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RADIO-ELECTRONICS

JANUARY 1956

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HUGO GERNSBACK, Editor

9th Annual TV Issue

Special Articles and Features

- Adapt Your Set To Receive Color
- Trends in Recent TV Receivers
- Whistle Your Set On and Off
- Color Television Test Equipment
- Easily Constructed Antenna Orienter Uses Transistor

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(See page 4)

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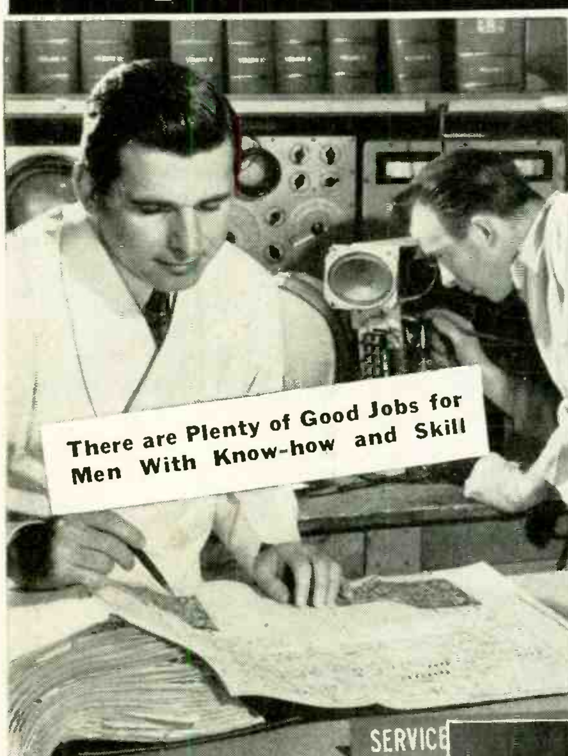

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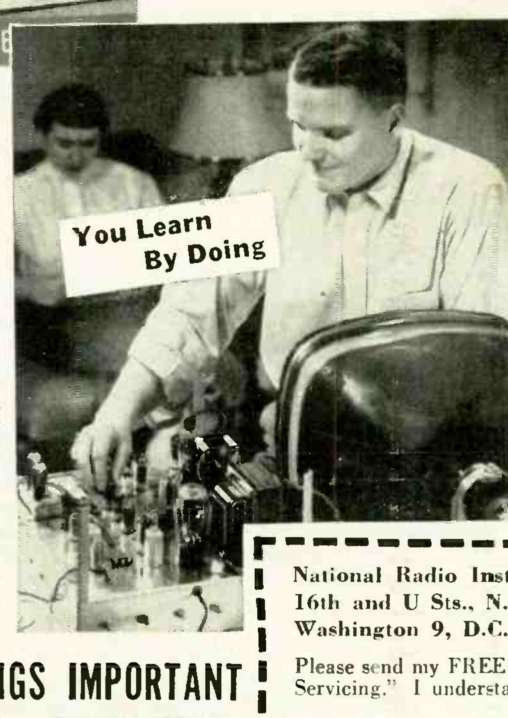

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ON THE COVER

Our cover this month depicts RCA Service Co. technician Samuel R. Fairbanks, Jr. completing the installation of a color receiver in our Editorial Director's living room—a scene that will be reenacted in many thousands of homes this year.

Color original by Dan Rubin

JANUARY 1956 — Vol. XXVII, No. 1

9th ANNUAL TV ISSUE

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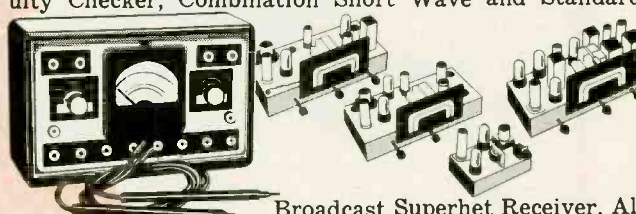

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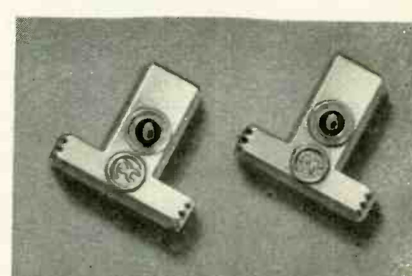

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the Radio month

SHALLOWER PICTURE TUBE is now the subject of concentrated experimentation by television receiver and tube manufacturers, the goal being a smaller and lighter TV set. To date, the industry has come up with a developmental 21-inch 120° tube approximately 3 to 4 inches shorter and from 1.6 to 2 pounds lighter than its 90° counterpart.

