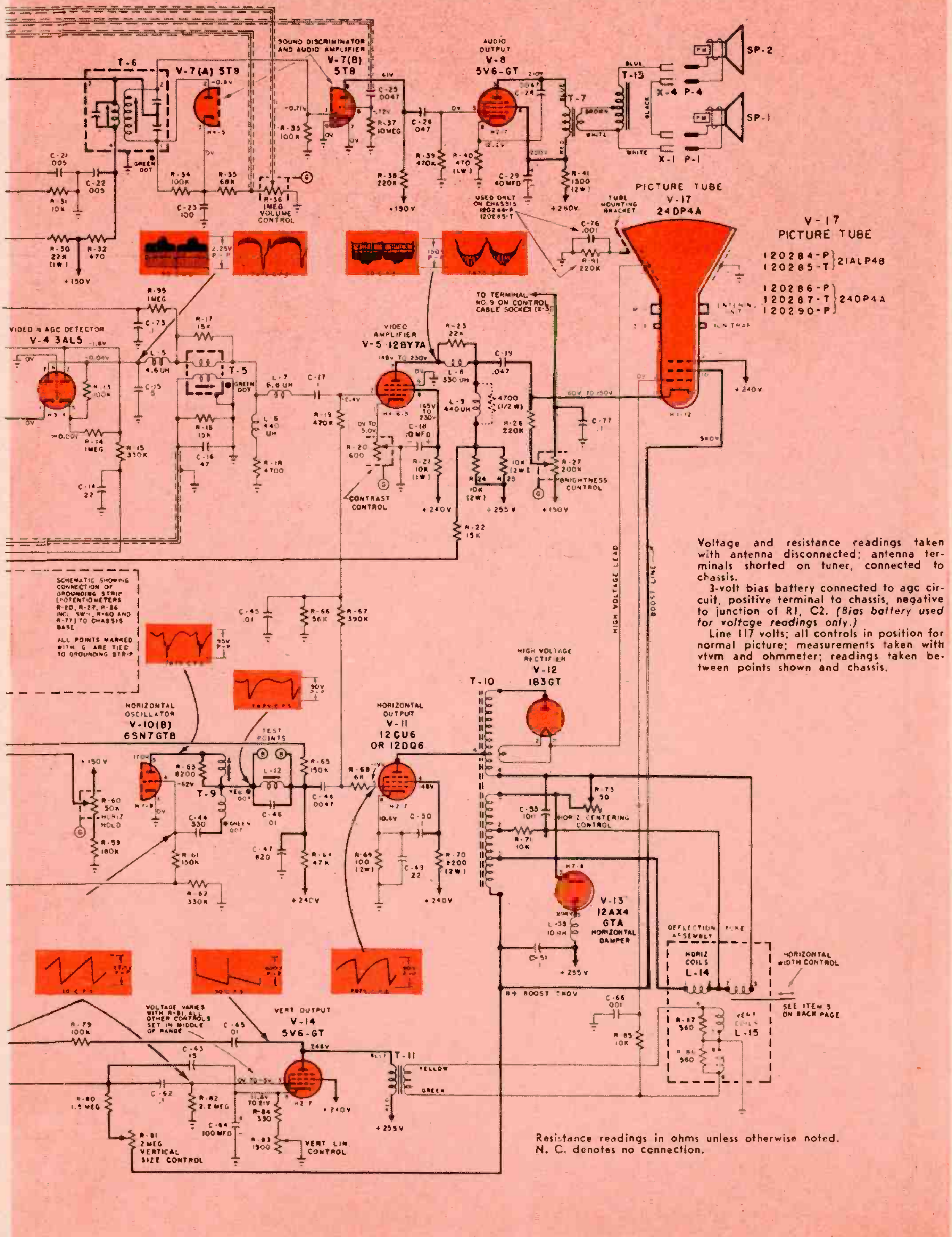




EMERSON


REMOTE CONTROL ASSEMBLY
REMOTE CONTROL ASSEMBLY USED ONLY ON CHASSIS 120290-P.
25 FEET OF CABLE
REMOTE CONTROL UNIT
CHANNEL SELECTOR
VOLUME CONTROL
BRIGHTNESS CONTROL
FINE TUNING CONTROL
MOTOR RELAY
DUAL RELAY
VHF ANTENNA
VHF TUNER
V-15 4BQ7A R.F. AMP
V-16 5AT8 OSC & MIXER
1ST VIDEO I.F. AMP
V-1 3CB6
2ND VIDEO I.F. AMP AND SOUND I.F. AMP
V-2 3CB6
3RD VIDEO I.F. AMP
V-3 3CB6
SOUND LIMITER
V-6(A)
5U8
LOW VOLTAGE RECTIFIER
V-18
5U4GB
SYNC. SEPARATOR
V-6(B)
5U8
SYNC. PHASE INVERTER
V-9(A)
6SN7GTB
HORIZONTAL CONTROL TUBE
V-10(A)
6SN7GTB
VERT. OSCILLATOR
V-9(B)
6SN7GTB
HEATERS
117 VOLTS AC LINE (60 CPS)
SAFETY INTERLOCK SWITCH
RESISTORS ARE IN OHMS (K=1000 OHMS) AND 1/2 WATT UNLESS OTHERWISE NOTED.
CAPACITORS LESS THAN ONE ARE IN MFD. CAPACITORS MORE THAN ONE ARE IN MMFD'S UNLESS OTHERWISE SPECIFIED.

CHASSIS 120284–P, 120285–T, 120286–P, 120287–T, 120290–P



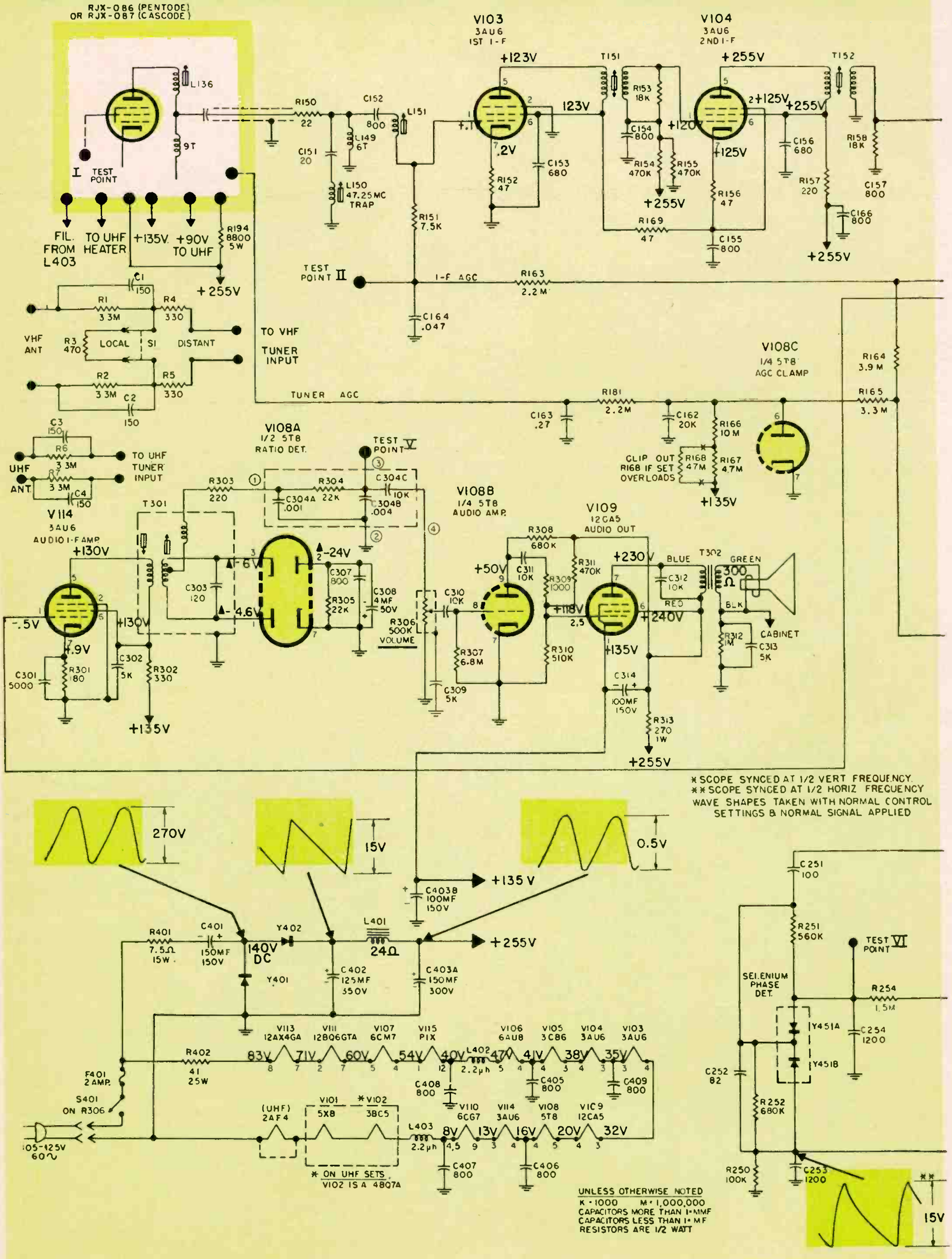
Voltage and resistance readings taken with antenna disconnected; antenna terminals shorted on tuner, connected to chassis.

3-volt bias battery connected to agc circuit, positive terminal to chassis, negative to junction of R1, C2. *(Bias battery used for voltage readings only.)*

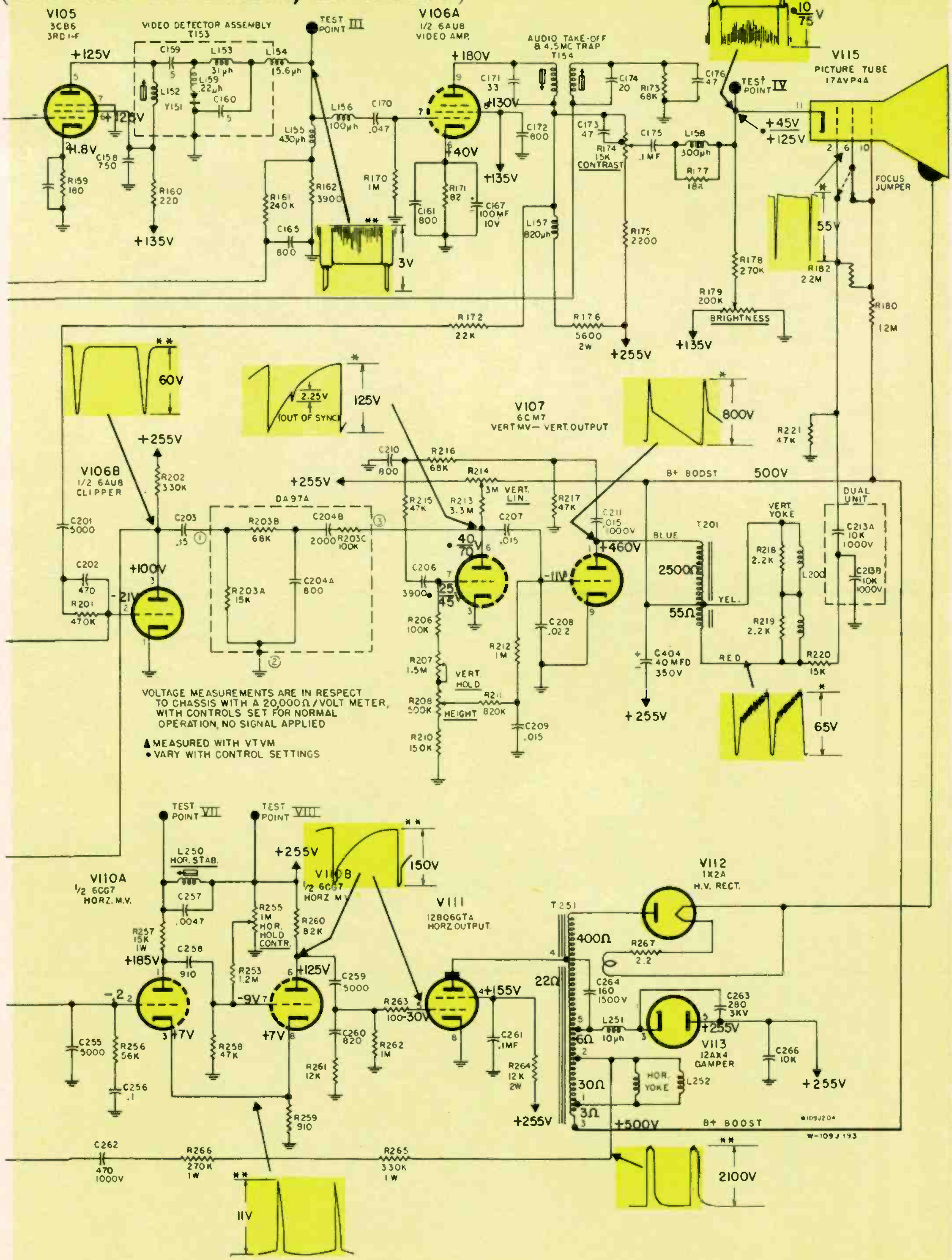
Line 117 volts; all controls in position for normal picture; measurements taken with vtvm and ohmmeter; readings taken between points shown and chassis.

Resistance readings in ohms unless otherwise noted.
N. C. denotes no connection.

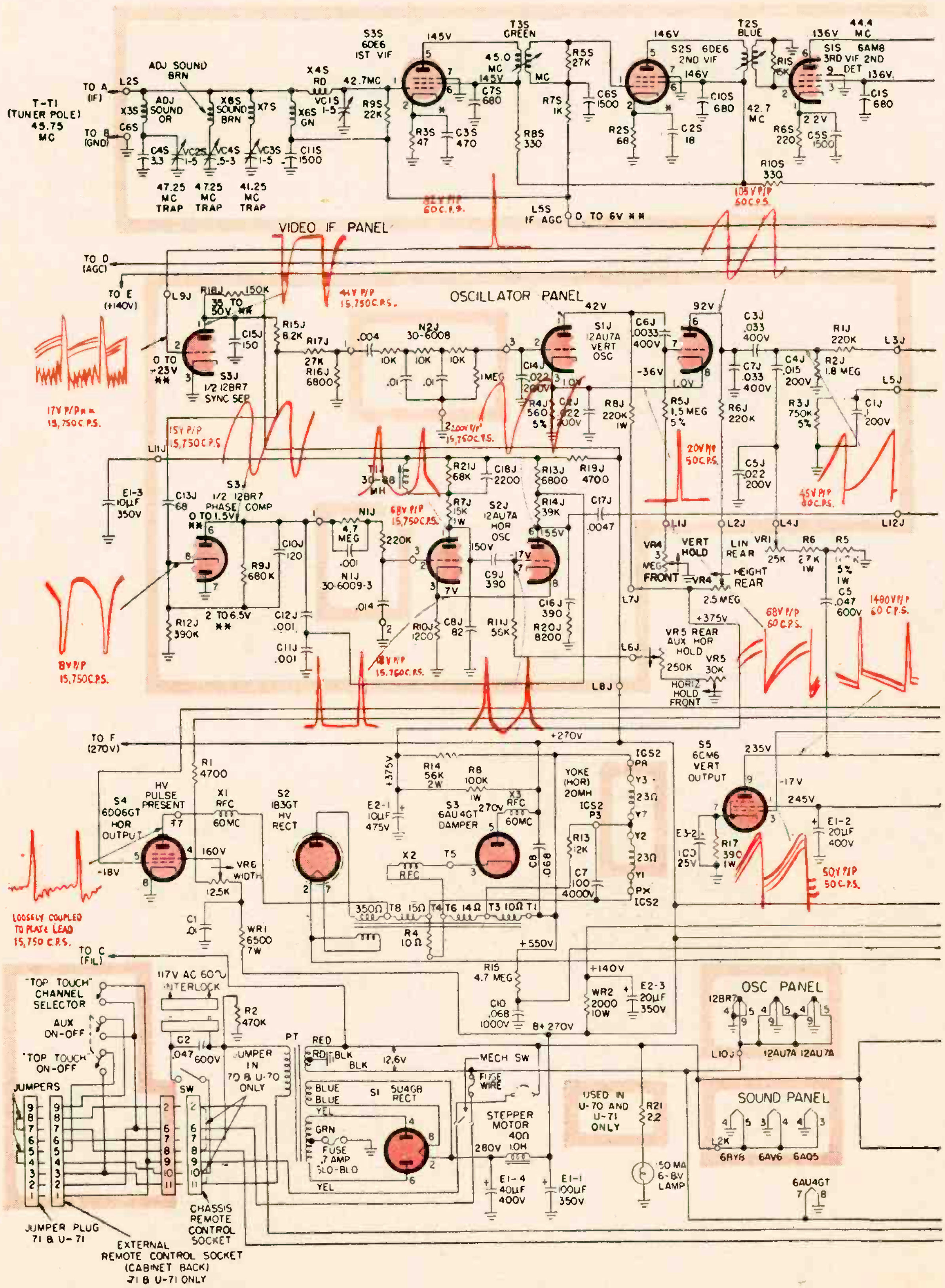
GENERAL ELECTRIC ER-S-MM56



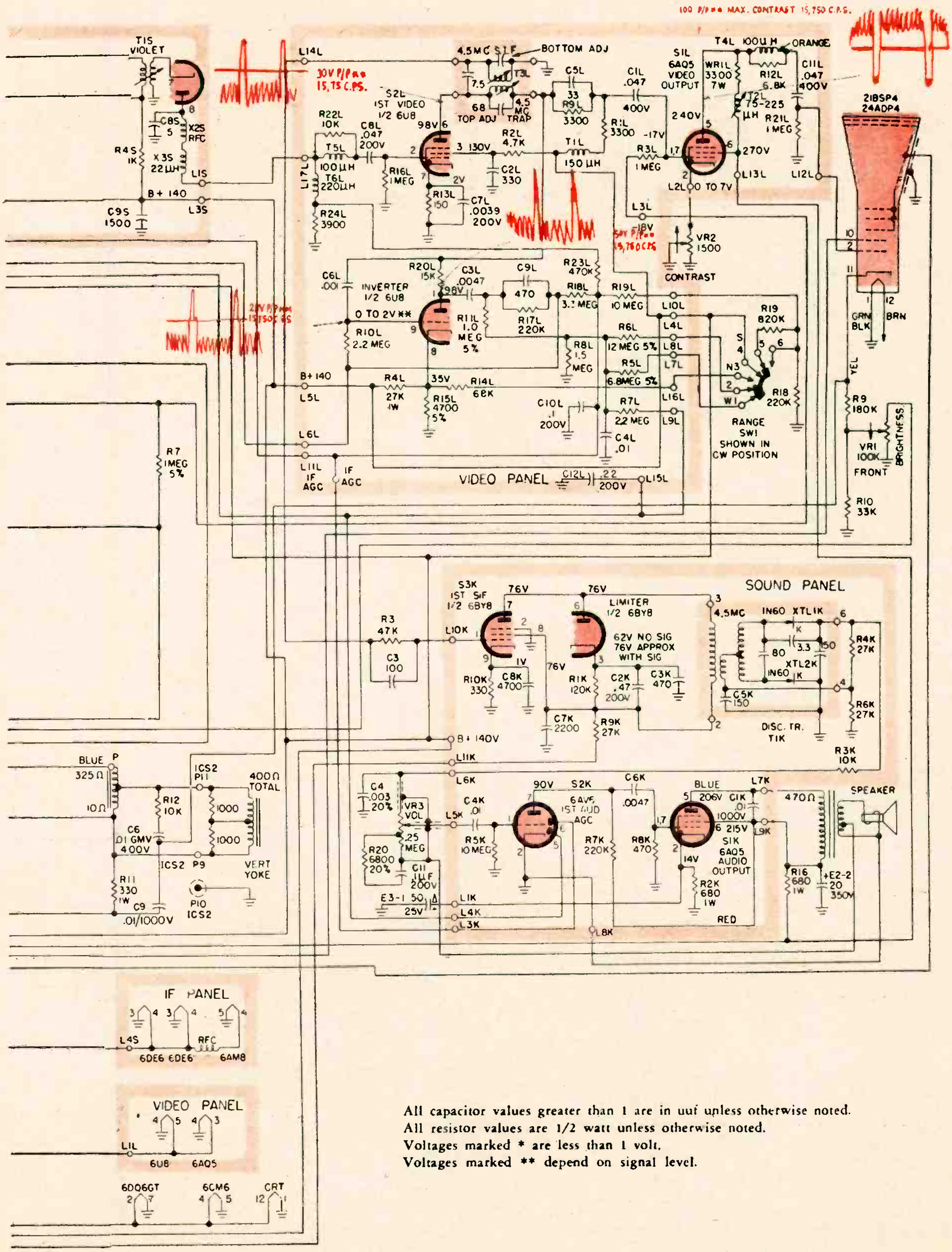
(Models 17T025, 17T026)



PHILCO TELEVISION



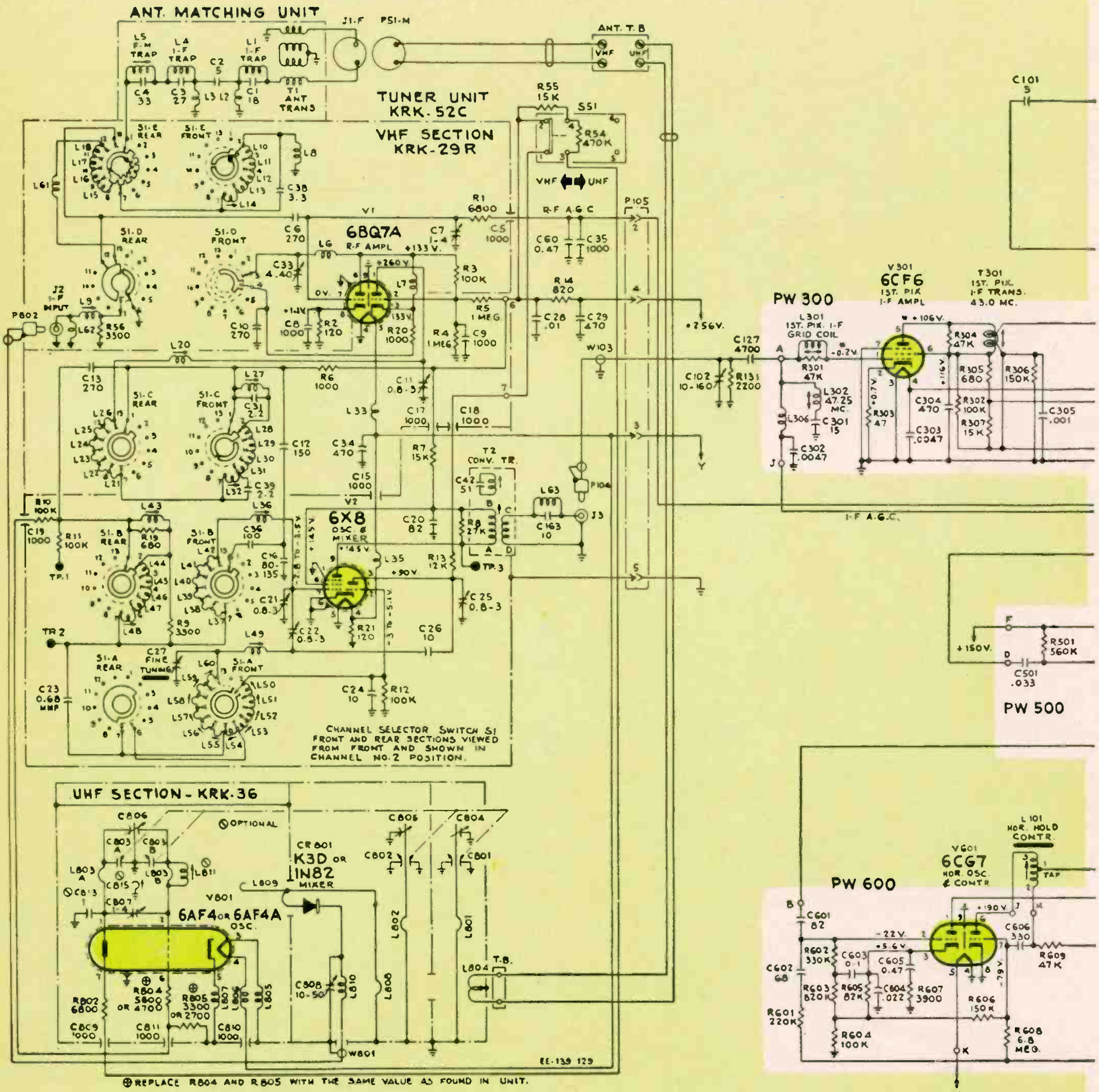
7L70, 7L71, 7L70-U, 7L71-U Chassis



All capacitor values greater than 1 are in uuf unless otherwise noted.
All resistor values are 1/2 watt unless otherwise noted.
Voltages marked * are less than 1 volt.
Voltages marked ** depend on signal level.

RCA VICTOR CHASSIS KCS98A, -C, -E, -F

Letter suffix on chassis number indicates type of tuner. Series A and E have KRK52B 12-channel vhf cascode tuners with switched incremental inductors. Series C and F use KRK52C all-channel tuners for 12 vhf channels and 70 uhf TV channels between 470 and 890 mc.

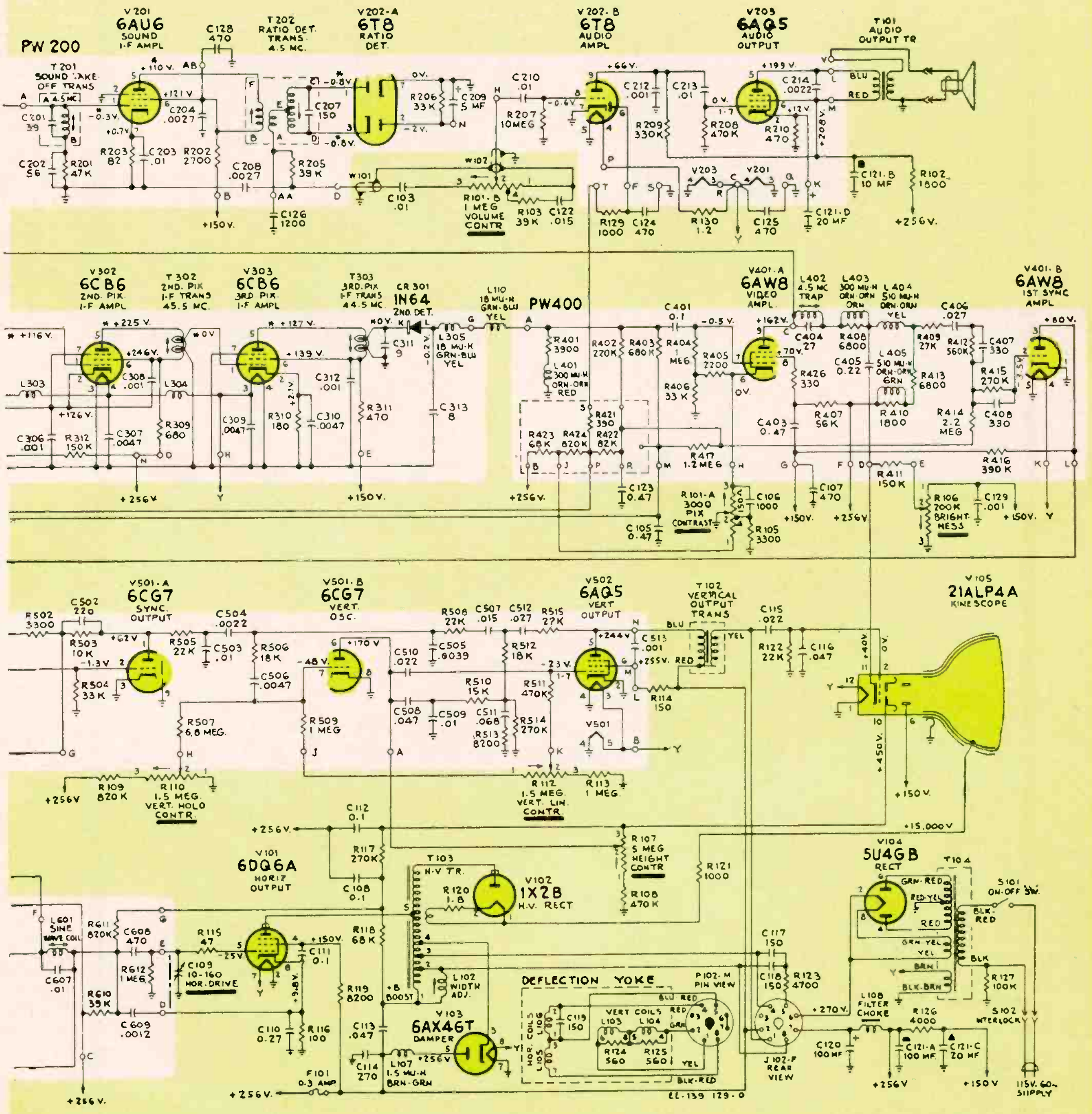


All-channel tuners have separate 300-ohm input terminals for vhf and uhf antennas. Install dpdt switch to connect lead-in to desired input terminals when using combination vhf–uhf antenna.

An RCA type 77858 matching transformer may be modified and used to provide correct match to 300-ohm terminals when using 72-ohm coaxial lead-in.

Models 21T-7112, 21-T-7113, 20-T-7117, 21-T-7152, 21-T-7153, 21-T-7157, 21-T-7355 and 21-T-7357

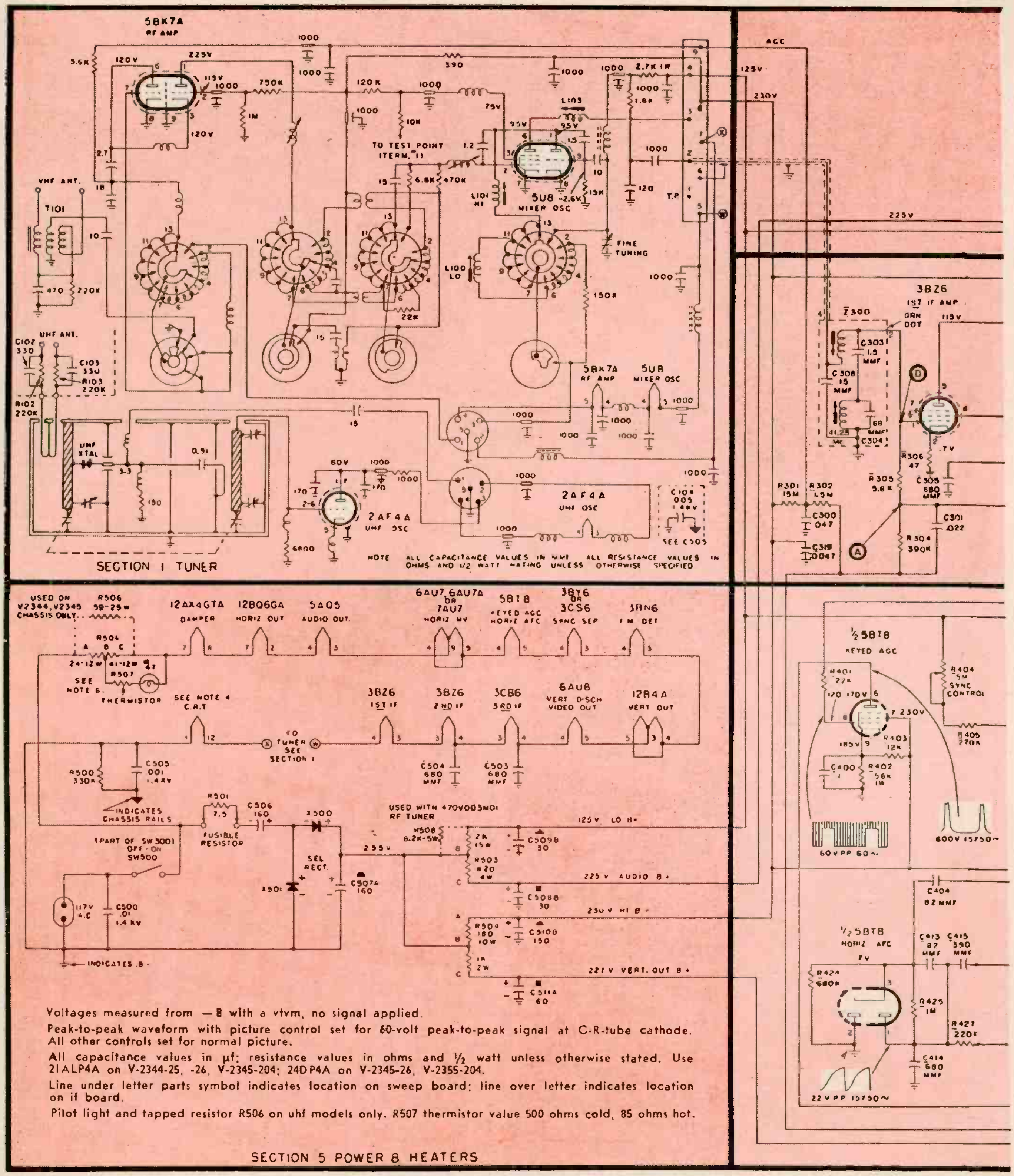
Uhf versions of these models are indicated by suffix U following model number. These models have separate tuning controls for uhf.



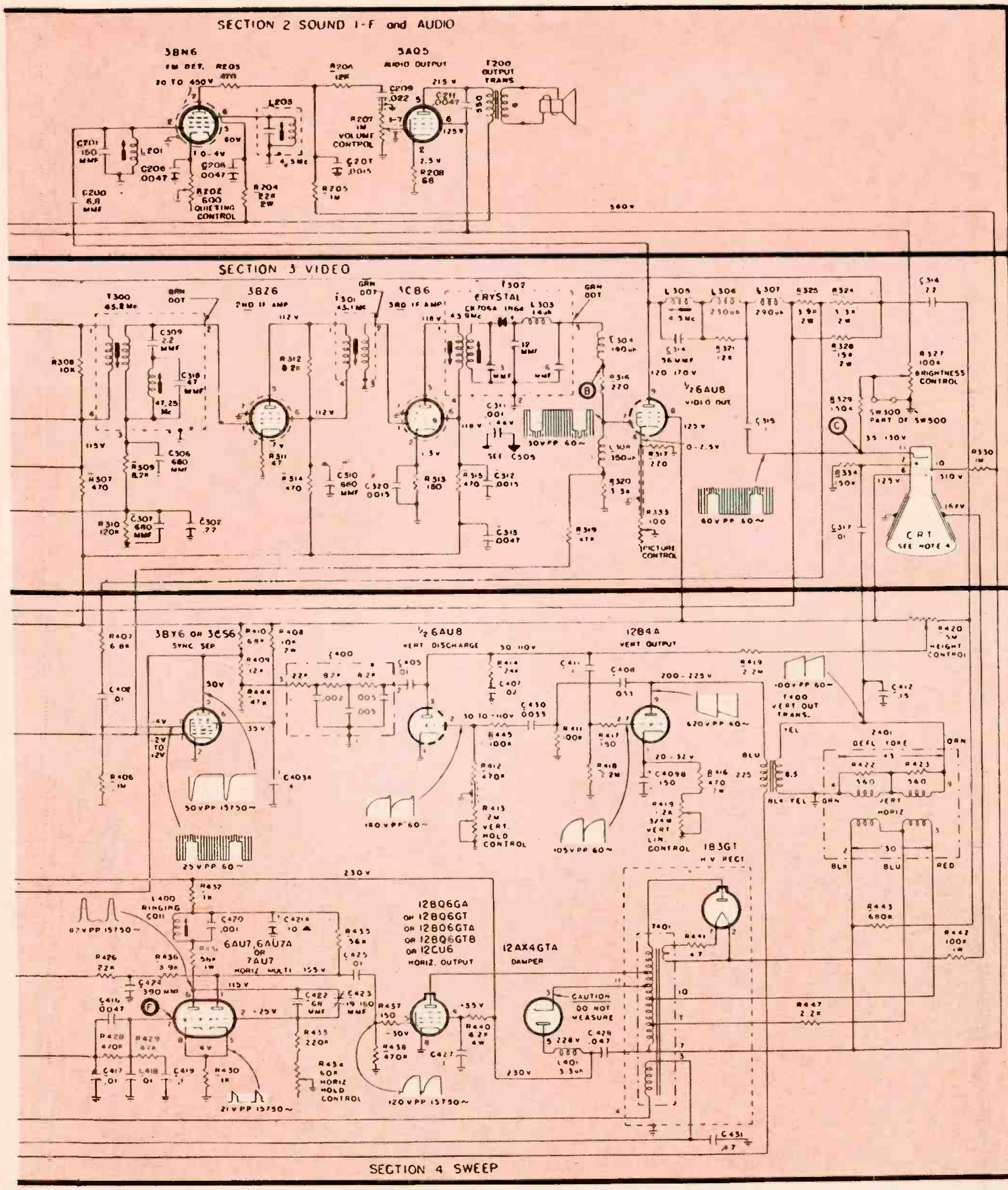
Tunable FM interference trap in antenna matching network can be tuned as low as channel 5 in some sets so always take care that adjustments do not reduce set's sensitivity on channels 5 or 6.

All voltages shown measured with vtvm and with no signal applied to the set. They should be within 20% when line voltage supply is 117.

WESTINGHOUSE



Chassis Assembly V-2344, V-2354 and V-2345, V-2355



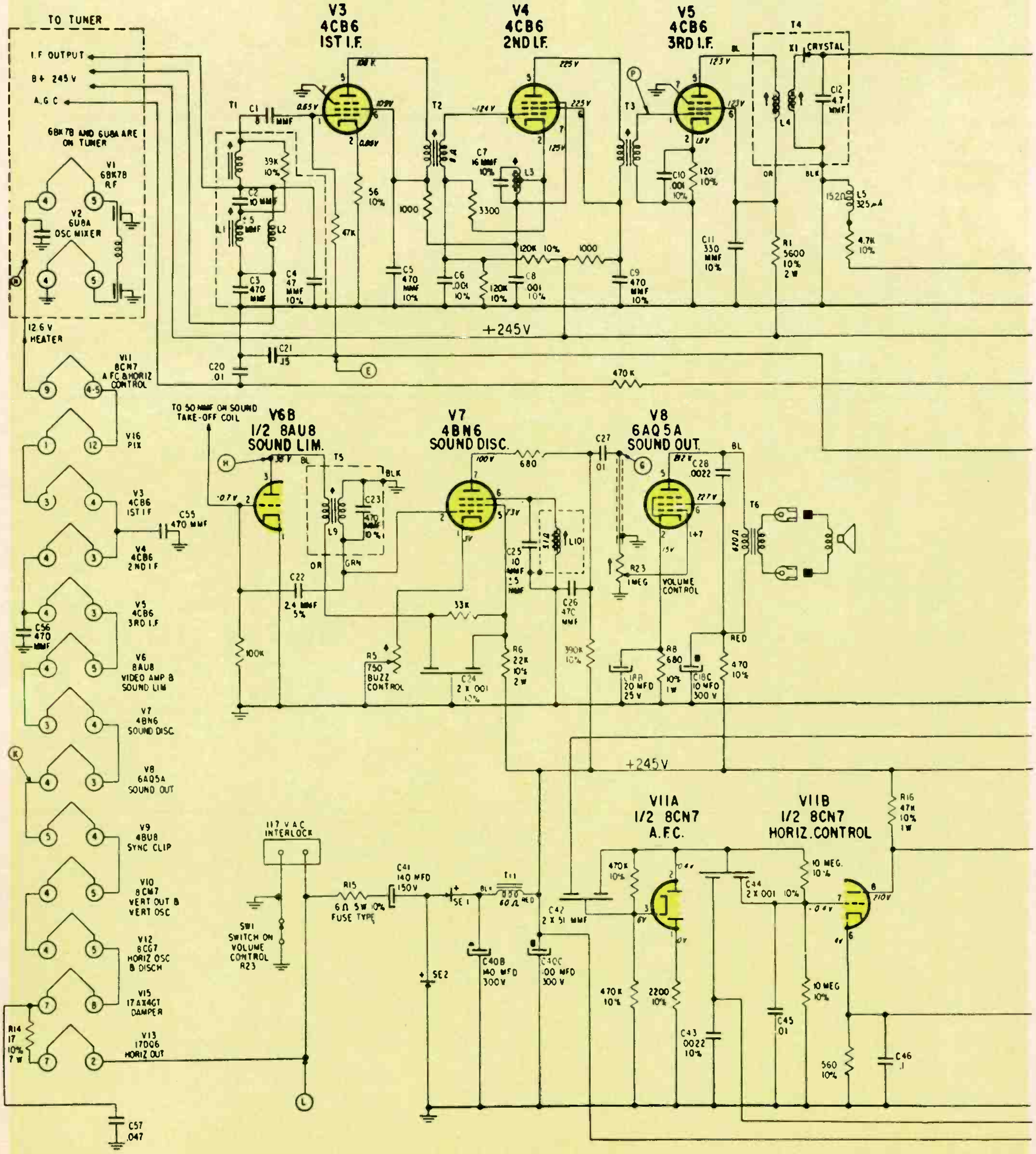
ZENITH 16Z20 SERIES

All voltages dc unless otherwise specified; measured from chassis to points indicated; all dc voltages measured by vtvm with 11 megohms input resistance.

Voltage measurements made with no signal present, normal control settings and selector set to channel 2 unless otherwise specified.

Capacitor values in µf; capacitor tolerances ±20%, unless otherwise specified.

Resistors ±20% carbon, 1/2 watt, unless



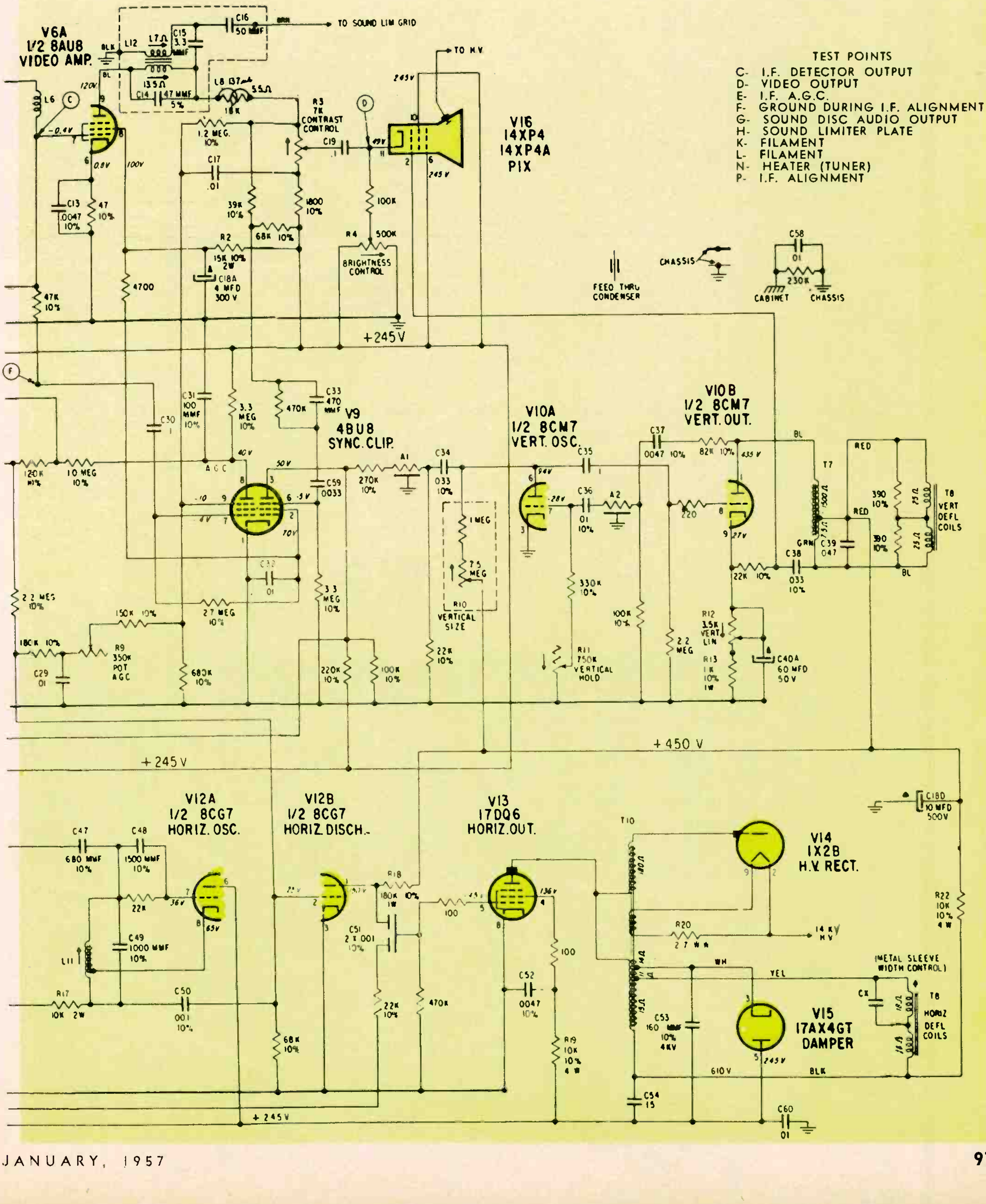
CHASSIS 16Z25

otherwise specified.

Resistance measurements shown with coils disconnected from circuit; coil resistances not given are under 1 ohm.

C-R tube 2d-anode voltage measured with electrostatic or 20,000 ohms-per-volt (minimum) high-voltage meter.

Circled letters indicate alignment and test points.



New

MODEL O-11

Shpg. Wt. 21 Lbs.

$69.50

- *An improved model of what was already an outstanding instrument.*
- *Performance is unmatched in this price range.*
- *Incorporates the extra features required for color TV servicing.*

HEATHKIT ETCHED CIRCUIT, PUSH-PULL

5″ Oscilloscope Kit

COLOR TV

The previous Heathkit oscilloscope (Model O-10) which was already a most remarkable instrument, has been improved even further with the release of the Heathkit Model O-11. It incorporates all the outstanding features of the preceding model, *plus* improved vertical linearity, better sync stability, especially at low frequencies, and much-improved over-all stability of operation, including less vertical bounce with changes in level. These improvements in the Model O-11 circuit make it even more ideally suited for color TV servicing, and for critical observations in the electronic laboratory. Vertical response extends from 2 CPS to 5 MC without extra switching. Response only down 2.2 DB at 3.58 MC. The 11-tube circuit features a 5UP1 cathode-ray tube. Sync circuit functions effectively from 20 CPS to better than 500 kc in five steps. Modern etched circuit boards employed in the oscilloscope circuit cut assembly time almost in half, permit a level of circuit stability never before achieved in an oscilloscope of this type, and insure against errors in assembly. Both vertical and horizontal output amplifiers are push-pull. Built-in peak-to-peak calibrating source — step-attenuated input — plastic molded capacitors and top-quality parts throughout — pre-formed and cabled wiring harness — and numerous other "extra" features. A professional instrument for the serviceshop or laboratory. Compare its specifications with those of scopes selling in much higher price brackets. You can't beat it!

Extra!

A FULL YEAR TO PAY

SEND FOR DETAILS OF HEATH TIME-PAYMENT PLAN.

5 BIG REASONS WHY

Heathkits®

ARE YOUR BEST BUY...

1 FEWER DOLLARS BRING MORE REAL QUALITY.

- Factory-to-you sales eliminate extra profit margin.
- "Build-it-yourself" eliminates labor charge.
- Heath purchasing power cuts component costs.

2 PERSONAL SERVICE ASSURES CUSTOMER SATISFACTION.

- You deal directly with the manufacturer.
- We are interested in you before and after sale.

3 PROVEN DESIGNS MEAN RELIABLE PERFORMANCE.

- Research and development efforts concentrated on kits only.
- All kits guaranteed to meet advertised specifications.

4 EVERY KIT BACKED BY WORLD-WIDE REPUTATION.

- The world's largest manufacturer of electronic equipment in kit form.
- Producer of more than a million electronic kits for the home workshop and industry.

5 EASY TIME-PAYMENT PLAN TO FIT YOUR BUDGET.

HEATH COMPANY

A SUBSIDIARY OF DAYSTROM, INC.

BENTON HARBOR 20, MICH.

GREATEST SELECTION . . .

Whether your particular special interest is in servicing, ham-radio, high-fidelity, or just experimenting—there are Heathkits to fill your needs. You can equip an entire service shop or lab, buy a complete ham station or high-fidelity system, or set up a really deluxe home workshop, by choosing from the more than 70 different "do-it-yourself" electronic kits by Heath. Just glance through the kits displayed in this ad, and you will get some idea of the tremendous array of low-priced, high-quality electronic equipment available.

New **HEATHKIT ETCHED CIRCUIT**

5" Oscilloscope Kit

* *Brand new model with improved performance specifications.*
* *Full 5" scope for service work at a remarkably low price.*
* *Attractively styled front panel in charcoal gray with sharp white lettering.*
* *Easy to build from step-by-step instructions and large pictorials. Not necessary to read schematic.*

This new and improved oscilloscope retains all the outstanding features of the preceding model, but provides wider vertical frequency response, extended sweep-generator coverage, and increased stability. A new tube complement and improvements in the circuit make these new features possible. Vertical frequency response is essentially flat to over 1 mc, and down only 1½ DB at 500 kc. The sweep generator multivibrator functions reliably from 30 to 200,000 CPS, almost twice the coverage provided by the previous model. Deflection amplifiers are push-pull, and modern etched circuits are employed in critical parts of the design. A 5BP1 cathode-ray tube is used. The scope features external or internal sweep and sync, one volt peak-to-peak reference voltage, 3-position step-attenuated input, adjustable spot-shape control, and many other "extras" not expected at this price level. A calibrated grid screen is also provided for the face of the CRT, allowing more precise observation of wave shapes displayed. The new Model OM-2 is designed for general application wherever a reliable instrument with good response characteristics may be required. Complete step-by-step instructions and large pictorial diagrams assure easy assembly.

MODEL OM-2

$42.50

Shpg. Wt. 21 Lbs.

HEATHKIT LOW CAPACITY PROBE KIT

Oscilloscope investigation of high frequency, high impedance, or broad bandwidth circuits encountered in television requires the use of a low-capacity probe to prevent loss of gain, circuit loading, or waveform distortion. The Heathkit low-capacity probe may be used with your oscilloscope to eliminate these effects. It features a variable capacitor, to provide correct instrument impedance match. Also, the ratio of attenuation can be varied.

No. 342

$3.50

Shpg. Wt. 1 Lb.

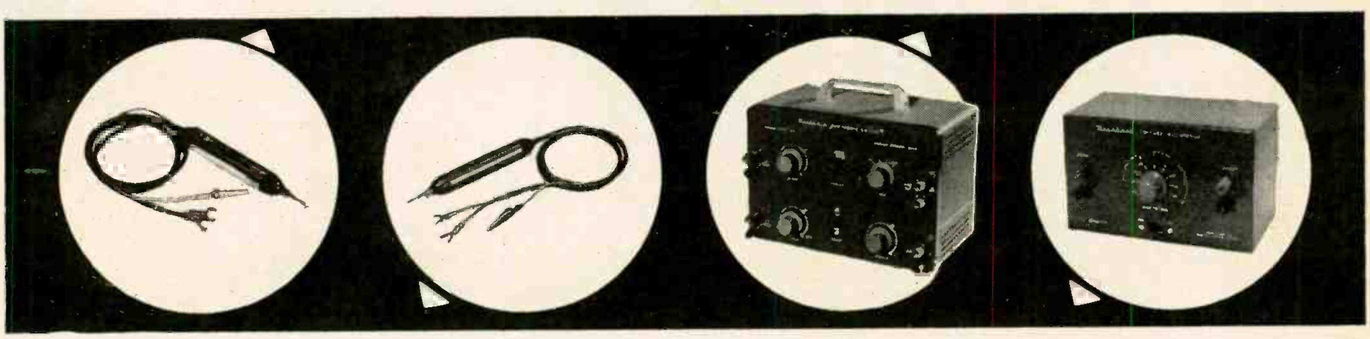
HEATHKIT ELECTRONIC SWITCH KIT

This handy device allows simultaneous oscilloscope observation of two signals by producing both signals, alternately, at its output. It features an all-electronic switching circuit, with no moving parts. Four switching rates are selected by a panel switch. Provides actual gain for input signals, and has a frequency response of ± 1 DB from 0 to 100 kc. Sync output provided to control and stabilize scope sweep. Will function at signal levels as low as 0.1 volt. This modern device finds many applications in the laboratory and service shop. It employs an entirely new circuit, and yet is priced lower than its predecessor.

MODEL S-3

$21.95

Shpg. Wt. 8 Lbs.



HEATHKIT SCOPE DEMODULATOR PROBE KIT

Extend the usefulness of your oscilloscope by employing this probe. Makes it possible to observe modulation of RF or IF carriers found in TV and radio receivers. Functions much like an AM detector to pass only modulation of signal, and not the signal itself. Among other uses, it will be helpful in alignment work, as a signal tracer, and for determining relative gain. Applied voltage limits are 30 volts (RMS) and 500 volts DC. It uses an etched circuit board to simplify assembly.

NO. 337-C

$3.50

Shpg. Wt. 1 Lb.

HEATHKIT VOLTAGE CALIBRATOR KIT

This entirely new voltage calibrator produces near-perfect square wave signals of known amplitude. Precision 1% attenuator resistors assure accurate output amplitude, and multivibrator circuit guarantees good, sharp square waves, as distinguished from clipped sine waves. Output frequency is approximately 1000 CPS. Fixed outputs selected by panel switch are; .03, 0.1, 0.3, 1.0, 3.0, 10, 30, and 100 volts peak-to-peak. Allows measurement of unknown signal amplitudes by comparing to known peak-to-peak output of VC-3 on an oscilloscope. Will also double as a square wave generator at 1000 cycles for determining gain, frequency response, or phase-shift characteristics of audio amplifiers. Equally valuable in the laboratory or in radio and TV service shops.

MODEL VC-3

$12.50

Shpg. Wt. 4 Lbs.

HEATHKIT ETCHED CIRCUIT VACUUM TUBE

Voltmeter Kit

✻ *Easy to build — a pleasure to use.*

✻ *1% precision resistors employed for high accuracy.*

✻ *Etched circuit board cuts assembly time in half.*

The fact that this instrument is the world's largest-selling VTVM says a great deal about its accuracy, reliability, and overall quality. The V-7A is equally popular in the laboratory or service shop, and represents an unbelievable test equipment bargain, without a corresponding sacrifice in quality. Its appearance reflects the performance of which it is capable. A large 4½" panel meter is used for indication, with clear, sharp calibrations for all ranges. Front panel controls consist of a rotary function switch and a rotary range selector switch, zero-adjust, and ohms-adjust controls. Precision 1% resistors are used in the voltage divider circuits and etched circuits are employed for most of the circuitry. This makes the kit much easier to build, eliminates the possibility of wiring errors, and assures duplication of laboratory instrument performance. This multi-function VTVM will measure AC voltage (rms), AC voltage (peak-to-peak), DC voltage, and resistance. There are 7 AC (rms) and DC voltage ranges of 0-1.5, 5, 15, 50, 150, 500, and 1500. In addition, there are 7 peak-to-peak AC ranges of 0-4, 14, 40, 140, 400, 1400, and 4000. 7 ohmmeter ranges provide multiplying factors of X1, X10, X100, X1000, X10K, X100K, and X1 megohm. Center-scale resistance readings are 10, 100, 1000, 10K, 100K ohms, 1 megohm, and 10 megohms. A DB scale is also provided. The precision and quality of the components used in this VTVM cannot be duplicated at this price through any other source. Model V-7A is the kind of instrument you will be proud to own and use.

HEATHKIT Etched Circuit RF PROBE KIT

This RF probe extends the frequency response of any 11-megohm VTVM so that it will measure RF up to 250 megacycles within ± 10%. Employs printed circuit for increased stability and ease of assembly. Ideal for extending service and laboratory applications of your Heathkit VTVM.

No. 309-C **$3.50** Shpg. Wt. 1 Lb.

HEATHKIT 20,000 OHMS/VOLT VOM KIT

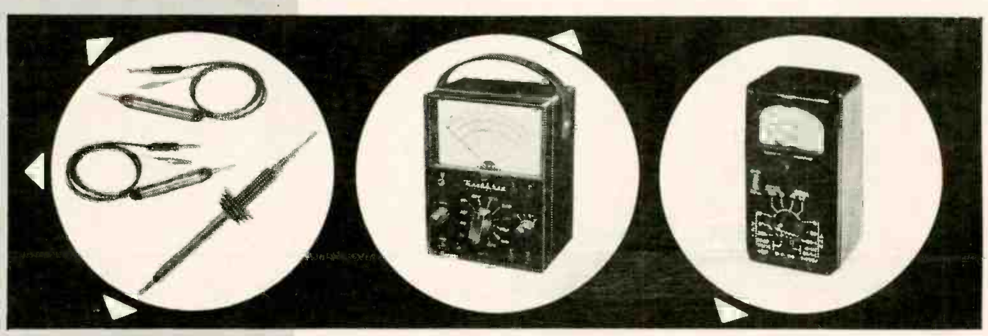
Sensitivity of this instrument is 20,000 ohms-per-volt DC and 5,000 ohms-per-volt AC. Measuring ranges are 0-1.5, 5, 50, 150, 500, 1500, and 5000 volts for both AC and DC. Also measures current in the ranges of 0-150 microamperes, 15 ma, 150 ma, 500 ma, and 15 a. Resistance ranges provide multipliers of X1, X100, and X10,000, resulting in center scale readings of 15, 15,000, and 150,000 ohms. DB ranges cover from —10 db to +65 db. Housed in attractive black bakelite case with plastic carrying handle, this fine instrument provides a total of 25 meter ranges on its two-color scale. It employs a sensitive 50 microampere, 4½" meter and features all 1% precision multiplier resistors. Requires no external power, and is, therefore, valuable in portable applications where no AC power is available.

MODEL MM-1 **$29.50** Shpg. Wt. 6 Lbs.

ETCHED CIRCUIT PEAK-TO-PEAK PROBE KIT

Use this peak-to-peak probe with your 11-megohm VTVM to measure peak-to-peak voltages directly on the DC scales of the instrument. Will measure p-to-p voltages in the frequency range of 5 kc to 5 mc. Employs etched circuit boards for increased circuit stability and simplified construction. Extend the usefulness of your VTVM. NOTE: Not required for the Heathkit V-7A VTVM.

NO. 338-C **$5.50** Shpg. Wt. 2 Lbs.



HEATHKIT 30,000 VOLT DC HIGH VOLTAGE PROBE KIT

This probe provides a multiplication factor of 100 on the DC ranges of the Heathkit 11-megohm VTVM. Precision multiplier resistor mounted inside the two-color plastic probe body. Plenty of insulation for completely safe operation, even at highest TV potentials. Designed especially for TV service work.

No. 336 **$4.50** Shpg. Wt. 2 Lbs.

HEATHKIT HANDITESTER KIT

The Model M-1 measures AC or DC voltage at 0-10, 30, 300, 1000, and 5000 volts. Direct current ranges are 0-10 ma, and 0-100 ma. Ohmmeter ranges are 0-3000 (30 ohm center scale) and 0-300,000 ohms (3,000 ohms center scale). Uses a 400 microampere meter for sensitivity of 1000 ohms-per-volt. A very popular test device for the home experimenter, electricians, and appliance repairmen, and for use as an "extra" instrument in the service shop. Its small size and rugged construction make it perfect for any portable application. Easily slips into your tool box, glove compartment, coat pocket, or desk drawer. Top quality, precision components employed throughout.

MODEL M-1 **$14.50** Shpg. Wt. 3 Lbs.

HEATH COMPANY
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BENTON HARBOR 20, MICH.

CONTROLLED QUALITY . . .

Incoming parts inspection, and inspection of material coming off of our own production line assures you of the finest "build-it-yourself" kit that money can buy. Each kit contains all the components you need for assembly—and you can have confidence in the quality of the parts themselves. In addition to this inspection procedure, an extensive proof-building program for each new kit guarantees easy-to-follow instructions and reliable performance.

HEATHKIT NEW AUDIO VACUUM TUBE

Voltmeter Kit

* *Brand new circuit for extended frequency response and added stability.*
* *Ten accurate ranges from 0-.01 to 0-300 volts.*
* *Modern, functional panel styling. "On-off" switch at both extreme ends of range switch.*

This brand new AC vacuum tube voltmeter emphasizes stability, broad frequency response, and sensitivity. It is designed especially for audio measurements, and low-level AC measurements in power supply filters, etc. Employs a cascode amplifier circuit with cathode-follower isolation between the input and the amplifier, and between the output stage and the preceeding stages. An extremely stable circuit with high input impedance (1 megohm at 1000 CPS). Response of the AV-3 is essentially flat from 10 CPS to 200 kc, and is usable for tests even beyond these frequency limits. Increased damping in the meter circuit stabilizes the meter for low frequency tests. Nylon insulating bushings at the input terminals reduce leakage, and permit the use of the 5-way Heath binding post.

The extremely wide voltage range covered by the AV-3 makes it especially valuable not only in high-fidelity and service work, but also in experimental laboratories. AC (RMS) voltage ranges are 0-.01, .03, .1, .3, 1, 3, 10, 30, 100, and 300 V. Decibel ranges cover −52 DB to +52 DB. An entirely new circuit as compared to the previous model. Employs 1% precision multiplier resistors for maximum accuracy. Handles AC measurements from a low value of one millivolt to a maximum of 300 volts.

MODEL AV-3

$29.95

Shpg. Wt. 5 Lbs.

HEATHKIT AUDIO WATTMETER KIT

This instrument measures audio power directly at 4, 8, 16, or 600 ohms. Load resistors are built in. Covers 0-5 MW, 50 MW, 500 MW, 5 W, and 50 W full scale. Provides 5 switch-selected DB ranges covering from −10 DB to +30 DB. Large 4½" 200 microampere meter and precision multiplier resistors insure accuracy. Frequency response is ± 1 DB from 10 CPS to 250 kc. Functions from AC power line. Use in the audio laboratory or in home workshop.

MODEL AW-1

$29.50

Shpg. Wt. 6 Lbs.

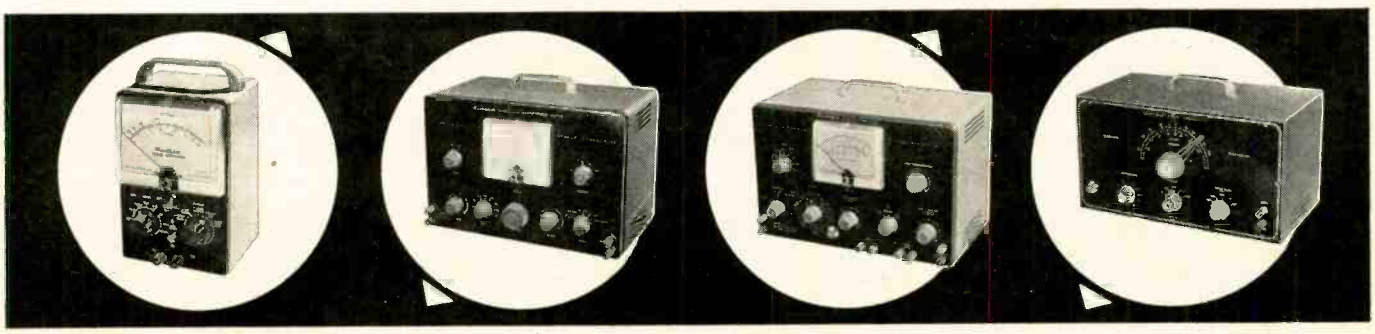
HEATHKIT AUDIO ANALYZER KIT

This multi-function instrument combines an AC VTVM, an audio wattmeter, and an intermodulation analyzer into one case, with combined input and output terminals and built-in high and low frequency oscillators. The VTVM ranges are .01, .03, .1, .3, 1, 3, 10, 30, 100, and 300 volts (RMS). Wattmeter ranges are .15 MW, 1.5 MW, 15 MW, 150 MW, 1.5 W, 15 W, 150 W. IM scales are 1%, 3%, 10%, 30%, and 100%. Provides internal load resistors of 4, 8, 16, or 600 ohms. A valuable instrument for the engineer or serious audiophile.

MODEL AA-1

$49.95

Shpg. Wt. 13 Lbs.



HEATHKIT HARMONIC DISTORTION METER KIT

The HD-1 is equally valuable for the audio engineer or the serious audiophile. Used with a low-distortion audio signal generator, this instrument will measure the harmonic content of various amplifiers under a variety of conditions. Functions between 20 and 20,000 CPS, and reads distortion directly on the panel meter in ranges of 0-1, 3, 10, 30, and 100 percent full scale. Built-in VTVM for initial reference settings and final distortion readings has voltage ranges of 0-1, 3, 10, and 30 volts. 1% precision resistors employed for maximum accuracy. Features voltage regulation and other "extras". Meter calibrated in volts (RMS), percent distortion, and DB.

MODEL HD-1

$49.50

Shpg. Wt. 13 Lbs.

HEATHKIT AUDIO OSCILLATOR KIT

Producing both sine waves and square waves, the Model AO-1 covers a frequency range of 20 to 20,000 CPS in three ranges. An extra feature is thermistor regulation of output for flat response through the entire frequency range. AF output is provided at low impedance, and with low distortion. Produces good sine waves, and good, clean square waves with a rise time of only two micro-seconds for checking square wave response of audio amplifiers, etc. Designed especially for the serviceman and high-fidelity enthusiast. A real dollar value in test equipment.

MODEL AO-1

$24.50

Shpg. Wt. 10 Lbs.

HEATHKIT

Audio Generator Kit

MODEL AG-9

$34.50

Shpg. Wt. 8 Lbs.

This particular audio generator is "made to order" for high fidelity applications. It provides quick and accurate selection of low-distortion signals throughout the audio range. Three rotary selector switches on the front panel allow selection of two significant figures and a multiplier for determining audio frequency. In addition, it incorporates a step-type output attenuator and a continuously variable attenuator. Output is indicated on a large 4½" panel meter calibrated in volts and in db. Attenuator system operates in steps of 10 db, corresponding with the meter calibration. Output ranges are 0-.003, .01, .03, .1, .3, 1, 3, and 10 volts rms. A "load" switch provides for the use of a built-in 600 ohm load or an external load of higher impedance when required. Output and frequency indicators accurate to within ± 5%. Distortion is less than .1 of 1% between 20 cps and 20,000 cps. Total range is 10 cps to 100 kc. New engineering details combine to provide the user with an unusually high degree of operating efficiency. Oscillator frequency selected entirely by the switch method means that accurate resetability is provided. Comparable to units costing many dollars more, and ideal for use in critical high fidelity applications. Shop and compare, and you will appreciate the genuine value of this professional instrument.

- *Less than 0.1% distortion — ideal for hi fi work.*
- *Large 4½" meter indicates output.*
- *Step-type tuning for maximum convenience.*

HEATHKIT RESISTANCE SUBSTITUTION BOX KIT

The RS-1 contains 36 10% 1-watt resistors ranging from 15 ohms to 10 megohms in standard RETMA values. All values are switch-selected for use in determining desirable resistance values in experimental circuits. Many applications in radio and TV service work.

MODEL RS-1 **$5.50** *Shpg. Wt. 2 Lbs.*

HEATHKIT CONDENSER SUBSTITUTION BOX KIT

This kit contains 18 RETMA standard condenser values that can be selected by a rotary switch. Values range from 0.00001 mfd to 0.22 mfd. All capacitors rated at 400 volts or higher. Capacitors are either silver-mica, or plastic molded.

MODEL CS-1 **$5.50** *Shpg. Wt. 2 Lbs.*

HEATHKIT AUDIO GENERATOR KIT

The Model AG-8 is a low cost, high performance unit for use in service shop, or home workshop. It covers the frequency range of 20 cps to 1 mc in five ranges. Output is 600 ohms, and overall distortion will be less than .4 of 1% from 100 cps through the audible range. Output is available up to 10 volts, under no load conditions, and output remains constant within ±1 db from 20 cps to 400 kc. A five-step attenuator provides control of the output. Precision resistors are employed in the frequency determining network.

MODEL AG-8 **$29.50** *Shpg. Wt. 11 Lbs.*

HEATHKIT DECADE CONDENSER KIT

Precision, 1% silver-mica capacitors are employed in the Model DC-1 in such a way that a selection of precision capacitor values is provided ranging from 100 mmf (.0001 mfd) to 0.11 mfd (110,000 mmf) in 100 mmf steps. Extremely valuable in all types of design and development work. Switches are ceramic wafer types.

MODEL DC-1 **$16.50** *Shpg. Wt. 3 Lbs.*

HEATHKIT DECADE RESISTANCE KIT

The Model DR-1 incorporates twenty 1% precision resistors arranged around five rugged switches so that various combinations of switch positions will provide a total range of 1 ohm to 99,999 ohms in 1-ohm steps. Switches are labeled "units," "tens," "hundreds," "thousands," and "ten thousands." Use it for ohm-meter calibration in bridge circuits as test values in multiplier circuits, etc.

MODEL DR-1 **$19.50** *Shpg. Wt. 4 Lbs.*

HEATHKIT VARIABLE VOLTAGE REGULATED POWER SUPPLY KIT

This power supply is regulated for stability, and the amount of DC output available from the power supply can be controlled manually from zero to 500 volts. Will provide regulated output at 450 volts up to 10 ma, or up to 130 ma at 200 volts output. In addition to furnishing B-plus, the power supply provides 6 volts AC at 4 amperes for filaments. Both the B-plus output and the filament output are isolated from ground. Ideal power supply for use in experimental work in the laboratory, the home workshop, or the ham shack. Large 4½" panel meter indicates output voltage or current.

MODEL PS-3 **$35.50** *Shpg. Wt. 17 Lbs.*

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BENTON HARBOR 20, MICH.

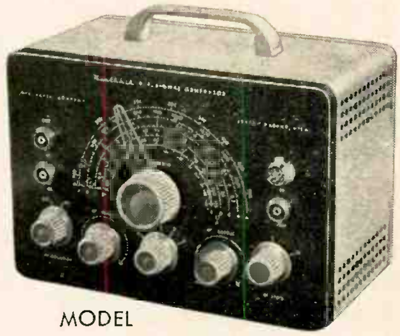
BONUS PERFORMANCE . . .

If a single word had to be selected to describe Heath Company advertising policy, it would be "conservative." By this we mean that the performance specifications and features are not exaggerated, and that the descriptions are accurate. We specify performance on the conservative side so you can be sure of equaling or exceeding our specifications. In almost every instance our kits will do more than we claim. Extra care in construction, and calibration against an accurate standard can extend performance well beyond advertised levels.

HEATHKIT

Signal Generator Kit

- * *No calibration required with pre-aligned coils.*
- * *Modulated or unmodulated RF output.*
- * *110 mc to 220 mc frequency coverage.*



MODEL SG-8

$19.50 Shpg. Wt. 8 Lbs.

Here is an RF signal generator for alignment applications in the service shop or the home workshop. Thousands of these units are in use in service shops all over the country. Produces RF signals from 160 kc to 110 mc on fundamentals on five bands. Also covers from 110 mc to 220 mc on calibrated harmonics. RF output is in excess of 100,000 microvolts at low impedance. Output is controllable with a step-type and a continuously variable attenuator. Front panel controls provide selection of either unmodulated RF output or RF modulated at 400 cps. In addition, two to three volts of audio at approximately 400 cps are available at the output terminals for testing AF circuits. Employs a 12AU7 and a 6C4 tube. Built-in power supply uses a selenium rectifier.

One of the most outstanding features about the Model SG-8 is the fact that it can be built in just a few hours, even by one not thoroughly experienced in electronics work. Complete step-by-step instructions combined with large pictorial diagrams assure successful assembly. Pre-aligned coils make calibration from an external source unnecessary.

HEATHKIT LABORATORY GENERATOR KIT

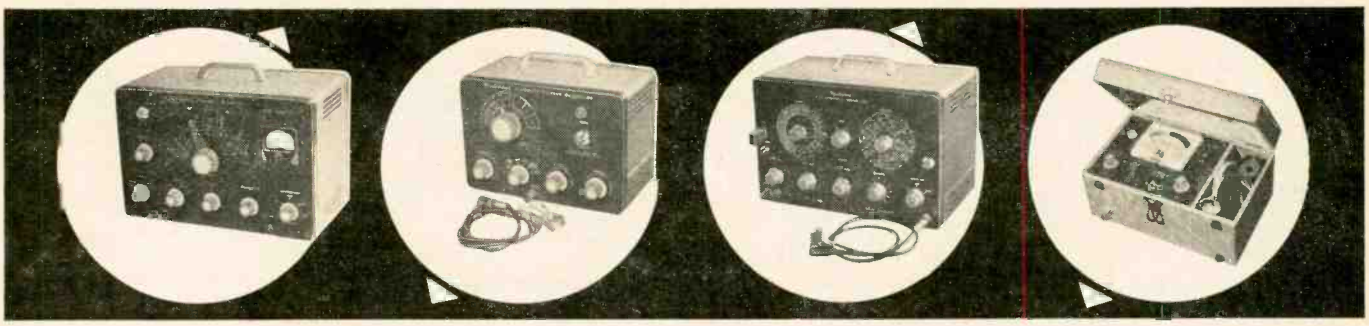
This laboratory RF signal generator covers from 100 kc to 30 mc on fundamentals in five bands. The output signal may be pure RF, or may be modulated at 400 cycles from 0 to 50%. Provision for external modulation has been made. RF output available up to 100,000 microvolts. Output controlled by a fixed step and a variable attenuator. Output impedance is 50 ohms. Panel meter reads RF output or percentage of modulation. Incorporates voltage regulated B+ supply, double shielding of oscillator circuits, copper plated chassis, and other "extras."

MODEL LG-1 $48.95 Shpg. Wt. 16 Lbs.

HEATHKIT TV ALIGNMENT GENERATOR KIT

This improved sweep generator model provides essential stability and flexibility for work on FM, monochrome TV, or color TV sets. Covers 3.6 mc to 220 mc in four bands. Provides usable output even on harmonics. Sweep deviation from 0-42 mc, depending on base frequency. All-electronic sweep circuit eliminates unwieldy mechanical arrangements. Includes built-in crystal marker generator providing output at 4.5 mc and multiples thereof, and variable marker covering 19 to 60 mc on fundamentals and from 57 to 180 mc on harmonics. Effective two-way blanking.

MODEL TS-4A $49.50 Shpg. Wt. 16 Lbs.



HEATHKIT LINEARITY PATTERN GENERATOR KIT

This instrument supplies information for white dots, cross-hatch pattern, horizontal bar pattern, or vertical bar pattern. It feeds video and sync signals to the set under test, with completely controlled gain, and unusual stability. Covering channels 2 to 13, the LP-2 will produce 5 to 6 vertical bars and 4 to 5 horizontal bars. The dot pattern presentation is a *must* for the setting of color convergence controls in the color TV set. Panel provision made for external sync if desired. Use for adjustment of vertical and horizontal linearity, picture size, aspect ratio, and focus. Power supply is regulated for added stability. Essential in the up-to-date TV service shop.

MODEL LP-2 $22.50 Shpg. Wt. 7 Lbs.

HEATHKIT CATHODE RAY TUBE CHECKER KIT

This instrument checks cathode emission, beam current, shorted elements, and leakage between elements in electro-magnetic picture tube types. It eliminates all doubt for the TV serviceman, and even more important, for the customer. Features its own self-contained power supply, transformer operated to furnish normal test voltages for the CRT. Employs spring-loaded switches for maximum operator protection. Large 4½" meter indicates CRT condition on "good-bad" scale. Luggage-type portable case ideal for home service calls. Special "shadowgraph" test permits projection of light spot on screen. Also gives relative check of picture tube screen coating.

MODEL CC-1 $22.50 Shpg. Wt. 10 Lbs.

HEATHKIT

Tube Checker Kit

$29.50

MODEL TC-2

Shpg. Wt. 12 Lbs.

This fine piece of test gear checks tubes for quality, emission, shorted elements, open elements, and filament continuity. Will test all tube types normally encountered in radio and TV service work. Sockets provided for 4, 5, 6, and 7-pin large, rectangular, and miniature types, octal and loctal types, the Hytron 9-pin miniatures, and pilot lamps. Condition of tubes indicated on a large 4½" meter with multi-color "good-bad" scale. An illuminated roll chart is built right in, providing test data for various tube types. This tester provides switch selection of 14 different filament voltage values from 0.75 volts to 117 volts. Individual switches control each tube element. Close tolerance resistors employed in critical test circuits for maximum accuracy. A professional instrument both in appearance and performance.

The Model TC-2 is very simple to build, even for a beginner. It employs a color-coded cable harness for neat, professional under-chassis wiring. Comes with attractive counter style cabinet, and portable cabinet is available separately. At this price, even the part-time serviceman can afford his own tube checker for maximum efficiency in service work.

* *Attractive counter-style cabinet.*
* *Wiring harness simplifies assembly.*
* *Large 4½" meter with two-color "good-bad" scale.*
* *Separate tube element switches prevent obsolescence.*

HEATHKIT TV PICTURE TUBE TEST ADAPTER

Designed especially for use with the Model TC-2 tube checker. Use it to test TV picture tubes for emission, shorts, etc. Consists of 12-pin TV tube socket, 4 ft. cable, octal connector, and necessary technical data. Not a kit.

MODEL 355 **$4.50** *Shpg. Wt. 1 Lb.*

HEATHKIT PORTABLE TUBE CHECKER KIT

This portable tube checker is identical, electrically, with the Model TC-2. However, it is housed in an attractive and practical carrying case, finished in proxylin impregnated material. The cover is detachable, and the hardware is brass plated. This rugged unit is ideal for home service calls or any portable application.

MODEL TC-2P **$34.50** *Shpg. Wt. 15 Lbs.*

HEATHKIT VISUAL-AURAL SIGNAL TRACER KIT

Although designed primarily for radio receiver work, this valuable instrument finds extensive application in FM and TV servicing as well. Features a high-gain channel with demodulator probe, and a low-gain channel with audio probe. Will trace signals in all sections of a radio receiver and in many sections of a FM set or TV receiver. Uses built-in speaker and electron beam eye tube for indication. Also features built-in wattmeter and a noise locater circuit. Provision for patching speaker and/or output transformer into external set.

MODEL T-3 **$23.50** *Shpg. Wt. 9 Lbs.*

HEATHKIT DIRECT READING CAPACITY METER KIT

Operation of this instrument is simplicity itself. One has only to connect a capacitor to the terminals, select the proper range, and read the capacity value directly on the large 4½" meter calibrated in mmf and mfd. Ranges are 0 to 100 mmf, 1,000 mmf, 0.01 mfd, and 0.1 mfd full scale. Precision calibrating capacitors supplied. Not susceptible to hand capacity effects. Residual capacity less than 1 mmf. Especially valuable in production line checking, or in quality control.

MODEL CM-1 **$29.50** *Shpg. Wt. 7 Lbs.*

HEATHKIT CONDENSER CHECKER KIT

The Model C-3 consists of an AC powered bridge for both capacitive and resistive measurements. Bridge balance is indicated on electron beam eye tube, and capacity or resistance value is indicated on front panel calibrations. Measures capacity in four ranges from .00001 mfd to .005 mfd, .001 mfd to .5 mfd, .1 mfd to 50 mfd, and 20 mfd to 1000 mfd. Measures resistance in two ranges, from 100 ohms to 50,000 ohms, and from 10,000 ohms to 5 megohms. Selection of five different polarizing voltages for checking capacitors, from 25 volts DC to 450 volts DC. Checks paper, mica, ceramic, and electrolytic capacitors. Indicates power factor of electrolytic condensers.

MODEL C-3 **$19.50** *Shpg. Wt. 7 Lbs.*

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PIONEER DESIGN . . .
New and unique approaches to instrument and equipment designs are a Heath Company tradition. We concentrate all our development efforts on kit projects, since this is our prime activity—and not just a sideline. This logically results in more efficient, more reliable circuit designs—and you benefit from this constant engineering progress. Buying from the undisputed leader in the electronic kit field assures you of completely modern equipment, with outstanding advanced design features.

HEATHKIT

Impedance Bridge Kit

* *½% precision resistors and silver-mica capacitors.*
* *Battery-type tubes, no warm-up required.*
* *Built-in phase shift generator and amplifier.*

MODEL IB-2

$59.50 *Shpg. Wt. 12 Lbs.*

The Model IB-2 is a completely self-contained unit. It has a built-in power supply, a built-in 1000 cycle generator, and a built-in vacuum tube detector. Provision has been made on the panel for connection to an external detector, an external signal generator, or an external power supply. A 100-0-100 microampere meter on the front panel provides for null indications. Measures resistance from 0.1 ohm to 10 megohms, capacitance from 10 mmf to 100 mfd, inductance from 10 mh to 100 h, dissipation factor (D) from 0.002 to 1, and storage factor (Q) from 0.1 to 1000. ½ of 1% decade resistors employed for maximum accuracy. Typical accuracy figures are: resistance, ±3%; capacitance ±3%; inductance, ±10%; dissipation factor, ±20%; storage factor, ±20%. Employs a Wheatstone bridge, a Capacity Comparison bridge, a Maxwell bridge, and a Hay bridge. Special two-section CRL dial provides maximum convenience in operation. Use the Model IB-2 for determining values of unmarked components, checking production or design samples, etc. A real professional instrument.

HEATHKIT "Q" METER KIT

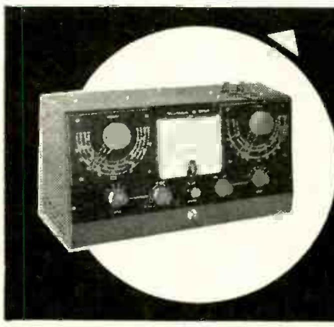
The Q Meter permits measurement of inductance from 1 microhenry to 10 millihenries, "Q" on a scale calibrated up to 250 full scale, with multiplying factors of 1 or 2, and capacitance from 40 mmf to 450 mmf, ±3 mmf. Built-in variable oscillator permits testing components from 150 kc to 18 mc. Large 4½" panel-mounted meter is features. Very handy for checking peaking coils, chokes, etc. Use to determine values of unknown condensers, both variable and fixed. Compile data for coil winding purposes, or measure RF resistance. Distributed capacity, and Q of coils.

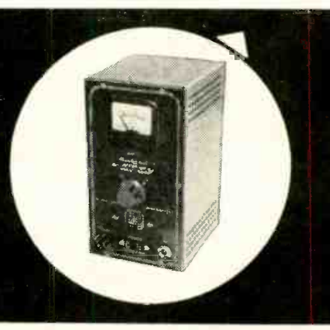
MODEL QM-1 **$44.50** *Shpg. Wt. 14 Lbs.*

HEATHKIT ISOLATION TRANSFORMER KIT

This device isolates equipment under test from the power line. It is rated at 100 volt-amperes continously, or 200 volt-amperes intermittently. AC-DC sets may be plugged directly into the IT-1 without the chassis becoming "hot." Additionally, since the IT-1 is fused, it is ideal for use as a buffer between the power line and a questionable receiver, or a new piece of equipment. Protects main fuses. Features voltage control, allowing control of the output from 90 volts to 130 volts. Panel meter monitors output voltage. A very handy device at an extremely low price.

MODEL IT-1 **$16.50** *Shpg. Wt. 9 Lbs.*






HEATHKIT 6-12 VOLT BATTERY ELIMINATOR KIT

This completely modern battery eliminator will supply DC output in two ranges for both 6-volt and 12-volt automobile radios. The output is variable for each range, so that operating voltage can be raised or lowered to determine how the receiver functions under adverse conditions. Range is 0-8 volts DC or 0-16 volts DC. Will supply up to 15 amperes on the 6-volt range, or up to 7 amperes on the 12-volt range. Two 10,000 microfarad output filter capacitors insure smooth DC output. Two separate panel meters indicate output voltage or output current. Makes it possible to test automobile radios inside at the workbench. Will also double as a battery charger.

MODEL BE-4 **$31.50** *Shpg. Wt. 17 Lbs.*

HEATHKIT 6-VOLT VIBRATOR TESTER KIT

This instrument functions very much like a tube checker, to test auto radio vibrators. Vibrator condition is indicated on a simple "good-bad" scale. Tests for proper starting and overall quality of operation, of both interrupter and self-rectifier types of 6-volt vibrators. The model VT-1 is designed to operate from any battery eliminator capable of delivering continuously variable output from 4 to 6 volts DC at 4 amperes or more. It is an ideal companion unit for the Heathkit Model BE-4 battery eliminator. The construction book for the VT-1 contains vibrator test chart for popular 6-volt vibrator types. A real time saver!

MODEL VT-1 **$14.50** *Shpg. Wt. 6 Lbs.*

HEATHKIT DX-100 PHONE AND CW Transmitter Kit

$189.50

MODEL DX-100

Shpg. Wt. 107 Lbs.

Shipped motor freight unless otherwise specified. $50.00 deposit required on c.o.d. orders.

- *Phone or CW on 160, 80, 40, 20. 15, 11 and 10 meters.*
- *Built-in VFO, modulator, and power supplies.*
- *High quality components used throughout for reliable performance.*
- *Features 5-point TVI suppression.*

The Heathkit DX-100 transmitter is in a class by itself in that if offers features far beyond those normally received at this price level. It takes very little listening on the bands to discover how many of these transmitters are in operation today. A truly amazing piece of amateur gear. The DX-100 features a built-in VFO and a built-in modulator. It is TVI suppressed, and uses pi network interstage coupling and output coupling. Will match antenna impedances from approximately 50 to 600 ohms. Extensive shielding is employed, and all incoming and outgoing circuits are filtered. The cabinet features interlocking seams for simplified assembly and minimum RF radiation outside of the cabinet. Provides a clean strong signal on either phone or CW, with RF output in excess of 100 watts on phone, and 120 watts on CW. Completely bandswitching from 160 through 10 meters. A pair of 1625 tubes are used in push-pull for the modulator, and the final consists of a pair of 6146 tubes in parallel. The VFO dial and meter face are illuminated, and all front panel controls are located for maximum convenience. Panel meter reads driver plate I, final grid I, final plate I, final plate voltage, and modulator current. The chassis is constructed of heavy #16 gauge copper-plated steel. Other high-quality components include potted transformers, ceramic switch and variable capacitor insulation, silver-plated or solid-silver switch terminals, etc. All coils are pre-wound, and the main wiring cable is pre-harnessed. The kit can be built by a beginner from the comprehensive step-by-step instructions supplied. It is a proven, trouble-free rig, that will insure many hours of "on-the-air" enjoyment in your ham shack.

HEATHKIT COMMUNICATIONS TYPE ALL BAND RECEIVER KIT

This receiver covers 550 kc to 30 mc in four bands, and is ideal for the short-wave listener or beginning amateur. It provides good sensitivity and selectivity, combined with good image rejection. Amateur bands clearly marked on illuminated dial scale. Employs transformer type power supply—electrical bandspread—antenna trimmer—separate RF and AF gain controls—noise limiter—headphone jack—and automatic gain control. Has built-in BFO for CW reception.

MODEL AR-3
$29.95
INCLUDING NEW EXCISE TAX
(Less Cabinet)
Shpg. Wt. 12 Lbs.

CABINET: Fabric covered cabinet with aluminum panel as shown. Part 91-15A. Shipping weight 5 Lbs. $4.95

HEATHKIT VFO KIT

You can go VFO for less than you might expect. Here is a variable frequency oscillator that covers 160, 80, 40, 20, 15, 11, and 10 meters with three basic oscillator frequencies, that sells for less than $20. Provides better than 10 volt average RF output on fundamentals. Plenty of drive for most modern transmitters. Requires a power source of only 250 VDC at 15 to 20 ma. and 6.3 VAC at 0.45A. Incorporates a regulator tube for stability. Illuminated frequency dial reads frequency directly on the band being employed. Temperature-compensated capacitors offset coil heating.

MODEL VF-1
$19.50
Shpg. Wt. 7 Lbs.

EASY ON THE BUDGET!

You can buy Heathkits on an easy time-payment plan that provides a full year to pay. Write for complete details and special order blank.

NEW HEATHKIT CW TRANSMITTER KIT

The brand new Heathkit Model DX-20 Transmitter is one of the most efficient little rigs available today. Featuring an entirely new circuit, it is ideal for the novice, and even for the advanced-class CW operator. A 6DQ6A final amplifier provides plate power input of 50 watts. A 6CL6 oscillator is employed, and a 5U4GB rectifier. The transmitter features one-knob bandswitching to cover 80, 40, 20, 15, 11 and 10 meters. It is designed for crystal excitation, but may be excited by an external VFO. A pi network output circuit matches antenna impedances between 50 and 1000 ohms. Front panel controls are functionally located for your convenience. If you appreciate a good signal on the CW bands, this is the transmitter for you!