The "miniaturization" process has created some major problems: It is more costly and difficult to apply the screen to the tube and aluminize it. Greater input power is required to deflect the electron beam over the wider angle; this means improved and possibly more expensive driving circuitry and transformers. The new wide-angle tube may have to use a narrower neck diameter to place the deflection yoke closer to the electron beam for more efficient deflection.

To minimize these troubles, some tube manufacturers are also experimenting with 110° tubes. Some companies—Westinghouse, Sylvania, Thomas Electronics, Tung-Sol and others—are already sampling prospective customers on a limited basis.

AWARD TO RCA in recognition of its lengthy and consistent cooperation with the entire radio and television service industry was made by the Philadelphia Radio Service Men's Association. Presentation of the award, a plaque (see photo), was made by Richard G. Devaney (left), president of PRSMA, and accepted in behalf of RCA by Charles M. Odorizzi, executive vice president, corporate staff, RCA.

Charles M. Odorizzi—left—of RCA receives award for cooperation from Richard Devaney, PRSMA's president.

In accepting the award from the nation's oldest association of electronic service technicians (founded in 1928), Mr. Odorizzi cited RCA's longtime close association and cooperation with independent service organizations in providing them with up-to-the-minute technical information.

THUNDERSTORMS send signals all the way round the earth, in the form of low-frequency waves that travel between the earth and the ionosphere. A research team headed by Drs. Holzer, Dean and Ruttenburg of the Institute of Geophysics, UCLA, installed a radio receiver in a remote area of the Borrego desert of southern California and recorded signals for correlation with known major thunderstorm activity throughout the world. Signals so far received appear to have been produced by lightning flashes occurring in the great thunderstorm centers of Africa and South America.

Low-frequency signals produced by a bolt of lightning are apparently of the same type that produce radio static but are much too low in frequency to be picked up on a broadcast receiver. Vertical loop antennas were used for determining signal direction.

The isolated California desert was used to minimize interference from power lines. Research was carried out during a period when local thunderstorms were at a minimum.

Calendar of Events

Montreal Audio Show. Jan. 18–20. Windsor Hotel, Montreal, Canada.

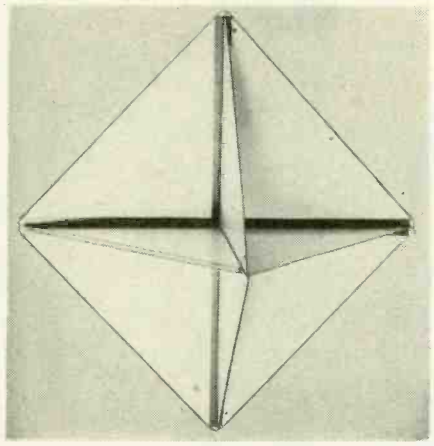
Toronto Audio Show. Feb. 1–3. Prince George Hotel, Toronto, Canada.

1956 Los Angeles High Fidelity Music Show. Feb. 8–11. Alexandria Hotel, Los Angeles.

ALL-COLOR TV STATION, the nation's first, will be WNBQ, Chicago. Beginning about April 15 all its local programs will be in color. Including the color programs on its regular NBC network broadcasts, WNBQ will transmit approximately 10 hours of color per day.

The announcement was made by David Sarnoff, board chairman of RCA and NBC, in a closed-circuit color TV press conference held simultaneously in New York and Chicago. Work on replacing the present monochrome TV equipment with color facilities is already well under way.

ELECTRONIC RED FLAG designed to make small boats highly conspicuous to the searching eye of radar from larger vessels is being marketed by Raytheon. The unit is a folding device made of sheet aluminum. It can be opened like an umbrella (see photo)



and raised to the top of a mast or held aloft at the end of an oar.

Radar, searching for a small boat, is much more likely to pick up a pip on its screen from the aluminum radar reflector than from a low-lying small craft in the water.

AURAVISION, a photographic process that combines sound with printed matter for use in recordings, has been announced by Columbia Records. Using specially treated printed surfaces, recorded speech or music can be transcribed on postcards, instructional brochures, etc. Records of any speed can be produced and played on standard phonographs.

The process requires that the printed matter be limited to four colors. Columbia then photographs the illustration and manufactures the recording, perforated around the edges so that it can be easily removed. Because of cost and quality factors, playing time is limited to 2 minutes. The record may be used about 50 times without appreciable wear.

RADIO - CONTROLLED TRAFFIC signals have been installed at 13 busy street intersections in Chicago. Designed and built by General Electric, the central control station is located at City Hall and a transmitter and antenna on the roof of the Board of Trade Building. The control station is linked to the antenna by existing underground cable. This is believed to be the first time such a system has been used under large-city conditions. (For a small-city installation, see RADIO-ELECTRONICS, November 1955, page 58.)