MODEL DX-20
$35.95
Shpg. Wt. 18 lbs.

HEATH COMPANY
A Subsidiary of Daystrom, Inc.
BENTON HARBOR 20, MICH.

DOLLAR-SAVING ECONOMY . . .

There would be no particular achievement in selling inexpensive merchandise at a low price—although it is being done every day. However, there is something to crow about when, through tremendous purchasing power and factory-to-you distribution, Heath Company can offer top-quality equipment, using name-brand components, at such low prices. This is real economy, as opposed to the so-called "bargains". Needless to say, there is a big difference.

HEATHKIT PHONE AND CW

Transmitter Kit

* *6146 final amplifier for full 65-watt plate power input.*
* *Phone and CW operation on 80, 40, 20, 15, 11, and 10 meters. Pi network output coupling.*
* *Switch selection of three crystals – provision for external VFO excitation.*

The DX-35 features a 6146 final amplifier to provide 65 watts plate power input on CW, with controlled carrier modulation peaks up to 50 watts on phone. In addition, it is a most attractive transmitter. Modulator and power supplies are built-in, and the rig covers 80, 40, 20, 15, 11, and 10 meters with a single band-change switch. Pi network output coupling provided for matching various antenna impedances. A 12BY7 buffer stage provided ahead of the final amplifier for plenty of drive on all bands. 12BY7 oscillator and 12AU7 modulator. Provision for switch selection of three different crystals. Crystals reached through access door at rear. Front panel controls marked "off–CW–stand-by–phone", "final tuning", "antenna coupling", "drive level control", and "band change switch". Panel meter indicates final grid current or final plate current. A perfect low-power transmitter both for the novice, and for the more experienced operator. A remarkable power package for the price. Incidentally, the price includes tubes, and all other components necessary for assembly. As with all Heathkits, comprehensive instruction manual assures successful assembly.

MODEL DX-35

$56.95 *Shpg. Wt. 24 Lbs.*

HEATHKIT ANTENNA IMPEDANCE METER KIT

This instrument employs a 100 microampere panel meter and covers the impedance range of 0-600 ohms for RF tests. Functions up to 150 mc. Used in conjunction with signal source, such as the Heathkit Model GD-1B grid dip meter, the Model AM-1 will determine antenna resistance and resonance, match transmission lines for minimum standing wave ratio, determine receiver input impedance, etc. Will also double as a phone monitor. A very valuable device for many uses in the ham shack.

MODEL AM-1

$14.50

Shpg. Wt. 2 Lbs.

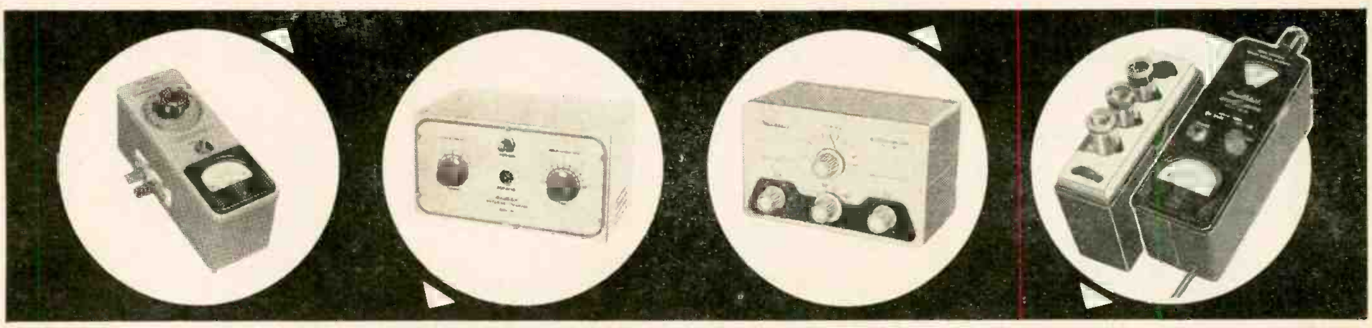
HEATHKIT "Q" MULTIPLIER KIT

The QF-1 functions with any receiver with an IF frequency between 450 and 460 kc that is not AC-DC type. Operates from the receiver power supply, requiring only 6.3 VAC at 300 ma. and 150 to 250 VDC at 2 ma. Simple to connect with cable and plugs supplied. Provides additional selectivity for separating two signals, or will reject one signal and eliminate heterodyne. A big help on crowded bands. Provides an effective Q of approximately 4,000 for sharp "peak" or "null". Tunes to any signal within the IF bandpass of the receiver, without changing main receiver tuning dial.

MODEL QF-1

$9.95

Shpg. Wt. 3 Lbs.



HEATHKIT ANTENNA COUPLER KIT

This device is designed to match the Model AT-1 transmitter to a long-wire antenna. In addition to impedance matching, this unit incorporates an L-type filter which attenuates signals above 36 megacycles, thereby reducing TVI. Designed for 52 ohm coaxial input. Handles power up to 75 watts, 10 through 80 meters. Uses a tapped inductor and variable capacitor. Neon RF indicator on front panel. Copper-plated chassis—high quality components throughout—simple to build. Eliminates waste of valuable communications power due to improper matching. A "natural" for all AT-1 transmitter owners.

MODEL AC-1

$14.50

Shpg. Wt. 4 Lbs.

HEATHKIT GRID DIP METER KIT

The grid dip meter was originally designed for the ham shack. However, its use has been extended into the service shop and laboratory. Continuous frequency coverage from 2 mc to 250 mc with pre-wound coils. 500 microampere panel meter employed for indication. Use for locating parasitics, neutralizing, determining RF circuit resonant frequencies, etc. Coils are included with kit, as is a coil rack. Front panel controls include sensitivity control for meter, and phone jack for listening to zero-beat. Will also double as an absorbtion-type wavemeter.

MODEL GD-1B

$19.95

Shpg. Wt. 4 Lbs.

HEATHKIT BROADCAST BAND Receiver Kit

MODEL BR-2
(Less Cabinet)
Shpg. Wt. 10 Lbs.

$18.95
INCLUDING NEW EXCISE TAX‡

ATTENTION BEGINNERS . . .

This kit is an ideal "first project" if you have never built a Heathkit before. A good chance to "learn by doing."

- *Miniature tubes and high-gain IF transformer.*
- *Rod-type built-in antenna. Good sensitivity and selectivity.*
- *5½-inch PM speaker.*
- *Provision for phono jack.*
- *Transformer - operated power supply.*

You need no previous experience in electronics to build this table-model radio. The Model BR-2 receiver covers 550 kc to 1620 kc and features good sensitivity and selectivity over the entire band. A 5½" PM speaker is employed, along with high gain miniature tubes and a new rod-type built-in antenna. Provision has been made in the design of this receiver for its use as a phonograph amplifier. The phono jack is located on the back chassis apron. A transformer operated power supply is featured for safety of operation, as opposed to the usual AC-DC supply commonly found in "economy radio kits." Don't let the low Heathkit price deceive you. This is the kind of set you will want to show off to your family and friends after you have finished building it.

Construction of this radio kit is very simple. Giant size pictorial diagrams and detailed step-by-step instructions assure your success. The construction manual also includes an explanation of basic receiver circuit theory so you can "learn by doing" as the receiver is built. The manual even provides information on resistor and capacitor color codes, soldering techniques, use of tools, etc. If you have ever had the urge to build your own radio receiver, the outstanding features of this popular Heathkit deserve your attention.

CABINET: Proxylin impregnated fabric covered plywood cabinet available for the BR-2 receiver as shown. Complete with aluminum panel, reinforced speaker grill, and protective rubber feet. Shipping weight 5 lbs., part No. 91-9A . . . . $4.95‡

HEATHKIT PROFESSIONAL RADIATION COUNTER KIT

This sensitive and reliable instrument has already found extensive application in prospecting, and also in medical and industrial laboratories. It offers outstanding performance at a reasonable price. Front-panel meter indicates radiation level, and oral indication produced by panel-mounted speaker. Meter ranges are 0-100, 600, 6,000 and 60,000 counts per minute, and 0—.02, .1, 1 and 10 milliroentgens per hour. The probe, with expansion cord, employs type 6306 bismuth counter tube, sensitive to both beta and gamma radiation. It is simple to build, even for a beginner.

MODEL RC-1
$79.95
Shpg. Wt. 8 Lbs.

HEATHKIT CRYSTAL RECEIVER KIT

The crystal radio of Dad's day is back again, but with big improvements! The Model CR-1 employs a sealed germanium diode, eliminating the critical "cat's whisker" adjustment. It is housed in a compact plastic box, and features two Hi-Q tank circuits, employing ferrite core coils and variable air tuning capacitors. The CR-1 covers the standard broadcast band from 540 kc to 1600 kc, and no external power is required for operation. Could prove valuable for emergency signal reception. This easy-to-build kit is a real "learn by doing" experience for the beginner, and makes an interesting project for all ages.

MODEL CR-1
$7.95
INCLUDING NEW EXCISE TAX‡
Shpg. Wt. 3 Lbs.

- *Amazing new circuit for high efficiency.*
- *Compact, portable and rugged.*
- *Stable circuit requires only one 67½ volt "B" battery and two 1½ volt "A" batteries.*

HEATHKIT ENLARGER TIMER KIT

The Model ET-1 is an easy-to-build device for use by amateur or professional photographers in controlling the timing cycle of an enlarger. It covers the range of 0 to 1 minute with a continuously variable, clearly calibrated scale. The timing period is pre-set, and the timing cycle is initiated by depressing the spring-return switch to the "print" position. Front panel provision is made for plugging in the enlarger and a safelight. The safelight is automatically turned "on" when the enlarger is "off". Handles up to 350 watts. The timing cycle is controlled electronically for maximum accuracy and reliability. Very simple to build in only one evening, even by a beginner.

MODEL ET-1
$11.50
Shpg. Wt. 3 Lbs.

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BENTON HARBOR 20, MICH.

COMPREHENSIVE INSTRUCTIONS . . .

The step-by-step assembly instructions provided with each Heathkit are the finest available anywhere. Each manual begins at the beginning, and assumes no previous training or experience on the part of the kit builder. This means that our kits can be built successfully by anyone who can follow instructions. As a matter of fact, new manuals are tested by having the kit built by someone in our office who has had no previous experience in electronics. This is your guarantee of complete and thorough instruction material.

HEATHKIT HIGH FIDELITY

Preamplifier Kit

- *5 switch-selected inputs, each with its own level control.*
- *Equalization for LP, RIAA, AES, and Early 78's.*
- *Separate bass and treble tone controls, and special hum control.*
- *Clean, modern lines and satin-gold enamel finish.*

Literally thousands of these preamplifiers are in use today, because the kit meets or exceeds specifications for the most rigorous high-fidelity applications, and will do justice to the finest available program sources. Provides a total of 5 inputs, each with individual level controls (three high-level and two low-level). Frequency response is within 1 DB from 25 CPS to 30,000 CPS, or within 1½ DB from 15 CPS to 35,000 CPS. Hum and noise are extremely low, with special balance control for absolute minimum hum level. Tone control provides 18 DB boost and 12 DB cut at 50 CPS, and 15 DB boost and 20 DB cut at 15,000 CPS. Cabinet measures only 12-9/16" W. x 3⅜" H. x 4⅞" D, and it is finished in beautiful satin-gold enamel. 4-position turnover and 4 position roll-off controls provide "LP," "RIAA," "AES," and "early 78" equalization, and 8, 12, 16, and 1 flat position for roll-off. Derives operating power from the main amplifier, requiring only 6.3 VAC at 1 ampere and 300 VDC at 10 MA. Easy to construct from step-by-step instructions and pictorial diagrams provided.

MODEL WA-P2 *(With Cabinet) Shpg. Wt. 7 Lbs.*

$19.75

HEATHKIT HIGH FIDELITY FM TUNER KIT

- *Illuminated slide-rule dial covers 88 to 108 MC.*
- *Modern circuit emphasizes sensitivity and stability.*
- *Housed in attractive satin-gold cabinet to match WA-P2 and BC-1.*

This amazing new FM tuner can provide you with real high-fidelity performance at an unbelievably low price level. Covering 88 to 108 MC, the modern circuit features a stabilized, temperature-compensated, oscillator, A.G.C., broadbanded IF circuits, and better than 10 UV sensitivity for 20 DB of quieting. A high gain, cascaded, RF amplifier is used ahead of the mixer to increase overall gain and reduce oscillator leakage. It employs a ratio detector for high efficiency without sacrifice in high-fidelity performance. IF and ratio transformers are pre-aligned, as is the front end tuning unit. This means the kit can be constructed by a beginner, without elaborate test and alignment equipment. The FM-3A is designed to match the WA-P2 preamplifier and the BC-1 AM tuner. An illuminated slide-rule dial is employed for frequency indication. Step-by-step instructions and large pictorial diagrams assure success.

MODEL FM-3A **$25.95** INCLUDING NEW EXCISE TAX *(With Cabinet) Shpg. Wt. 7 Lbs.*

HEATHKIT BROADBAND AM TUNER KIT

This AM tuner has been designed especially for high-fidelity applications. It incorporates a low-distortion detector, a broadband IF, and other features essential to usefulness in high-fidelity. Special voltage-doubler detector employs crystal diodes for low distortion. Sensitivity and selectivity are excellent. Audio response is ± 1 DB from 20 CPS to 2 kc, with 5 DB of pre-emphasis at 10 kc to compensate for station roll-off. Covers the standard broadcast band from 550 to 1600 kc. Incorporates a 10 kc whistle-filter and provides a 6 DB signal-to-noise ratio at 2.5 UV. RF and IF coils are prealigned, and power supply is built-in. Incorporates AVC, two outputs, and two antenna inputs.

MODEL BC-1 **$25.95** INCLUDING NEW EXCISE TAX *(With Cabinet) Shpg. Wt. 8 Lbs.*

HEATHKIT ELECTRONIC CROSS-OVER KIT

This unusual device functions to separate low frequencies and high frequencies so that they may be fed to separate amplifiers and to separate speakers. This eliminates the need for conventional cross-over circuits, since the Model XO-1 does the complete job electronically. Cross-over frequencies of 100, 200, 400, 700, 1,200, 2,000 and 3,500 CPS are selectable with front panel controls on the XO-1, and a separate level control is provided for each channel. Minimizes intermodulation distortion problems. Handles unlimited power, since frequency division is accomplished ahead of the power stage. Attenuation is 12 DB per octave, with sharp "knee" at cut-off frequency.

MODEL XO-1 **$18.95** *Shpg. Wt. 6 Lbs.*

HEATHKIT ADVANCED-DESIGN *HIGH FIDELITY*

Amplifier Kit

MODEL W-5M
Shpg. Wt. 31 Lbs.
Express Only

$59.75

This 25 watt unit is our finest high-fidelity amplifier. Using a special design peerless output transformer, and KT-66 output tubes by Genalex, the Model W-5M provides performance characteristics unsurpassed at this price level. Frequency response is ± 1 DB from 5 to 160,000 CPS at 1 watt. Harmonic distortion is less than 1% at 25 watts and IM distortion is less than 1% at 20 watts (60 and 3,000 CPS. 4 to 1). Hum and noise are 99 DB below 25 watts. Damping factor is 40 to 1. Input voltage for 5 watts output is 1 volt. Tubes employed are a pair of 12AU7's, a pair of KT-66's and a 5R4GY rectifier. Measures 13-3/32" W. x 8½" D. x 8¼" H. Output impedance is 4, 8, or 16 ohms. Featured, also, is the "tweeter saver" which suppresses high frequency oscillation, and a new type balancing circuit requiring only a voltmeter for indication. This balance is easier to adjust, and results in a closer "dynamic" balance between output tubes. The Model W-5M provides improved phase shift characteristics, reduced IM and harmonic distortion, and improved frequency response. Conservatively rated high-quality components are used throughout to insure years of trouble-free operation. No technical background or training is required for assembly. Step-by-step instructions are provided for every stage of construction, and large pictorial diagrams illustrate exactly where each wire and component is to be placed. An amplifier for music lovers who can appreciate subtle differences in performance. Just ask the audiofile who owns one!

MODEL W-5

Consists of Model W-5M *plus* Model WA-P2 preamplifier.

Shpg. Wt. 38 Lbs.
Express only.... $79.50

- *Full 25 watt output with KT-66 output tubes.*
- *All connectors brought out to front chassis apron.*
- *Protective cover over all above-chassis components.*

HEATHKIT DUAL-CHASSIS—WILLIAMSON TYPE HIGH FIDELITY AMPLIFIER KIT

This 20-watt high-fidelity amplifier employs the famous Acrosound Model TO-300 "ultra-linear" output transformer and uses 5881 output tubes. The power supply is built on a separate chassis, and the two chassis are inter-connected with a power cable. This provides additional flexibility in mounting. Frequency response is ± 1 DB from 6 CPS to 150 kc at 1 watt. Harmonic distortion is only 1% at 21 watts, and IM distortion is only 1.3% at 20 watts. (60 and 3,000 CPS). Output impedance is 4, 8, or 16 ohms. Hum and noise are 88 DB below 20 watts. A very popular high-fidelity unit employing top-quality components throughout.

MODEL W-3M: Shpg. Wt. 29 Lbs. Express only........ $49.75

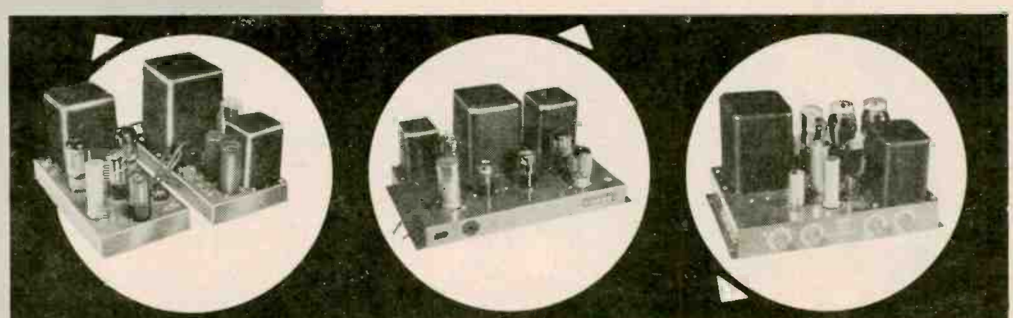
MODEL W-3: Consists of Model W-3M *plus* Model WA-P2 preamplifier. Shpg. Wt. 37 Lbs. Express only............. $69.50

HEATHKIT SINGLE CHASSIS—WILLIAMSON TYPE HIGH FIDELITY AMPLIFIER KIT

The 20-watt Model W-4AM Williamson type amplifier is a tremendous high-fidelity bargain. Combining the power supply and main amplifier on one chassis, and using a special-design output transformer by Chicago Standard brings you savings without a sacrifice in quality. Employing 5881 output tubes, the frequency response of the W-4AM is ± 1 DB from 10 CPS to 100 kc at 1 watt. Harmonic distortion is only 1.5% at 20 watts. Output impedance is 4, 8, or 16 ohms. Hum and noise are 95 DB below 20 watts.

MODEL W-4AM: Shpg. Wt. 28 Lbs. Express only....... $39.75

MODEL W-4A: Consists of Model W-4AM *plus* Model WA-P2 preamplifier. Shpg. Wt. 35 Lbs. Express only.............. $59.50



HEATHKIT 7-WATT AMPLIFIER KIT

This amplifier is more limited in power than other Heathkit models, but it still qualifies as a high-fidelity unit, and its performance definitely exceeds that of many so-called "high-fidelity" phonograph amplifiers. Using a tapped-screen output transformer of new design, the Model A-7D provides a frequency response of ± 1½ DB from 20 to 20,000 CPS. Total distortion is held to a surprisingly low level. Output stage is push pull, and separate bass and treble tone controls are provided. *Shpg. Wt. 10 Lbs.*

MODEL A-7D
$17.95
INCLUDING NEW EXCISE TAX

MODEL A-7E: Similar to the A-7D, except that a 12SL7 tube has been added for preamplification. Two inputs, RIAA compensation, and extra gain. **$19.95‡**

HEATHKIT 20-WATT HIGH FIDELITY AMPLIFIER KIT

This high-fidelity amplifier features full 20-watt output using push pull 6L6 tubes. Built-in preamplifier provides 4 separate inputs, selected by a panel-mounted switch. It has separate bass and treble tone controls, each offering 15 DB boost and cut. Output transformer is tapped at 4, 8, 16, and 500 ohms. Designed primarily for home installations, but also used extensively for public address applications. True high-fidelity performance with frequency reponse of ± 1 DB from 20 CPS to 20,000 CPS. Total harmonic distortion only 1% (at 3 DB below rated output).

MODEL A-9B
$35.50
Shpg. Wt. 23 Lbs.

HEATH COMPANY
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BENTON HARBOR 20, MICH.

All prices marked with a ‡ include a new federal excise tax that now applies to receivers, tuners and some amplifiers, even though they may be in kit form. Since the tax is in effect as of July 5, 1956, we have no choice but to reflect it in our kit prices. This note is just to let you know we are not increasing our prices on some kits, but merely including this new tax in them.

Thank you,

HEATH COMPANY

HEATHKIT HIGH FIDELITY

Range Extending

SPEAKER SYSTEM KIT

* *High quality speakers of special design — 15" woofer and compression-type super-tweeter.*
* *Easy-to-assemble cabinet of furniture-grade plywood.*
* *Attractively styled to fit into any living room. Matches Model SS-1.*

MODEL SS-1B

$99.95 Shpg. Wt. 80 Lbs.

This range extending unit is designed especially for use with the Model SS-1 speaker system. It consists of a 15" woofer, providing output between 35 and 600 CPS, and a compression-type super-tweeter that provides output between 4,000 and 16,000 CPS. Cross-over frequencies are 600, 1,600, and 4,000 CPS. The SS-1 provides the mid-range, and the SS-1B extends the coverage at both ends of the spectrum. Together, the two speaker systems provide output from 35 to 16,000 CPS within ± 5 DB. This easy-to-assemble speaker enclosure kit is made of top-quality furniture-grade plywood. All parts are pre-cut and pre-drilled, ready for assembly and the finish of your choice. Complete step-by-step instructions are provided for quick assembly by one not necessarily experienced in woodworking. Coils and capacitors for proper cross-over network are included, as is a balance control for super-tweeter output level. The SS-1 and SS-1B can provide you with unbelievably rich audio reproduction, and yet these units are priced reasonably. The SS-1B measures 29" H. x 23" W. x 17½" D. The speakers are both special-design Jensens, and the power rating is 35 watts. Impedance is 16 ohms.

HEATHKIT HIGH FIDELITY **SPEAKER SYSTEM KIT**

MODEL SS-1

$39.95

Shpg. Wt. 30 Lbs.

* *Special design ducted-port, bass-reflex enclosure.*
* *Two separate speakers for high and low frequencies.*
* *Kit includes all parts and complete instructions for assembly.*

This speaker system is a fine reproducer in its own right, covering 50 to 12,000 CPS within ± 5 DB. However, the story does not end there. Should you desire to expand the system later, the SS-1 is designed to work with the SS-1B range extending unit — providing additional frequency coverage at both ends of the spectrum. It can fulfill your present needs, and still provide for the future. The SS-1 uses two Jensen speakers; an 8" midrange-woofer, and a compression-type tweeter. Cross-over frequency is 1,600 CPS, and the system is rated at 25 watts. Nominal impedance is 16 ohms. The cabinet is a ducted-port bass-reflex type. Attractively styled, the Model SS-1 features a broad "picture-frame" molding that will blend with any room decorating scheme. Pre-cut and pre-drilled wood parts are of furniture grade plywood. The kit is easy-to-build, and all component parts are included, along with complete step-by-step instructions for assembly. Can be built in just one evening, and will provide you with many years of listening enjoyment thereafter.

HEATH COMPANY A Subsidiary of Daystrom, Inc. **BENTON HARBOR 20, MICH.**

ORDER BLANK

NOTE: All prices subject to change without notice.

Enclosed find ( ) check ( ) money order for________

Please ship C.O.D. ( ) postage enclosed for________pounds.

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ON PARCEL POST ORDERS include postage for weight shown. ORDERS FROM CANADA and APO'S must include full remittance.

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City & Zone________________State________

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SHIP VIA

☐ Parcel Post
☐ Express
☐ Freight
☐ Best Way

QUANTITY	ITEM	MODEL NO.	PRICE

self-calibrating marker generator

By RICHARD GRAHAM

Simple wide-range instrument uses dual crystals for audible calibration at points 100 kc and 1 mc apart

Front view of the generator.

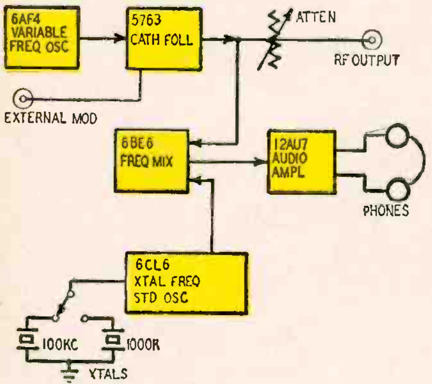


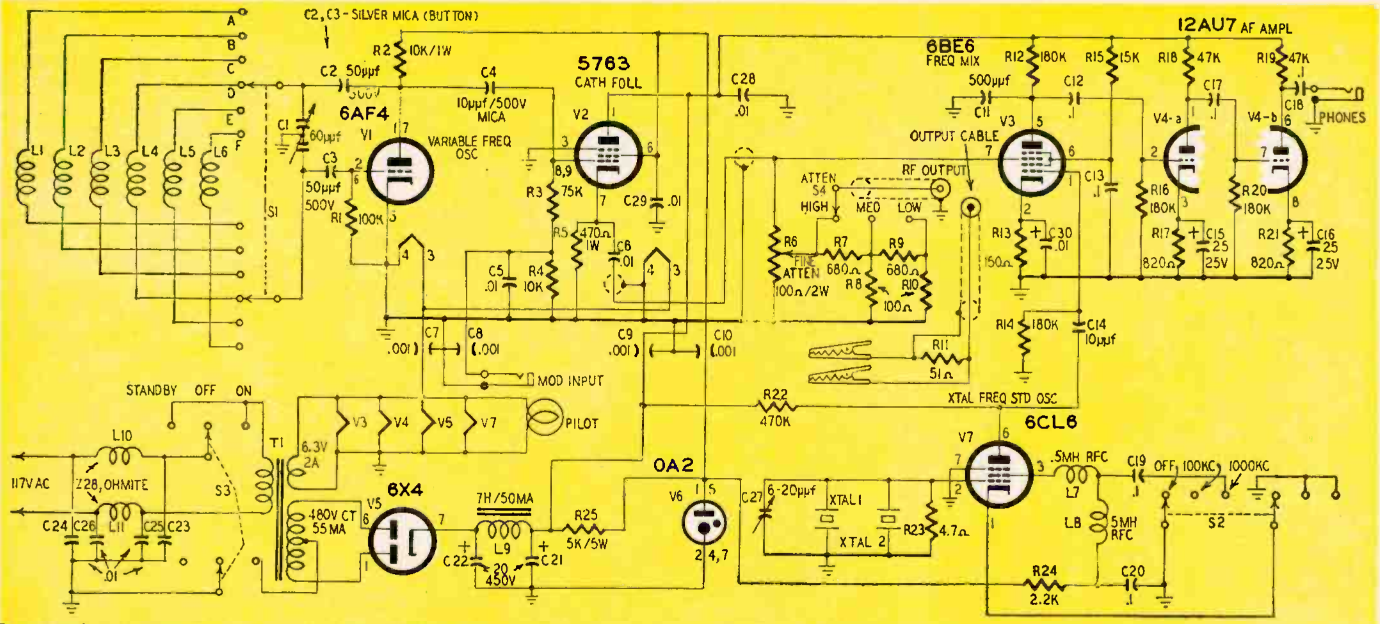
Fig. 1—Block diagram of the marker generator with calibrator.

PERHAPS the most serious problem in the home construction of test equipment is to calibrate the completed instrument. This particularly applies to rf generators of all types where the usual procedure of beating with known frequencies (such as broadcast stations) often leads to spotty and unsatisfactory calibration.

This problem has been successfully eliminated in the marker generator described. It has its own built-in frequency calibrator, which serves not only to calibrate the unit initially but also to insure the calibration accuracy whenever the unit is used.

The instrument is designed primarily as a marker generator for use in aligning TV and FM receivers. As a result the frequency coverage is limited to the frequencies used by these receivers plus a liberal margin. The generator has a continuous coverage of 1.0 to 215 mc in six overlapping bands.

The output over this frequency range is in excess of 1 volt. This high output voltage is desirable in any marker generator because it allows the generator to be very loosely coupled to the circuit under test. This minimizes its loading effect on the frequency response of the amplifier being aligned. A high rf voltage output is also desirable when a stage is being aligned for the first time, for example, after an if transformer is replaced.



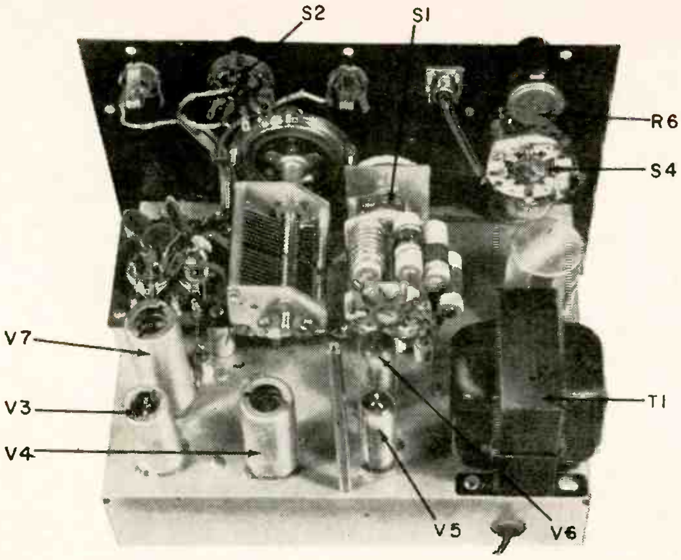
C1—60-µµf split-stator variable (Hammarlund RMC-140-S, 1 rotor and 2 stator plates removed. Cut stator bars to form 2-gang unit).
C2, C3—50-µµf button type silver mica, 500 volts
C4—10 µµf, mica, 500 volts
C5, C6, C23 C24, C25, C26, C28, C29, C30—.01 µf, disc ceramic, 600 volts
C7, C8, C9, C10—.001 µf, ceramic feedthrough, 500 volts
C11—500 µµf, ceramic
C12, C13, C17, C18, C19, C20—0.1 µf, paper, 400 volts
C14—10 µµf, ceramic, 600 volts
C15, C16—25 µf, 25 volts, electrolytic
C21, C22—20 µf, 450 volts, electrolytic
C27—6-20 µµf, variable air trimmer

R1—100,000 ohms
R2—10,000 ohms, 1 watt
R3—75,000 ohms
R4—10,000 ohms
R5—470 ohms, 1 watt
R6—100 ohms, 2 watts, pot
R7, R8, R9, R10—100 ohms
R11—50 ohms
R12, R14, R16, R20—180,000 ohms
R13—150 ohms
R15—15,000 ohms
R17, R21—820 ohms
R18, R19—47,000 ohms
R22—470,000 ohms
R23—4.7 ohms
R24—2,200 ohms
R25—5,000 ohms, 5 watts
All resistors ½ watt unless noted.

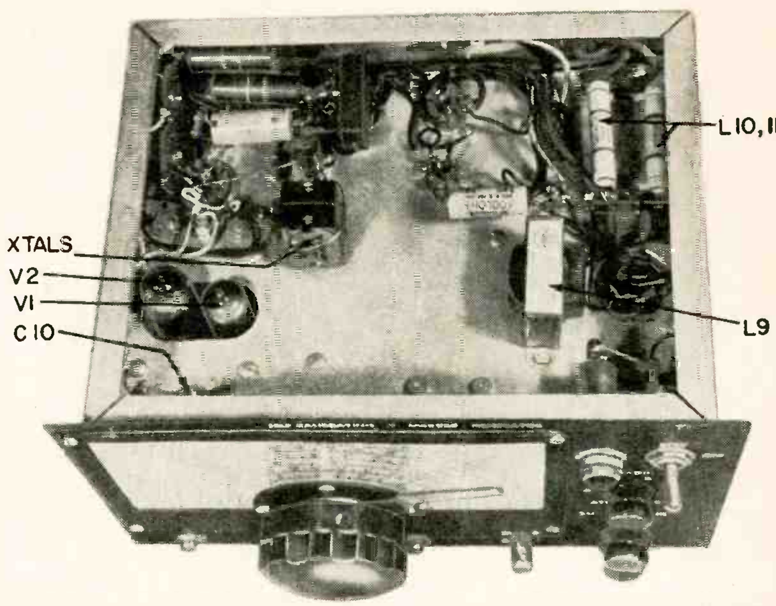
L1-L6—See coil table
L7—rf choke, 0.5-mh
L8—rf choke, 5-mh
L9—filter choke, 7 henries, 50 ma
L10, L11—rf choke, 21 µh, 600 ma. (Ohmite Z-28)
S1—rotary switch, 2 poles, 6 positions, ceramic insulation, 2 decks
S2—rotary switch, 2 poles, 3 positions
S3—toggle switch, dpdt (neutral center for on-off-on operation)
T1—power transformer, 480 volts ct, 55 ma; 6.3 volts, @ 2 amps
XTAL1, XTAL2—quartz crystals, 100 and 1,000 kc in one mounting (Valpey type DFS)
V1—6AF4
V2—5763

V3—6BE6
V4—12AU7
V5—6X4
V6—OA2
V7—6CL6
1—pilot lamp and assembly
2—panel type open circuit jacks
1—coax connector
4—sockets, 7-pin miniature
3—sockets, 9-pin miniature
1—cabinet, 7 x 10 x 8 inches (approx.)
1—chassis, 9 x 7 x 2 inches (approx.)
4—standoff insulators, ½ inch diameter, 1¼ inches long
Knobs, hookup wire, wire for coils, National R-50 rf choke for L1, standoff insulators for mounting C1, S1 and the subchassis

Fig. 2—The self-calibrating marker generator—complete schematic.



Rear view of the chassis. Normally suspended upside down in the cabinet, the threaded rod supports the rear of the chassis.



Underside of the chassis is up when mounted in the cabinet.

The circuit of the self-calibrating marker generator is shown in the block diagram of Fig. 1 and the schematic in Fig. 2. The oscillator is a 6AF4 in a conventional Colpitts circuit. Output is taken from the plate of the oscillator and fed into a 5763 cathode follower.

The 5763 provides good isolation between the output circuit and the oscillator and also transforms the oscillator output into a low impedance. A 5763 beam power tube was used primarily because of its high transconductance.

Normally there is little need to modulate the output of a marker generator but if it becomes necessary an external source of audio modulation may be applied to the grid of the 5763 cathode follower through a jack on the front panel.

The output of the cathode follower is fed into coarse and fine attenuation and then out to the output jack on the front panel of the unit.

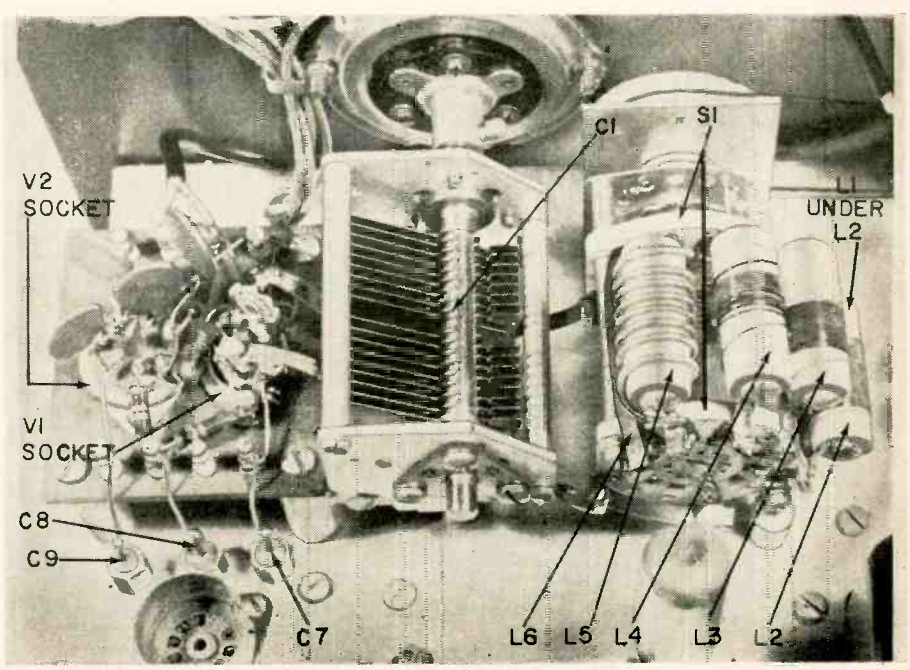
The cathode-follower output is also fed into the frequency-calibrator section of the marker generator. This frequency calibrator consists basically of a 100–1,000-kc 6CL6 crystal oscillator used as the frequency standard, a 6BE6 frequency mixer using a two-stage audio amplifier using a 12AU7 dual triode.

The 5763 cathode-follower signal is fed into the 6BE6 mixer stage. The

COIL TABLE

L1—Band A 1.0–2.6 mc	0.5-mh rf choke (National R-50) with one pie removed.
L2—Band B 2.3–5.4 mc	95 turns No. 34 enameled wire closewound.
L3—Band C 5.3–12.7 mc	41 turns No. 30 enameled wire closewound.
L4—Band D 12.6–30 mc	14 turns No. 24 enameled wire spaced to 1/2 inch.
L5—Band E 29–69 mc	7 turns No. 12 tinned wire spaced to 1 1/8 inches.
L6—Band F 67–215 mc	1 3/4 inches thin copper strap 3/32 inch wide.

NOTE: L2, L3, L4 and L5 wound on 1/2-inch diameter ceramic forms (standoff insulators) 1 1/4 inches long. See diagram and parts list for L7 through L11.



Close-up of the variable-frequency oscillator section.

output of the 6CL6 frequency-standard oscillator which can operate at either 100 kc or 1 mc as selected by S2 is also fed into the 6BE6 mixer tube. The crystal oscillator is rich in harmonics. Whenever the variable 6AF4 oscillator is tuned to a harmonic of the frequency standard, an audio beat develops in the 6BE6 mixer plate circuit. This audio beat is amplified by the 12AU7 and fed to a phone jack on the front panel.

The harmonics of the frequency-standard oscillator diminish in amplitude at the higher frequencies, therefore the beats resulting from the 100-kc oscillator cannot be heard on the highest frequency range of the generator. However the 1,000-kc beats are still quite usable and intermediate points can be readily interpolated.

Among the most important considerations in building this marker generator (or any signal or marker generator for that matter) is the mechanical construction. Everything associated with the frequency-determining components must be rigidly mounted or secured. To minimize stray capacitances and to reduce lead lengths, the 6AF4 oscillator and 5763 cathode follower were mounted on a piece of Bakelite terminal board 2¼ x 2½ inches. This assembly was then mounted upside down on 1-inch ceramic standoffs with the tubes extending downward through a clearance hole in the chassis. (See photos.) In addition to short leads, this construction makes this assembly easy to wire. The terminals on the board section used for this assembly provide convenient tie points and further aid rigidity.

The filament, B-plus and other leads to the oscillator assembly are brought through the chassis through individual ceramic feedthrough capacitors.

This assembly is mounted as close as possible to the variable capacitor. The leads between the oscillator assembly and the capacitor are made with thin copper strap approximately 5/32 inch wide. This reduces the lead inductance. This capacitor should preferably have front and rear bearings for increased rigidity.

The bandswitch is also mounted as close as possible to the variable capacitor and is connected to it with more of the thin 5/32-inch copper strap. The bandswitch is supported in the front by an L bracket to the chassis and in the rear by a ½-inch standoff insulator and a spade bolt. This maintains rigidity, aiding oscillator stability. The decks of the bandswitch are spaced to approximately 1½ inches by using additional spacers between them.

To locate the bandswitch as close as possible to the variable capacitor, it is necessary to devise a pulley and dial-cord arrangement so the control comes through on the right edge of the panel.

The coils for bands B, C, D and E (2.3–69 mc) are wound on ceramic insulators ½ inch in diameter and 1¼ inches long. A solder lug is fastened to each end of the insulator as a terminal for the coil ends and also as an aid in mounting the coils on the bandswitch. These coils are then liberally coated with polystyrene Q-Dope which keeps the turns in place on the form. The coil for bank F (67–215 mc) is not wound on a form. A coil for 1.0–2.6 mc is made from an rf choke and is also self-supporting. Coil-winding data is given in the table.

The frequency calibrator is not as critical as the oscillator section just described. The general mechanical details for the remainder of the generator can be seen in the photographs.

Calibration procedure

The calibration begins by adjusting the crystal frequency standard to exactly 100 and 1,000 kc. This is done by comparing the 100-kc harmonic at 5 mc to WWV also at 5 mc. Tune a receiver to WWV. Run a wire from the receiver antenna terminal to the vicinity of the crystal in the marker generator. Now set the CALIBRATE switch S2, to 100 kc. Adjust the variable capacitor C27 to a zero beat. This calibrates both the 100-kc and 1,000-kc crystals in the generator. The crystal specified consists of two matched crystals; thus setting one also sets the other.

Begin calibrating the generator frequency dial on the lowest frequency band. Set CALIBRATE switch S2 on 1,000 kc. Turn the generator on and plug a set of phones into the phone jack. Rotate the dial to the low-frequency end. At the very end a beat note should be heard. Adjust tuning carefully for zero beat. This is at 1,000 kc. Thus one calibration point is made. Switch S2 to 100 kc and mark the calibration points of every succeeding 100-kc point; i.e. the next beat note to be heard will be 1.1 mc, then 1.2, 1.3, 1.4 mc, etc., until the low band is completely calibrated. The next band which extends from 2.3 to 5.4 mc is calibrated similarly. That is, set S2 to 1,000 kc and turn C1 starting at the low-frequency end until you get a zero beat. This will be 2.0 mc. The

TEST INSTRUMENTS

next beat as C1 is rotated will be a 3 mc, then 4 and 5 mc. S1 is then set to 100 kc and the 100-kc points filled in the same way as before. Band C extending from 5.3 to 12.7 mc follows the same procedure.

Bands D, E and F require that some outside known frequency calibration be used for one frequency on each band. In all cases this frequency source can be an FM or TV receiver. If an FM receiver is used, its dial can be set to 88 mc and the generator turned around the middle of the D (12.6–30 mc) band until the generator carrier is noted. This corresponds to 22 mc. The generator's built-in calibrator takes over from here. Turn on the 1,000-kc crystal and touch up C1 for zero beat. This point is exactly 22 mc. With one known frequency, the remainder of the dial can be self-calibrated in the following manner. The next zero beat higher in frequency will be 23 mc, the second higher 24 mc and so on. Similarly the next lower frequency beat will be heard at 21, 20, 19 mc, etc.

The 100-kc crystal can be used but it results in too many calibration points on the dial. These intermediate 100-kc points can be easily determined by counting the 100-kc beat notes from the known 1-mc calibration points on the dial.

The E and F bands are calibrated exactly the same as the D band, using an FM or TV receiver to obtain one known frequency. The generator described was calibrated entirely in this manner and has proved satisfactory.