The transmitter provides remote control of electronically equipped stop-and-go signals through coded radio tones. Existing stop-and-go lights have been adapted to radio control by equipping them with antennas, receivers, decoders and electronic mechanisms. Immediately after a decoder receives its signal, it actuates the timing mechanism of its traffic signal as directed by central control. The most desirable signal timing is put into operation automatically each day but is modified as often as necessary to facilitate the movement of traffic.

TV HOTEL REGISTRATION permits motorists to register for rooms without having to leave their cars. Convenient and fast, it allows a guest to go to his room without having to stop at a desk inside the hotel.

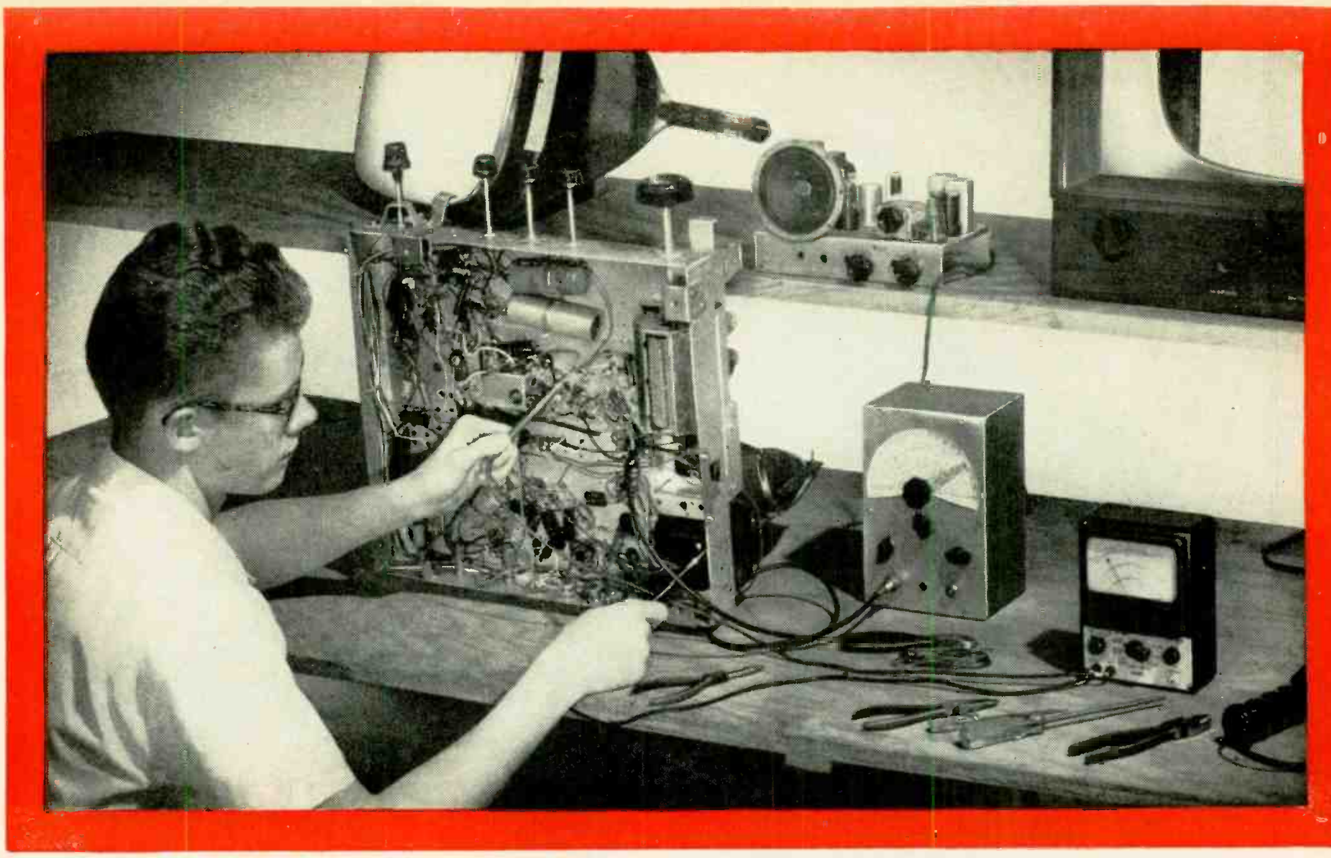
A TV drive-in service has been installed by Du Mont for the Temple Hotel in Pendleton, Ore. Cars, driving to a special curbside booth at one side of the hotel, trigger a signaling device which alerts a room clerk inside the hotel. At the same time, the car enters in view of a two-way Du Mont closed-circuit television system, flashing a picture of the driver on a screen inside the hotel. The clerk sees the driver and in turn his picture can be seen by the driver on a screen in the curbside booth. The two can then talk and make the necessary room arrangements through an audio system.