When precise marker frequencies are required during alignment, a procedure similar to the initial calibration is followed. For example: To find the FM if center frequency of 10.7 precisely, it is necessary only to set the generator to 10.7 mc. Set the CALIBRATE switch to 100 kc and adjust the dial slightly to zero beat. The same procedure is used to establish the plus and minus 100-kc bandwidth markers necessary for correct bandwidth alignment. This same procedure is carried out in determining the marker frequencies for TV alignment. END

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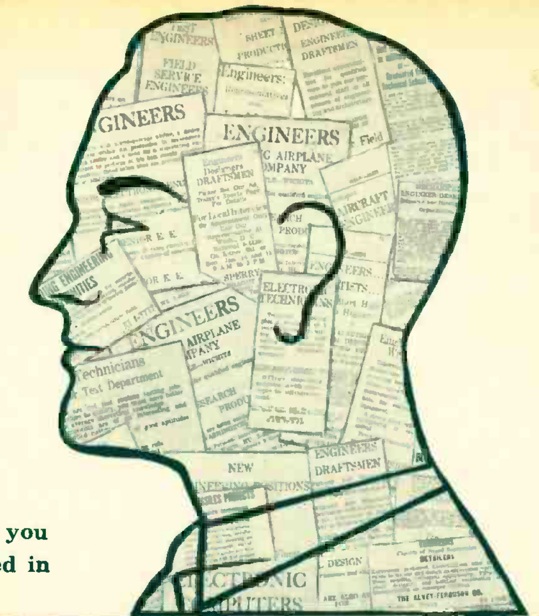

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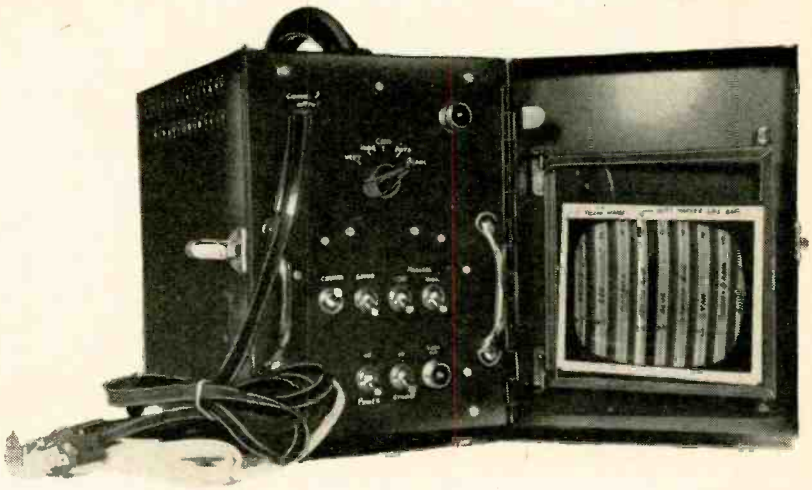
Portable TV Pattern Generator

Part I—Fundamentals and Circuitry



For monochrome and color servicing in shop or home, this generator has crystal control for stability and positive lock-in

By EARL T. HANSEN

THIS compact portable TV generator was designed to replace the one described in the July, 1956, issue. It supplies a variety of test signals used to adjust and check both monochrome and color sets in the shop as well as in the home. It provides lines, dots and crosshatch patterns for linearity and convergence adjustments. The dots and lines are sufficient in number and very sharply defined. Experience has shown that it is confusing and unnecessary to be able to vary the number and size of dots and lines for convergence adjustments. The size, spacing and number of picture elements in this unit are rigidly fixed for uniform results. Their small size and relatively large number have proven to be ideal for precise adjustments.

The generator supplies accurate sync pulses for all types of presentations. This results in good interlace and freedom from any jitter or crawl. It also insures that color receiver sweep circuits will be operating at the correct frequencies, so necessary for correct convergence. The sync signals are controlled by frequency division of a crystal-controlled source. A standard 10-bar chroma presentation is also available. The chroma frequency is also crystal-controlled. Markers are supplied for raster centering adjustments and color bar identification. The channel 3 rf output is crystal-controlled and modulated over 90% on line and dot signals.

Channel 3 was chosen as it was one of the least used of the lower channels. However, it does not matter if there is a station on this channel in the area. The signal from the generator will completely override the station when the regular antenna is removed.

A crystal-controlled sound carrier can be turned on to check for proper setting of the receiver fine-tuning control, especially on color sets where sound carrier in the chroma circuits causes objectionable beat interference. As the photos show, there are no variable controls or adjustments on the front panel. All signals are obtained by switching. Individual toggle switches permit the greatest combination of outputs. A video output test signal and standby switch are also included.

The generator can be constructed from readily available parts by experienced technicians, with the aid of the wide-band scope, grid-dip meter, field-strength meter and audio oscillator normally found in a well equipped shop.

Circuit description

The block diagram is shown in Fig. 1 and the schematic in Fig. 2. Sync pulse timing is controlled by a master 378-kc crystal oscillator. This oscillator (V1-a) also controls the color bar gating frequency and the vertical lines or dot rows. An inexpensive surplus crystal is used in an antiresonant circuit. The cathode of V1-a is returned to ground through peaking coil L2 and diode damper D1. This network forms sharp pulses which are amplified, inverted and further sharpened by V1-b. A portion of this pulse voltage is fed to line–dot mixer V7-a through the function switch S2-b. The pulse is also used to synchronize the 189-kc multivibrator V2, giving a frequency division of 2. The 189-kc square wave from the plate of V2-b keys the chroma signal through chroma gate V6-b.

V6-a is the chroma oscillator using a type of Pierce circuit recommended by the crystal manufacturer. When the chroma is turned off by opening S1 in the cathode return of V6-a, R36 is grounded to equalize the load in the B-plus circuit. Output from the cathode of the oscillator is directly coupled to the cathode of chroma gate V6-b. The 189-kc square wave from V2-b is applied to the grid of chroma gate V6-b. During the positive portion of the square wave, the grid voltage is clamped at zero by D5; thus V6-b amplifies and passes the chroma signal to the plate-tuned circuit L3–C23. R31 lowers the Q and increases the bandwidth of this circuit. During the negative portion of the square wave the tube is cut off and no signal appears on the plate.

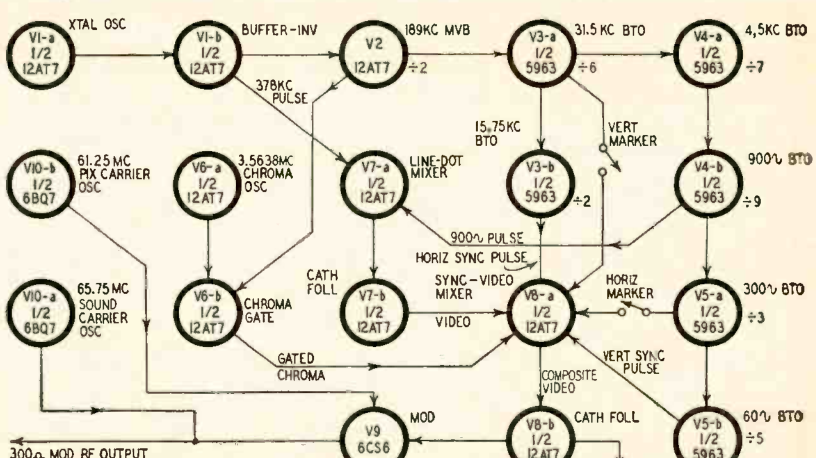


Fig. 1—Block diagram of the improved portable TV pattern generator.

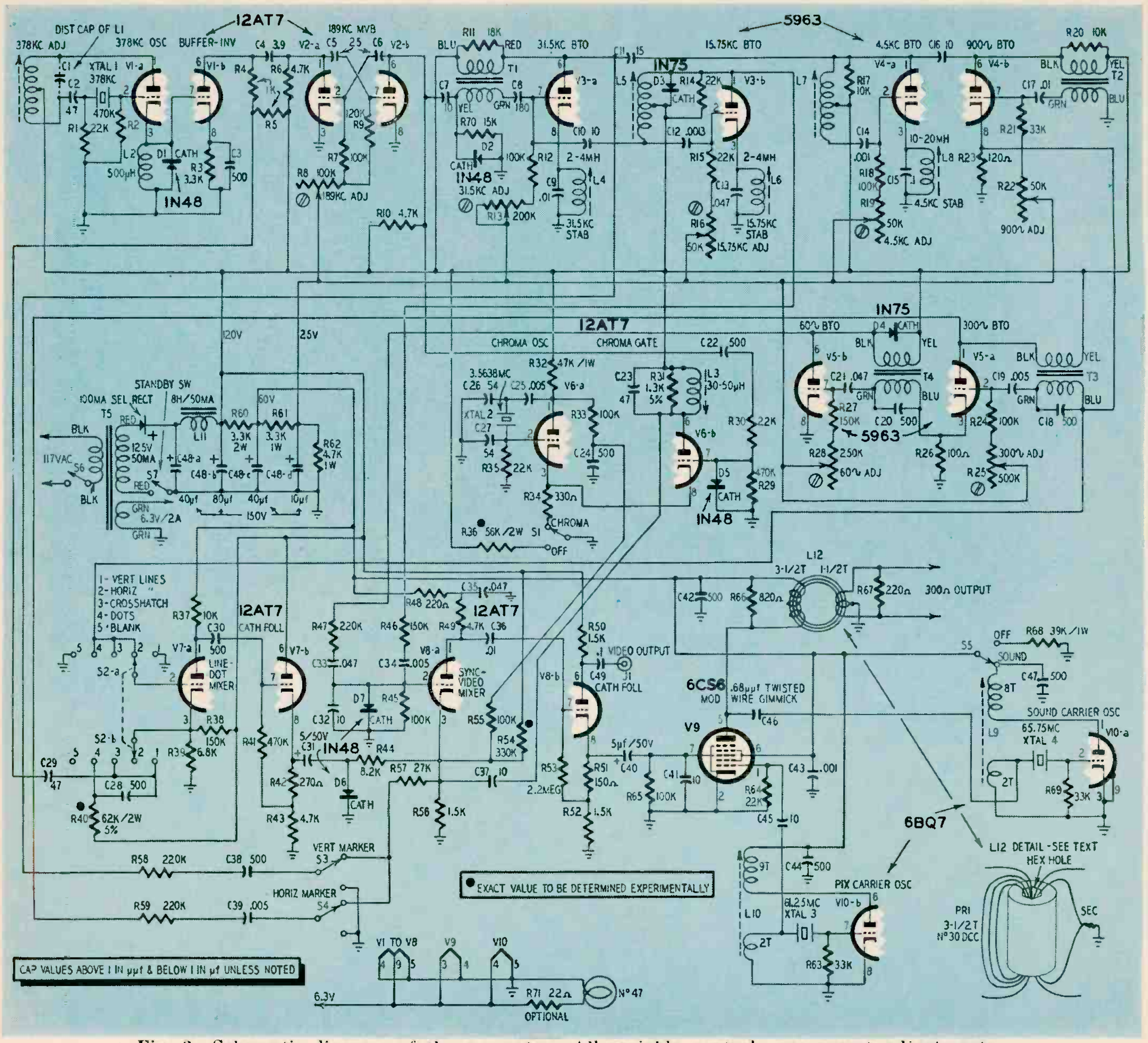


Fig. 2—Schematic diagram of the generator. All variable controls are preset adjustments.

C1—distributed capacitance of L1
C2, 23, 29—47 μμf, disc ceramic
C3, 18, 20, 22, 24, 28, 30, 38, 42, 44, 47—500 μμf, disc ceramic
C4—3.9 μμf, ceramic
C5, 6—25 μμf, NPO ceramic
C7, 10, 16, 32, 37, 41, 45—10 μμf, ceramic
C8—180 μμf, silver mica
C9, 17—.01 μf, 400 volts, molded paper
C11—15 μμf, ceramic
C12—.0013 μf, silver mica
C13, 21, 33, 35—.047 μf, 400 volts, molded paper
C14—.001 μf, silver mica
C15, 49—0.1 μf, 200 volts, molded paper
C19—.005 μf, 200 volts, molded paper
C25, 34, 39—.005 μf, disc ceramic
C26, 27—54 μμf, ceramic
C31, 40—5 μf, 50 volts, miniature electrolytic
C36—.01 μf, GMV (guaranteed minimum value) disc ceramic
C43—.001 μf, disc ceramic
C46—twisted-wire gimmick
C48—40-40-80-10 μf, 150 volts, electrolytic
R1, 14, 15, 30, 35, 64—22,000 ohms
R2, 29, 41—470,000 ohms
R3—3,300 ohms
R4, 5—1,000 ohms
R6, 10, 43, 49—4,700 ohms
R7, 12, 18, 24, 33, 45, 55, 65—100,000 ohms
R8—pot, 100,000 ohms, linear, short slotted shaft
R9—120,000 ohms
R11—18,000 ohms
R13—pot, 200,000 ohms, linear, short slotted shaft
R16, 19, 22—pot, 50,000 ohms, linear, short slotted shaft
R17, 20, 37—10,000 ohms
R21, 63, 69—33,000 ohms
R23—120 ohms
R25—pot, 500,000 ohms, linear, short slotted shaft
R26—100 ohms
R27, 38, 46—150,000 ohms
R28—pot, 250,000 ohms, linear, short slotted shaft
R31—1,300 ohms, 5%
R32—47,000 ohms, 1 watt
R34—330 ohms
R36—56,000 ohms, 2 watts
R39—6,800 ohms
R40—62,000 ohms, 5%, 2 watts
R42—270 ohms
R44—8,200 ohms
R47, 58, 59—220,000 ohms
R48, 67—220 ohms
R50, 52, 56—1,500 ohms
R51—150 ohms
R53—2.2 megohms
R54—330,000 ohms
R57—27,000 ohms
R60—3,300 ohms, 2 watts
R61—3,300 ohms, 1 watt
R62—4,700 ohms, 1 watt
R66—820 ohms
R68—39,000 ohms, 1 watt
R70—15,000 ohms
R71—22 ohms, 1 watt

All resistors ½ watt unless noted

D1, 2, 5, 6, 7—germanium diode, 1N48 or 1N34
D3, 4—germanium diode, 1N75, 1N70, 1N127, 1N63 or 1N68A
L1—slug-tuned inductor, 1–3 mh center-tapped, Miller 6197 or equivalent
L2—peaking coil, 500 μh, Miller 6174 or equivalent
L3—slug-tuned 4.5-mc trap, Miller 1470 or equivalent
L4, 6—slug-tuned inductors, 2–4 mh, Miller 6313 or equivalent
L5, 7—Synchroguide type tapped horizontal oscillator coil, Miller 6212 or equivalent
L8—stabilizer coil for Synchroguide circuit, Miller 6314 or equivalent
L9, 10—(see text) forms ¼ inch in diameter, 1 inch long, slug-tuned
L11—filter choke, 8 henries, 50 ma
L12—(see text) form, ferrite tuning slug ¼-inch diameter, ⅜ inch long, hexagonal hole through center
S1, 3, 4, 5—switch, spdt toggle
S2—switch, 2 poles, 5 positions, rotary
S6, 7—switch, spst toggle
SEL RECT—selenium rectifier, 130 volts, 100 ma
T1—transformer, horizontal blocking oscillator, Merit A3002 or equivalent
T2, 3, 4—transformer, vertical blocking oscillator, Crosley 155255-3, Stancor A-8125 or equivalent
T5—half-wave power transformer, 125 volts @ 50 ma, 6.3 volts @ 2 amp, Stancor PA8421 or equivalent
V1, 2, 6, 7, 8—tube, 12AT7
V3, 4, 5—tube, 5963
V9—tube, 6CS6
V10—tube, 6BQ7
XTAL 1—crystal, 378 kc (surplus, in FT-241 type holder marked channel 4, 20.4 mc)*
XTAL 2—crystal, 3.5638 mc, tolerance .01%, FA-9 holder**
XTAL 3—crystal, 61.25 mc, tolerance .01%, FA-9 holder**
XTAL 4—crystal, 65.75 mc, tolerance .01%, FA-9 holder**
6—9-pin miniature socket without shields
1—9-pin miniature socket with shield, for V10
2—9-pin turret type socket, for V4 and V8
1—7-pin miniature socket
2—octal socket, for crystals
1—cabinet and chassis assembly from BC-906-C frequency meter or equivalent
1—dial lamp and socket assembly
Line cord, hookup wire, nuts, bolts, tie strips, etc.

* Available from Texas Crystals, River Grove, Ill.; Crystals, Inc., Odell, Ill.; Sun Parts Distributors, Ltd., 514 10th St. N.W., Washington, D.C., and others.

** International Crystal Mfg. Co., 18 No. Lee, Oklahoma City, Okla., or equivalent.

Since the chroma is keyed at a 189-kc rate, there are 12 bursts of chroma for each horizontal scan (12 × 15.750 kc = 189 kc). The first is blanked out by the horizontal sync pulse. The second follows the sync pulse closely and acts as the subcarrier burst signal. The remaining 10 are displayed on the screen as color bars. (See Fig. 3.) The 189-kc signal also triggers the 31.5-kc blocking oscillator V3-a, giving a frequency division of 6.

The 31.5-kc output of V3-a is used three ways: First to trigger the 15,750-cycle blocking oscillator V3-b, dividing by 2 and providing a source of horizontal sync pulses. Second, to trigger the 4,500-cycle blocking oscillator V4-a, dividing by 7, for further countdown. Third, as a vertical marker to identify the fifth color bar and aid in picture centering.

The diode across the plate portion of L5 provides the damping necessary for good negative pulse output without positive overshoot and ringing. V3-a, V3-b and V4-a have an adjustable resonant circuit in their cathodes to provide sine-wave stabilization. This improves stability, especially under the effect of aging tubes and power supply variations.

The 4,500-cycle oscillator V4-a supplies the triggering pulse for blocking oscillator V4-b, dividing by 5 for 900-cycle output. Positive 900-cycle pulses from the cathode of this stage trigger the 300-cycle blocking oscillator V5-a and are also directed through S2-a to the line–dot mixer grid to form horizontal lines or rows of dots.

The 300-cycle oscillator V5-a supplies horizontal markers to check vertical raster centering and it also triggers the 60-cycle oscillator V5-b, giving a final division by 5. This 60-cycle signal supplies the vertical sync pulse. Diode D4 is used across the plate winding of T4 for damping.

S2 and the line–dot mixer

With switch S2 in position 1 (VERT) for vertical lines, the grid of the line–dot mixer V7-a is grounded. Negative pulses from the plate circuit of V1-b are applied to the cathode through S2-b. Since the bias on V7-a is approximately at cutoff, these 378-kc pulses cause the tube to conduct and negative pulses to appear on the plate. This signal and that for all other functions of this tube go through V7-b, V8-a and V8-b with no change in polarity. Since these pulses occur at a rate just 24 times the horizontal sweep rate (24 × 15.75 kc = 378 kc) there will be 24 vertical lines on the raster of the receiver. At least two of them will occur during retrace time. One of these is blanked out by the horizontal sync pulse. The other appears as a faint broad wavy line on the left half of the raster in Fig. 4. This will usually not be seen on a color set because most of them employ horizontal retrace blanking.

The remaining 22 lines will be visible unless obscured by slow retrace time or excessive width. *The monochrome receiver used in all photos had considerably excessive width and was slightly off center.* This explains why some vertical lines and one color bar are missing. At the same time, it points out the value of being able to identify positively the numerical sequence of the color bars with a marker.

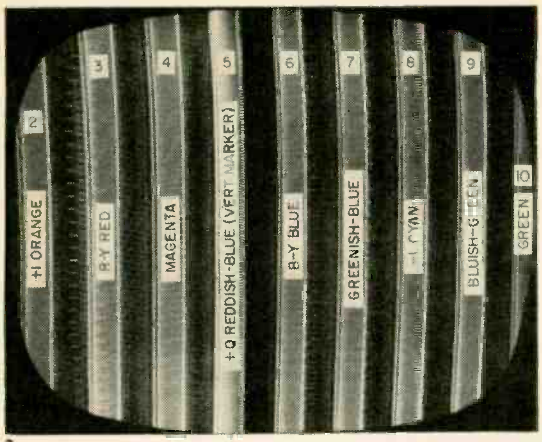
With the function switch in position 2 for horizontal bars, S2-b is open and the grid of V7-a receives 900-cycle positive pulses from the cathode of V4-b through S2-a. The bias is the same as before and therefore they cause conduction resulting in negative pulses on the plate. The pulse rate is just 15 times the vertical sweep rate so there will be 15 horizontal lines. One occurs simultaneously with the vertical sync pulse and thus is blanked out by it. This leaves a possible 14 lines which could be visible as in Fig. 5.

A crosshatch pattern is produced with the switch in position 3. Pulses of 378 kc and 900 cycles are applied to the tube. The bias being the same, the tube conducts with either or both pulses present. Therefore, both horizontal and vertical lines will be present and form a crosshatch pattern. See Fig. 6.

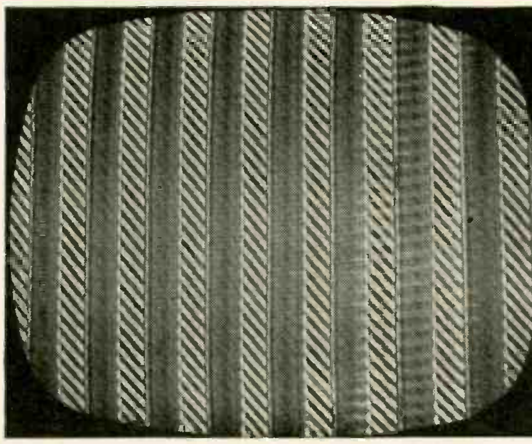
With the switch in the DOTS (position 4), both signals are again applied to the tube. This time, however, the bias is increased to more than twice cutoff. This is done by making the cathode more positive by switching R40 from B plus to cathode. It now requires the simultaneous application of both the positive 900-cycle pulse on the grid and the negative 378-kc pulse on the cathode to cause current flow in the plate load. This occurs only where the lines cross. Therefore dots are formed at the intersection and appear as negative pulses on the plate of V7-a.

With S2 set at BLANK, the grid is grounded and no pulses are fed to the cathode. Thus there is no dot or line information at the plate to be fed through V7-b to the mixer tube V8-a. The result is a relatively blank video signal. However this blank signal contains complete sync information and has a luminance level of black. The blank signal is used as a background for the color bar and marker displays.

The negative signals from the plate of V7-a (present in all positions of S2 except BLANK) go through cathode follower V7-b. This output is clamped with diode D6 to prevent the signals from modulating into the sync pulse region. V8-a is a mixer tube to which sync signals are applied to the grid and other video and chroma information to the cathode. The bias on this tube, as set by R54, R55 and R56, allows just a very slight current flow, causing approximately a 1-volt drop across plate load R49. This determines the black level. The lines, dot and marker signals applied to the cathode of V8-a, being negative in polarity, cause a decrease of bias and thus a decrease in plate voltage and therefore modulate



3a



3b

Fig. 3—Color bar patterns as seen on a monochrome set. Only nine bars appear, indicating that set has excessive width. First bar (yellow–orange) is offscreen at left. The vertical marker is on in Fig. 3-a above, brightening the fifth bar for identification. Fig. 3-b right shows 920-kc beat when fine tuning is misadjusted with sound-carrier oscillator turned on.

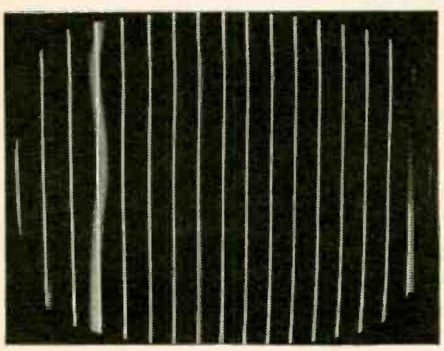


Fig. 4—Vertical bars on black-and-white set with excess width.

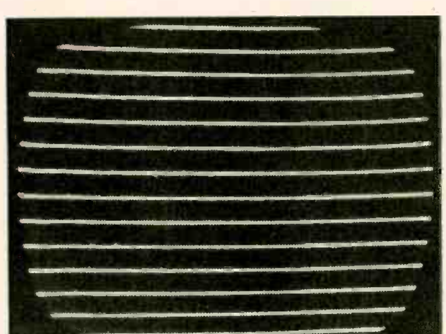


Fig. 5—The horizontal bar pattern.

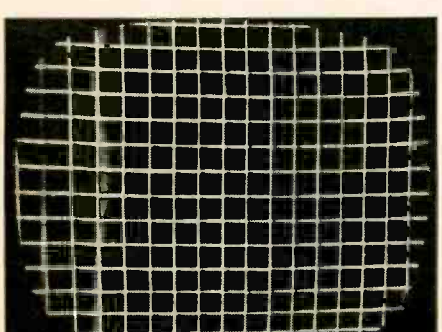


Fig. 6—The cross-hatch presentation.

into the white region. These "white" pulses are somewhat exaggerated in amplitude but are later clipped in the modulator to form nicely squared whites.

When the chroma is turned on (S1 is closed), square bursts (bars) of chroma signal are applied to the cathode through C37. As the chroma oscillator V6-a is activated by the chroma switch, its plate voltage drops to about half its no-load value. This reduction in dc voltage is carried through R33 and R55 to the cathode of V8-a. The resulting reduction of positive bias on the cathode of V8-a increases its average plate current. This increases the drop across the plate load resistor and consequently increases the luminance level. Therefore, when chroma is added to the output signal, the luminance level rises automatically and prevents the chroma from modulating into the sync region.

Both the horizontal and vertical negative sync pulses are applied to the grid of V8-a. The amplitude is sufficient to cut off the plate current of the tube. Therefore when either or both pulses are present on the grid, the plate voltage rises to equal the supply voltage, which represents the peak value of the sync pulse tips. Since the tube is cut off for the duration of the pulses, all chroma, lines, dots and markers are unable to pass through the tube and are therefore blanked out during the sync period.

Diode D7 on the grid of V8-a clamps the sync pulses and prevents them from modulating into the video region of the carrier. The composite signal from this stage is fed through cathode follower V8-b to the 6CS6 modulator. Though the dc component of the video is lost through coupling capacitors C36 and C40, it is restored in the modulator tube. The grid-to-cathode diode characteristics of the tube clamp the positive-going sync pulse tips to cathode (ground) potential. Therefore, the sync tips produce maximum rf output from the modulator tube and the correct black level is restored.

V10-b is a crystal oscillator using a fifth-harmonic crystal at the picture carrier frequency. Low-level output from the oscillator is fed to the first control grid (grid 1) of the modulator tube. The video signal on the second control grid (grid 3) varies the amount of rf reaching the plate circuit of the modulator.

L12 is a broadly tuned toroid coil with a balanced 300-ohm output. Approximately 25,000-μv output can be expected. V10-a is a crystal oscillator at the sound carrier frequency. When switched on, it supplies a signal equal to about half the peak value of the picture carrier. The video output connector supplies a negative-going signal of approximately 4 volts peak to peak. The standby switch removes plate voltage from all tubes while leaving the filaments hot, ready for immediate use.

TO BE CONTINUED

AFC improves FM tuners

Eliminate frequency drift with a simple modification

By G. FRANKLIN MONTGOMERY

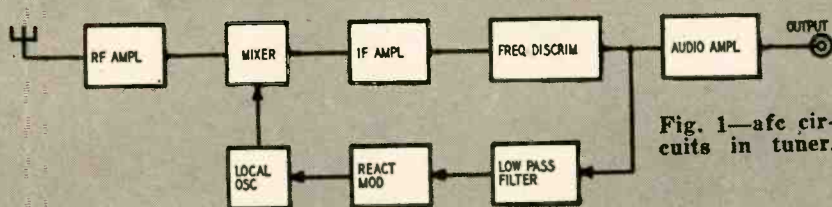


Fig. 1—afc circuits in tuner.

A NUMBER of inexpensive FM tuners, either completely wired or in kit form, are presently available for assembly into home music systems. Most tuners, however, including some expensive ones, have a small amount of frequency drift evident particularly during warmup. Because of this it is necessary to retune to the station one or more times during the half-hour after the tuner has been turned on.

Thermal drift in the local oscillator is not a deficiency in tuner design as such. It is simply impossible to compensate completely for the effects of changing temperature. Even if the circuit elements were completely compensated, one would still have to deal with changes in the interelectrode capacitances of the oscillator tube.

The practical answer is automatic frequency control. Fortunately, the circuit design of some of the inexpensive tuners is such that effective afc can be added with only a few circuit changes and with the addition of less than $3 worth of parts. The method proposed can be used in any tuner that includes a stage of audio amplification in its tube lineup; the Heathkit FM-3 or Meissner 8-CK exactly as shown. Other tuners may require modifications as discussed later. The normal operating features of the tuner are unaffected by the modification.

Automatic frequency control consists of dc negative feedback from a frequency discriminator to a modulator that controls a reactance in the local oscillator circuit. (See Fig. 1.) When the tuner is receiving a station, any slowly changing difference in frequency produces a direct voltage at the discriminator output. The modulator translates this voltage into a reactance change that pulls the oscillator frequency in the proper direction to reduce the original frequency difference. Small changes in local oscillator frequency due to temperature variations are thus reduced automatically. The effect of afc from an operating standpoint is the same as if the tuning bandspread were increased, when a station is present, several times over its normal amount. This feature is an operating convenience allowing much finer tuning than is ordinarily available.

The usual reactance modulator in afc circuits requires an extra tube. An equally effective device for this purpose, however, is the diode reactance modulator, using a crystal diode that needs no heater power and takes little space. The diode modulator does require control voltage from a low-resistance source, but the audio amplifier in the FM-3 can be used partly as a dc cathode follower to fill this requirement.

The portion of the FM-3 circuit to be modified is shown in its original form in Fig. 2 and the modified circuit arrangement in Fig. 3. No switch has been added to disable the afc for experience has shown no receiving conditions under which its use is not desirable. The modification requires short leads in the oscillator and diode part of the circuit but no other special wiring precautions need be observed. Revise the circuit as shown in Fig. 3, omitting the connection between points A and B. Then make the following checks:

1. With the tuner operating but tuned between stations, measure the cathode voltage of the 6C4 audio amplifier at point B. Normally, this will be about 4 volts positive.

2. Measure the voltage from point A to ground as the tuning is varied

(*Continued on page* 126)

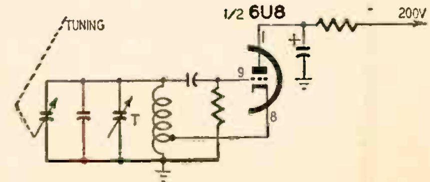


Fig. 2—Portion of Heathkit circuitry before modification.

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The Model TD-55 incorporates a newly designed element selector switch system which reduces the possibility of obsolescence to an absolute minimum. Any pin may be used as a filament pin and the voltage applied between that pin and any other pin, or even the "top-cap"

Checks for shorts and leakages between all elements
The Model TD-55 provides a super sensitive method of checking for shorts and leakages up to 5 Megohms between any and all of the terminals. Continuity between various sections is individually indicated. This is important, especially in the case of an element terminating at more than one pin. In such cases the element or internal connection often completes a circuit.

Elemental switches are numbered in strict accordance with R.M.A. specification.
One of the most important improvements, we believe, is the fact that the 4 position fast-action snap switches are all numbered in exact accordance with the standard R.M.A. numbering system. Thus, if the element terminating in pin No. 7 of a tube is under test, button No. 7 is used for that test.

The Model TD-55 comes complete with operating instructions and charts. Housed in rugged steel cabinet. Use it on the bench—use it for field calls. A streamlined carrying case, included at no extra charge, accommodates the tester and book of instructions.

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Superior's New Model TV-11

STANDARD PROFESSIONAL TUBE TESTER

SPECIFICATIONS:

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- ★ Uses the new self-cleaning Lever Action Switches for individual element testing. Because *all elements are numbered according to pin-number in the RMA base numbering system,* the user can instantly identify which element is under test. Tubes having tapped filaments and tubes with filaments terminating in more than one pin are truly tested with the Model TV-11 as any of the pins may be placed in the neutral position when necessary.
- ★ 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.

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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.

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Superior's New Model TV-40

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Tests ALL magnetically deflected tubes ... in the set ... out of the set ... in the carton!!

- 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.
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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 for all leakage tests.

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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with a range of .00001 Microfarad to 1000 Microfarads (Measures power factor and leakage too.)

IT'S A
SIGNAL TRACER
which will enable you to trace the signal from antenna to speaker of all receivers and to finally pinpoint the exact cause of trouble whether it be a part or circuit defect.

IT'S A
RESISTANCE BRIDGE
with a range of 100 ohms to 5 megohms.

IT'S A
TV ANTENNA TESTER
The TV Antenna Tester section is used first to determine if a "break" exists in the TV antenna and if a break does exist the specific point (in feet from set) where it is.

SPECIFICATIONS

✔RESISTANCE BRIDGE SECTION

2 Ranges: 100 ohms to 50,000 ohms: 10,000 ohms to 5 meg-ohms. Resistance can be measured without disconnecting capacitor connected across it. (Except, of course, when the R C combination is part of an R C bank).

✔CAPACITY BRIDGE SECTION

4 Ranges: .00001 Microfarad to .005 Microfarad; .001 Microfarad to .5 Microfarad; .1 Microfarad to 50 Microfarads; 20 Microfarads to 1000 Microfarads. This section will also locate shorts, and leakages up to 20 megohms. And finally, this section will measure the power factor of all condensers from .1 to 1000 Microfarads. (Power factor is the ability of a condenser to retain a charge and thereby filter efficiently.)

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A built-in high gain pentode voltage amplifier, plus a diode rectifier, plus a direct coupled triode amplifier are combined to provide this highly sensitive signal tracing service. With the use of the R.F. and A.F. Probes included with the Model 76, you can make stage gain measurements, locate signal loss in R.F. and Audio stages, localize faulty stages, locate distortion and hum, etc. Provision has been made for use of phones and meter if desired.

As Design Engineers, we the undersigned would like to say that the Model 76 is in our opinion the best combination unit of its kind we have been privileged to design. Although it is comparatively a low-priced tester, it will, after you become acquainted with its multiple services, be your most frequently used instrument.

S. LITT
L. MELENKEVITZ

✔ TV ANTENNA TESTER SECTION

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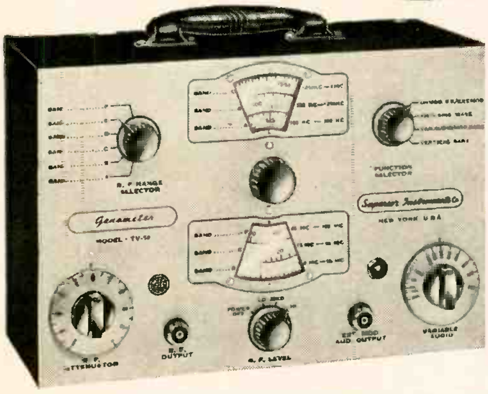
Model 76 comes complete with all accessories including R.F. and A.F. Probes; Test Leads and operating instructions. Nothing else to buy. Only............ **$26.95 NET**

Superior's New Model TV-50

GENOMETER



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- ✔ Color Dot Pattern Generator
- ✔ Marker Generator

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VARIABLE AUDIO FREQUENCY GENERATOR: In addition to a fixed 400 cycle sine-wave audio, the Model TV-50 Genometer provides a variable 300 cycle to 20,000 cycle peaked wave audio signal.

BAR GENERATOR: The Model TV-50 projects an actual Bar Pattern on any TV Receiver Screen. Pattern will consist of 4 to 16 horizontal bars or 7 to 20 vertical bars.

CROSS HATCH GENERATOR: The Model TV-50 Genometer will project a cross-hatch pattern on any TV picture tube. The pattern will consist of non-shifting horizontal and vertical lines interlaced to provide a stable cross-hatch effect.

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MARKER GENERATOR: The Model TV-50 includes all the most frequently needed marker points. The following markers are provided: 189 Kc., 262.5 Kc., 456 Kc., 600 Kc., 1000 Kc., 1400 Kc., 1600 Kc., 2000 Kc., 2500 Kc., 3579 Kc., 4.5 Mc., 5 Mc., 10.7 Mc., (3579 Kc. is the color burst frequency.)

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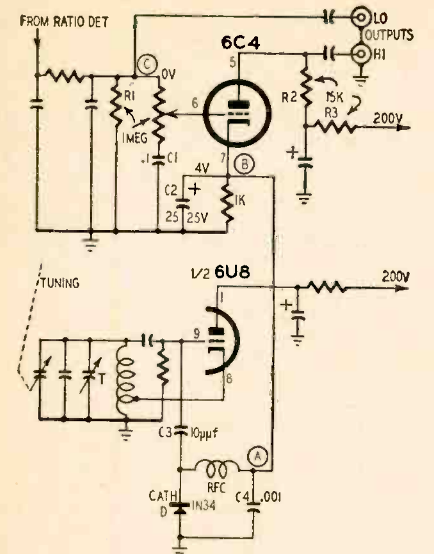

R1—1 megohm, 1/2 watt
R2—15,000 ohms, 1/2 watt
R3—15,000 ohms, 1/2 watt
Resistor—1 megohm, 1 watt (used as form for RFC)
C1—0.1 μf, paper
C2—25 μf, 25 volts, electrolytic
C3—10 μμf, mica
C4—.001 μf, disc ceramic
D—1N34 crystal diode
RFC—18 turns of No. 26 wire (see text)
Terminal strip, three lugs, center-grounded
Enameled wire, No. 26, approximately 2 feet

Fig. 3—Partial schematic of the FM-3 after modification for afc.

over its entire range. This voltage should be greater than 4.5 volts positive; typically, it will vary between 5 and 7. If it is not at least 4.5 volts, another 6U8 tube should be substituted. If none will produce the required voltage, check the capacitive coupling between the oscillator and mixer input circuits and the adjustment of the *mixer* tuning trimmer. The oscillator and mixer circuits may be coupled too tightly, thus loading the oscillator excessively. If these procedures fail, check the 1N34 diode.

3. With a station tuned in, measure the voltage at point C. This voltage should be zero with the tuning properly centered on the station. Now, slowly increase the dial reading toward a *higher* frequency. The voltage at C should swing *negative*. If it becomes positive, the connections from the secondary winding of the ratio-detector transformer to the 6AL5, pins 5 and 7, must be reversed.

If the above checks prove satisfactory, the connection between points A and B can be wired and the modification will be complete.

Adding the reactance modulator can be expected to change the total capacitance of the oscillator circuit and will require slight readjustment of the oscillator tuning trimmer to correct the dial calibration. This should be done as outlined in the Heathkit instruction book, by locating a station of known frequency near the high-frequency end of the tuning range.

Proof of the effectiveness of the afc is the fact that on most stations the tuner can be operated for several hours, turned off and, when turned on again the following day, will receive the same station satisfactorily without retuning.

Two worth-while improvements,, although not related to afc, can be made in the FM-3 and similar units at the same time the afc is installed. A slight residual hum may be noted in some cases when the tuner is tuned to a station; the same hum disappears between stations. Most of it is due to inadequate filtering of the plate supply for the local oscillator and can be reduced greatly by connecting a 20-μf 250-volt electrolytic capacitor from pin 1 of the 6U8 to ground. (A convenient location for the capacitor is parallel to the edge of the chassis and above the first if transformer, using ter-

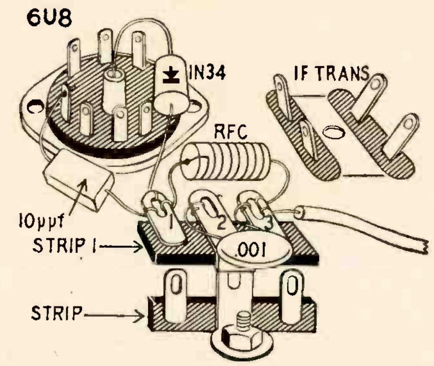

Fig. 4—Pictorial diagram shows portion of modification for the afc.

minal U2 as the ground point.) In some models tunable hum has been found, generated because of stray coupling between the local oscillator and the 6X4 power rectifier. The remedy is to bypass the 6X4 rectifier plates; .001-μf ceramic capacitors connected from each plate to ground will cure the trouble.

Modification procedure

The following steps should be followed in making the afc modification. It is based on the layout of the **FM-3**. When making the modification on other units, this procedure should be adhered to as closely as possible. Fig. 4 shows the approximate physical layout.

Make the rf choke by winding 18 turns of No. 26 enameled wire on a 1-megohm 1-watt resistor. The ends of the wire should be stripped, wrapped around the resistor leads and soldered. (In the **FM-3** follow the construction of the heater choke connected between C4 and D3.) Dope the winding with coil dope to keep the turns in place.

Obtain a three-lug terminal strip with the center lug grounded. Cut off all of the mounting-lug foot except a short projection of about 1/8 inch. Solder this projection to the ground lug of the bottom strip so that the lugs of the new terminal strip (strip 1) are parallel to the chassis and project toward the transformer. Be sure the two free lugs of strip 1 do not make contact with the lugs of the bottom strip.

Connect the 10-μμf mica capacitor from pin 9 of the 6U8 socket to strip 1, as shown. Keep the capacitor leads as short as possible. Connect the 1N34 diode from the socket center pin to strip 1. The cathode end of the diode goes to the strip. When soldering, grip the diode lead with pliers next to the diode body to prevent heat from damaging the diode. Keep the diode leads short.

Connect C4 as shown and dress it close to the terminal strip. Next connect the choke. When soldering, grip the diode lead with pliers next to the diode body as before. Wire in C2, observing the polarity of the electrolytic capacitor. Next, remove the 47,000-ohm resistors in the plate circuit of the 6C4 and replace with 15,000-ohm 1/2-watt resistors.

Remove the 1-megohm resistor connected to the grid of the 6C4, the .01-μf capacitor connected to the grid of the 6C4 and the volume-control ground connection. Then connect R1 and C1 as indicated in Fig. 3. Be sure the outside foil of C1 goes to ground.

With a vtvm or high-impedance voltmeter make the checks previously discussed. Connect points A and B together with a wire dressed close to the chassis. Adjust the oscillator tuning trimmer

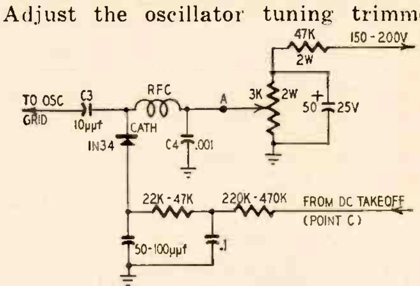

Fig. 5—Experimental circuit for other FM tuners and receivers.

to correct the dial calibration (refer to the rf alignment procedure in the instruction book).

Other types of tuners

Tuners whose audio circuits do not closely resemble those in the FM-3 and Meissner 8-C will probably have to be modified slightly when adding this afc system. In some models, it may be more practical to add a 6C4, using the circuit values between point C on the schematic and the oscillator grid. In this case, the audio signal available at the 6C4 plate can be fed to a recorder or monitoring circuit. The dc takeoff point is usually easy to locate. It will probably be the high side of the volume control if there is no blocking capacitor between it and the de-emphasis network.

The more venturesome experimenter may try the approach described in the August, 1956, issue of *Wireless World* (London, England). Connect point A to a voltage divider supplying a positive voltage (preferably variable) between 3 and 10. (See Fig. 5.) A capacitor of 50–100 μμf is inserted between the anode end of the 1N34 and ground. Connect this junction of capacitor and diode directly to the detector's dc takeoff (point C) through a resistor of 22,000–47,000 ohms in series with one of 220,000–470,000 ohms. Bypass the junction of the two resistors to ground through a capacitor of 0.1 μf or so. END

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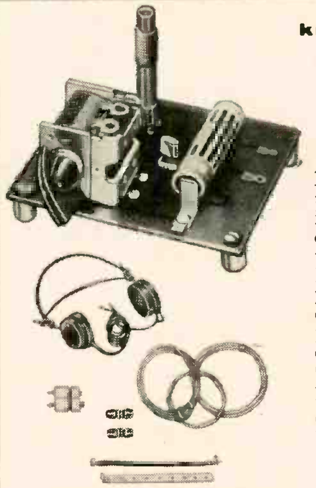

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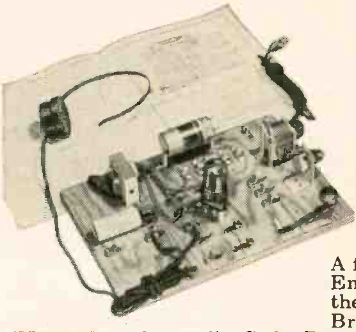

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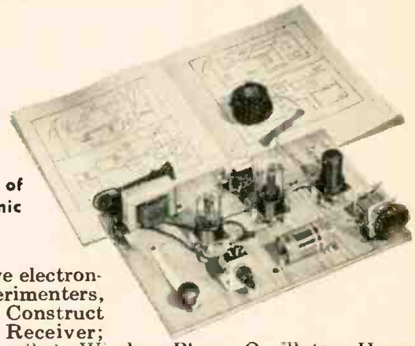

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Model S-705 **$9⁵⁰**

This fascinating unit makes it possible to "broadcast" witn phonograph or microphone through any standard radio receiver up to 50 feet away—without any connection to the set. May be used with crystal or magnetic cartridge, or with microphone. Broadcasts a clear, full-toned signal. High-gain stage permits using magnetic cartridge without need for external preamp. Complete with all parts, tubes, wire and solder (less microphone). 4½ x 5 x 6". Easy to assemble. Shpg. wt., 3 lbs.