A bellboy then brings a registration sheet to the car, gives the guest the room key, takes his baggage and directs him to parking space in the garage. The TV system does away with traffic jams in front of the hotel.

AIRPLANE RELAY TELECAST conducted by NBC and the Cuban TV network, CMQ, sent live pictures from Havana into the homes of millions of American viewers. As part of NBC's *Wide Wide World* program of Nov. 13, 1955, the first controlled telecast from an overseas foreign land was relayed

from a plane. The aircraft, flying in a series of tight figure-8's at 11,000 feet and 60 miles from the initial receiving point atop the Fontainebleau Hotel in Miami Beach, Fla., carried the receiving and transmitting relay equipment.

The Havana transmitting post was located atop a 35-story apartment building where TV cameras viewed local points of interest. Other cameras, in the historic Cathedral Square, picked up a portrayal of 1830 Cuban customs and dances. END



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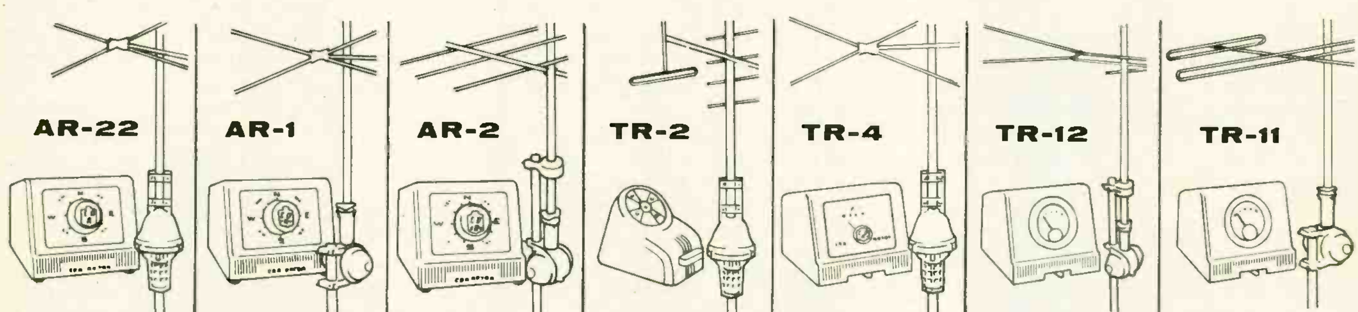

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Correspondence

BRIGGS SPEAKS UP

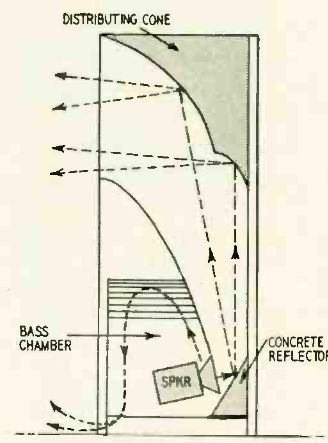
Dear Editor:

I have recently come across Mr. Augspurger's article "Horn Type Speaker Systems" (May, 1955), a subject on which I too have made many experiments.

The technical press in Britain has often deplored the fact that technicians in the U. S. A. are not always kept informed of what goes on over here, and I am sure that Mr. Augspurger is not aware of developments which took place in this country before the war. I refer to his comments about the Voigt corner horn, which he stated had been developed as the complement of the Lowther P.M.2 driver. This driver is a postwar development; the Voigt corner horn was well known long before the war. I myself heard demonstrations of the Voigt corner horn during lecture tours by Mr. Voigt in the 1930–1938 period. Mr. Voigt then used his excited, high-flux-density field magnet and twin diaphragm in conjunction with his horn and Lowther amplifiers. This combination undoubtedly set the standard in pre-war Britain.

In the Voigt corner speaker the horn which dealt with the middle and upper frequencies used the walls as part of the system while the bass, after expanding through an elongated folded and outwardly expanding air passage, radiated into the room from the corner, using both walls and floor as part of the system. The theory showing the advantages of radiating into one-eighth sphere in this way is clearly set down in Mr. Voigt's British Patent No. 447749 dated October, 1934. In my own little book *Loudspeakers*, published in 1948, I included an illustration of the Voigt design and described it as an example of the study of room acoustics which was well ahead of its time. The accompanying diagram was published by courtesy of *Wireless World*, who reviewed the Voigt speaker over 20 years ago—in their issue of Dec. 28, 1934.

When I saw Mr. Voigt in Toronto last year, I was indeed sorry to learn that his business in England had come



to a standstill, but I think it is only fair that he should be given full credit for his original work in the field of corner horn loading of loudspeaker units.

It is nice to learn from articles such as the one by Mr. Augspurger that his fundamental work, not forgotten in England, is also coming to be recognized on your side of the Atlantic.

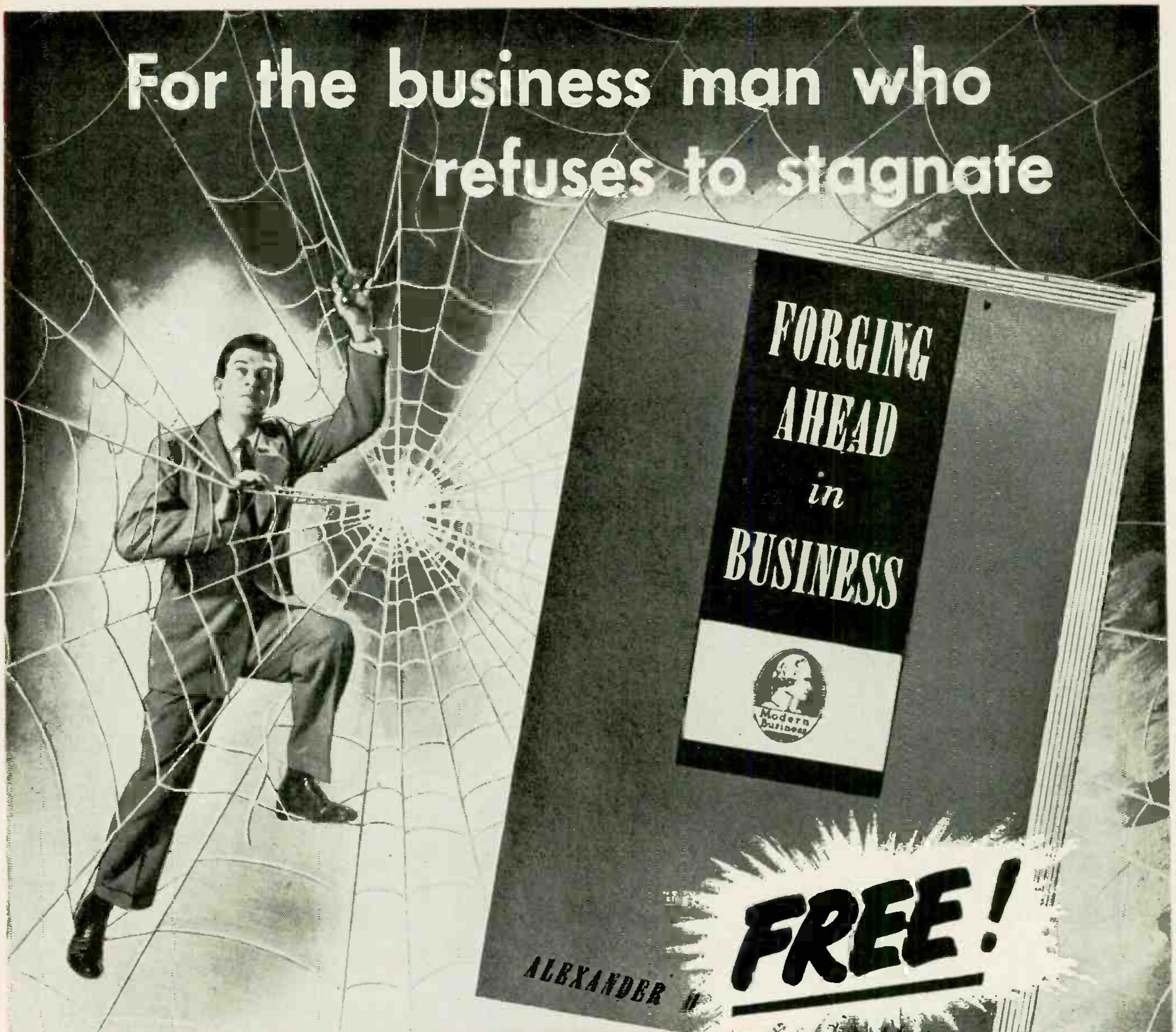
G. A. Briggs
Managing Director
Wharfdale Wireless Works Ltd.
Yorkshire, England

VOIGT AND LOWTHER

Dear Editor:

Mr. Felix' letter (November, 1955) directed me to that of Mr. Chave (July, 1955) which I had missed. Reading the latter indicates that the situation should be cleared up and I hope what follows will do so:

I have known Voigt since before he ever designed a speaker, at the time when he was chief recording engineer for the long-defunct Edison Bell Record Co. of London. As a friendly competitor I watched his progress as an independent speaker designer and manufacturer with the greatest interest and our diverging views never interfered with our friendship. In my article on speakers (March, 1954) I gave a picture of the twin-cone Voigt unit, which at that time had an electromagnet. This unit was used in conjunction with regular exponential horns of straight form as well as the Voigt corner horn, the latter being a domestic type of loading which worked very well. At a later date Voigt found the need for using permanent magnets. To get the flux and field he wanted some changes were made to the design of the pole pieces; he also cleaned up the gen-



HALF the world is half asleep! Men who could be making *twice* their present salaries are coasting along, hoping for promotions but doing nothing to bring themselves forcefully to the attention of management.