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S-556. Microphone for above with 5-ft. cable **$3.95**

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Model S-760 **$5⁸⁵**

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Model S-755

$44.50

Williamson-Type Circuit
Printed Circuit Board
Chrome-Plated Chassis

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Model S-755. Basic 25 Watt Hi-Fi Amplifier Kit. Net only **$44.50**
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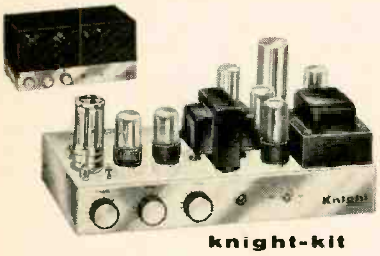

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10-WATT HI-FI AMPLIFIER KIT

Model S-753

$23.50

Chrome-Plated Chassis

Famous for wide response and smooth reproduction at low cost. Only 0.5 volt drives amplifier to full output. Frequency response: ±1 db, 30-20,000 cps at 10 watts. Harmonic distortion less than 0.5% at 10 watts. Intermod. distortion less than 1.5% at full output. Controls: on-off-volume, bass, treble. Input for crystal phono or tuner. Chromed chassis; punched to accommodate magnetic cartridge preamp. Matches 8 ohm speakers. Shpg. wt., 14 lbs.

Model S-753. Amplifier Kit. Net **$23.50**
Model S-235. Preamp Kit for above $3.10
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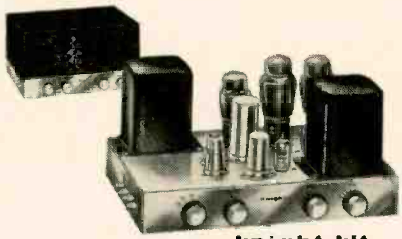

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20-WATT HI-FI AMPLIFIER KIT

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Model S-253. "Z" Bridge Kit. Net only **$5.85**

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OSCILLATING OSCAR

By A. von ZOOK

THIS is a true story about Oscar, a wayward radio. Oscar, a Sentinel radio model IU-2931, came into my life over a year ago.

Placing the patient upon the operating table, I gave him a thorough examination. He seemed to be in perfect health, outside of a poor voice—a sort of gurgling sound.

Removing his throat, I sent it to a specialist for reconing. With the newly reconed speaker installed, I turned the set on. Gosh! It sounded like an opera singer. Such tone, such quality! The radio seemed like a new one just off the assembly line. The customer was very pleased.

About 3 months passed. One day I heard a knock on the door. There was little Oscar asking to be let in. It seemed the same trouble had developed. Well, not exactly the same, but fairly close. This time it was a combination of gurgling and burping.

Again placing Oscar on the operating table, I again gave him a careful and thorough checkup. I found a few doubtful capacitors—these were replaced. All resistors checked perfect.

From one end to the other, Oscar was 100% checked, tested, diagnosed and analyzed. Outside of those few doubtful capacitors, he was in perfect health. Kept under surveillance for a couple of days, the patient talked and sang like a man of distinction. So, again I brought him to his home.

Hardly a week later I was called to attend Oscar again. Leading me into the parlor, his owner showed me Oscar in a tantrum. He sounded like a cat with its tail caught in the refrigerator door. I unplugged Oscar from the socket and told his owner that this one was on me.

Before leaving, I inquired as to the actual time the radio was generally played and how long each time. I figured that I'd try and play the set the same time each day and just as long. Placing the Oscar back on the operating table, I plugged him in and waited for him to start howling—the blasted thing began playing like some virtuoso.

I did my best to make Oscar act up —he wouldn't. Then I got desperate. I began hitting him with a hammer. I put a heat lamp on him. Oscar merely shrugged his shoulders and kept working like an angel playing a harp. Oscar was brought home again. There he sang like a canary.

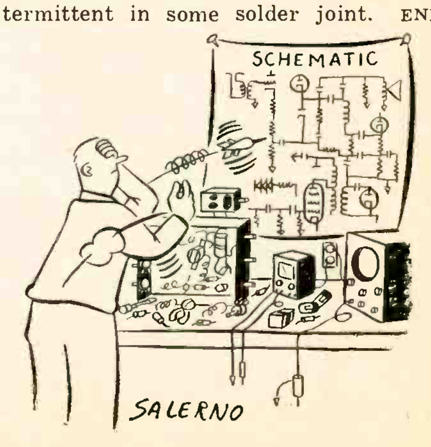
He behaved for the rest of that year. It was some time after the first of the new year that again I was told to observe this devil in another of his tantrums. As before, Oscar was producing gruesome sounds. Reaching over and shutting the beast off, I toted him back to the sweatshop. As before, I plugged the set in and turned it on.

Lo and behold! For the first time the set actually made the same sound I had heard in the customers house. Taking the radio out of its case and turning it on its back, I plugged the set on. It was still making those noises. Then while I was reaching for a probe, Oscar began to play again. I kept the set in the same position for over 2 weeks and waited for it to act up. Then I tried it in all positions.

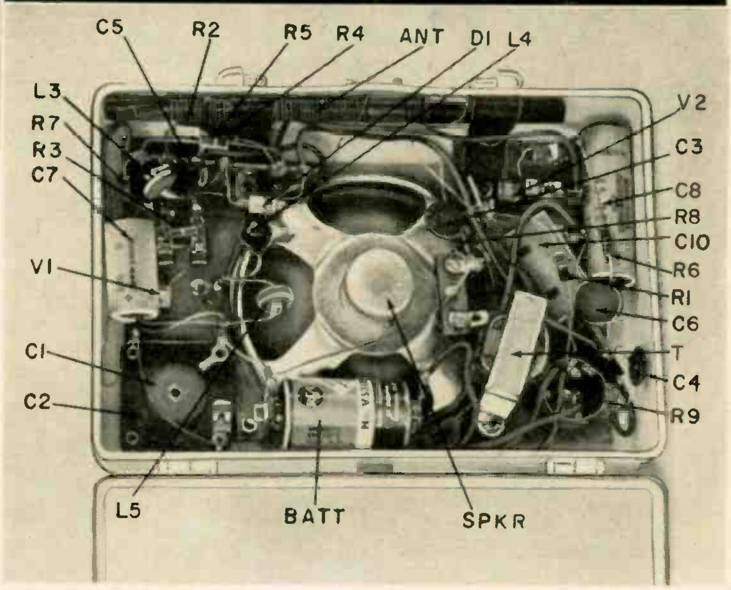
One day a heavy truck went by the house and the set began its ungodly shrieking. As before, when I started to test for some intermittent part, the blasted thing began to play again. Some time later that afternoon the same truck went by the house and again the set acted up for about 3 or 4 minutes. I began to do some fast thinking. What relationship was there between this truck going by and the condition in front of the house of the person who owned this set?

The customer lived on a main highway. Heavy trucks passed by frequently. I brought the set back to the customer and asked him to keep a record of what was passing by when the set acted up. Sure enough it began whenever a big truck came by. What caused it to act up this way? That was the big question.

I took the set home and carefully resoldered every connection in the radio. It has now been close to 2 years since I did this and Old Oscar is still playing, even though the same heavy trucks still pass by his house. Evidently only certain vibrations caused an intermittent in some solder joint. END



TWO-TRANSISTOR PORTABLE OPERATES LOUDSPEAKER



Upper left, The set looks much like a small tube portable. Above, inside view of receiver. Large speaker adds to efficiency and quality.

By NATHANIEL RHITA

THIS amazing new transistor radio, using only two transistors and a crystal diode, provides full speaker volume on many of the stronger local stations. It can be heard clearly 10 feet from the speaker. It has only two dials and tuning is noncritical. The set is available in kit form.

To simplify assembly, it uses components of conventional size, Fahnestock clips and lug strips to support and connect the parts. A 4-inch speaker delivers good tone with plenty of volume. Although no efforts have been made to miniaturize, this receiver is definitely a portable. It measures only 7½ x 5 x 1⅝ inches and weighs but a little over a pound. Its 9-volt mercury battery supplies less than 7 ma, so long life is assured. The set plays indoors or out, with a self-contained ferrite coil antenna for pickup. For weaker stations, there is provision for adding a short 2–10-foot antenna.

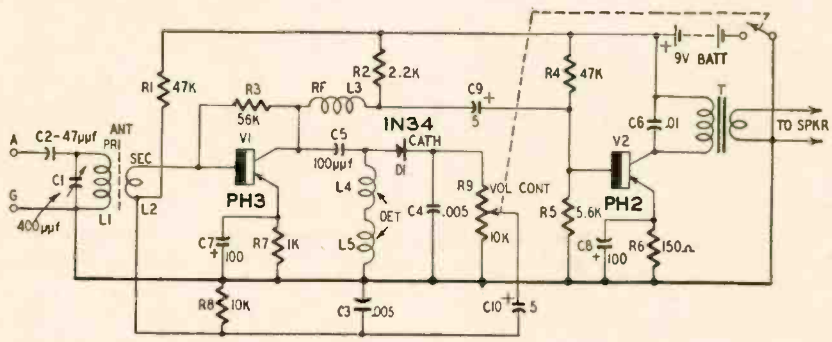
The ferrite loop (Fig. 1) transmits its power to V1, a high-frequency transistor. After amplification, the rf passes through C5 to a diode. Chokes L4, L5 prevent loss of signal to ground at this point. After detection by D1, the audio component appears across R9, the volume control. The rf is shorted out by C4. C1 is a special small-size, solid-dielectric variable, with capacitance high enough to permit tuning from below to well above the broadcast band.

The audio is passed through C10 and L2 back to V1. Both the coil and capacitor have low reactance to the af. C3 is added to short out any rf that may still remain. V1 now *reamplifies* the signal, this time at audio frequency. This circuit is called a reflex, a type which became fairly popular at one time in tube sets. The amplified af cannot get through the small capacitor C5 but easily flows through L3. The coil's reactance for af is low but high for rf. R3 is a feedback resistor to stablize this stage. Its exact value depends on the transistor used.

The signal is now impressed upon V2, an audio amplifier designed for large signals. Output flows into the transformer which feeds the speaker. This circuit is easy to tune and operate because there is no regeneration to control, no superhet to align. The reflex feature is very important, permitting the transistor to do double duty, according to the set's designer, William Lipson of Philmore Mfg. Co., N. Y. C., a concern long known for crystals and crystal receivers.

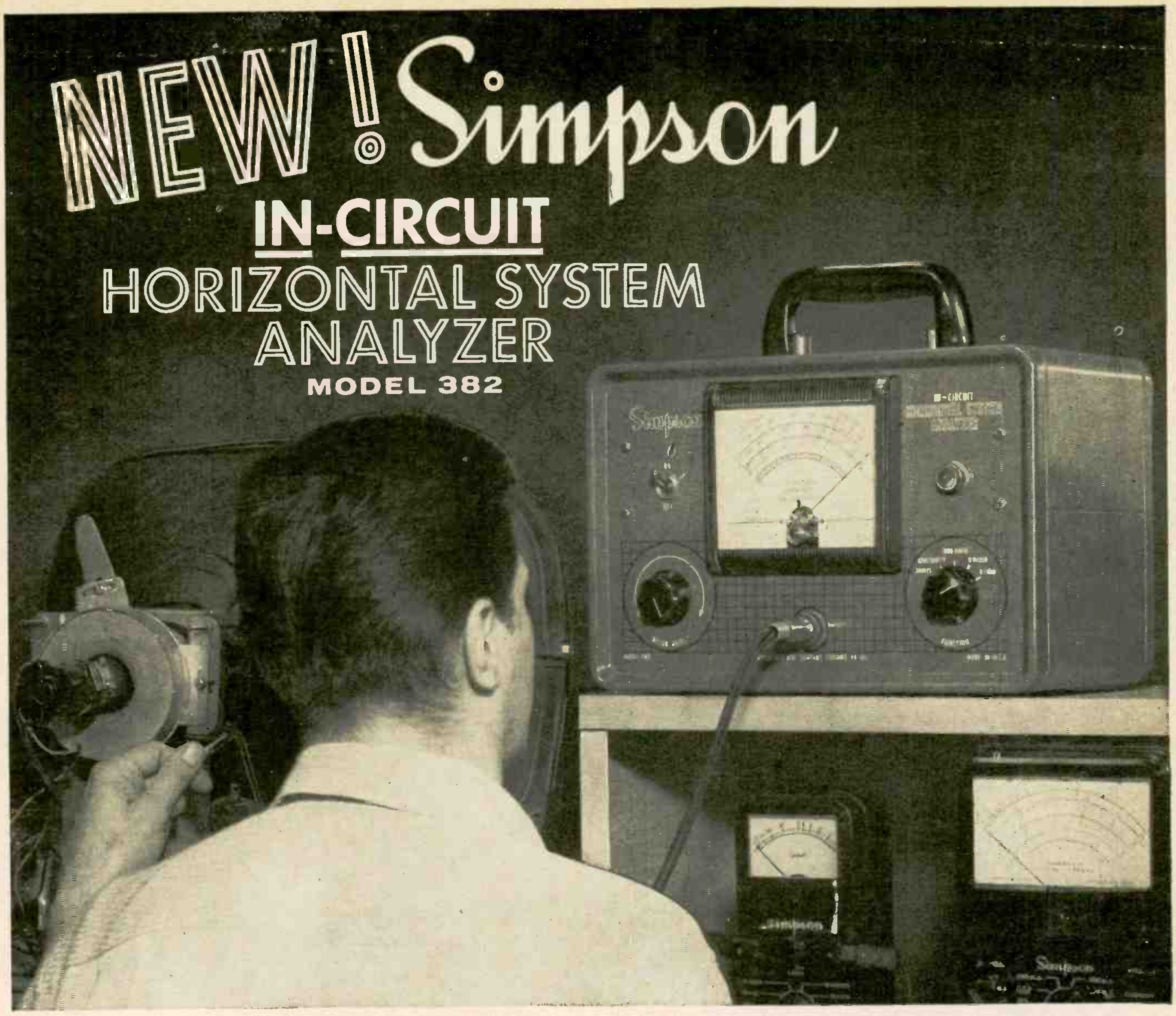
Assembly is easy and there is plenty of space to mount all parts. Step-by-step assembly instructions and operating instructions assure that even a novice will have no trouble.

The set tunes very easily and brings in all locals (within 10–15 miles) with full speaker volume. Selectivity is ample for nearly any case that may be encountered. On some of the stronger stations, the volume control must be held down because the output is strong enough to overload the set. The tuning control is frequency-calibrated, with 1240 and 640 (Conelrad points) marked on the dial. The plastic case is hinged for easy access to the interior. END



R1, R4—47,000 ohms
R2—2,200 ohms
R3—56,000 ohms (Nominal value, depending on transistor used. Optimum value determined experimentally.)
R5—5,600 ohms
R6—150 ohms
R7—1,000 ohms
R8—10,000 ohms
R9—10,000-ohm pot with switch
C1—400 µµf, variable
C2—47 µµf
C3, C4—.005 µf
C5—100 µµf
C6—.01 µf
C7, C8—100 µf
C9, C10—5 µf
L1, L2—ferrite loop antenna
L3—rf choke, about 350 µh
L4, L5—special detector chokes: L4 about 475 µh, L5 about 350 µh.
T—output trans, 20,000–3.2 ohms
V1—transistor PH3 (replaceable by 2N136, 2N112, CK760, GT761)
V2—transistor PH2 (replaceable by GT81, 2N138, 2N109, 2N44)
D1—diode 1N34
SPKR—4-inch PM speaker, 3.2 ohms
BATT—9-volt battery; RCA VS-300, Eveready 226, Ray-O-Vac 1600
All resistors ½-watt 10%; all capacitors 10 volts or any higher voltage.

The reflex circuit introduces few complications in circuitry.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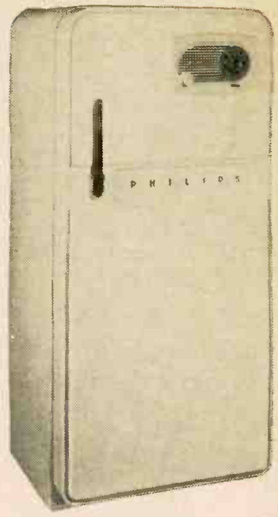
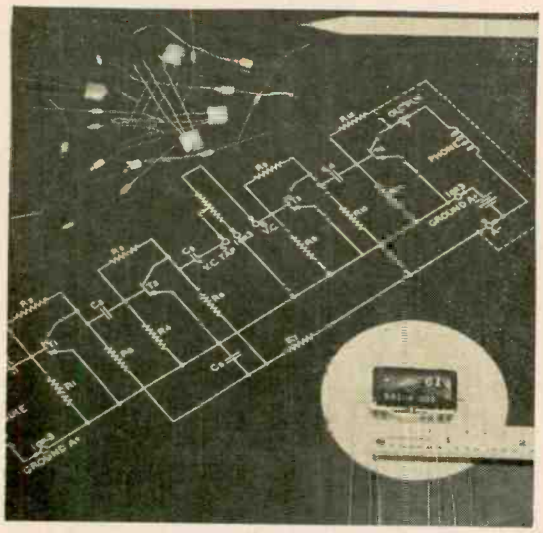


REFRIGERATED RADIO

is presented by Philips (Europe) and was demonstrated in Paris a short time ago. The radio is mounted in the door of what is apparently the freezer compartment, where the cold should prevent deterioration of parts as well as increase the efficiency of the radio by reducing the resistance of the various coils and conductors!



FOUR-STAGE AMPLIFIER fits into an area less than 1¼ x 11/16 x ¼ inch and contains 4 transistors, 12 resistors and 5 capacitors. Made by Centralab, it is somewhat similar in form to the company's simpler Packaged Electronics Circuits. It is a complete hearing-aid amplifier and has applications wherever a high-gain ultra-miniature amplifier is needed. Power output is 1 milliwatt at 15% distortion, 0.36 mw at 2%; frequency range 250–20,000 cycles ±5 db; input impedance 1,000 ohms; gain 75 db at 1,000 cycles. Power supply is 4 ma at 1.3 volts. The amplifier requires an external volume control, which is also the plate resistor of the second transistor.

TAPE RECORDER uses transistors throughout its amplifying circuits. (A 12BH7 is used as bias and erase oscillator.) Designed and manufactured by RCA, the unit is of professional quality, for use in broadcasting as well as home sound systems. Four transistors are used, one 2B175 and three 2N109's. Speeds of 3¾ and 7½ inches are provided, as well as fast forward and rewind. It covers the full audible range from 30 to 15,000 cycles (within 3 db from 40 to 12,000 cycles). An automatic tape lift during fast winding and jack for high-impedance monitoring phones are features. The unit is built for mounting in a standard 19-inch rack or in a conventional case.

HEADPHONE RADAR is world's smallest and lightest. By using headphones instead of a cathode-ray tube as an indicator, much bulky apparatus is eliminated and a portable unit that can be carried and operated by a two-man team becomes possible. Tested by the Signal Corps at Fort Monmouth, N. J., and Fort Huachuca, Ariz., it proved its efficiency over a range of 3 miles. The radar, a Sperry development, appears to be of the Doppler type, and trained operators can learn to distinguish a vehicle from moving personnel and distinguish between different types of vehicles or pick out a single man walking half a mile away. It is expected to be invaluable for nighttime or foggy weather protection of exposed ground troops. The complete radar is contained in the 14-inch diameter case and is powered by a lightweight generator easily carried by the second team member.

3-WAY CROSSOVER DESIGN

By NORMAN H. CROWHURST

SINCE my first article on crossover design was published in the July, 1952, issue of RADIO-ELECTRONICS, there has been an ever-increasing trend toward the use of three-way systems rather than the simpler system with two speakers. This introduces a need for three-way crossover systems to separate the spectrum into three bands instead of just two.

The principles of crossovers in general—the kinds of filter and the requirements to be met for correct operation—have been discussed fully elsewhere so we will not take up space here to recapitulate them. But one or two complications introduced in three-way systems do not apply to two-way networks so they will be discussed briefly to complete the picture.

There are two basic ways of designing a three-way crossover. These are illustrated in Fig. 1. The block schematic of Fig. 1-a shows the simpler form, which consists of high-, band- and low-pass filters, each delivering its specified band to the appropriate unit. The alternative way is to split the band in two (Fig. 1-b) and then take one of these bands and further split that.

In the example shown the first crossover is the lower one, giving at one output the feed to the woofer and at the other the feed for the middle- and high-frequency units. An additional low-pass and a high-pass filter separate the middle from the high. Alternatively, the first division could be made at the upper crossover, separating the frequency for the super-tweeter from the remainder. Then this remainder would be fed to additional high- and low-pass filters to separate the woofer from the tweeter or squawker.

Having shown the basic principles we can now turn to some simple complete circuits that apply them. In Fig. 1-c the arrangement of Fig. 1-a is applied to simple series-reactance feeds connected in parallel. This uses a series capacitance for the high-pass filter, a

(*Continued on page* 140)

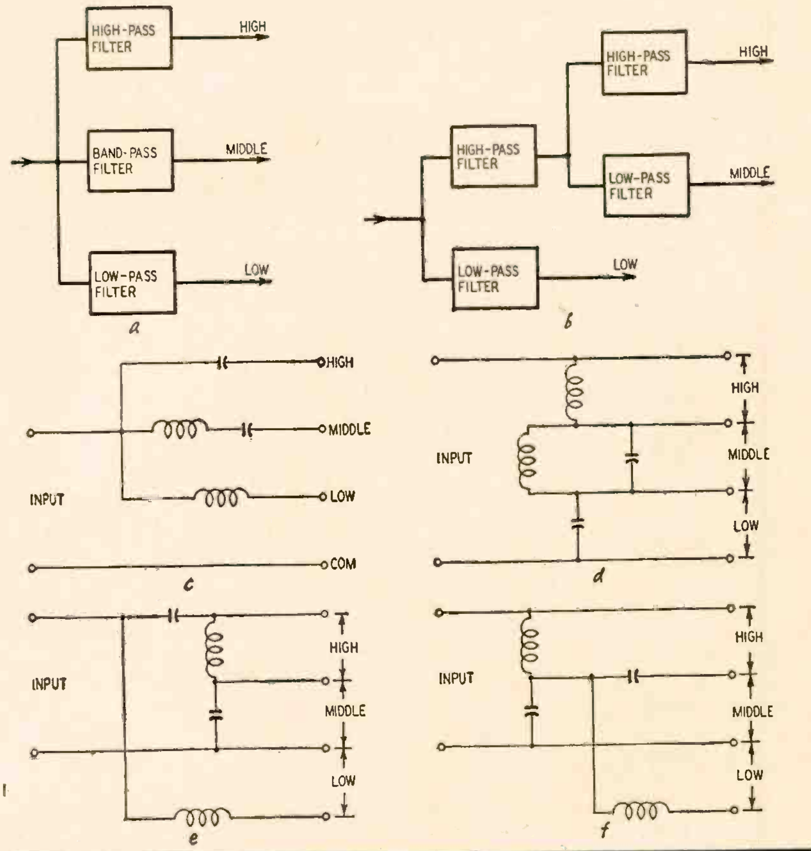


Fig. 1

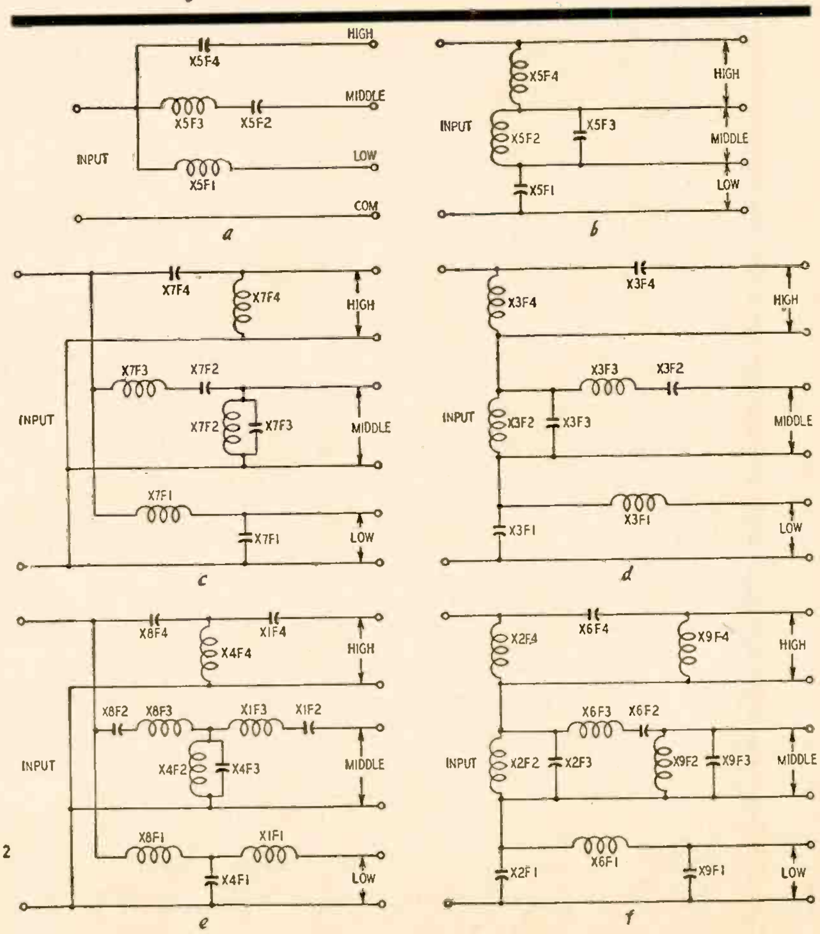


Fig. 2

Fig. 1. Block schematics and simple complete circuits to illustrate the two basic ways of designing a three-way cross-over system.

Fig. 2. Six circuits using the low-pass, bandpass, highpass methods of design, together with the reactance codes used for designing them.

World's largest computer

"The computer is probably the largest one in the world, with over a million components. Flattened out, it would probably fill a ball field. The computer analyzes radar data on every object in the sky. Then it checks each object against available traffic information and identifies it as either friendly or hostile. It can make suggestions, but it can't send a Nike missile against what it thinks is a 'baddie.' Only airmen can make that decision."

Bill gets $10,000 computer education at IBM Kingston

Supervises fifteen

Recently promoted to Group Supervisor, Bill now directs an entire shift of 15 men, reporting to a Group Manager. His job: to maintain the computer in combat readiness. "I have to be familiar with the entire system. I rely on two types of specialists to help me: computer units men who are specialists in certain areas; systems engineers for the over-all computer."

Miles does diagnostic programming on the Maintenance Console of the Sage Computer

Miles nails down problem with Site Manager R. Schimmel

Buys house, car

Bill has bought a 7-room house in Mt. Holly. When not busy with his son and twin daughters, he likes to bowl. He drives a '56 automobile. He's enjoying the good life, and expects it to get even better. His employee benefits alone represent a cash value of many hundred dollars a year. He expects the IBM-sponsored General Education Program will prepare him for higher management responsibilities. Later, Bill's manager said, "He's currently assuming the responsibilities of an electrical engineer."

But the question remains: Is Bill really an engineer?

The "professional" engineer

"No, I certainly don't consider myself a 'professional' engineer, qualified to design machines, for instance. But the point is, I'm doing work ordinarily done by engineers . . . work usually denied to men without a degree."

IBM upgrades technicians

Could he do this elsewhere? "Of all the companies I know, IBM appears to be one of the few upgrading the technician to the level of engineering responsibility. Fortunately for me, IBM had the imagination to get men without degrees and encourage them to rise in responsibility and income to the level of their native talents . . . not what their formal education dictates."

"Student" Bill Miles diagrams computer circuit

Both titles gain

Is this a sign that the educational system is wrong? "Not at all," answers Bill Miles. "A Doctor's, a Master's, a B.S. degree stand for something and always will. But if a technician can perform many jobs that traditionally belong to the engineer, they both stand to gain. The technician, because he gets much of the engineer's salary, satisfaction and recognition; the engineer, because he is free to do work which *only* a man with his formal training can do. When everybody wins, and nobody loses, it's the sign of a good thing."

Since Bill Miles joined IBM, opportuni-

Home-town assignment pleased Miles' wife, son, twin girls

ties in the Project Sage program, destined for long-range national importance, have grown more promising than ever. If IBM considers your experience equivalent to an E.E., M.E. or Physics degree, you'll receive 8 months' training, valued at $10,000 per man, as a Computer *Systems Engineer.* If you have 2 years' technical schooling or the equivalent experience, you'll receive 6 months' training, as a Computer *Units Field Engineer*, with opportunity to assume full engineering responsibility. Assignment in area of your choice. Every channel of advancement in entire company open—and IBM is leader in a field that's skyrocketing in growth. All the customary benefits and more. WRITE to Nelson O. Heyer, IBM, Kingston, New York. Include the questions you would want answered. You'll receive a prompt reply.

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capacitance and inductance for the bandpass and an inductance for the low-pass filter. The filters are fed in parallel and—if the correct values are used—the circuit will very closely approximate constant resistance.

Fig. 1-d shows the alternative construction, putting the feeds in series instead of in parallel. Here a shunt inductance provides the high-pass feed, a parallel-resonant circuit consisting of inductance and capacitance the middle-frequency feed, or bandpass filter, and a shunt capacitance provides the low-frequency feed.

Fig. 1-e is an example of the second basic method. Looking in at the input terminals, we first come to a junction between an inductance and capacitance: the inductance is a series feed for the low unit and corresponds with the low-pass filter at the bottom of Fig. 1-b; the capacitance is the series feed for the combined middle and high unit and corresponds to the high-pass filter at the left of Fig. 1-b. This combined output is then fed to a series-separated arrangement, consisting of inductance and capacitance that feed the middle and high units, respectively.

It would be possible to rearrange this so that the first division was a series feed instead of parallel, in which case it would be more convenient to make the second one parallel instead of series. Fig. 1-f shows an example of this. Here, however, the first division occurs at the higher crossover, separating the super-tweeter frequencies across the upper inductance and leaving the middle and low frequencies across the capacitance. The output across this capacitance is then divided by a parallel-feed arrangement into the middle frequencies, fed through a further capacitance and low frequencies through the inductance.

Relative merits

These are simple circuits employing the principles of Fig. 1-a and 1-b. Of course each variety of circuit can be further complicated to use more than a single reactance element for each filter. It will be seen that, either way, the same number of elements are used to achieve the same degree of filtering.

If the successive high- and low-pass filtering method of Fig. 1-b is used *and accurately terminated*, it will achieve true constant-resistance results. If, in Fig. 1-b, both the high- and middle-frequency units look like pure resistance of the correct value to terminate the filter, then the input to this combined filter will be a constant resistance. This forms a constant-resistance load for the first high-pass filter which, when combined with a pure resistance load applied to the output of the first low-pass filter, will reflect to the final input as a true constant resistance.

However, in practical filters the output termination is not usually a pure resistance and in this circumstance the better arrangement appears to be that of Fig. 1-a, in which any mismatch is reflected straight through its own individual filter back to the input rather than reflecting adversely on the performance of other filters.

Academically, a bandpass filter will not combine with a high-pass or low-pass filter to produce a true constant-resistance characteristic. Strictly, either a number of bandpass filters, all of the same bandwidth, will combine to produce a constant-resistance overall characteristic or, alternatively, a high-pass filter will combine with a low-pass filter to produce this result and multiple bands can be made by synthesis of the kind shown in Fig. 1-b.

However, with the kind of bandwidth used in three-way systems for the middle-frequency unit, the deviation from constant resistance using high-, low- and band-pass filters is very small. The greater deviation will usually be due to the impedance of a loudspeaker termination rather than to inherent mismatch in the filters themselves.

Design method

We will use Fig. 1-c to illustrate the principle of three-way crossover design. Assume first that we have a single crossover between the high and middle units: we could use a simple capacitance to feed the high unit and inductance to feed the middle unit. Next, assume that we have a single crossover to feed the low and middle units: here we have the inductance to feed the low unit and a capacitance to feed the middle one.

To effect a combined crossover response for the middle unit we merely put the inductance required for crossover from the high unit in series with the capitance required for crossover from the low unit.

But now we have a situation where each of these reactances interacts with the other: at crossover from the high frequency, the principal reactance will be due to the inductance but there will be a small reactance of opposite sign

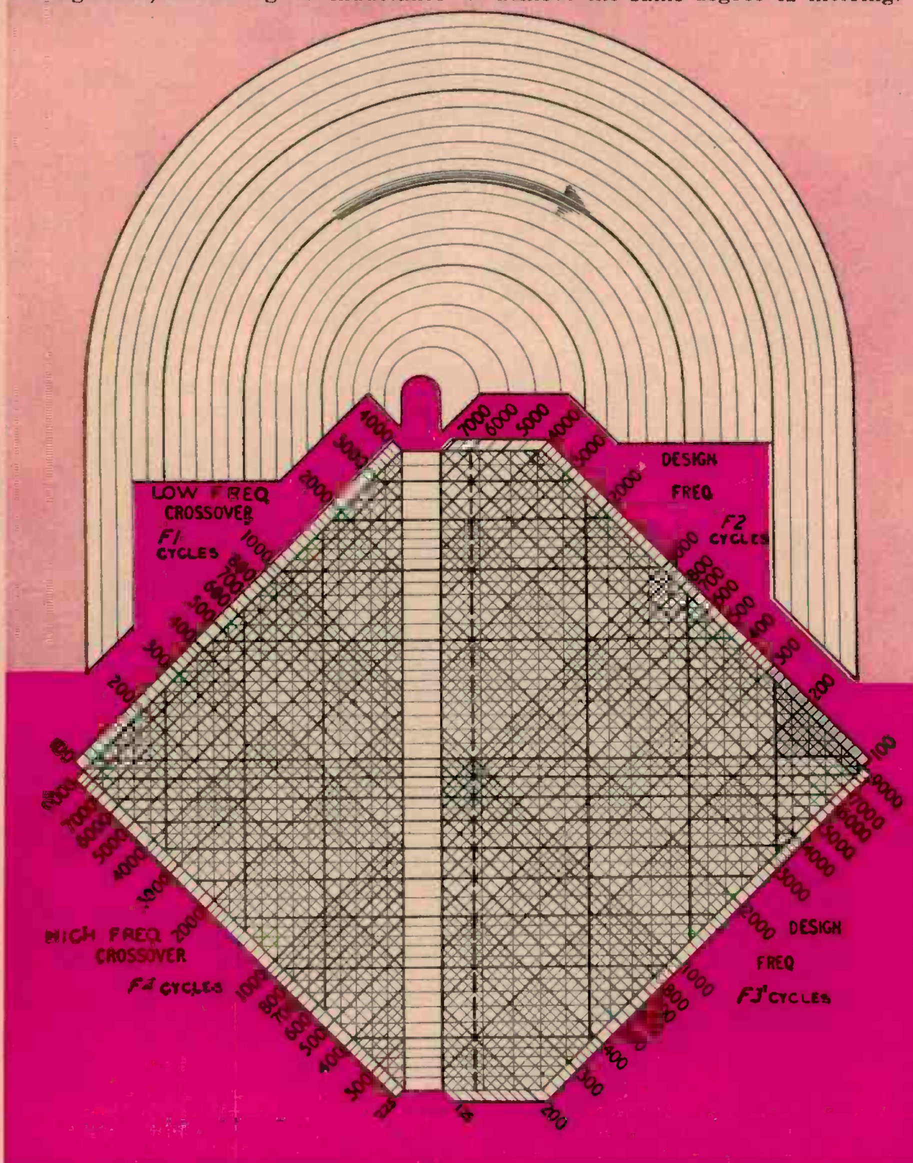
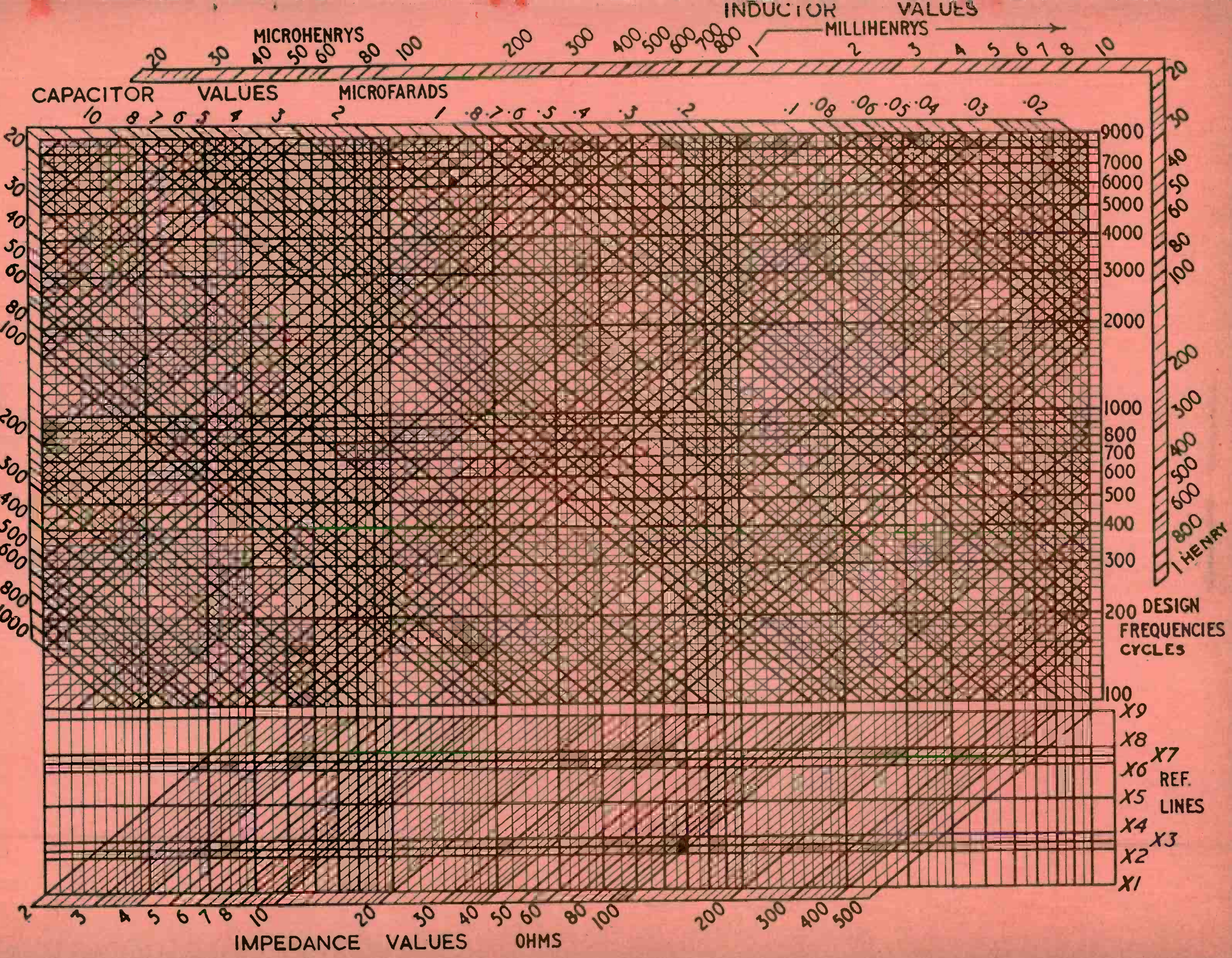


Fig. 4. Chart for calculating all the element values, using code information in Fig. 2, and frequencies obtained from Fig. 3.

Fig. 3. Frequencies F1 and F4 are the low and high. This chart calculates the other two code frequencies, F2 and F3.



INDUCTOR VALUES
MICROHENRYS
20 30 40 50 60 80 100 200 300 400 500 600 700 800
MILLIHENRYS
1 2 3 4 5 6 7 8 10
20 30 40 50 60 80 100 200 300 400 500 600 800 1 HENRY
CAPACITOR VALUES MICROFARADS
10 8 7 6 5 4 3 2 1 .8 .7 .6 .5 .4 .3 .2 .1 .08 .06 .05 .04 .03 .02
MICROFARADS
20 30 40 50 60 80 100 200 300 400 500 600 800 1000
9000 7000 6000 5000 4000 3000 2000 1000 800 700 600 500 400 300 200 100
DESIGN FREQUENCIES CYCLES
X9 X8 X7 X6 X5 X4 X3 X2 X1
REF. LINES
2 3 4 5 6 7 8 10 20 30 40 50 60 80 100 200 300 400 500
IMPEDANCE VALUES OHMS

due to the capacitance—which will tend to cancel some of the inductance—so the inductance needs to be made a little larger to take care of that. Similarly at the crossover from the low-frequency side: the principal reactance in series with the middle unit is due to capacitance but there will be a small reactance also due to the inductance, so the reactance of the capacitor requires to be a little larger (that is, a smaller value capacitor) to offset this effect.

If each of the *modified* values were used without the other, the rolloff would be a little nearer the middle of the band. That is to say, for the upper crossover, the inductance in series with the middle-frequency unit would be larger and hence the rolloff would be at a lower frequency. For the lower crossover, the capacitance will be smaller and hence the rolloff will be at a higher frequency.

The effect of combining the two reactances is to widen the frequency band at both ends. So we offset this by designing the values for the middle-frequency unit as if the crossover frequencies were withdrawn a little.

The "code" system

To do this we use four design frequencies which can be numbered F1 through F4. F1 and F4 will correspond to the low- and high-frequency filter frequencies, respectively, and are the ultimate crossovers on which the filter is designed. Between these will be two further frequencies, F2 and F3, used for calculating the inductance and capacitance values for the middle-frequency unit.

On this basis we can form a "code" for each reactance value in any variety of circuit we may choose to use. Fig. 2 shows six principal forms of three-way crossover unit, together with the reactance coding. In each case, the X number identifies the relative value of reactance *at the design frequency*. This part follows exactly the method of design employed for the single crossover arrangement, given in the article of July, 1952.

The difference is that various design frequencies are used for obtaining these reactance values, so a second code number—an F number, is used to identify the frequency (from F1 to F4) to be employed for obtaining that particular reactance.

Fig. 3 is a simple chart for obtaining the frequency values to be used for design: F1 and F4 are the selected values of low- and high-frequency crossover, respectively; the chart is then used to find the remaining two frequencies, F2 and F3.

The more usual sequence of frequencies will be that F1 through F4 progress in numerical order from lower to higher frequencies. But in some instances, the positions of F2 and F3 will be reversed. To aid in avoiding possible errors on this, the vertical dashed line has been added in Fig. 3.

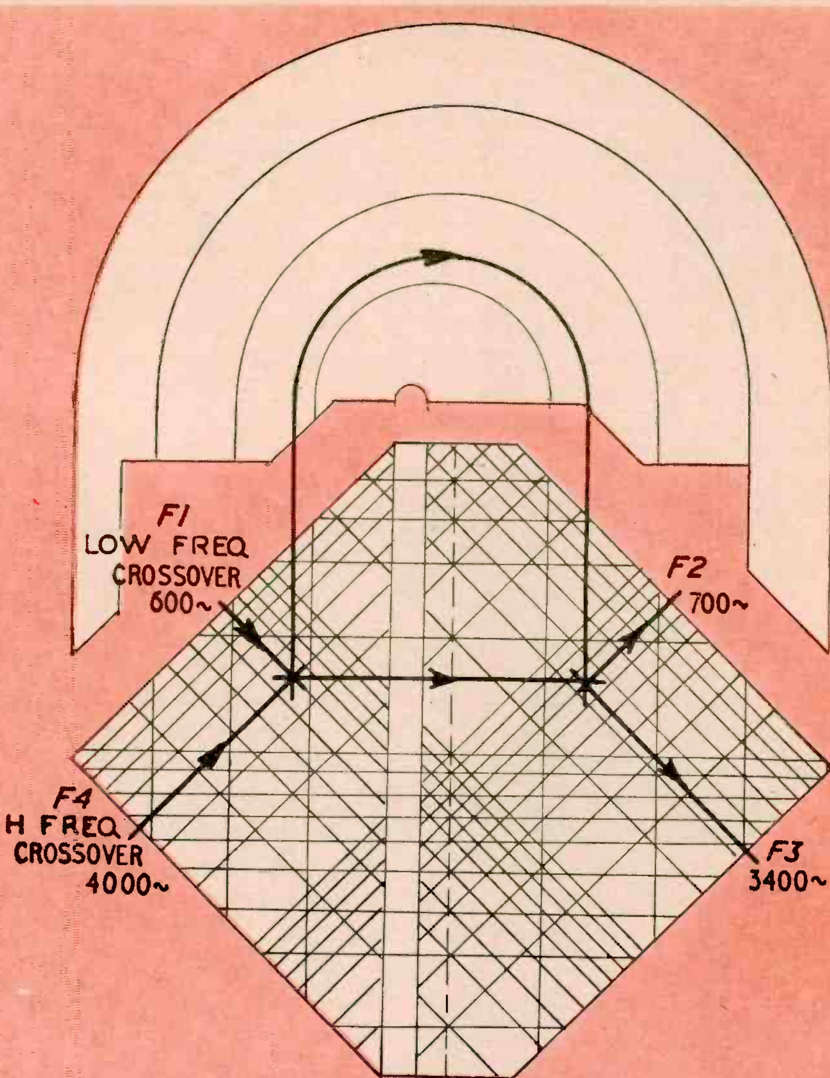


Fig. 5. Illustrative example shows how to use the chart of Fig. 3.