They're *wasting* the most fruitful years of their business lives . . . throwing away thousands of dollars they may never be able to make up. And, oddly enough, they don't realize—even remotely—the tragic consequences of their failure to forge ahead while time is still on their side.

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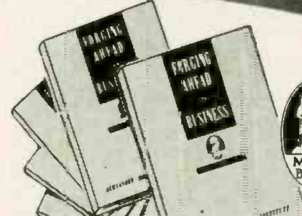

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eral chassis design and made it a much tidier looking unit. It was clearly, however, a development of his original design which appeared in my article.

After I had established a skeleton distribution in the U. S. A. for my own speakers I approached Voigt and said that as his design did not compete with mine, I would be very glad to introduce his units to the American market. He said that much as he would like to do that, he had found the strain of running his own business, Voigt Patents Ltd., too much for his rather delicate health and had sold his interests to the Lowther Manufacturing Co. He had, therefore, no jurisdiction over the sale of his speakers anywhere in the world.

At a later date I heard that the Lowther Manufacturing Co. had come to terms with my good friend Victor Brociner to represent them in the U. S. A. But between the time that Voigt had sold out to Lowther and the appearance of Voigt speakers on the American market it is a fact that these speaker units were advertised in the London *Wireless World* as "Lowther-Voigt" speakers. I think this shows beyond dispute that the Voigt designs were acquired by Lowther.

Last winter, during a friendly discussion with Mr. Brociner on other matters, he asked if I would like to see the latest units he was getting from England. I said I would and had an opportunity of inspecting what Mr. Chave refers to as P.M.2 and P.M.4 units. It would be most improper for me to make any comment on the performance of any other manufacturer's speakers, but from my nearly 30 years' experience of designing speakers I can say that my unhesitating opinion of what I saw was that these units were virtually Voigt speakers of the permanent-magnet type. There may have been some slight modification of the speakers I knew came from the original Voigt factory, but I did not see them. The speakers looked alike and to my ears they sounded alike.

I cannot see why Mr. Chave should take up the attitude so clearly displayed in his letter of July. When all is said and done Voigt's is an honored name in the roll of speaker designers, and I would have thought the attachment of his name to the Lowther output would have been a commercial asset. But this, of course, is Mr. Chave's business, not mine.

H. A. HARTLEY

London, England

THE VOCATROL

Dear Editor:

Last August I was delighted to find your write-up on the Vocatrol. I have been looking for such an article and trying to devise a Vocatrol ever since I saw one demonstrated at the IRE convention in New York in 1951. Mr. R. C. Jones described how he developed it. He also demonstrated it, even differentiating between a singing commercial and the singing portion of an opera. The loud and lengthy enthusiasm evinced by that overflowing hall of staid engineers was heartwarming.

Calmer consideration with the passage of time caused a little nagging doubt to exist as the performance of the gadget seemed too good, and his name with those initials seemed too appropriate. He said he had applied for a patent, but to date it has not been issued. And having built the Vocatrol described, my doubts grow larger.

I'm not able to make the thing work but, if everyone gets together and points out the gimmicks found in it, maybe they will add up to a workable circuit. Below are those I found:

1. I do not believe that stage V3-a in conjunction with V2-a is a logarithmic amplifier as V3-a is not a variable-mu tube and positive bias developed by V2-a is the wrong polarity.

2. In applying audio to the circuit, it was found to disappear at the grid of V3-a. This is due to V2-a giving a positive output causing the V3-a grid to draw current and have a conductive resistance small compared to the 10-megohm series resistor. Eliminating this, and then the entire filter, does not help. Reversing V2-a produces a voltage across the 2-μf capacitor (about −50 at full gain measured with a 20,000-ohm-per-volt meter on the 300-volt scale) that is usually larger for voice than for music but not reliably so. This is as the article stated. For reversing V2-a causes the device to be actuated by the increases rather than the decreases of signal level. Adding a phase-reversing stage of unity gain following V3-a gave no difference in voltage level across the 2-μf capacitor.

Incidentally, the connection shown to the receiver requires that the grid resistor in the receiver be at least several megohms or the 22 megohms be reduced, as the plate voltage of V5 only goes to −80 when the tube conducts.

EDWARD E. PREDMORE

New York, N. Y.

(The item referred to was printed in good faith, using all the information available from the manufacturer. We would be interested in hearing of other readers' experiences with it.—*Editor*)

CONVERSION CORRECTION

Dear Editor:

There are, unfortunately, some mistakes in my letter as printed in the November, 1955 issue, which, I am sure, will cause dissatisfaction to anyone attempting to make this conversion.

Item 1 should read:

Remove V104, T111, T112 and input circuitry associated with V104.

Item 2 should read:

Electronics Boom Seen

Need For Television Technicians To Rise

Industry Warned About Shortage Of Trained Men

TV SALES SET NEW RECORD

Sylvania Head Expects Huge Electronic Gains

RCA HEAD PREDICTS SALES BOOM FOR COLOR TV SETS

Transistor Radios Developed

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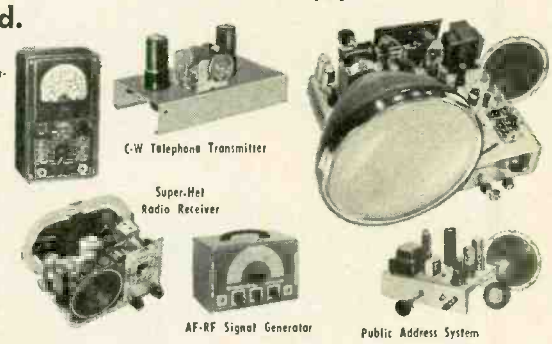

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Install a 4.5-mc pickup coil in the circuit connecting the 6AL5 video detector to the grid of V105.

V105 is necessary as a limiter for the following discriminator stage.

Although noise rejection may be poorer in fringe areas, I doubt that this circuit is any less sensitive than that suggested in Mr. Bierman's article.

It should also be kept in mind that oscillator drift, so troublesome when using u.h.f. converters, is not a problem restricted to fringe areas.

The RCA T120 converts in a similar manner, but all sound tubes must be retained in this circuit since it has one less stage than the 630. Here it is necessary to remove the original input circuitry of the first stage and introduce the 4.5-mc pickup coil instead.

FREDERICK J. NORVIK
Albany, N. Y.

ADDING A "SQUARER"

Dear Editor:

The wide-range oscillator described by Mr. Graham in July, 1954, was an interesting little test instrument. I see in the November, 1955, issue (page 143) that a correspondent wished to add to the circuit to produce square waves in addition to the sine waves of the original instrument.

As I had space on my chassis, I added a "squarer" similar to the one you published. I also installed an extra tube and tuning capacitor to give me an oscillator tuning from TV channels 2 to 6. This gadget adds two controls to the front panel—the tuning capacitor and a switch in the heater of the oscillator tube, but it gives dandy bars, vertical and horizonal, for checking linearity of a TV set.

The output, coupled from the cathode of the new oscillator tube to the grid of the original output tube, is available at the same output terminals from which the audio is obtained.

The bars are clean black-and-white with no smears. In addition, varying the audio produces fantastic patterns on the TV screen. My 2-year-old enjoys them as much as some of the programs.

JOHN DEWAR
RCAF Station
Clinton, Ontario
Canada

TRANSISTOR SYMBOLS

Dear Editor:

I find your suggestion of using a square or triangle (October, 1955) around transistors better than using a circle. However, I prefer no enclosure. Space should be occupied with factual matter such as voltages, pin numbers, etc.

Circles are not needed around tubes. Anyone not capable of distinguishing a grid from a resistor would not be able to understand any circuit, no matter how drawn.

A. W. CLEMENT
Galion, Ohio

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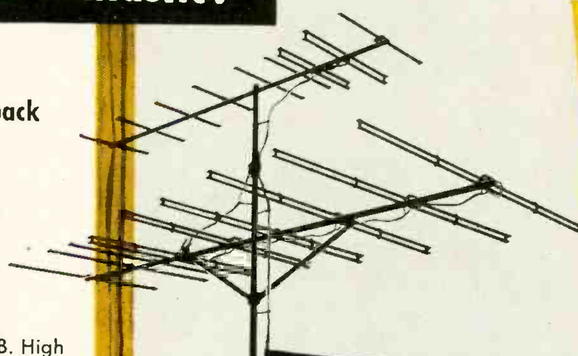