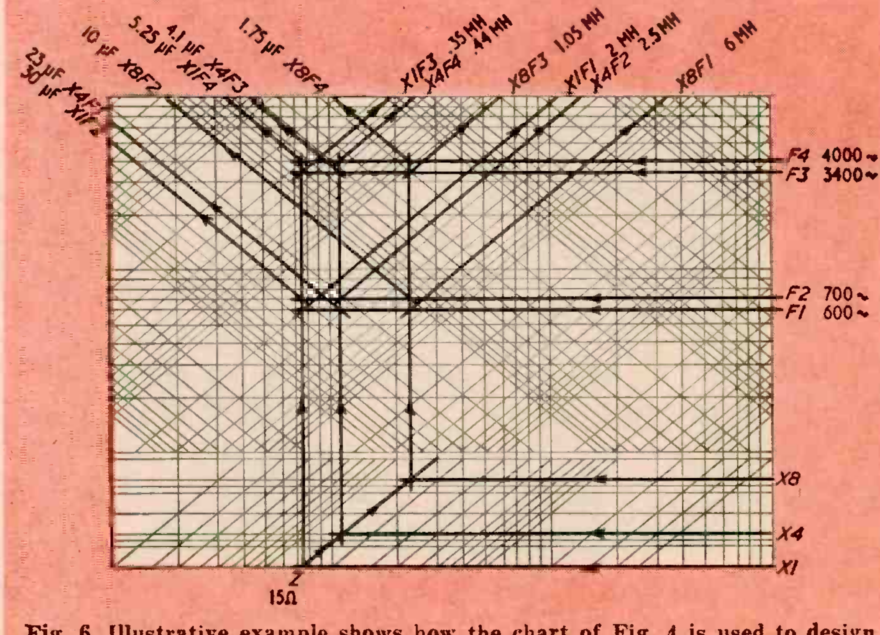


Fig. 6. Illustrative example shows how the chart of Fig. 4 is used to design the filter of the configuration shown at Fig. 2-e.

If the position of F2 and F3 falls to the left of this dashed line, then F2 will be at higher frequency than F3. This is, of course, quite evident from the chart references but the dashed line acts as an additional reminder that the order has been reversed. In the major area of the chart, to the right of the dashed line, the order for frequencies F2 and F3 follows the natural numerical sequence.

The chart of Fig. 4 is identical with the one published in the previous article except that the frequency range has been extended so that it will usefully cover both the low- and high-frequency crossovers normally used in three-way systems. Its use will be a little different from that of the original chart because, for a two-way crossover, only one frequency reference need be used; for the three-way crossover, four frequency references.

Using the charts

The correct use of both of these charts is made clear by Figs. 5 and 6. Fig. 5 shows a typical calculation made with the aid of Fig. 3. It is assumed that the low-frequency crossover F1 is 600 cycles, while the high-frequency crossover F4 is 4,000 cycles. These are quite popular values.

Using the chart in the manner shown in Fig. 5, we find that F2 is 700 cycles while F3 is 3,400 cycles.

These are the four frequencies that will be used to design any of the configurations shown in Fig. 2, with the aid of the chart of Fig. 4.

To illustrate this, the design of one of the more complicated configurations —that shown in Fig. 2-e—is shown in detail in Fig. 6. This is a more complicated three-way crossover than you will probably be using but is used as an illustration to show how simply the chart provides all the values. If you use one of the simpler configurations for the purpose, such as that at Fig. 2-a, -b, -c or -d, you will have fewer references to make to get all the figures. The impedance—15 ohms—is that of *each* of the three speakers, which must have the same value in this type of network. (Nominal 16-ohm voice coil speakers would be used here.)

A brief study of Fig. 2-e in conjunction with Fig. 6 will show how each of the values is calculated, using the code method of design. The circuit is designed for 15 ohms, so this impedance

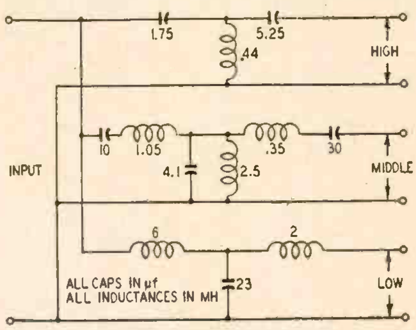


Fig. 7. The circuit of Fig. 2-e redrawn and the values obtained as shown in Figs. 5 and 6 inserted.

is used with the reference lines on the chart for X1, X4 and X8 to get the three vertical lines, which are found by starting at the 15-ohm point on the impedance scale at the bottom of the chart, then following the slanting line upward till it intersects with the horizontal lines X1, X4 and X8. The vertical lines through these intersections are followed up to the points where these three reactance reference lines cross the four frequency reference lines to get the 12 elements needed. By referring to the left-hand side for capacitances and the right-hand side for inductances, this chart will give the values to as close as precision as is practicable in use for this kind of crossover system. The circuit of Fig. 2-e is redrawn in Fig. 7 with the circuit values obtained from the charts put in. END

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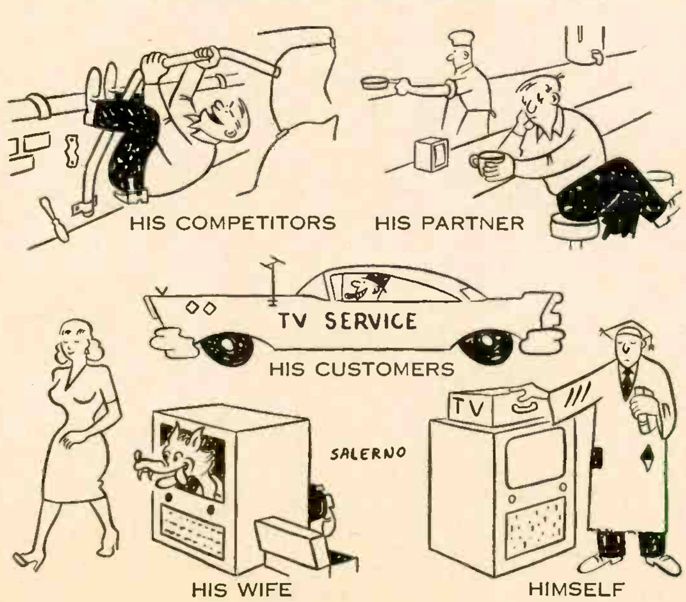
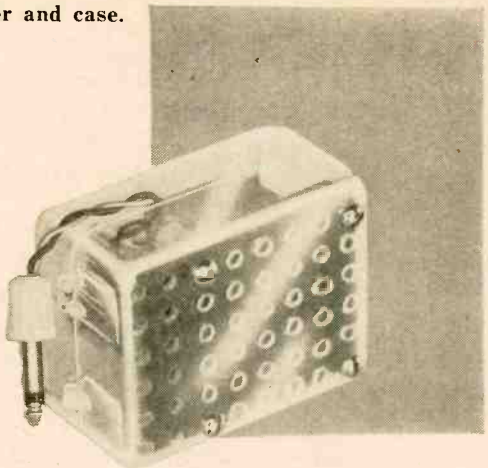


adding a speaker to the shirt-pocket radio

The small speaker and case.



By I. QUEEN
EDITORIAL ASSOCIATE

READERS interested in the True Shirt-Pocket Radio (RADIO-ELECTRONICS, July, 1956) or similar transistor tuners can make a simple modification and adapt it for speaker operation. With few additional parts, the signal is boosted and made audible several feet from a speaker in a quiet location. The output stage is coupled directly to the transistor detector, thus simplifying construction. The amplifier is similar to that used in G-E receiver models 675-676.

Fig. 1 shows the class-B detector used in the shirt-pocket radio. When modified

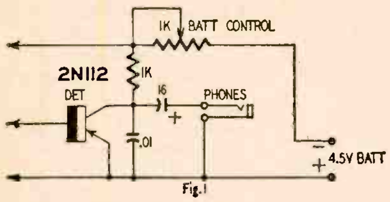


Fig. 1—Original detector circuit.

for an additional audio stage, the circuit looks like Fig. 2. Note that an n-p-n transistor audio stage must be used when the detector transistor is p-n-p. The direction of current through the p-n-p collector is correct for biasing the n-p-n base.

In Fig. 2, variable resistor R acts as detector load as well as volume control. It replaces the 1,000-ohm fixed resistor, originally part of the shirt-pocket radio. It may be a dime-size potentiometer (for example, Lafayette VC-33) and it occupies the hole originally drilled for the battery control which is no longer used. A 560-ohm resistor is added for isolation and filtering.

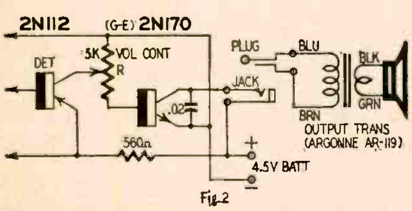
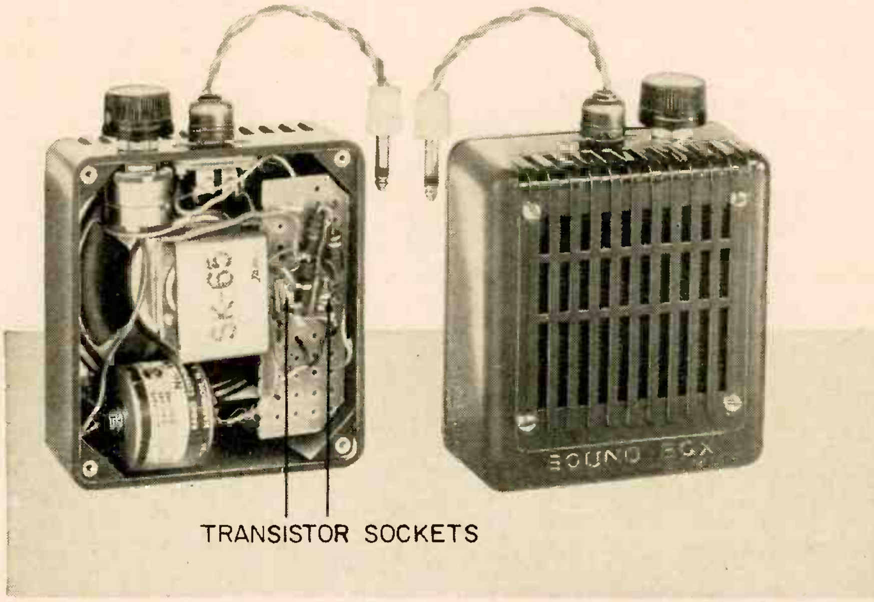


Fig. 2—The modified shirt-pocket radio detector and audio stage.



Amplifier–speaker seen from front and rear. Input and output transformers are beneath the perforated plastic.

A tiny speaker assembly can be made up with Argonne AR-95 speaker and Argonne AR-119 transformer. This speaker is only 1½ inches square and 1⅞ inches deep. The transformer has a 500-ohm primary (center tap is not used) and a 3.2-ohm secondary. This speaker fits into the hinged plastic box in which the transformer is sold. Slight filing down of the speaker sides may be needed for a neat fit.

To increase the baffling action and to strengthen the assembly, I use a piece of perforated plastic board (Lafayette Radio part MS-262) between speaker and plastic box. The perforated board permits sound to pass out of the speaker. Of course corresponding holes must be drilled through the front of the plastic box. Only 6 rows of holes are needed through the box, because the speaker is 1½ inches square (see photo). One of the speaker screws holds the transformer inside the box. Leads from the transformer primary should end in a Telex or similar subminiature plug for insertion into the jack on the set.

With this amplifier, most stations come in too loud on an earpiece and the volume control will have to be cut down. With a speaker, the signals are audible up to 5 or 6 feet away. The last stage requires about 0.5 to 5 ma, depending on signal strength.

The speaker, transformer and other components in the Argonne line are available from Lafayette Radio.

If you want a full-power signal from your pocket radio, add the direct-coupled stage (Fig. 2) but use a class-B amplifier before the speaker. The class-B stage is small enough to be placed within the speaker case along with its battery supply. Output will

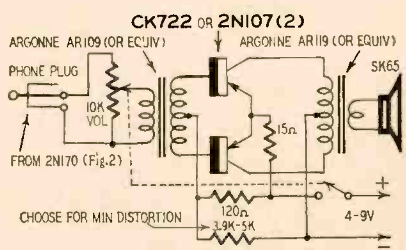


Fig. 3—The push-pull class-B amplifier and speaker assembly.

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be sufficient to be loud and clear many feet from the speaker, yet power consumption is low.

Fig. 3 shows the class-B circuit. It may be operated from any voltage from 4 to 9. All parts are mounted on a piece of perforated board measuring about 2½ x ⅞ inches. When completed, the board may be wedged at one side of the speaker as shown in the photo.

The speaker and Sound Box are designed for each other. The speaker is a 2½-inch unit (Lafayette SK 65). The sound box or speaker case is already fitted with a beautifully styled grill, and a two-pin socket at the top. Incidentally, this case machines very well. It can be drilled or filed without fear of the cracking or chipping that we expect from most plastic material.

The battery used in this particular device is an RCA VS 308 which gives 4 volts. Voltage may be boosted up to about 9 with proportional increase in output power.

The volume control (with switch) is mounted on top of the speaker case. It is single-hole mounted.

This sound box makes a very attractive and useful addition to the Shirt-Pocket Radio (July, 1956, page 60). It permits listening in at comfortable sound levels and can be attached to the radio with a flexible cable. Some constructors prefer to use the same power source for both the radio and the class-B amplifier. This is easily arranged since they both require approximately the same voltage. Alternatively, both units may be built into the same box, and energized from the same battery. This will give you a high-performance device with all desirable features: two stages of high-gain if, power detector, class-B audio and low drain from an inexpensive battery. END

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With the growing interest in construction—largely inspired by the transistor—RADIO-ELECTRONICS is including a larger number of construction articles. To make life easier for constructors (though hardly for the editors!), we are increasing the amount of information given in schematics and photographic illustrations.

- SCHEMATICS will generally have all parts coded (R1, C2, etc.) in addition to our long-time practice of having the value noted next to the part.
- CODED PARTS LIST will also be furnished. This should settle such parts list questions as: which of the five 100 K-ohm resistors specified are ½ watt, 1 watt and 2 watt?
- PHOTOGRAPHS will have many more call-outs than in the past, to eliminate difficulties which might result from parts placement different from the original constructor's and to make parts location obvious without need for careful study.

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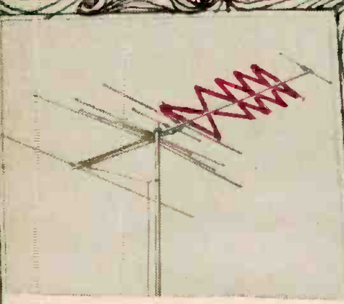

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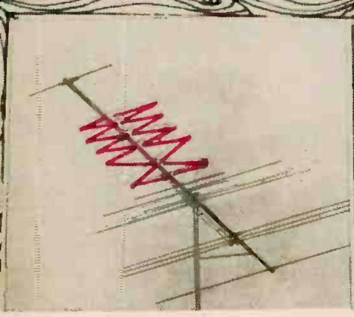

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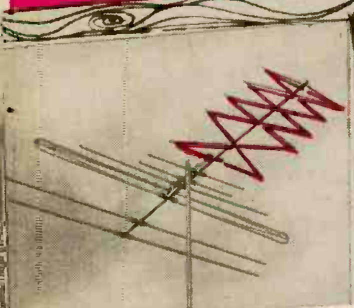

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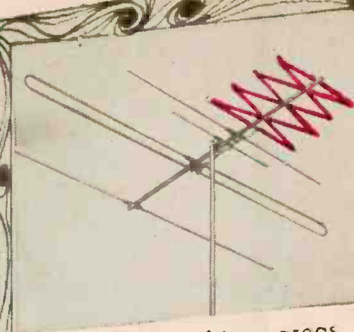

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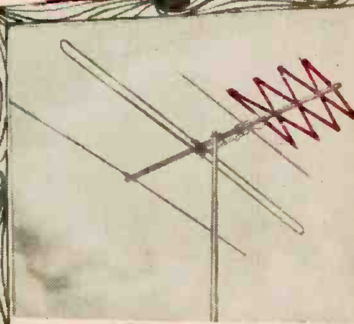

for local areas
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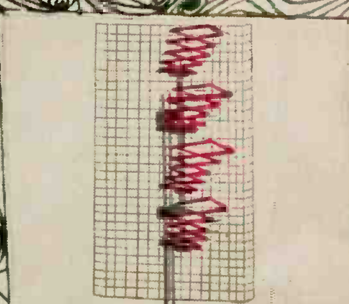

for fringe areas
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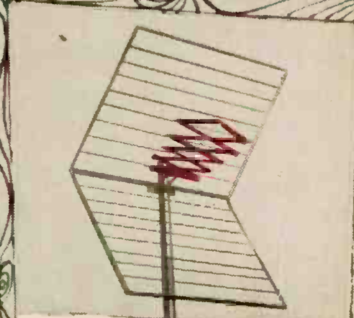

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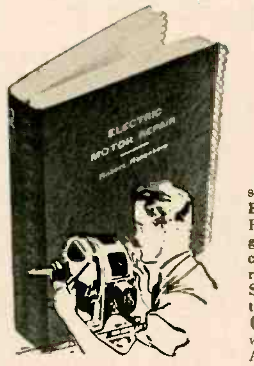

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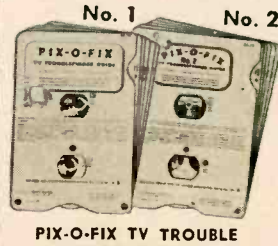

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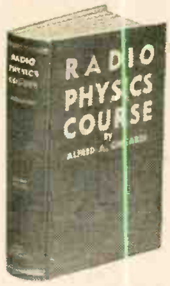

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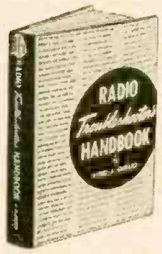

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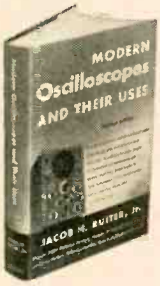

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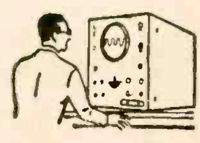

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ABBREVIATIONS and Symbols

By CHARLES S. KIMBALL

(Continued from December, page 109)

L

L —Self-Inductance.
—Circuit symbol for a coil.
—In physics, latent heat.
—A pad or attenuator having the shape of the letter L.
—In radar, type of indicator that presents target range data. Same as type K indicator except signals from two lobes are placed back to back.
—In radar, a band of frequencies from 390–1550 mc.

Lambda (Λ, λ) Greek letter symbol for:
—Permeance (capital letter).
—Wavelength.
—Attenuation constant.

L-C —Inductance–capacitance.
L/C —Inductance–capitance ratio.
LCT —Local Civil Time (navigation).
lf —Low frequency (frequency band).
LHA —Local Hour Angle (navigation).
LIM —Limiter.
LIN —Linearity.
LN —Natural logarithm.
LO —Local oscillator.
Log —Logarithm.
LP —Long play (records).
—Low pass (filters).
LORAC —LOng Range ACcuracy system (navigation).
LORAN —LOng RAnge Navigation system (navigation).

M

M —Mutual inductance.
—Abbreviation for prefix meg or mega.
—In mathematics, modulus.
—In mechanics, mass.
—Meridan.
—Meter.
—Minutes.
—In radar, type of indicator that presents target range data. Type of target presentation given on type A indicator except for added range step or notch. Used in gun-laying radar.

m —Abbreviation for prefix milli.
ma —Milliampere.
max —Maximum.
mc —Megacycle.
MCF —Mean carrier frequency (FM radio).
MCW —Modulated continuous Waves.
MDF —Main distributing frame (telephony).
MDS —Minimum discernible signal (radar).
meg(a) —Prefix meaning 1,000,000 times the unit.
MEV —Million electron volts.
MEW —Microwave Early Warning (radar).
MF —Medium frequency (frequency band).
MFP —Mean free path (nuclear physics).
MG —Motor generator.
mgc —Manual gain control.
mh —Millihenry; also written mhy.
micro —Prefix meaning one-millionth; symbol is Greek mu.
μa —Microampere.
μf —Microfarad.
μμf —Micro-microfarad.
μh —Microhenry.
μsec —Microsecond.
μv —Microvolt.
mike —Colloquialism for microphone.
milli —Prefix meaning 1/000 of the unit.
MIN —Minimum.
MKS —Meter-kilogram-second system of units.
mm —Millimeter.
MO —Master oscillator.
MOD —Modulator.
MOPA —Master oscillator, power amplifier.
MSD —Magnetic storage drum (computers).
—Memory storage drum (computers).
MTI —Moving Target Indicator (radar).
MU —Mass unit (Physics).
mu (μ) Greek letter symbol for:
—Amplification factor of vacuum tube.
—Permeability of magnetic material
—Prefix meaning one-millionth part.
MUF —Maximum usable frequency.
MULT —Multiplier.
MVB —Multivibrator.
mv —Millivolt.
mw —Milliwatt.

N

N —Negative polarity.
—In physics, the neutron.
—In mathematics, an indefinite, such as nth.
—In radar, type of indicator that presents

target data. Combination of type K and M indicators.
—(Lower case) Region in junction-type transistor; this region is designated as n-type when an impurity rich in electrons is added to germanium.

Nav —Navigation.
NBFM —Narrow-band frequency modulation.
NBS —National Bureau of Standards.
NC —No connection; used in tube-base diagrams.
NEC —National Electric Code.
NEG —Negative.
NE —Neon.
NET —Network.
Neut —Neutralize.
n-p-n —Type of junction transistor in which collector, when biased for reverse current flow, collects electrons from n-type emitter layer which then increases reverse current.
Nu (v) —Greek letter symbol for reluctivity.

O

O —Any pad or attenuator having shape of letter O.
od —Outside diameter.
ODR —OmniDirectional Range (Omnirange).
Omega (Ω, ω) Greek letter for:
—Ohms (capital).
—Angular velocity.
OPV —Ohms per volt.
OSC —Oscillator.
OUT —Output.

P

P —Power.
—Plate or anode of vacuum tube.
—Primary winding of transformer.
—Positive.
—In mechanics, pressure.
—In classification of types of radio-frequency emissions, pulse modulation.
—Band of radar frequencies from 225–390 mc.
—(Lower case) Region in a junction type transistor; this regioni s designated as p-type germanium when an impurity deficient in electrons or rich in "holes" is added to germanium.
PA —Phase angle.
—Public address (system).
—Power amplifier.
PABX —Private automatic branch exchange (telephony).
PAM —Pulse-amplitude modulation.
PAR —Precision approach radar.
PAX —Private automatic exchange (telephony).
PBX —Private branch exchange (telephony).
PC —Printed circuit.
PCM —Pulse-code modulation.
PDM —Pulse-duration modulation.
PEC —Photoelectric cell.
PERM —Permanent.
Pf —Power factor.
Phi (ϕ) Greek letter for:
—Magnetic flux.
phone —Telephone.
Pi (π) Greek letter for:
—Ratio of circle circumference to diameter.
pix —Picture (TV)
—Type of pad or attenuator.
P^3I —Precision PPI (radar).
P^4I —Photographic projection PPI (radar).
PL —Pilot lamp.
PM —Permanent magnet.
—Phase modulation.
—Pulse modulation.
p-n-p —Type of junction transistor in which emitter electrode, when biased for forward current flow, injects current carriers "holes" into base of germanium wafer.
POPI —Post-office position indicator. (Radar; developed by personnel of British Postal System).
POS —Positive.
POT —Potentiometer.
PP —Peak-to-peak.
—Push-pull (amplification).
PPI —In radar, plan position indicator. Type of indicator in wide general use.
PPM —Pulse-position modulation.
PPS —Pulses per second.
preamp —Preamplifier.
PRF —Pulse-Recurrence (Repetition) Frequency (radar).
PRI —Primary (transformer winding).
PRT —Pulse-recurrence time (radar).
PTM —Pulse-time modulation.
PVC —Designation (trade mark) for type of plastic, composition of which is polyvinyl chloride.
PW —Pulse width (radar).
PWM —Pulse-width modulation.
PWV —Peak working voltage.
In vacuum-tube terminology:
P_o —Power output.
P_{g2} —Screen (grid 2) dissipation.
P_{max} —Power maximum.
P_p —Plate dissipation.
P_{in} —Power input.

TO BE CONTINUED

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new Records

MONITOR

RIMSKY-KORSAKOV: *Scheherezade*
Mario Rossi conducting Vienna State Opera Orchestra
Vanguard SRV-103

This is the third Scheherezade I've reviewed. It is billed on the jacket as a demonstration record. I am not being in any sense derogatory when I say that in my judgment it is not up to Westminster's old WL-5234 for this purpose. The Westminster is still the most spectacular. The drums and the high-high cutlery particularly are far more awesome in the Westminster. On the other hand, this is more naturally balanced and freer of hi-fi effects, though still gorgeous in overall sound and probably more acceptable from a strictly musical point of view. Though it is very live in acoustics, it does not suffer the loss of detail and definition I noted in the recent Capitol version. The Westminster, therefore, is likely to make the most spectacular impact on hi-fi customers; while the Vanguard is a finer example of the new trend away from hi-fi effects and toward an overall sound more closely resembling what one hears in the concert hall. And for this it deserves a high recommendation. It is noteworthy that the same orchestra is heard on both discs. The differences reflect not only different conductors and engineers but the different acoustics of two halls.

BEETHOVEN: *Overtures*
Leonore Nos. 1, 2 and 3
Fidelio
Cariolan
Munch conducting Boston Symphony
RCA Victor LM-2015

As far as I'm concerned this is the definitive recording of these works, combining authoritative musical interpretation and performance with a very fine sound. Another of the really fine records RCA is discing in Boston. It is especially notable for the acoustics. The auditorium reverberation is plainly audible, especially in the severe attacks and stops of the *Cariolan*. The tonal balance is very good without exaggeration anywhere and the recording is exceptionally clean. The overall sound is highly impressive and the presence very good.

LEKEU: *Violin Sonata in G*
Also encores from Delius, Handel, Nin, Beethoven, Rimsky-Korsakov
Yehudi Menuhin, violin
Accompanied by Marcelle Gazelle at piano
RCA Victor LM-2014

HINDEMITH: *Cello Sonata*
BARBER: *Cello Sonata (Op. 6)*
Gregor Piatigorski, cellist
RCA Victor LM-2013

Speaker systems using multiple speakers with dividing networks pose many problems. Often the individual speakers have a slightly different coloration of tone so that, if the reproduction of an instrument shifts from one speaker to another as the frequency goes up or down, the tone color changes. Similarly, if the speakers are separated by any distance, a shift may appear to make the instrument jump from one spot to another. The word *homogeneity* has been applied to describe the absence of these effects. These two recordings may be useful for testing homogeneity in systems with crossovers from 250 to 3,000 cycles. A solo instrument is far more useful for such tests and between them these two records pretty well cover the range from 100 cycles or so to about 3,000 cycles on fundamentals.

NEW RECORDS *(Continued)*

The music in the Piatigorski recording is not particularly outstanding, though the Hindemith presents the cello with an opportunity for a number of unusual effects. The Lekeu sonata also does not have any particularly memorable music, though it does give the fiddle an opportunity to cover a wide range. However, the five short encores will be more familiar and pleasant. The buzz in the *Flight of the Bumblebee* is very real; and the plucked or pizzicato transients in Nin's *Granadina* are very nice. Both Menuhin and Piatigorski deliver very fine performances but, I'm afraid, unless you have a need for the special test value or are a connoisseur of violin or cello music, there are many fiddle and cello recordings you'll like better.

GLANVILLE-HICKS: ***Etruscan Concerto for Piano and Chamber Orchestra***
HOLMBOE: ***Concerto No. 11 for Trumpet, Two Horns and Strings***
Carlos Surinach conducting MGM Chamber Orchestra
MGM E-3357

MGM continues to mine the contemporary fields of music. The *Etruscan Concerto*, in fact, is so contemporary that it has been heard in a public live performance only once (a week before this recording). And I think that most of those who buy the record will thank MGM for recording it. It may not be very important music but it is both novel and interesting without being jarring to the ear, and it is thoroughly enjoyable. It has a wide variety of percussive coloring, including a section of part 2 where for many measures the tympani roll under the music constantly but not ominously. Holmboe is a Danish composer, and this concerto is also stimulating though not perhaps as engaging. Both works are nicely and cleanly recorded. If you'd like the opportunity to judge some really fresh music which, chances are, nobody in your town has ever heard before, this is your chance to do so not only without pain but with some pleasure at the quality of the sound if not all the music.

BERGER: ***Serenade Concertante***
BLOCK: ***Four Episodes***
BRITTEN: ***Sinfonietta***
PINKHAM: ***Concertant***
Izler Solomon conducting various chamber groups
MGM E-3245

The Block and Britten pieces were previously issued by MGM on a 10-inch which I recommended highly for the intimate presence, definition and fine overall sound. The addition of the Berger and Pinkham works doesn't detract at all and will give collectors of modern music an additional reason for buying the disc. The Block is one of the finest chamber records I know of; the Britten has one of the finest single bass viols I've heard. Pinkham's piece adds a nice, harpsichord and a subtly used celeste. All in all, if you like the small orchestra and at least don't mind moderate examples of contemporary modern music, you'll like this. Anybody at all should like the sound which on a good system could fool a blind man into thinking that the players were right in your living room.

Electra Playback System Calibration Record
Electra 35

A new and valuable frequency test record covering the full audio range from 18.75 to 20,000 cycles and some 40 points in between, recorded, like the Cook LP-10, flat above 500 cycles and with a 6-db slope below at 33 rpm. It is notable for two things especially: 1. It is pressed of a much stiffer plastic material than normal, to minimize needle-to-groove resonance which is very likely to occur with softer materials in the range between 8,000 and 20,000 cycles. The claim is that this material moves the point of possible resonance above 20,000 cycles. I have tried it with several cartridges of various types and the claim appears to hold water. 2. The low frequencies especially are recorded with very low harmonic distortion so that any doubling which may occur below 50 cycles can pretty safely be ascribed to the loudspeakers, and hence the low frequencies when played back present a good test of loudspeaker distortion.

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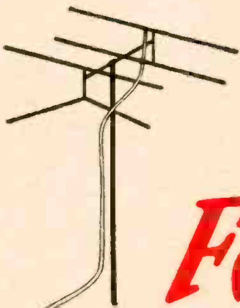

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Rotor Lead-in

TV-1188—Rugged, dependable, long-life rotor lead-in. Weather-resistant. Insulated with "silver" vinyl. Three 7-strand conductors of .0121 AWG soft bare and one conductor of .0121 AWG tinned soft bare.

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From these points of view this is one of the very best of the frequency records available for completely objective testing of equipment. However, most commercial records are pressed of soft materials and many pickups were designed for use with such materials, their response being adjusted to allow for groove resonance. The response of such pickups to this recording will not, then, be entirely representative of response to commercial recordings or of merit in reproducing commercial recordings.

Some pickups will test better and some worse than they would on a material more comparable to that used in commercial pressings. Nevertheless, the minimization of groove resonance disposes of still another obfuscating factor in measuring pickup performance and a comparison of performance on this and other test records will enable one to make some measure of groove resonant effects. No single frequency record offers a safe criterion and this addition to the library should be most welcome, especially to designers of pickups. The two sides are identical. There are no voice announcements or other clear identification of test points, and one has to keep track of the tones very closely if absolute frequency identification is desired.

MOZART: *Sonatas for Organ and Orchestra, Vols. I, II*
Richard Elsasser, organist
Winograd conducting the Hamburg Chamber Orchestra
MGM E-3363 and E-3364

These very little known works should please the Mozart lovers. The delicacy of the contrast between organ and chamber music should also please the critical ear that wants to measure system definition. The organ and string sonatas in the first volume are especially good for this because the balance between strings and orchestra is very even throughout and it will take good ears and a good system to separate the blend into the separate components. The second volume has some stronger contrasts and includes three sonatas for organ plus brasses, winds and tympani, as well as strings. Though these were written for church use they are by no means "religious" in sound and effect and are thoroughly listenable in the home.

GRIEG: *Lyric Suite, Opus 54*
Old Norwegian Romance With Variations, Opus 51
Winograd conducting Philharmonia Orchestra of Hamburg
MGM E-3368

Just about everybody but the overly sophisticated and musically bored loves this music. An excellent rendition with a fine, round sound and a fine resonance. Played fairly loud with some bass boost or loudness control, it produces a fairly spectacular sound, especially in the *March of the Dwarfs.* END

Thirty-Five Years Ago

In Gernsback Publications

HUGO GERNSBACK, *Founder*

Modern Electric	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 larger libraries still have copies of ELECTRICAL EXPERIMENTER on file for interested readers.

In December, 1922, Science and Invention (formerly Electrical Experimenter)

Newspaper as a Loudspeaker, by Clyde Fitch.
Home-Made Loud-Talkers — Winners of $100.00 Prize Contest.
Operation of a Naval Radio Station, by A. P. Peck.
My First Radio Set, by Mike R. Farrods.
Radio Wrinkles for Those Who Build Their Own, by A. P. Peck.
Radio for the Beginner, by Armstrong Perry, No. 11—How to Acquire a Simple Receiving Station.
Radio Oracle.

new Devices

6-TRANSISTOR PORTABLE RADIO KIT, *IF-KIT 5,000.* 3 455-kc if transformers. One 455-kc oscillator coil. Superheterodyne circuit. Parts list. Assembles on either printed or wired

circuit as portable or built-in.—**Vokar Corp.,** 7300 Huron Drive, Dexter, Mich.

AM–FM TUNER KIT, *model 1000.* Driftless tuning with afc defeat switch and temperature-compensated oscillator circuit. Armstrong FM circuit and Foster-Seeley discriminator for 20–20,000-cycle response. 7-tube circuit plus selenium rectifier. Superheterodyne circuit with avc and ferrite loopstick antenna in AM section. Chassis

contains own power supply and front-panel selector switch. Step-by-step, illustrated instruction manual.—**Quality Electronics, Inc.,** 319 Church St., N. Y. 13, N. Y.

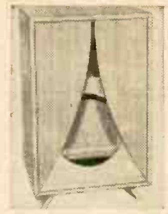
AUDIO VACUUM TUBE VOLTMETER KIT, *model AV-3.* Designed especially for audio measurements and low-level ac measurements in power supply

filters, etc. Handles ac measurements from low value of 1 millivolt to maximum of 300 volts. Employs cascode amplifier circuit with cathode-follower isolation between input and amplifier, output and preceding stages. Increased damping in meter circuit. Nylon insulating bushings. 1% precision multiplier resistors. Input impedance of megohm at 1,000 cycles. Flat response from 10 cycles to 200 kc. Ac (rms) voltage ranges are 0-.01, .03, 0.1, 0.3, 1, 3, 10, 30, 100 and 300. Decibel ranges cover −52 db to +52 db.—**Heath Co.,** 305 Territorial Rd., Benton Harbor, Mich.

CONSOLETTE TAPE RECORDER, *model CR-820,* with *Hi-Five* speaker system. Can be used room-to-room. 2 electrostatic tweeters and intermediate speakers. 1 woofer. Storage compart-

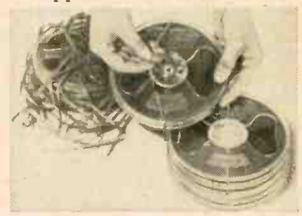
ments for tapes, microphone and accessories. — **DeJur Amsco Corp.,** Northern Blvd. & 45th St., Long Island City 1, N. Y.

ENCLOSURES. Kits and assembled unfinished models with hardwood exteriors capable of fine furniture finish. Precision



measurements microphone. — **Karlson Associates,** 1610 Neck Rd., Brooklyn, N. Y.

NO-SPILL REEL. Rubber band is slipped over 2 notches on



opposite ends of reel to hold tape securely. 28 square inches of indexing space on flange areas, 2 on each side.—**ORRadio Industries, Inc.,** Shamrock Circle, Opelika, Ala.

REPLACEMENT PHONO CARTRIDGE, for Chrysler Highway Hi-Fi system (Columbia), *WC20.* Ceramic cartridge with minimum needle force of 2½ grams and response to 12,000 cps. Re-

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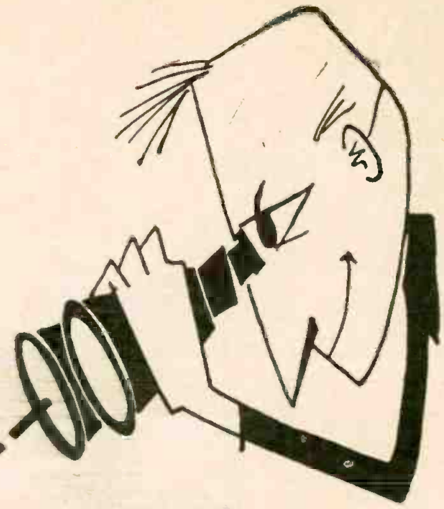

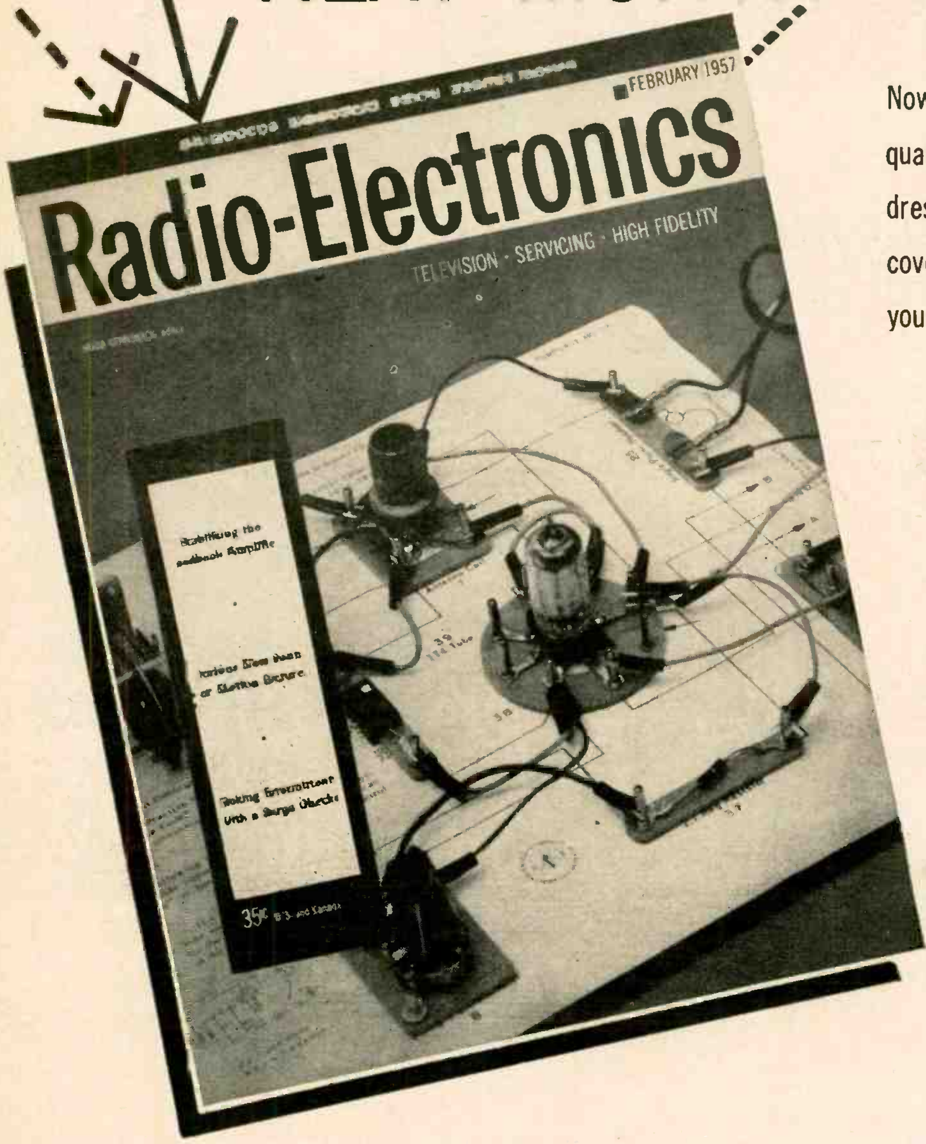

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places PC20A. Tracks at extremely low pressures. .003-inch (3/10-mil) sapphire stylus.—**Shure Bros., Inc.**, 222 Hartrey Ave., Evanston, Ill.

where size and weight must be kept at minimum. Copperweld leads serve as terminals. Plastic outer insulating sleeves available. Working voltages from 3 to 25 dc; capacitance values of from 1 to 50 μf. Standard operating temperature −20° C to + 65° C. Size range: 3/16 to ⅜ inch diameter, and ½ to ¾ inch long. Special capacitors made to order.—Aerovox, 740 Belleville Ave., New Bedford, Mass.

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10,000 cycles. Peak-free when matched to ½–1-megohm input of triode stage. Cable with minimum of 90% shielding; telephone type plug fully shielded.—**Ronette Acoustical Corp.**, 135 Front St., N.Y., N.Y.

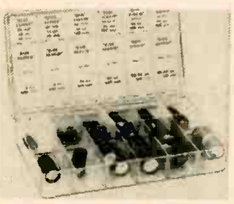
SPEAKER, *Panasonic, model 8P-W1*. 8 inches. PM double-cone system, bass-reflex type. Response 40–16,000 cycles, ±10 db; 80–10,000 cycles, ±7 db. Flux density 10,500 gausses. Cone res-

onance 40–50 cycles. Has impedance 7.3 ohms at 400 cycles. Acoustic fiber material. 19 x 13 x 9 inches.—**R. I. Mendels, Inc.**, 672 Milton Rd., Rye, N. Y.

TONE-ARM KIT. 3 basic parts. Total weight of moving arm supported on a needlepoint. Selector index permits instant adjustment for any stylus pres-

sure. Accommodates any cartridge. Cartridge housing designed with partly open sides for full view of stylus-to-record alignment. 12 and 16 inches.—**Audak Co.**, 500 5th Ave., N. Y. 36, N. Y.

CAPACITOR SERVICE KITS. *Blue Beaver* (illustrated) contains 22 most widely used electrolytic capacitors. *Cub* 76 mold-



ed tubulars of assorted ratings and types. Location chart, ratings, prices, products guide supplied. Flat, clear plastic, hinged cover. 11 x 6½ x 1⅞ inches.—**Cornell-Dubilier Electric Corp.**, S. Plainfield, N. J.

MINIATURE ALUMINUM-CAN ELECTROLYTIC CAPACITOR, *type XPP*. For applications

TV PICTURE-TUBE TEST AND REPAIR INSTRUMENT, *Rejuva-Check, model RJC-1*.

Checks cathode emission, indicates shorts and leakage between elements, estimates remaining useful life of CRT, clears interelement shorts and leakage, removes cathode surface contamination and restores emission. Can be carried about in tube caddy.—**Century Electronics Co., Inc.**, 111 Roosevelt Ave., Mineola, N. Y.

TUBE BOOSTER, *Juvenator model RPS-2*. For both parallel-

and series-filament circuits. One-piece assembly free of loose ends and hanging weights.—**DeRo Electronics**, Roosevelt, N. Y.

VIDEO TRANSISTOR AMPLIFIER, *Transifier, model 126A*. Fully transistorized modular plug-in unit. Low-drain, low-

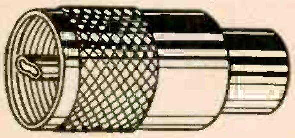
voltage transistors. Feedback circuit built in. Self-contained in cast aluminum housing with standard banana plug input and output.—**Kay Electric Co.**, 14 Maple Ave., Pine Brook, N. J.

CONVERTER, *Automatic*. Operates without switching on either 6- or 12-volt battery in car, truck, boat or plane and changes to 100 volts ac for small appliances such as shavers, radios, phonographs, tape recorders, portable TV sets, etc.—Terado

Co., 1068 Raymond Ave., St. Paul 14, Minn.

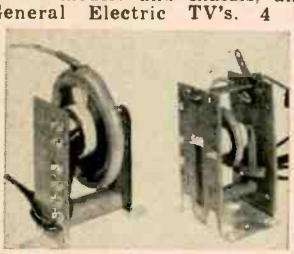
MINIATURE RF NOISE SUPPRESSION FILTER, *AF1047.* Hermetically sealed. Shock-resistant. Contains 11 capacitor sections, 11 toroids, 2 resistors. Can be custom-designed without shape limitations for missile, portable or airborne applications. — **Astron Corp.,** 255 Grant Ave., E. Newark, N. J.

SOLDERLESS CABLE CONNECTORS. *Model P-118* for RG-11/U cables, *P-59S* for RG-59/U. Brass shell and body. Silver-plated phosphor-bronze pin. Insulating bushing of thermal-setting plastic with low dielectric constant. 2-step thread



clamps outer jacket and grounds shield. Tubular spring locks center conductor. Connectors removed by unscrewing and can be reused or soldered in place for certain applications.—**B-T Labs Corp.,** 526-36 North Ave., Westfield, N. J.

REPLACEMENT PARTS. Yokes, flybacks, etc., for 250 Motorola, Hoffman, Hallicrafter, 100 Magnavox models and chassis, and General Electric TV's. 4 if



transformers for printed-circuit applications.—**Merit Coil & Transformer Corp.,** 4427 N. Clark St., Chicago 40, Ill.

PUSH-PULL SWITCH CONTROL. Rotates for control action—push-pulls for switching. Turns control on or off at any setting without disturbing it. Can be combined with any series 47 composition-element 15/16-inch-diameter control. *AG-17,* spst, 0.5 amp 125 vdc or 1 amp

125 vac; *AG-18,* spst, 0.5 amp 125 vdc or 3 amp 125 vac; *AG-19,* spst, 0.5 amp 125 vac. Operating force: *AG-17,* 3 to 7 oz; *AG-18* and *AG-19,* 5 to 14 oz.—**Clarostat Manufacturing Co., Inc.,** Dover, N. H.

TRANSFORMERS. *ZC Constant-Voltage type.* For 70-volt

constant-voltage systems. Draw predetermined amount of power from a 70-volt line. *ZC-100, ZC-200, ZC-300* and *ZC-400* equipped with terminal board with pin jack adjustment for desired input power. Heavy-duty screw terminals for speaker and line connection. Transformers completely impregnated and dip-processed for all climates. All except *ZC-3514* mountable in W-1 weatherproof transformer cases.—**Jensen Manufacturing Co.,** 6601 S. Laramie Ave., Chicago, Ill.

CODE-PRACTICE OSCILLATOR. Monitors CW transmitter with a few minor circuit changes. Special jacks interconnect two units to simulate station-to-station operation. Tone-controlled by built-in potentiometer. P-n-p junction transistor. External magnetic phones and key. 6¼ x 3¾ x 2 inches. 1¼ lbs. Molded bakelite

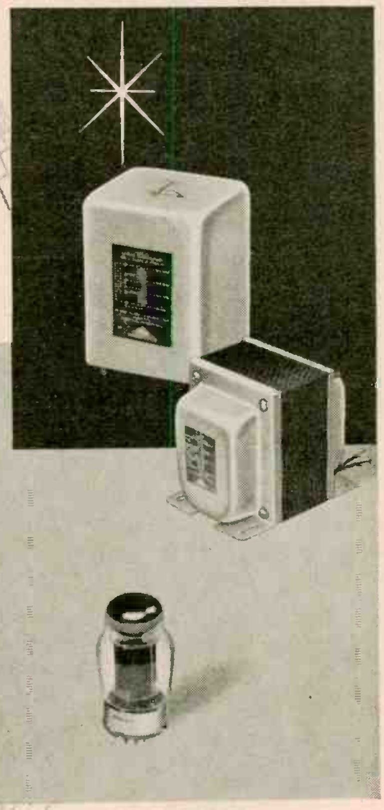
case.—**Jackson Electric Instrument Co.,** 16 S. Patterson Blvd., Dayton 2, Ohio.

POWER-LAB, *Precise models 711* and *713.* Battery eliminator and dc–ac high power supply acting as battery eliminator and charger; high current line voltage Variac; ac line voltmeter, ammeter and wattmeter; ac line-isolation transformer; low-voltage, high ac supply; dc line voltage variable supply; dc high current ammeter and ac bias box. Also usable for servicing

auto radios.—**Precise Development Corp.,** 2 Neil Court, Oceanside, N. Y.

5-INCH OSCILLOSCOPE KIT, *Knight-Kit.* For general-purpose use with AM, FM, TV receivers and other high-frequency applications. Printed-circuit board. Laced wiring harness. Blanking circuit to eliminate retrace lines

designed specifically for the 6550 tube



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WALKIE-talkie plans. 50c, FABCO ELECTRONICS, 7400-RE Jackson Park, Birmingham, Mich.

OPPORTUNITY to earn $15,000-$30,000 annually. Franchise protected. Granted on $12,500 base. Live at home. No merchandise to buy. Self employed. One of most exclusive and noncompetitive businesses in U.S. and Canada. Send for free explanatory booklet. HARRELL & CO., Box 7-B, Louisville, Ill.

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COMPLETE Television Sets $11.95. JONES TV, 1115 Rambler, Pottstown, Pa.

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DIAGRAMS! Repair Information! Radios—Amplifiers—recorders $1. Televisions $1.50. Give make, model, chassis.—Norelco-Philips & Amperex tubes in stock! TV MILTIE, Box 101EA, Hicksville, N.Y.

on all ranges. Frequency-compensated vertical input attenuator. Internal, external, positive and negative synchronization. Phantastron linear sweep generator. High second anode voltage for high-intensity trace. Sweep range 15–150,000 cycles in 4 ranges. Vertical response down 3 db at 700 kc (1,000-cycle reference). 25-rms-mv/in vertical sensitivity. 1-volt peak-to-peak, square-wave, regulated calibrating voltage internally injected by front-panel switch. 70-rms-mv/in horizontal sensitivity. Horizontal amplifier frequency response down 3 db at 200 kc (1,000-cycle reference). Direct-coupled positioning controls. Complete with all tubes, including CRT, steel case with disappearing handle, all parts, detailed instructions and diagrams.—**Allied Radio Corp.**, 100 N. Western Ave., Chicago 80, Ill.

RF/IF/VF MARKER ADDER, *RCA WR-70A*. For sweep-fre-

quency alignment of black-and-white and color TV receivers. Choice of 4 shapes. All controls grouped on front panel.—**RCA Components Div.**, Front & Cooper Sts., Camden, N. J.

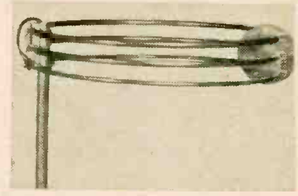
TESTER, *Capacitest, series 11.* Checks all capacitor types and

selenium rectifiers. Applied voltage of 150. 4 x 4 x 2 inches. 2 test leads and full instructions. —**Barjay Co.**, 145 W. 40th St., N. Y., N. Y.

VIBRATOR CHECKER, *model 906*. Use with any battery eliminator to check 6- and 12-volt vibrators. Reads condition on bad–good scale. Checks both in-

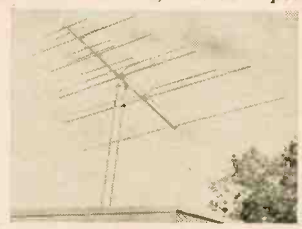
terrupter and self-rectifier type for proper starting point and quality of operation.—**Electronic Measurement Corp.**, 625 Broadway, N. Y., N. Y.

ANTENNA, *Saturn 6 Mobileer*. For 6 meters. Horizontally polarized. End-loaded folded dipole. 3-ring design approximately 20 inches in diameter, 5 inches



high. Design center 50.5 mc. Trimmer between capacitor plates permits resonating antenna between 50.0 and 53.0 mc. Easily fed with RG58/U cable. Aluminum. 2 lbs.—**Hi-Par Products Co.**, 347 Lunenburg St., Fitchburg, Mass.

TV ANTENNA, *Color-Ceptor*.



Available as 11-element model or 18-element Yagi with addition of Power-Pack unit, both with Electro-Lens director system for gain boost on vhf channels.—**Winegard Co.**, 3000 Scotten Blvd., Burlington, Iowa.

AUDIO-SIGNAL GENERATOR, RCA WA-44B. Frequency range from 11 cycles to 100 kc per second, covered in 4 stages. Amplified automatic gain con-

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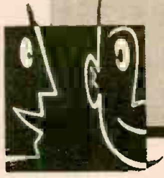
SPEAKER ENCLOSURES. Corner and bass-reflex. Kit and completed form. Can be used

with 12- or 15-inch speaker for single, 2-way or 3-way speaker systems. ¾-inch plywood with mahogany veneer. Woven maroon plastic grille cloth. Precut adapter board for addition of tweeters or other speaker components. All parts, screws, glue, step-by-step instructions. —**Allied Radio Corp.**, 100 N. Western Ave., Chicago 80, Ill.

All specifications given are from manufacturers' data.



Technicians' News

OPPOSED TO LICENSING

A new organization, dedicated to the proposition that the service technicians' problems will not be solved by licensing or legislation, has been founded in Missouri. The new group, the Electronics Association of Missouri, launched its campaign with a meeting at the Kingsway Hotel, St. Louis. The meeting was attended by some 4,000 service technicians.

President John V. Glass of TEAM stated that, if the aim of licensing was to promote more ethical servicing, experience had shown that morality cannot be legislated. If the true purpose was the elimination of the part-time service technician, he believed that their threat to the industry has been exaggerated. There is today a lack of service technicians, he asserted.

Mr. Glass was also critical of the recent BBB bulletin charging unnecessary repair work and unnecessary parts replacement by some St. Louis firms. He pointed out that one service technician might in good faith perform labor and install parts which another might feel unnecessary, and declared that in most cases "only the repairman himself" knew whether he was attempting an honest job or not.

BBB HITS 7 TV FIRMS

The St. Louis Better Business Bureau has issued a special bulletin accusing seven local firms of overcharging, misrepresentation and improper TV repair methods, according to *Retailing Daily*. The bureau placed a number of gimmicked sets in customers' homes. The gimmick consisted of blowing a fuse or tube filament.

Excess charges ranged from $6.53 to $39.86. In most cases, the bulletin stated, the overcharges were based on installation of superfluous picture-tube brighteners and replacement of tubes which did not require it. In some cases, the bureau stated, fuses of incorrect size were installed and good tubes replaced with faulty ones.

A minority report by the owner of four of the firms criticized, Jack Mueller, protested that the BBB did not show the reverse side of his invoices, on which all labor charges were listed, and insisted that his labor charges averaged $5 per hour. He also pointed out that whereas the BBB knew exactly what had been done to the receivers, his technicians had no way of knowing what parts had been tampered with. However, a rebuttal by the president and general manager of the St. Louis BBB implied that some of the services carefully itemized had actually not been performed.

NEW RTASCV PRESIDENT

The Radio-Television Association of the Santa Clara Valley elected Al Limberatos president, Quentin Muchow vice president, Jim Wright secretary and Harold Kelley sergeant-at-arms. A board consisting of Harold Kelley, Ben Floyd, Richard Kelso, H. Lawrence Schmitt (past president), Quentin Muchow, Tom Miner and Jim Wright was also elected.

The RTA booth at the Santa Clara County Fair was a great success, reported Fair Committee Chairman Muchow. It was well visited by the public, and many questions were asked. A spot scanner was used to generate a signal on two television sets on display in the booth. RTA's emblem and two short messages, advising the public of the benefits that the association's technicians have to offer, were displayed on the screens of both sets.

ATTACKS CAPTIVE SERVICE

This large 4-section folder was distributed at the "Unite to Fight" meeting

in Detroit mentioned in our December issue (page 129). Made of heavy card, each of its four sections is a pocket containing several pieces of informative literature, some for the recipient's own perusal, and some in the form of handbills, stickers, mats, etc., to distribute among colleagues or otherwise use as ammunition in the fight against captive service.

NATESA FILES CHARGES

Charges of unfair trade practices by television manufacturers were alleged in a complaint recently filed with the anti-trust division of the United States Justice Department by the National Alliance of Television & Electronic Service Associations.

The complaint alleged that the unfair practices consisted of:

. . . Operating retail service businesses, sometimes directly, at other times through various corporatie gimmicks; using such unfair practices as subsidies through tie-in advertising with their manufacturing divisions office and shop space and personnel; special replacement parts; cost concessions; etc.

. . . Issuance, exclusively to their own service shops, of special service data which reveals bad parts runs, poor engineering, etc., which immeasurably assists these companies to eliminate inherent defects with the result of added public prestige.

. . . Issuance first to their own companies of all warranty replacement components, including improved type components.

. . . Special service tie-in deals to set-selling dealers.

. . . Use of parts warranty registrations to solicit service business on a retail basis.

. . . Offers of nine months' parts replacement extension contracts at below cost which require retail customers' use of factory service facilities.

NEW S. C. GROUP

Greenville, S. C., reports formation of the Greenville Radio & TV Service Association. Objectives are to establish a code of ethics, provide a channel for handling customer grievances, work together on mutual industry problems and carry out such other activity as may raise the professional and economic standards of the membership. The grievance committee includes a member of the local BBB.

PHILLY SEEKS UNITY

The Philadelphia Council of Radio and Television Associations discussed a plan for a united front to solve the problems of captive service, loss of technicians to manufacturing, increased overhead and others, at a recent meeting. This was the first joint meeting of the membership of the various associations that form Philadelphia's CRTA.

Proposals were considered to form a single association, dissolving the present group of organizations; or, alternatively, to establish a main body with the various associations maintaining their identity as locals of the main group. The major problem was to establish a harmonious body representing such different interests as the service technician, dealer, contractor, etc.

The lure of electronics seems to be exceptionally powerful in Philadelphia. While experienced bench men earn $90 to $100 per week, electronics firms are offering $100 to $115 as starting salaries.

TUBE REPROCESSER HELD

Charged with two counts of felony and 16 of misdemeanor, Stanley Seltzer, 27-year-old repair man and tube seller, was arrested in New York City after offering allegedly new G-E tubes at an 80% discount. Large numbers of the tubes, bought by persons acting for General Electric, were tested at the company's Owensboro, Ky., plant and found to be 86% defective. G-E's chief engineer, Walter Mills, also found that tubes bore forged trade marks and code numbers.

Stamping, branding and printing machinery were found in Seltzer's shop at the time of his arrest. Police also confiscated more than 30,000 tubes in the shop.

FAST DATA SERVICE

Service material covering TV sets back to 1948—as well as radios as far back as 1926—is being offered by Supreme Publications, on an airmail basis. Cost of TV data is 75c and radio material 40c for any one model.

PASADENA HEARS BILL

The Radio-Television Technicians Association of Pasadena (Calif.) listened to the first reading of a proposed bill for the licensing of technicians and service dealers. Purpose of the reading was to present the bill for membership study, comment and proposals for modification. Copies of the bill are being printed and circulated to groups affiliated with RTTA, after which it will be presented for enactment to the California legislature.

At the same meeting members finalized plans for installation of 1957 officers. The ceremony will take place at a dinner dance at the Altadena Country Club, Jan. 12, 1957. END

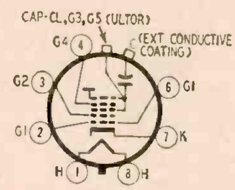
New Tubes & Semiconductors

Variety is the keynote this month with an especially interesting picture tube, the 110° 21CEP4, a vertical output tube for use with this picture tube, a wide range of diodes and transistors and some tubes of foreign design.

110° 21CEP4

RCA has announced a new, directly viewed, rectangular, glass picture tube having a 21⅜-inch diagonal and a 110° deflection angle. It has very short length—approximately 5½ inches shorter than types having the same size faceplate and 90° deflection. As a result, this new tube establishes new concepts for cabinet styling and for the design of more compact TV receivers.

In addition to its wide deflection angle and very short length, the 21CEP4 features a neck diameter of only 1⅛ inches. This not only makes possible the use of a deflecting yoke having high deflection sensitivity, but also permits deflection of the beam through the wide deflection angle with only slightly more power than is required to scan a tube with a 90° deflection angle.



8HR

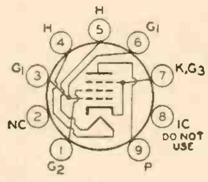
Another design feature of the 21CEP4 is its completely new electron gun of the "straight" type having improved focus and a unique prefocus lens system to maintain image sharpness over the entire screen area. The new electron gun eliminates the need for an ion-trap magnet.

The 21CEP4 is of the low-voltage electrostatic-focus and magnetic-deflection type. It has a spherical faceplate, an aluminized screen 19 1/16 x 15 1/16 inches with slightly curved sides and rounded corners, and a minimum projected screen area of 262 square inches. In addition, the 21CEP4 has an external conductive bulb coating which with the internal conductive coating forms a supplementary filter capacitor. It has an integral glass-button base (see diagram) which eliminates any possibility of loose base-pin connections.

6CZ5

A high-perveance beam power tube of the nine-pin miniature type, the 6CZ5 is designed primarily for use as a vertical-deflection amplifier tube in

TV receivers utilizing picture tubes having diagonal deflection angles of 110° and operating at ultor voltages up to 18,000. Announced by RCA, the 6CZ5 has a 6.3-volt 0.45-ampere heater having controlled warmup time to insure dependable performance in television receivers utilizing series heater-string arrangement.



9CK

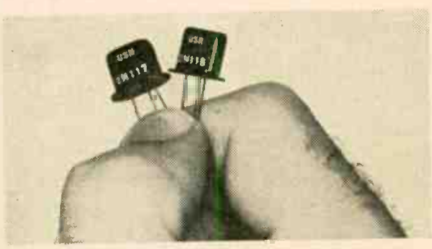
The 6CZ5 has a maximum peak positive-pulse plate voltage of 2,200 (absolute) and a maximum peak cathode current of 140 ma. These ratings in addition to a maximum plate dissipation of 10 watts enable a single 6CZ5, in suitable circuits, to provide adequate vertical deflection for picture tubes used in 110° systems.

Because of its high power sensitivity and high efficiency, the 6CZ5 is also useful in the audio output stages of television and radio receivers. In push-pull arrangement, it is an excellent tube for the output stages of high-fidelity amplifiers. For example, in push-pull class-AB1 service, this tube can deliver a maximum-signal power output of 21.5 watts with a total harmonic distortion of only 1%.

The 6CZ5 has a plate structure designed to minimize hot spots, an electrically isolated base pin to withstand high pulse plate voltages, and double base-pin connections for grid 1 to provide for cooler operation and greater flexibility of circuit connections.

2N117, 2N118

The first two production types of silicon transistors, the 2N117 and 2N118, meeting the rigid requirements of Navy specifications have been announced by Texas Instruments. Absolute maximum ratings at 25°C ambient temperature for these transistors are: collector voltage referred to base, 30; emitter voltage referred to base, 1; collector current, 25 ma; emitter current, −25 ma; collector dissipation, 150 mw.



The n-p-n grown junction units (see photo) are 0.360 inch high and 0.490 inch in maximum width. The 2N117 has a frequency cutoff rating of 4 mc and a slightly lower feedback voltage ratio and current transfer ratio than the 2N118. The frequency cutoff of the 2N118 is 5 mc. END

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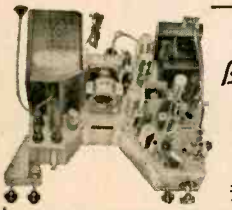

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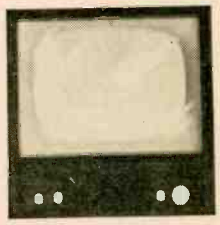

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Mention type of CRT used

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50 – 120KΩ 1 WATT RESISTORS 10%........ $1
50 – 150KΩ 1 WATT RESISTORS 5%........ $1
50 – 470KΩ 1 WATT RESISTORS 10%........ $1
50 – 2.2 MEGΩ 1 WATT RESISTORS 10%..... $1
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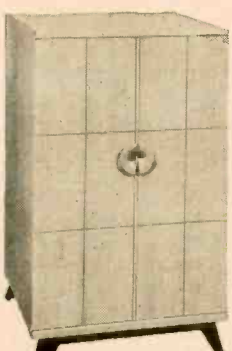

H-41" W-26" D-25"

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Patents

SEMICONDUCTOR CAMERA TUBE

Patent No. 2,749,463

John R. Pierce, Berkeley Heights, N.J. (Assigned to Bell Telephone Labs., Inc.)

This tube is similar to the image orthicon in appearance, except that its target is a thin wafer of germanium or silicon. The opposite surface of the target is coated with a thin, transparent layer of metal through which the optical image passes. The light pattern controls the electron beam and generates the video signal.

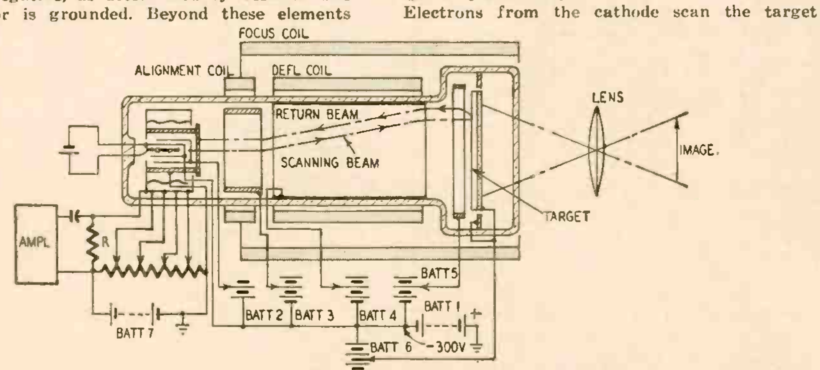
The figure shows the tube in detail. The electron gun is at the left. Its cathode is biased 300 volts negative by BATT1. The control element is slightly negative, as determined by BATT2. The accelerator is grounded. Beyond these elements are cylindrical anodes, one biased to 200 volts positive by BATT3 and the other to 250 volts by BATT4. BATT5 energizes an alignment ring used to deflect the beam so that it arrives at the target straight on. The metal coating of the target is near cathode potential, as controlled by BATT6.

Just outside the gun at the left is an electron multiplier. It does not affect the outgoing beam but serves to amplify the beam returning to the cathode. BATT7 may be about 1500 volts. The tube also requires alignment, focusing and deflection coils as shown.

Light falling on the target (from the right) produces hole-electron pairs in the semiconductor. Due to special processing of this material, electrons move toward the metal layer. Holes are repelled toward the semiconductor surface where they become trapped. Therefore the target retains a positive charge pattern that corresponds to the original optical image.

Electrons from the cathode scan the target in a low-velocity beam. Where holes are trapped, part of the beam is neutralized, the remainder returning to the cathode. The return beam contains the video signal since its variations correspond to the optical image variations. The return beam is increased by the multiplier and appears as a voltage across the load R. Further amplification is provided for it.

This tube has high sensitivity, output and resolution. It is not difficult to manufacture.



FLAT KINESCOPE

Patent No. 2,760,119

Pierre Marie Gabriel Toulon, New York, N. Y. (Assigned 75% to Products & Licensing Corp., Greenwich, Conn., and 25% to Nelson Moore and William D. Hall, as joint tenants)

Conventional kinescopes require considerable depth. The larger the screen, the deeper the tube. This adds undesirable weight and size to a TV receiver. For example, in modern portables, the set is largely kinescope, the other tubes and circuits adding but little to the total volume. If the tube could be made flat, as described here, the TV set would look more like a picture and could be hung on a wall, perhaps as shown in Fig. 1. This may be done by eliminating the electron gun system, and using "dots" of phosphor coated in rows on the screen. Each dot is energized at the correct instant to make it glow.

Fig. 2 shows a possible form of tube. It is convex on both sides, glass in front, metal at the rear. It contains a gaseous atmosphere and the screen is phosphor-coated. The gas is maintained partly ionized, and when a phosphor dot is energized (by an applied voltage) it glows.

The dots are coated in rows. There are 500 dots in each horizontal line, and there are 525 horizontal lines. Each horizontal row and vertical column of dots is associated with a control electrode which is connected to a terminal. To energize any desired dot, voltage is applied to the corresponding control elements (horizontal and vertical). For example, if power is fed to the 4th column and the 7th row, the dot at this intersection will glow.

A high speed distribution system (not de-

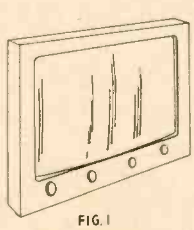


FIG. 1

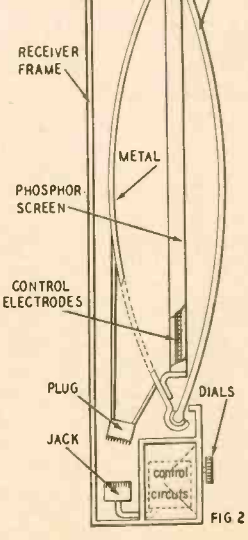


FIG 2

scribed in the patent) works the leads corresponding to the columns and rows. With proper design, the dots will be scanned along each horizontal line as required.

PICTURE RECORDING ON TAPE

Patent No. 2,743,318

Lee de Forest, Los Angeles, Calif.

The main problem of recording TV pictures on magnetic tape has been how to record without having to transport the tape at excessive speeds. De Forest has solved the problem by scanning the tape with rapidly moving magnetic styli (S) while the tape itself moves at

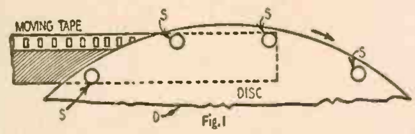


Fig.1

relatively slow speed. (See Fig. 1.) The styli are mounted at the rim of a rotating disc. As one stylus leaves the tape, another begins the scan so there is no interruption in the recording process. Fig. 2 shows how the tape is scanned in narrow strips, one beginning where the previous one left off.

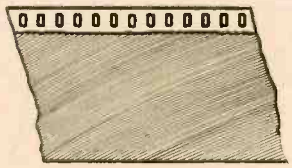


Fig.2

The patent suggests using 125 styli along the rim of a rotating disc 20 inches in diameter. Disc speed would be 120 revolutions per second; tape width would be ½ inch.

Due to the high speed of each stylus and their number, it would not be practical to design each as a separate recording head. Instead a large electromagnet is fixed above the rotating disc and

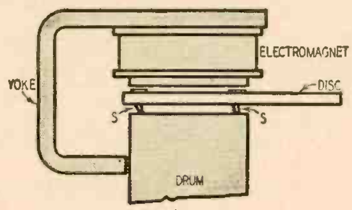


Fig.3

its yoke completes the magnetic path to the drum over which the tape is riding. The function of each stylus is only to narrow the air gap which is through the tape. Thus recording occurs only while a stylus is contacting the tape. (See Fig. 3.) The electromagnet itself is energized by the video signal to be recorded. EHD

CORRECTION

In the electronic switch on page 126 of the November issue, oscillator grid (pin 1) of the upper 6BE6 is grounded by an erroneous connection to the lower end of the step attenuator for the upper channel. The connections to pin 1 of the upper stage are exactly the same as those in the lower one and both oscillator grids return to ground through individual 470,000-ohm resistors.

Our thanks to Marvin J. Moss of Gainesville, Fla., for sending in this correction.

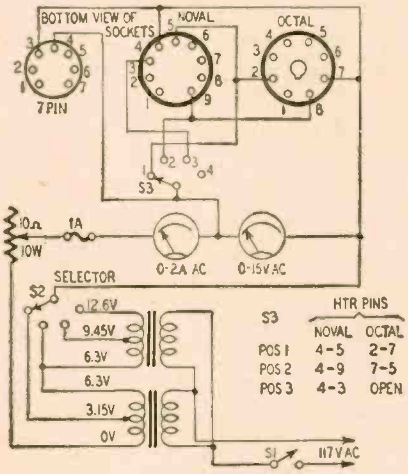
Mr. Pugh reports an error in his article on the transistorized trf receiver in the November issue. On page 106, the last word in the second line from the end reads C2-a. This should be C1. C2-a does not have enough range to compensate for differences in antenna lengths.

radio-electronic Circuits

CONTINUITY TESTER FOR SERIES TUBES

Checking heater continuity with an ohmmeter to locate an open tube in a series-string TV set is time-consuming. The job can be handled easier and faster with a checker like this one whose diagram appeared in *Du Mont Service News*.

Two 6.3-volt center-tapped filament transformers are connected with their primaries in parallel and secondaries in series-aiding to provide voltages for testing most tubes commonly used in TV



circuits. Voltages are selected by S2 and applied to the proper socket terminals by S3.

To operate, turn the voltage selector to the range nearest the tube's heater voltage rating, adjust the variable resistor so its full resistance is in the circuit and set S3 to apply voltage to the correct pins on the tube being tested. Plug in the tube, close S1 and adjust the resistor for rated heater current. The ac ammeter shows heater current and continuity. The voltmeter is optional. If it is included, its reading should be within 5% of the rated heater voltage with rated current flowing through the circuit.

ANOTHER FULL-WAVE DOUBLER

In his article "Heater–Cathode Stress in Full-Wave Doublers" in the September issue, Mr. G. C. Chernish describes a circuit he developed to minimize heater–cathode shorts. It employs a separate "floating" dc supply to counteract static stress. Stresses caused by ac are not appreciably lessened.

Fig. 1 is a circuit that offers another

solution to the problem. The heaters are fed from a dc source so there is no ac component to cause hum or to punc-

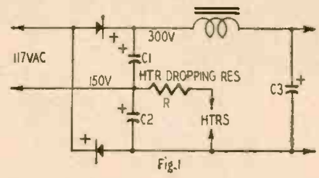


Fig.1

ture heater–cathode insulation. The additional saving of parts (one rectifier and one capacitor) results in increased compactness and economy.

A dc heater supply permits a logical distribution of heaters along the series string in accord with the heater–cathode ratings of individual tube types. Note the position of the 25Z6 heater in Fig. 2. By placing it at the

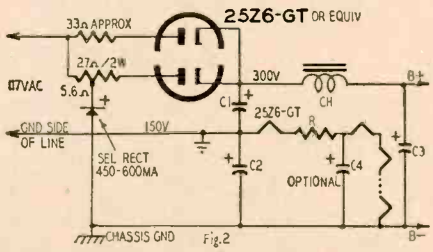


Fig.2

top of the string, the heater–cathode difference is only 150 volts. The heater is negative to cathode, which is also desirable. The other tubes are below R on the string and are therefore safe.

A dc heater supply also invites the use of small filament type tubes, with consequent savings.—*Roderick Mohrherr*

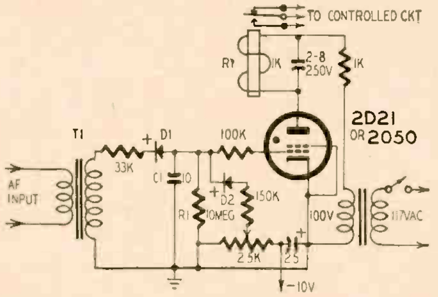
SOUND-OPERATED RELAY HAS ADJUSTABLE TIME DELAY

Sound - operated time - delay relays have a number of applications in industry and experimental work. When fed from an audio source, they can be made to sound an alarm or perform some switching function if the audio is interrupted for a predetermined period. For example, such a relay can be added to an intercom for automatic switching and can be installed in a tape recorder to stop the tape when the recordist stops speaking into the microphone.

Circuits designed for this purpose generally use a rectifier to charge a capacitor in the grid circuit of the tube controlling the relay. The negative charge on the capacitor biases the tube to cutoff so the relay does not operate. When the signal is interrupted, the charge gradually leaks off through the grid resistor and the tube conducts. One disadvantage of this arrangement is that the plate current increases gradually and the relay has a tendency to chatter and will not pull in sharply.

This thyratron-controlled circuit, reprinted from *Wireless World* (London, England) was designed to overcome these difficulties. A thyratron's plate current is either zero or a maximum determined by circuit constants. And, when ac is applied to the plate, only a small change in grid voltage is required to turn the tube on and off.

The delay in this circuit (see diagram) is determined by the values of C1 and R1 and the voltage across C1 at the instant that the sound is interrupted. Where the signal level varies

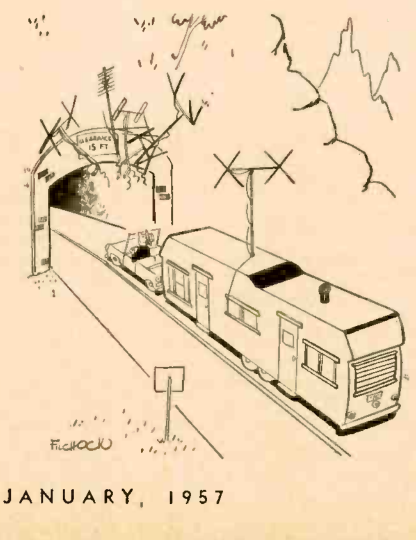


over a wide range—as when different types of musical selections are played—the voltage on the capacitor, and the timing will depend on signal level.

A dc voltage limiter or clamp (diode D2) with adjustable bias control prevents the voltage across C1 from rising above the level set by the 25,000-ohm time-delay control.

The characteristics of the input transformer (T1) must be determined empirically since they depend on the voltage and impedance of the audio source, the time delay required and the speed with which the thyratron cuts off when the audio signal is restored. A selenium rectifier should be used for D1 because the back resistance of germanium and cupric-oxide types is so low that C1 will not hold a charge long enough for the desired delay after the program is interrupted.

In the original model, D1 consists of two subminiature selenium rectifiers in series. Each has a maximum peak inverse voltage rating of 68, a current rating of around 1 ma and a back resistance of 45 megohms at 5 volts dc. D2 is a similar type with a current rating of 250 μa. As substitutes you can use miniature and subminiature selenium rectifiers made by International Rectifier Corp. and others. Be sure that the rectifier can handle the voltage applied to it and that sufficient series resistance is used to limit the current to a safe value. END



Question Box

DUAL-CASCODE TV BOOSTER

I live around 150 miles from Seattle, Wash., and receive TV channels 4 and 5 fairly well with a 10-element Yagi cut for these channels. Please show the circuit of a self-powered booster that will improve reception.—I. E., North Vancouver, B.C., Canada

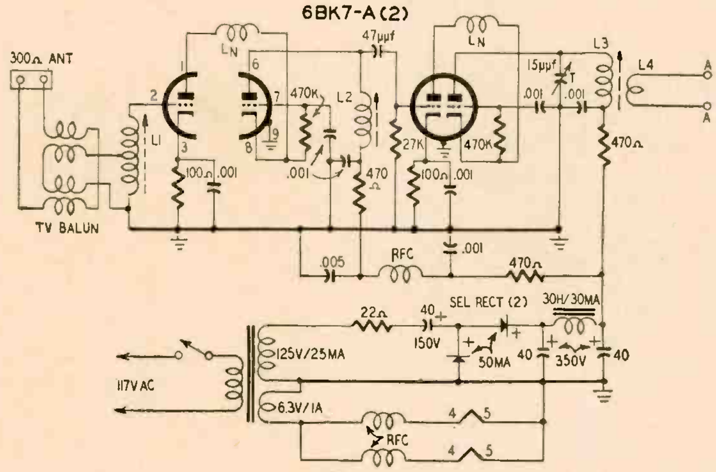


Fig. 1

Fig. 1 shows a dual cascode booster that should work out nicely. However, if your set has a cascode front end, you may not notice any increase in signal-to-noise ratio or improvement in noise figure. In that case, mount the booster at the antenna on top of the mast. This improves the signal-to-noise ratio and minimizes effects of noise and interference picked up on the transmission line. The modifications for antenna-top installation are shown in Fig. 2.

In this arrangement the booster is powered by two 25-volt filament transformers (1 ampere or more) connected back-to-back with one at the receiver and the other on the booster chassis. Blocking capacitors prevent dc from circulating through the booster output and receiver input coils and rf chokes prevent the signal from being shorted out or attenuated in the transformers and tube heaters.

For the FM and low-band TV channels, coils L-1, L2 and L3 may be National type AR-5 coils. On the lower frequencies it may be necessary to shunt each coil with 15 μμf or so to reach the desired channel. Use the smallest value of capacitance that provides satisfactory performance. AR-2 coils can be used in the same manner for the high-band channels. When the booster is mounted at the receiver, the trimmer across L3 may be mounted on the panel for convenient circuit peaking.

L4 must be adjusted for the best match to the transmission line. Start with around five turns of hookup wire for the low band and around two turns

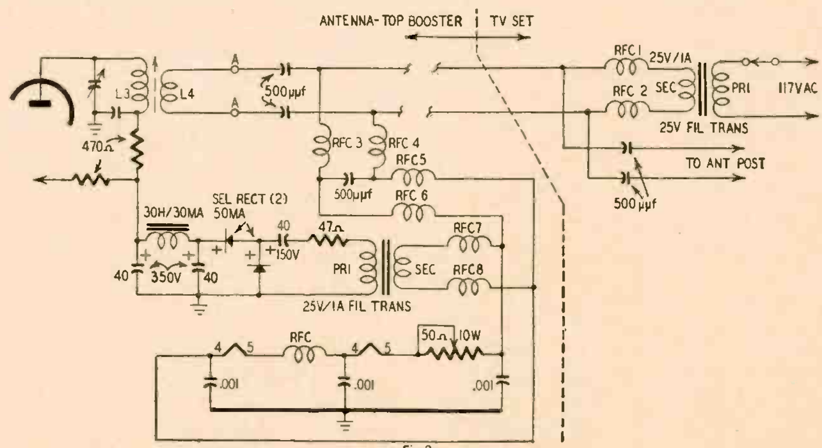


Fig. 2

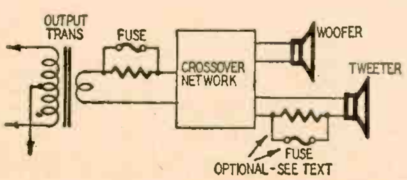
for the high. Neutralizing coils L_n are closewound with No. 24 enameled wire on ¼-inch diameter forms and the turns are spaced for lowest noise. You will need around 35 turns for channels 2 and 3, 26 turns for 4 and 5 and around 20 for channel 6 and the FM band. Use 10–12 turns for the high band. The rf chokes in Fig. 1 and in the heater circuit in Fig. 2 should have an inductance of around 1 μh. They may consist of 25 turns of No. 24 enameled wire closewound around a 47,000-ohm ½-watt resistor and connected in parallel with it. Chokes RFC1 through RFC8 in Fig. 2 should have an inductance of at least 10 μh and a rating of 2 amps or more. Use J. W. Miller type 5221 or equivalent or 30 turns of No. 20 enameled wire closewound with an inside diameter of ¾ inch. The balun in the antenna input may be a Miller 6104, RCA 73591 or equivalent.

This booster can be used on the police, amateur, taxi and other services in the 30-300-mc range with the proper coils and capacitors. You can wind your own coils or use types made by J. W. Miller, National, Cambridge Thermionic Corp., North Hills Electric and others and use a grid dip meter to adjust them to the desired range.

PROTECTING LOUDSPEAKERS

My new amplifier is rated at 50 watts and delivers up to 100 watts on peaks. I use it with a 25-watt speaker system. Is there any safeguard that I can use to prevent accidental speaker overloads and burnouts?—E. H. M., Plainfield, N. J.

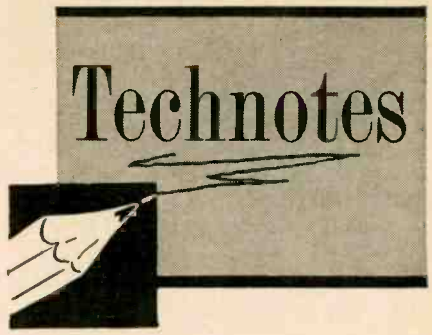
One method of protecting the speaker system against damaging overloads is to follow a University Loudspeakers recommendation and insert a parallel-connected fuse and resistor in series with one of the speaker leads as shown



in the diagram. The resistor's wattage should equal that of the speaker or speaker system and its resistance should equal the speaker's impedance.

The fuse should be rated at around 750 ma to protect a 25-watt 16-ohm speaker. When peak currents are excessive, the fuse blows and inserts the resistor in series with the speaker. The system now operates with the speakers receiving only half the output power.

If the tweeter wattage rating is much lower than that of the woofer, protect it with a separate fuse-resistor combination. The fuse should be a slow-blow type selected to open up at about 0.6 the maximum current based on the tweeter's impedance and wattage rating. Use Ohm's law for making the calculations. END

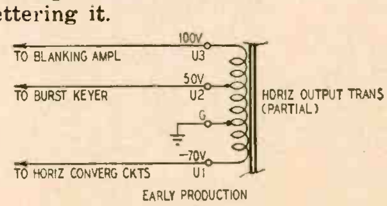


HOFFMAN COLORCASTER 706

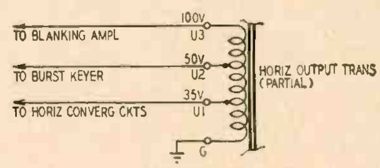
Popping noise in the audio and arcing in the picture whenever brightness or contrast is advanced to a high setting can be cured by repairing ground contacts for the neutralizing magnet ring assembly and picture-tube shield. Good ground contacts for these components are essential or they will charge up to the second-anode voltage. This also applies to the front control panel and mask assembly. In this case the symptoms positively identify the trouble as not being a true high-voltage arc—the arcing occurs when the second-anode voltage is minimum (maximum brightness and contrast). For any symptom of this type check to see that the ends of the mounting ring for the magnet assembly are making good contact on the top of the chassis pan.—*Hoffman Radio, The Diddle-stick*

RCA 21CT660 COLOR SET

Recently we were called on a rush job to a 21-inch color TV set with no high voltage—there was an open in the primary of the horizontal output transformer. A new transformer restored the high voltage. However, horizontal dynamic convergence was all off—it appeared that the red, green and blue horizontal amplitude controls were operating backward, throwing the edge convergence farther out instead of bettering it.



EARLY PRODUCTION
a



LATE PRODUCTION
b

A scope check showed that the pulse to the horizontal convergence circuits was *negative*, instead of positive as called for in the waveform diagrams. Wrong connections? The connections were traced out and proved to be OK. The transformer was supplying the convergence pulse in wrong polarity.

The transformer supplied for replacement (Fig. a) was for an earlier production of receiver in which the ground to the pulse winding was not made at the end of the coil (Fig. b) but to a tap. This inverted the convergence pulse.

What to do? It was noted that the burst keyer tap on the winding provided a 50-volt positive pulse. This was 15 volts higher than required but this extra voltage could be dropped by setting the horizontal amplitude controls to lower positions. The only remaining considerations were possible crosstalk of the convergence circuits into the burst keyer circuit and possible overload of the burst keyer winding.

The lead from the horizontal convergence circuits was connected to the burst keyer tap. Having nothing to lose, we turned on the power switch to see what would happen.

The burst keyer worked OK and the color picture appeared on the screen. A little fiddling with the horizontal dynamic convergence controls produced almost perfect white dots at the left and right edges of the screen, where we were having the trouble.

Then we explained to the pleased customer that a nonstandard repair had been made and, while it could not be guaranteed against the possibility of callback, it appeared to be a satisfactory expedient and would save a 3-week wait for the proper replacement transformer.
—*Robert G. Middleton*

COLOR CONVERGENCE

The green and red dots on a Motorola TS-902 could be converged to a crossover point in the center-screen area but the blue dots could not be moved vertically far enough to meet them.

It was thought that magnet polarities were incorrect, and these were reversed in turn. The situation only got worse. The blue beam positioning magnet appeared to be weak since it had to be pushed to the end of its travel to approach blue convergence. A replacement magnet was not readily available.

With nothing to lose by a quick trial, the blue beam magnet was swapped for the green magnet. This did the trick. The green and red dots could still be brought to the crossover point and the blue dot could now be moved through the convergence point and a small distance beyond.

Edge convergence was out but was worked in satisfactorily with the dynamic convergence controls, interspersed with readjustment of the beam magnets. A slight amount of misconvergence at the extreme edges of the screen finally remained but was invisible at a distance of 3 feet. We agreed that this was about par for the course.
—*Robert G. Middleton*

CROSLEY CHASSIS R-104

Some of the static noise in model JC-8 radios has been traced to static feedback from the speaker voice coil to the antenna. This feedback condition can be corrected by grounding one side of the voice coil to the speaker frame at the transformer support bracket.—*Crosley Radio Service Information* END

try This one

HV FILAMENT WINDING

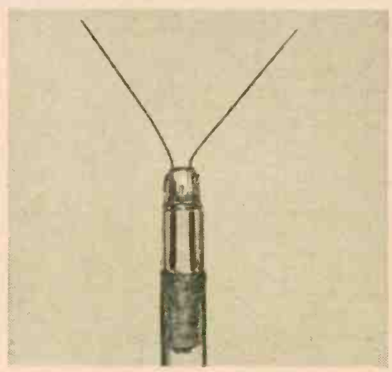
A TV set that had been repaired twice by a competitor within a short time was brought to me when it again developed the same trouble—a shorted 1B3 filament winding on the flyback transformer. Excessive heat had melted the plastic coating on the winding and caused the short. Luckily another set of the same make and model was in the shop.

Examining the filament winding on its horizontal output transformer, I noted that it was apparently covered with rubber and cloth to withstand the heat. My parts distributor could not supply this type of wire or a suitable substitute so I decided to try automobile ignition (spark plug) wire. It worked nicely.

The set has been back in the owner's hands for some time now and is still "firing on all cylinders."—*Carleton A. Phillips*

CORONA FEELER

Equipment with very high voltage power supplies, such as Geiger counters, scintillometers, oscilloscopes, television receivers and radar installations, is often unpleasant and at times hazardous to service because of high-voltage leakage fields, resulting in coronas and the charging of isolated metal



masses in the equipment. Shocks from these may occur many hours (or even days) after the equipment has been turned off, particularly when ground wires have been broken or bleeder resistors have opened.

Coronas and high-voltage residual charges can be detected rapidly and safely with a neon-bulb feeler, consisting of a small neon bulb and a long insulated handle. When the feeler is brought near a high-voltage field, the bulb lights. The effect is strong and consistent at field strengths exceeding 5,000 volts per inch and is present erratically at lower field intensities. Sen-

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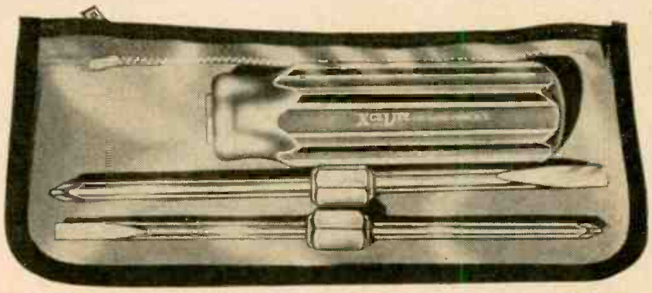

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sitivity is influenced in part by humidity.

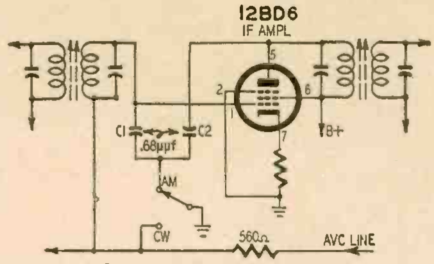
A very satisfactory corona feeler can be made by cementing a NE-2 neon bulb into the end of an 18-inch long plastic aligning tool, such as a GC (General Cement Mfg. Co.) No. 8897 with the metal bit removed from the tip. The "business" end of the feeler is shown in the photo.

This method of detecting coronas and highly charged objects is much more effective than the usual method of "drawing sparks" with a screwdriver and permits testing at a much greater distance from possible danger areas.—*Ronald L. Ives*

SIMPLE BFO CIRCUIT

While converting a small ac–dc Motorola radio to receive shortwave signals, I was faced with the problem of adding a bfo circuit to the already too-crowded chassis. A bfo circuit was required because the owner of the receiver was primarily interested in CW reception. But where to put the tube, coils, resistors and capacitors so necessary for such a circuit?

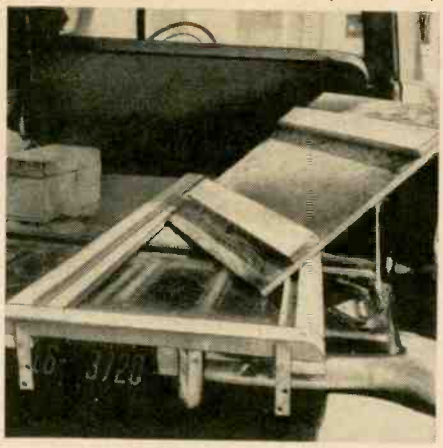
After mulling over the problem for several days, I recalled a simple but apparently little-known bfo circuit used in some inexpensive amateur radios. The circuit, as added to the Motorola, is shown in the accompanying diagram. With the spdt switch in the CW position, feedback occurs through capacitors C1 and C2 between the plate and grid of the 12BD6 if amplifier, causing the stage to oscillate. The avc voltage is grounded out through the 560-ohm resistor to keep the gain of the receiver at maximum. In the AM switch position, the capacitors are grounded and the receiver operates in the normal manner.



I used two 0.68-$\mu\mu$f capacitors (Centralab type TCZ) for C1 and C2, but the exact value does not appear to be too critical. Any value up to a couple of micromicrofarads with a 400-volt rating should suffice.–*Warren J. Smith*

TV LOADING DEVICE

TV technician Don Stanley of Sarasota, Fla., made a light wooden framework that hooks onto the back of his delivery truck. On top of this rides a plywood platform onto which the TV set is loaded. The sliding platform moves from one end of the truck body to the other, thus reducing labor when loading and unloading and minimizing the possibility of damaging the set.



One photo shows the underside of the platform and rail construction. The metal strips on the front end of the

rail or framework hold it in place in the vehicle. The other photo shows the device in use.—*Harry J. Miller*

SPEAKER REPAIRS

I am continuously running into delays in obtaining factory replacements for special TV and radio loudspeakers. One of the most common causes for replacement is a voice coil that rubs the pole piece and causes distortion. This is usually due to the cone shrinking or stretching unevenly and exerting more pull on one side of the voice coil. I have found a way to make temporary repairs that enable the customer to use his set until a replacement is obtained.

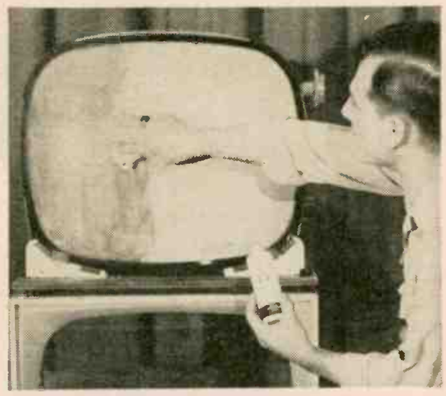
I use a razor blade to cut completely around the cone just above the voice coil terminals and then slightly flex the voice coil to return it to its correct centered position. Now, all that is necessary is to close the incision with genuine (nonshrinking) speaker cement.—*S. Winterfeld* END

"I hear his start in show business came about from handling hot 5V4G's."

Business

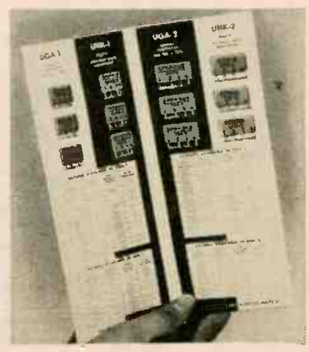
Merchandising and Promotion

CBS-Hytron, Danvers, Mass., is promoting a TV picture-tube cleanup plan



on the Garry Moore TV Show. The campaign is designed to promote the cause of the independent service technician.

Sprague Products Co., North Adams, Mass., is selling its new Universal



ceramic replacement capacitors in kit form. A selection of four of the new ceramics takes the place of 42 conventional types.

Clarostat Manufacturing Co., Dover, N. H., is merchandising its Greenohm power resistor assortments mounted on wall cards which include six different selections.

Jensen Industries, Forest Park, Ill., is promoting its sapphire needles in a special deal including an attractive display rack.

RCA established a traveling exposition to demonstrate color TV and the latest RCA electronic developments in key department stores in major cities.

JFD Manufacturing Co., Brooklyn, N. Y., is having unusual success with its Sell-A-Bration distributor–technician promotion on its Colortenna TV antennas for black-and-white and color TV. Technicians and distributor salesmen are given specified bonus points having a cash value for antenna sales.

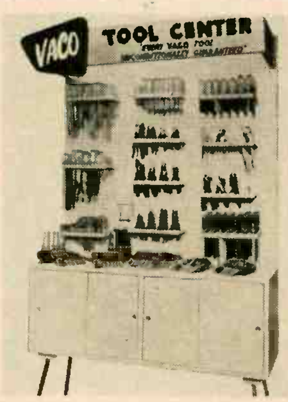
Premiums include everything from fishing rods to Chris Craft cruisers. Promotion runs to March 15, 1957.

David Bogen Co. Inc., Paramus, N. J., launched the heaviest consumer advertising campaign in its history for its high-fidelity music systems. A full page in the New York Sunday Times kicked off the campaign, which will include followups in a number of consumer magazines.

Electronic Instrument Co., Brooklyn, N. Y., manufacturer of Eico kits, recently produces its one-millionth unit, which was sold by Federated Purchaser, Eico distributor, with a string of outlets across the United States. Photo shows Max Epstein (left) president of Federated Purchaser, accepting the one-millionth instrument from Harry R. Ashley, Eico president.

Jensen Manufacturing Co., Chicago, reports tremendous success with its do-it-yourself hi-fi booklet. Ed Shaver, left, Jensen advertising and sales promotion manager, is shown demonstrating the new metal display rack designed for the manual, to Carl T. James, vice president of MusiCraft, Chicago high-fidelity outlet.

Vaco Products Co., Chicago, developed a new self-service Tool Center Display for its tools for electronic, automotive, electrical and similar fields.



Electrovox Co., Inc., East Orange, N. J., developed a new needle sales training manual for dealer sales personnel. It stresses instructions on how to remove old needles, and briefs clerks on how to identify customers' needles.

New Plants and Acquisitions

Shure Brothers, Inc., opened a scientific manufacturing center in Evanston, Ill. The company distributed a special descriptive brochure outlining the facilities of the new plant.

Weston Electrical Instrument Co., Newark, N. J., opened district sales offices in Los Angeles, Cincinnati, Philadelphia, and in Union, N. J.

Electronic Measurements Corp. is now located at new larger quarters at 625 Broadway, New York City.

Cannon Electric Co., Los Angeles, signed a 10-year lease for 100,000 square feet of space for its Diamond Division in Salem, Mass. Cannon acquired the facilities and inventory of Diamond Manufacturing Co., Wakefield, Mass., last year.

Cornell-Dubilier, South Plainfield, N. J., completed acquisition of the majority of stock of Tobe Deutschmann Corp., Norwood, Mass., power capacitor manufacturer.

Philco Corp. purchased Sierra Electronic Corp., San Carlos, Calif., in a move to expand its research, engineering and development facilities. The subsidiary will move to a new plant in Menlo Park, Calif. next month.

Madison Fielding Corp., Brooklyn, N. Y., was established by Leonard Feldman and Stephen E. Lipsky, for the manufacture of hi-fi units and components.

Business Briefs

. . . **Hickok Electrical Instrument Co.**, Cleveland, inaugurated a new service–instruction warranty policy on its test instruments. Parts and workmanship still carry the RETMA 90-day guarantee but, in addition, a 1-year service–instruction warranty is also included. The company reported a 50% increase in sales of its meters. Hickok negotiated a 100% production contract with Supreme Electronics Corp. of Greenwood, Miss., to accommodate this increased business.

. . . **United Motors Service**, Detroit, Mich., established a new school on repair and maintenance of its Delco auto radio and Guide Autronic Eye headlamp control. Instructions on transistors will be included. Classes will be held in key cities across the country.

. . . **RCA** granted three college scholarships worth $800 each annually to outstanding graduates of RCA Institutes.

. . . **ORRadio Industries, Inc.**, Opelika, Ala.; **Elektra Corp.**, New York City; **Duotone Co.**, Keyport, N. J., and **Recoton Corp.**, Long Island City, N. Y., joined the Institute of High Fidelity Manufacturers, bringing total membership to 74.

. . . **RETMA** changed the name of its Statistical Dept. to the Marketing Data Dept. and broadened its scope. END

People

Obituary

John S. Mills, at one time vice president in charge of sales and advertising for Tele-Tone Radio Corp., president of Rico Television Corp. and an executive with several other well-known firms, in Miami Beach, Fla. He recently established Mills Electro-Dynamics Corp., Coral Gables, Fla., hi-fi systems manufacturing firm.

Personnel

J. Frank Leach joined Amphenol Electronics Corp., Chicago, Ill., as director of manufacturing. He comes to the company from Studebaker–Packard where he was director–production programming and control, and traffic.

A. R. Hopkins, manager of the RCA Broadcast and Television Equipment Dept., was appointed to the newly created post of manager–Commercial Electronic Marketing Dept., Camden, N. J.

William Q. Nicholson, director of engineering for the Instrument Division of Hycon Manufacturing Co., Pasadena, Calif., was promoted to chief staff engineer for the company.

David C. Adkins joined CBS–Hytron, Danvers, Mass., as public relations manager. Prior to joining the company he was managing director of the Greater Lynn (Mass.) Chamber of Commerce.

Douglas F. Hudson, vice president and director of Permo, Inc., Chicago, manufacturer of Fidelitone phonograph needles and accessories, was elected president of the company by the board of directors.

Edward M. Boykin, C. Harper Brubaker, Clarence A. Shoop and Roy E. Wehndahl, executives of Hughes Aircraft Co., Culver City, Calif., were ap-

pointed vice presidents. Photo shows (seated) C. Harper Brubaker (left), new vice president of planning and programming, and Edward M. Boykin, vice president–field operations; (standing) Roy E. Wendahl (left), vice president and manager of Tucson, Ariz., operations, and Clarence A. Shoop, vice president–flight operations.

Personnel Notes

. . . **Frank M. Folsom**, president of RCA, will receive the 1957 Gold Medal of Achievement from the Poor Richard Club, an association of advertising executives at its 52nd annual dinner in Philadelphia, Jan. 17, commemorating the 251st anniversary of Benjamin Franklin's birth.

. . . **Henry F. Argento** was named vice president–commercial sales for Raytheon Manufacturing Co., Waltham, Mass. He had been vice president and general manager of the company's now discontinued Television and Radio Operations in Chicago. **F. D. Edes** was named assistant to the vice president and general manager of Raytheon's Receiving and cathode-ray tube operations in Newton, Mass. He had been assistant secretary and treasurer of Raytheon with offices in Chicago. **Vinton K. Ulrich**, former general sales manager of David Bogen Co., joined Raytheon as head of applications engineering for the Receiving Tube Division.

. . . **Victor Mucher**, president of Clarostat Manufacturing Co., Inc., Dover, N. H., has been appointed to serve on the board of directors of the New Hampshire Manufacturers Association for 1956–57.

. . . **James E. Smith** was elected chairman of the board of directors of National Radio Institute, Washington, D. C. **J. Morrison Smith** was elected president, and **Edward L. Degener**, secretary and treasurer.

. . . **Bernard O. Holsinger**, general sales manager of the Sylvania Radio and Television Division was appointed to the newly created post of director of sales promotion for the company. He will move his offices from Buffalo to New York.

PEOPLE *(Continued)*

. . . Lawrence J. Epstein and Charles Ray were promoted to director of sales and merchandising, and jobber sales manager, respectively, for University Loudspeakers, Inc., White Plains, N. Y. Epstein had been general sales manager, and Ray, sound sales manager.

. . . George Friedl, Jr., joined Litton Industries, Beverly Hills, Calif., parent company of Triad Transformer Corp., as vice president. He comes to the company from Link Aviation where he had been vice president and director of advanced planning.

. . . Leon Podolsky, technical assistant to the president of Sprague Electric Company, North Adams, Mass., received an engineering award at the 28th annual Fall Meeting of RETMA and the IRE held in Syracuse last fall.

. . . Richard M. Fielding, advertising and sales promotion manager of the Philco TechRep Division, Philadelphia, Pa., was promoted to supervisor of public relations for the Government and Industrial Division.

. . . Rear Admiral Dwight M. Agnew, USN (Ret.) was elected a member of the board of directors and vice president in charge of public relations for Capitol Radio Engineering Institute, Washington, D. C.

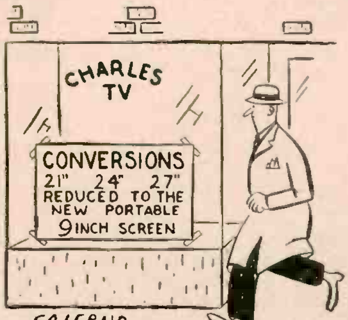
. . . Burtis E. Lawton joined Allen B. Du Mont Laboratories, Inc., Clifton, N. J., as senior applications manager in the Industrial Tube Sales Dept. He had been electronics service and sales manager for H. S. Martin & Co.

. . . George R. Haase, vice president and general manager of the DuKane Corp., St. Charles, Ill., was elected president of the company. J. McWilliams Stone, president since 1922, is now chief administrative officer and chairman of the board.

. . . Jules F. Maier, manager–product control of the RCA Tube Division, Harrison, N. J., was promoted to administrator–Tube Industry Sales, Tube Division.

. . . Harry G. McKenzie is the new general sales manager of Gray Research & Development Co., Manchester, Conn., manufacturers of hi-fi systems and electronic equipment. He joined the company last June.

. . . Ed Grigsby, Altec Lansing Corp., was appointed vice chairman of the Institute of High Fidelity Manufacturers Show Committee for the Los Angeles High Fidelity Show. Lee J. Goodman, Radio Craftsman, Los Angeles, was added to the committee headed by Edward A. Altschuler, American Electronics. END



technical Literature

PICTURE TUBES

TV Life on the Brighter Side features RCA Silverama super-aluminized picture tubes. Its descriptive material is accompanied by cartoons on the subject of TV, taken from past issues of RADIO-ELECTRONICS.

RCA Distributors.

CAPACITORS

Information on the electrical and mechanical interchangeability of single, dual, triple and quadruple capacitor units, a list of the manufacturer's electrolytic capacitors for TV receivers and an index of his complete line of products are contained in the 24 pages of *TM-1-1*.

Pyramid Distributors, or Pyramid Electric Co., 1445 Hudson Blvd., N. Bergen, N. J.

HI-FI

Catalog 117, Guide to High Fidelity Loudspeaker Systems, and *Catalog 118, How to Choose High-Fidelity Speakers and Components*, together compose a 32-page guide to speaker system selection.

118 gives special attention to the new building-block kit (which includes matched components and wiring harness) and presents wiring diagrams along with a crossover network chart.

Electro-Voice, Inc., Buchanan, Mich., 25c.

RADIO AND TELEVISION CAREERS

A 65-page catalog outlines home-study courses in radio and television and describes job and career opportunities in these fields.

National Radio Institute, Washington, D. C.

SERVICE MANUALS AND THEIR USE

How to Use Supreme Publications for Faster Television and Radio Repairs details Supreme service publications and particularlizes the new 1957 TV manual.

Supreme Publications, 1760 Balsam Rd., Highland Pk., Ill.

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. UNLESS OTHERWISE STATED, ALL ITEMS ARE GRATIS. ALL LITERATURE OFFERS ARE VOID AFTER SIX MONTHS.

PARTS

Catalog 200D-3 cross-references by classification and type the maker's ceramic, electrolytic and mica capacitors, filters, hardware, printed circuits and other items.

Cornell-Dubilier Electric Corp., Dept. 63, 333 Hamilton Blvd., S. Plainfield, N. J.

PHONOGRAPH NEEDLES

A dictionary of needle terms is one of the features of *Jenselector,* a reference guide for correct phonograph needle sales. The replacement guide is so keyed as to make it possible in many cases to fill an order for a customer who does not have full information on his record player. Illustrations of pickup heads—to be shown the customer—are an additional aid.

Jensen Industries, Inc., 7333 W. Harrison St., Forest Pk., Ill., $2.

LEE DE FOREST STORY

Because this year is the 50th anniversary of Dr. de Forest's invention of the grid vacuum tube, a 5 x 7 inch, 12-page illustrated booklet in two colors has been added to a series of biographies about industrial founders, *Fathers of Industries.* The back cover of the booklet is blank to allow for the sponsor's message.

Mercer Publishing Co., 16 E. 52d St., New York 22, N. Y., minimum order of $1 for 10 booklets; lower large-quantity prices.

REPLACEMENT PARTS

The 1957 issue of *Repl-Guide (No. 409)* covers all coils and transformers found in practically every TV set produced up to early 1956. The first 11 pages of this 127-page catalog list filter chokes, filament and power transformers and if–rf coils offered by the maker. The remainder presents manufacturers' part numbers.

Merit Coil & Transformer Corp., 4427 No. Clark St., Chicago 40, Ill.

SILICON RECTIFIERS

The latest information on silicon rectifiers is graphically illustrated by numerous charts and lists in the 20 pages of a new *Silicon Rectifier Handbook.*

Sarkes Tarzian, Inc., Rectifier Div., 415 No. College Ave., Bloomington, Ind., $1.

RADIO, TV AND ELECTRONICS

Catalog No. 571 is a complete buying guide for everything in the fields of radio, TV and electronics.

Burstein-Applebee Co., 1012-14 McGee St., Kansas City 6, Mo.

POWER AND GAS TUBES

Technical data on 175 types of tubes, including vacuum power tubes, rectifiers, thyratrons, ignitrons, magnetrons and vacuum-gauge tubes, is presented in *PG101C* by thumb-nail descriptions, charted dimensions, ratings, operating values, base or terminal-connection diagrams and photographs.

RCA Tube Distributors, or Commercial Engineering, RCA Tube Div., Harrison, N. J., 20c.

PANEL AND FLASHLIGHT LAMP CHART

A new chart lists numerically all panel and flashlight lamps made by the industry in categories of manufacturer, bulb type, base, volts, amps and bead color, and illustrates each bulb type, with physical dimensions.

Radio-Electronic Master, 106 Lafayette St., N. Y. 13, N. Y.

TAPE RECORDERS

Fifteen models of two, three and four-speed portable, battery-operated, spring-motor magnetic tape recorders especially designed for field applications are tabulated, mechanically and electrically described and illustrated in a 4-page folder.

Amplifier Corp. of America, 398 Broadway, New York 13, N. Y.

THE ULTRA-LINEAR CIRCUIT

The Theory and Operation of the Ultra-Linear Circuit offers the reader a detailed study of the subject, including mathematical analysis and a typical amplifier design. The booklet is 24 pages in length.

Keroes Enterprises, 369 Shurs Lane, Philadelphia 28, Pa., 25c.

KITS

A new 55-page catalog describes 70 kits covering a complete line of high-fidelity equipment including a new speaker system, amateur radio gear and service test instruments in kit form. The catalog lists the features and electrical specifications of each item.

Heath Co., 305 Territorial Rd., Benton Harbor 20, Mich. END

CORRECTIONS

Dr. Hedge has called our attention to an error in the values of the output grid resistors in Fig. 4 of his article "The Long-Tailed Cascode Pair" in the October issue. The grid resistors for the 1625's are shown as 47,000 ohms. The correct value is 470,000 ohms. These resistors are listed correctly in the parts list.

The parts list carries two 47,000-ohm resistors; one rated at ½ watt and the other at 1 watt. The 1-watt unit is in the cathode return of the input stage.

A number of readers have reported that the J. W. Miller coil type 2020 used in the transistorized transmitter (page 52 of the October issue) has only five terminals instead of six as required in the circuit.

The manufacturer reports that the design of the type 2020 coil has been changed. It is now to be used in a converter circuit rather than with a separate mixer and oscillator. Manufacture of the old-style 2020 coil has, however, been resumed and it is now available under a new part number, 2023.

Books

RCA VICTOR TELEVISION SERVICE CLINIC—700 Series Color Television Receivers, prepared by Commercial Service, RCA Service Co., Inc., Camden 8, N. J. 8 x 11 inches, 87 pages. $1.

The purpose of this book, as stated in the foreword, is to provide the TV service technician with practical information which will enable him to acquire rapidly an understanding of circuit operation, setup and servicing techniques applicable to the RCA Victor 700 series color television receivers. This book is *not* a text for those wanting to learn the fundamentals of color TV. By the same token, for those who have had some basic color TV theory, the book goes well beyond a mere narration of the properties of a particular chassis—it is almost a course in color TV, using the RCA 700 series as a basis.

The text is divided into three sections. The first is on technical features, presenting a circuit-by-circuit description of the two types of chassis in the 700 series. The second section is on setup procedure, covering the various chassis and picture tube controls. The third section discusses servicing the 700 series. Very nicely illustrated and containing foldout schematics, this book is a splendid coverage of the 700 series color TV receivers.—*JK*

SERVICING TV SWEEP SYSTEMS, by Jesse Dines. Howard W. Sams & Co., Indianapolis, Ind. 5½ x 8½ inches, 212 pages. $2.75.

An extremely thorough and well illustrated treatment of horizontal and vertical sweep systems, this text goes far beyond its title. As a matter of fact, most of the book is devoted to the theory of operation and a detailed explanation of the components used in television sweep systems.

The opening chapter covers the fundamentals of sweep system operation and is followed by one on detailed circuit analysis and the various features found in these arrangements. The third chapter covers horizontal and vertical sweep circuit variations including different types of flyback transformers and 90° systems. Chapter 4 on the construction of sweep component parts is especially well done, with numerous manufacturers' photos.

The fifth and sixth chapters cover troubleshooting and servicing with emphasis on the horizontal system. Most of the common faults are analyzed and remedies given. This book will be a valuable aid to the most experienced service technician.—*JK*

TRANSISTOR CIRCUIT HANDBOOK, by Louis E. Garner, Jr. Coyne Electrical School, Chicago 12, Ill. 5½ x 8 inches, 410 pages. $4.95.

Transistors have now passed their infancy and are holding down important jobs in engineering and gadgeteering. This book brings the reader up to date with a complete and practical description of circuitry. It has four parts: lab practice, basic circuitry, circuit applications, reference data.

Experimenters will be interested especially in Part 2, which discusses amplifiers, oscillators and special circuits. Here one may choose the configuration that appeals or applies to the work at hand and base further development upon it.

On the other hand, chief interest may be in a specific device; perhaps a square-wave generator, hi-fi preamp, crystal calibrator, rain alarm, radio or whatever. It will probably be found in Part 3, accompanied by a circuit description, parts list, construction hints and photos. Each unit described here has been tested by the author. There is no need to waste time, energy and money in further experimenting.

The last part lists characteristics of transistors. It describes printed circuit techniques and offers design equations and other valuable information.—*IQ*

VECTOR ANALYSIS, by Homer E. Newell, Jr. McGraw-Hill Book Co., New York. 216 pages. $5.50.

The algebra and calculus of vectors are important in almost every field of physics and engineering yet it is very often treated in such a manner as to interest only students of pure mathematics. This text treats the subject and develops the problems in the way that the physicist and engineer will use them in practice. Part I is a treatment of vector algebra and calculus and Part II is devoted to problems in kinetics, mechanics, navigation, electronics, electricity and magnetism.

HOW TO MAKE A TRANSISTORIZED PORTABLE RADIO AND 20 OTHER PRACTICAL APPLICATIONS FOR RF TRANSISTORS. Sylvania Electric Products, Inc. 1740 Broadway, New York 19, N. Y. 6 x 9 inches, 34 pages. 25c.

An earlier Sylvania booklet covered dc and low-frequency applications for transistors. Now that high-frequency transistors are common, this new booklet has been published to show various applications for them. The devices are grouped by chapter: for example, oscillators, ham radio, broadcast receivers, test instruments.

Receivers range from a one-transistor pocket radio (requiring an antenna) to a high-gain superhet. Also included are oscillators, grid-dip instruments, wireless mikes, metal locators and others. In each case there is a schematic, alignment data, coil table, where applicable, and other aids for the constructor.—IQ

COMMUNICATION ENGINEERING, by W. L. Everitt and G. E. Anner. McGraw-Hill Book Co., New York, N. Y. 6 x 9 inches, 644 pages. $9.

Like the preceding editions of this well-known book, this is a standard text for engineers and students. Greatly expanded, it retains the same complete yet clear treatment of networks. It is a theoretical work with mathematics used freely.

The reader will find here full treatment of network analysis and synthesis, transmission lines, filters and bridges. Impedance matching and transformation, reflection, resonance are among the topics discussed mathematically. The use of Smith and other charts simplify problems relating to lines. Line equalization and linear amplification are also described.—IQ

INTERNATIONAL DICTIONARY OF PHYSICS AND ELECTRICITY. D. Van Nostrand Co., Inc., Princeton, N. J. 7 x 10 inches, 1,004 pages, $20.

What is a fieldistor? a cosmic ray? a nuclide? Do you know the Fourier integral or the Geiger formula? Why does a rainbow appear? None of the answers will help you win a TV quiz, but they are important to persons interested in science. All may be found quickly by consulting this volume. Compiled by a number of distinguished scientists and educators, it without doubt contains more modern and useful scientific information than any other volume ever written.

The dictionary covers all important ideas, theories and terms of electronics, mechanics, optics, relativity, mathematical physics, and many other fields. Definitions are concise, equations (where applicable) are given in short form and illustrations are many. It's a real timesaver.—IQ END

ADVERTISING INDEX

Radio-Electronics does not assume responsibility for any errors appearing in the index below.

SCHOOL DIRECTORY PAGE 195

BRANCH ADVERTISING OFFICES: Chicago: 1413 Howard St. Tel. ROgers Park 4-8000. Los Angeles: Ralph W. Harker and Associates, 600 South New Hampshire. Tel. DUnkirk 7-2328. San Francisco: Ralph W. Harker and Associates, 582 Market St., Tel., GArfield 1-2481.

FOREIGN AGENTS: Great Britain: Atlas Publishing and Distributing Co., Ltd., London E.C. 4. Australia: McGill's Agency, Melbourne. France: Brentano's, Paris 2e. Belgium: Agence et Messageries de la Presse, Brussels. Holland: Trilectron, Heemstede. Greece: International Book & News Agency, Athens. So. Africa: Central News Agency, Ltd., Johannesburg, Capetown, Durban, Natal; Universal Book Agency, Johannesburg. Middle East: Steinmatz Middle East Agency, Jerusalem. India: Broadway News Centre, Dadar, Bombay #14. Pakistan: Paradise Book Stall, Karachi 3.

SCHOOL DIRECTORY

FREE! LAFAYETTE CATALOG

ELECTRONIC CATALOG
PACKED WITH MONEY SAVERS

Packed with the largest selection of Electronic, Radio and T.V. Parts, and equipment, PA, Hi-Fi systems, tubes, antennas, Transistor Kits, parts and components, Test Equipment, new build your own kits, tools, books, Microscope, drafting equipment, Binoculars, Telescopes, All Radio, TV and Ham supplies — ALL AT GREAT SAVINGS — For the economy minded servicemen, dealer, engineer and technician. CHUCK FULL OF BUYS! SEND FOR YOUR FREE COPY TO-DAY.

35 WATT HI-FI AMPLIFIER KIT WITH METERED OUTPUT AND 4 PUSH-PULL PARALLEL NEW EL84 TUBES

New Lafayette high power amplifier kit with a host of features not in any other single amplifier. Calibrated output meter permits use as either a recording or reproducing amplifier. EL84 power pentodes provide high peak power and low distortion required for better audio quality. Features exceptional control versatility and ample inputs for all associated custom hi-fi equipment. DC operated preamp filaments and balancing adjustment to minimize hum. Meter can be switched to indicate either recording voltage or output level of amplifier. Features rumble filter, loudness control, separate bass and treble controls, silencing switch, speaker selector switch, output balancing adjustment and monitoring jack.

SPECIFICATIONS

FREQUENCY RESPONSE: ± 1 db 20-40,000 cps. **HUM:** 85 db below rated output. **POWER OUTPUT:** 35 watts with 4% total distortion at full rated output. **INPUTS:** TV Sound, Radio, Magnetic Phono, Crystal Phono, Tape. **OUTPUT IMPEDANCE:** 4, 8 and 16 ohms; high impedance for tape recorder. **TUBE COMPLEMENT:** 3-12AX7, 1-12AU7, 4-EL84, 1-5U4. **FEEDBACK:** Negative feedback loops virtually eliminate distortion. **POWER:** 117V, 60 cps, 80/150 watts with auxiliary power receptacles. Removable escutcheon. Size 12⅛" L x 9¾" D x 4⅛" H.

A combination of high power, high fidelity, gleaming beauty and advanced engineering features unmatched at even twice the price. Supplied in complete kit form with simplified easy-to-follow instruction sheets. Shpg. w., 25 lbs.

KT-115—Complete kit, ...Net **59.50**

LAFAYETTE'S FM-AM TUNER KIT

- SIMPLIFIED DETAILED INSTRUCTION MANUAL
- MEETS FCC REQUIREMENTS FOR RADIATION
- GROUNDED GRID TRIODE AMPLIFIER
- ARMSTRONG FM CIRCUIT WITH FOSTER-SEELEY DISCRIMINATOR
- AFC DEFEAT CIRCUIT WITH FRONT PANEL CONTROL

The excellence of its design and the quality of its components combine to provide this compact high-fidelity FM-AM tuner with superb characteristics normally found in units costing several times as much, and with performance unbelievable at this low price. Features Armstrong FM circuit with limiter and Foster-Seeley discriminator. Simplified tuning with slide-rule dial and flywheel counterweighted mechanism. AFC defeat circuit combined with tuning control. Attractive etched copper-plated and lacquered finish.

SPECIFICATIONS

FREQUENCY RANGE: FM, 88-108 MC; AM, 530-1650 KC. **ANTENNA INPUT:** FM, 300 ohms; AM, Ferrite loopstick and high impedance external antenna. **CONTROLS:** 2—a function control for AM, FM, PHONO, TV and a tuning/AFC defeat control. **DISTORTION:** Less than 1% rated output: **FREQUENCY RESPONSE:** FM, ± .5 db 20 to 20,000 cps; AM, ± 3 db 20 to 5000 cps. **SENSITIVITY:** FM, 5 μv for 30 db quieting; AM, Loop sensitivity 80 μv/meter. **SELECTIVITY:** FM, 200 KC bandwidth, 6 db down — 375 KC FM discriminator peak to peak separation; AM, 8 KC handwith, 6 db down. **IMAGE REJECTION:** 30 db minimum. **HUM LEVEL:** 60 db below 100% modulation. **TUBE COMPLEMENT:** 2-12AT7, 1-6BA6, 1-6BE6, 2-6AU6, 1-6AL5 plus 1-6X4 rectifier. **SIZE:** 5¼" high x 9⅝" wide x 9½" deep (excluding knobs). **CONSUMPTION:** 30 watts. For 110-120V 60 cycles AC. Less metal case. Shpg. wt., 9 lbs.

KT-100 Complete kit, less cage. ....Net **34.95**
LT-10 —Completely wired...... Less metal case. ....Net **52.50**
ML-100—Metal cage for above, shpg. wt., 3 lbs.........................Net **5.00**

New!

HIGH FREQUENCY TWEETER WITH ACOUSTIC LENS

DIRECT IMPORTATION MAKES THIS PRICE POSSIBLE!

- FREQUENCY RESPONSE FROM 2000 CPS TO BEYOND AUDIBILITY
- LOUVERED ACOUSTIC LENS FOR UNIFORM SOUND DISPERSION
- HANDLES 25 WATTS OF POWER
- PRICED EXCEPTIONALLY LOW

14.95

New high frequency tweeter featuring a louvered acoustic lens for uniform sound dispersion and capable of handling up to 25 watts of distortion-free power. The directional tendency of high frequency notes is overcome by the natural wide dispersion angle of the short horn and the acoustic lens which disperses and radiates the high notes smoothly throughout the entire listening area. The lens is detachable for panel mounting, with a separate base for the tweeter furnished for external mounting where desired. Aluminum voice coil has 16 ohms impedance. Size: 4¼" long x 3" diameter, lens extends 2½". Requires a crossover network, preferably one with a level control, such as the LN-2. With full instructions. Shpg. wt., 5 lbs.

HW-7 ....Net **14.95**

METAL-CASED CONE TYPE HI-FI TWEETER

FREQUENCY RESPONSE 2000-16,000 CPS · HANDLES 20 WATTS OF POWER

5.95 Net

Highest quality cone type high frequency tweeter having a range from 2000 to 16,000 cycles. Especially efficient at higher end of audio spectrum where other cone type tweeters tend to lose clarity and volume. Entirely closed in a metal case with a base so that it can stand by itself or be mounted on a flat surface with mounting bracket supplied. Rated to handle 20 watts of power. A crossover network is required; the Lafayette LN-2 is ideal. Voice coil impedance 8-16 ohms. Size: 3⅛" x 2⅛" x 3" Diam. Shpg. wt., 3 lbs.

HK-3 ....Net **5.95**

CROSSOVER NETWORK

- CAPACITIVE-INDUCTIVE NETWORK WITH CROSSOVER AT 2000 CPS
- BUILT-IN LEVEL BRILLIANCE CONTROL

8.75

The frequencies above 2000 cycles are channeled to the high frequency tweeter by means of the high-Q inductance and capacitance comprising this efficient crossover network. The highs and lows are brought into acoustic balance by means of a continuously variable level-brilliance control. Control has a 2½ ft. long cable for remote mounting. Network matches 8-16 ohm speakers with insertion loss reduced to a minimum. Enclosed in metal case 6" L x 2⅝" H x 2⅝" D. With full instructions. Shpg. wt., 5 lbs.

LN-2 ....Net **8.75**

2 WAY SPEAKER SYSTEM 40-16,000 CYCLES

This 2-way speaker system is another excellent buy for the moderate purse. It is basically the same as the SY-85 system described at the top of the page, but incorporates the deluxe SK-68 speaker with 21.5 oz. Alnico V magnet. This results in more efficient reproduction and extension of the lower register. Complete system includes the SK-68 12" 25 watt woofer, HK-3 cone type tweeter and LN-2 crossover network with lever-brilliance control. Range of system 35-16,000 cycles. Shpg. wt., 18 lbs.

SY-87—Complete System..Net **27.50**
SY-86—Complete System, same as above except the HW-7 Tweeter with acoustical lens is supplied instead of HK-3. Shpg. wt., 20 lbs..........................Net **36.50**

New! **LAFAYETTE Mail Order Center** →

Lafayette Radio **165-08 Liberty Ave. JAMAICA 33; N. Y.**

Dept. JA-2

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ADDRESS ____________________

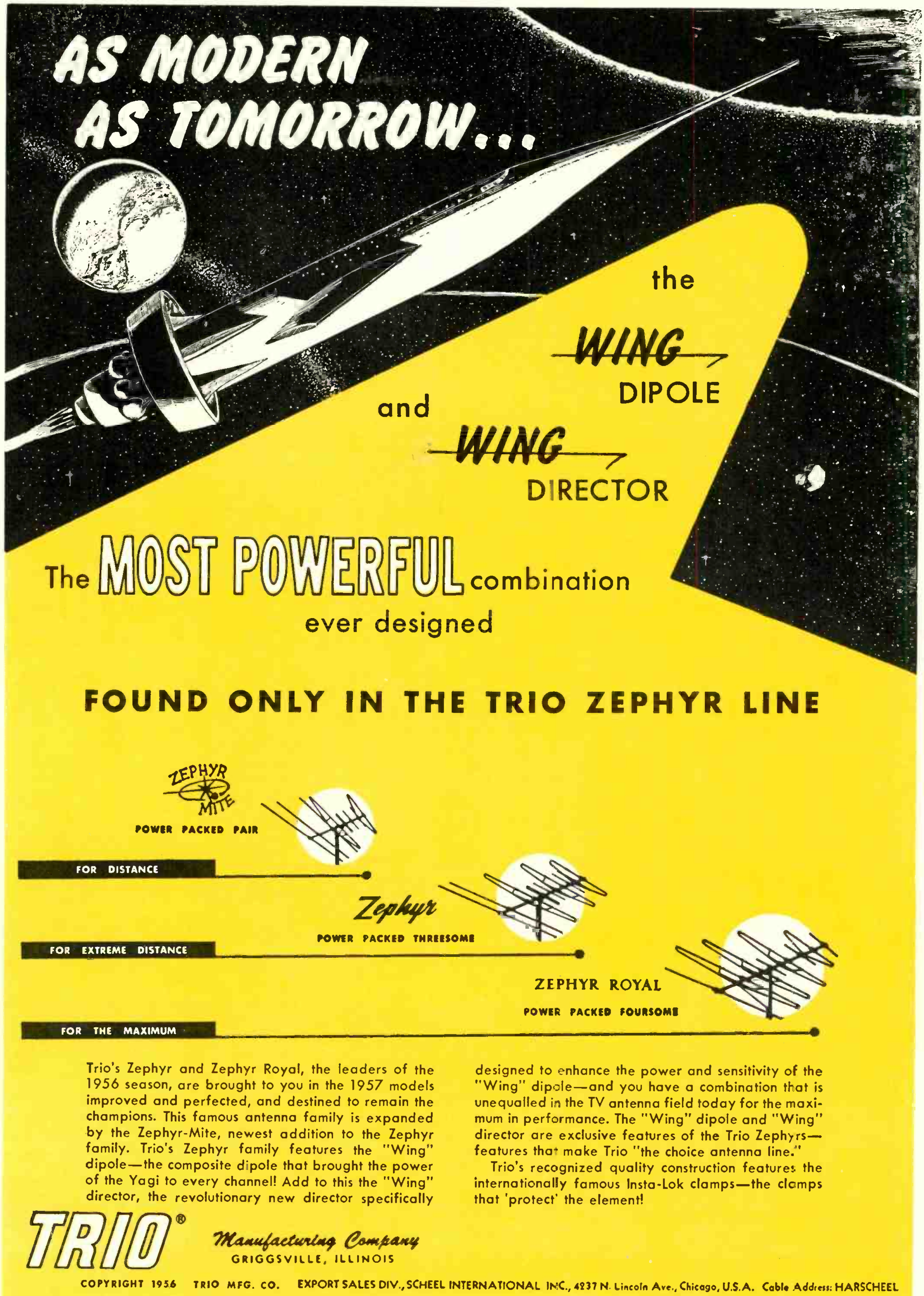
CITY ____________________

ZONE ____________________

STATE ____________________

SEND FREE LAFAYETTE CATALOG

CUT OUT AND MAIL TODAY!


AS MODERN
AS TOMORROW...
the
WING
DIPOLE
and
WING
DIRECTOR
The MOST POWERFUL combination
ever designed
FOUND ONLY IN THE TRIO ZEPHYR LINE
ZEPHYR MITE
POWER PACKED PAIR
FOR DISTANCE
Zephyr
POWER PACKED THREESOME
FOR EXTREME DISTANCE
ZEPHYR ROYAL
POWER PACKED FOURSOME
FOR THE MAXIMUM
Trio's Zephyr and Zephyr Royal, the leaders of the 1956 season, are brought to you in the 1957 models improved and perfected, and destined to remain the champions. This famous antenna family is expanded by the Zephyr-Mite, newest addition to the Zephyr family. Trio's Zephyr family features the "Wing" dipole—the composite dipole that brought the power of the Yagi to every channel! Add to this the "Wing" director, the revolutionary new director specifically designed to enhance the power and sensitivity of the "Wing" dipole—and you have a combination that is unequalled in the TV antenna field today for the maximum in performance. The "Wing" dipole and "Wing" director are exclusive features of the Trio Zephyrs—features that make Trio "the choice antenna line."
Trio's recognized quality construction features the internationally famous Insta-Lok clamps—the clamps that 'protect' the element!
TRIO®
Manufacturing Company
GRIGGSVILLE, ILLINOIS
COPYRIGHT 1956 TRIO MFG. CO. EXPORT SALES DIV., SCHEEL INTERNATIONAL INC., 4237 N. Lincoln Ave., Chicago, U.S.A. Cable Address: HARSCHEEL

"Low Background Noise...Long Life...Electrical Uniformity" are technical terms your service customers may not appreciate when talking to you about set troubles. But they do know when you have restored their sets to "like new" performance.

When the trouble is tube failure, you certainly want to minimize "tube juggling" and circuit realigning... to complete the service job quickly, confidently, profitably—*with full customer satisfaction*.

RCA enables you to *give full customer satisfaction* by controlling the quality of your replacement tubes. RCA's "don't spare the quality" selection of raw materials, stringent control of all manufacturing processes and techniques, second-to-none final inspection and testing methods are your assurance of tubes with low background noise, long life, electrical uniformity—your assurance that RCA RECEIVING TUBES are your *most dependable replacement tubes!*

RECEIVING TUBES

RADIO CORPORATION OF AMERICA
TUBE DIVISION • HARRISON, N. J.

ALWAYS USE DEPENDABLE-QUALITY TUBES...RCA TUBES