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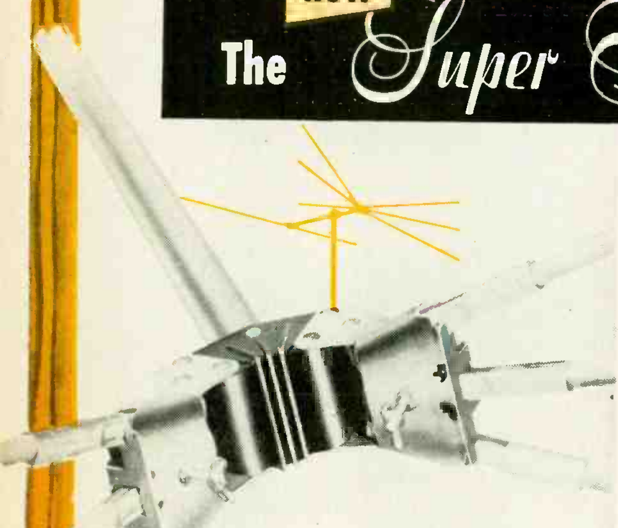

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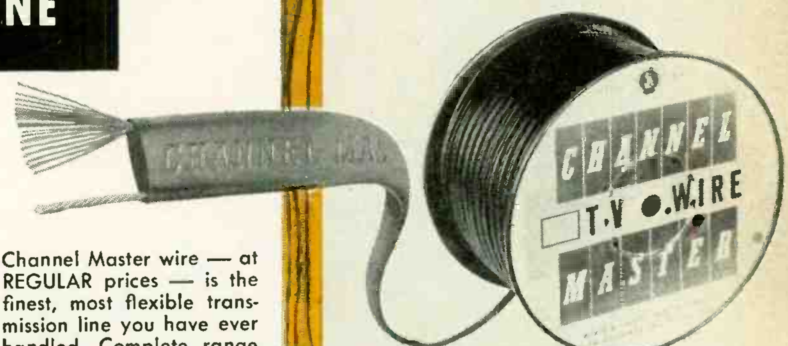

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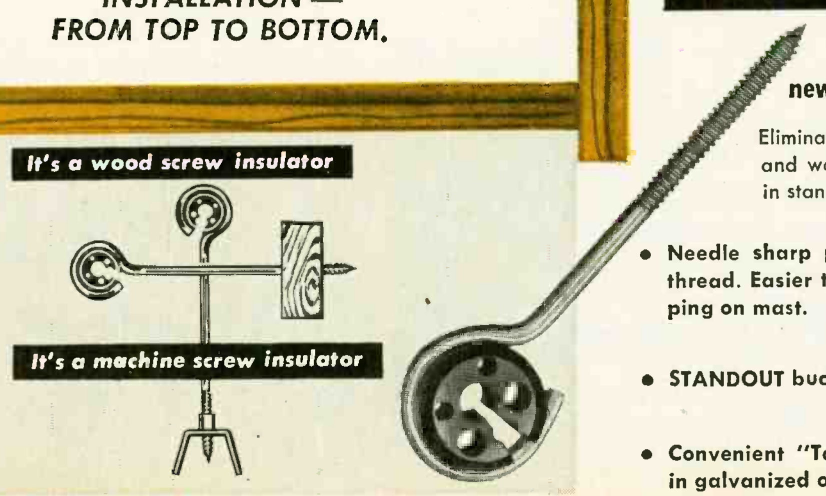

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12KP4A	12KP4	None.
	12QP4	Ground conductive coating. Remove ion trap.
	12QP4A	Ground conductive coating. Remove ion trap.
	12RP4	Ground conductive coating. Remove ion trap.
16KP4A	16KP4	None.
	16QP4	Ground conductive coating. Change ion trap.
	16RP4	Check conductive coating contact.
	16TP4	Space may not be sufficient in some cases.
	16XP4	Ground conductive coating. Change ion trap.
17BP4B	17BP4	Ground conductive coating.
	17BP4A	None.
	17BP4C	None.
	17JP4	Do not exceed voltage rating.
17HP4B	17HP4	None.
	17HP4A	None.
	17RP4	None.
17LP4A	17LP4	None.
	17VP4	None.
20DP4C	20DP4A	None.
21ALP4A	21ALP4	None.
	21ALP4B	None.
	21ANP4	Ground conductive coating.
	21ANP4A	Ground conductive coating.
21AUP4A	21AUP4	None.
	21AUP4B	None.
21AVP4A	21AVP4	None.
	21AVP4B	None.
21EP4B	21EP4	Ground conductive coating.
	21EP4A	None.
21FP4C	21FP4	Ground conductive coating.
	21FP4A	None.
21YP4A	21AFP4	Ground conductive coating.
	21YP4	None.
21ZP4B	21ZP4	Ground conductive coating.
	21ZP4A	None.
24CP4A	24CP4	None.
	24QP4	None.
	24TP4	None.
	24XP4	Ground conductive coating.
24DP4A	24DP4	None.
27EP4	27GP4	None.
	27NP4	Add filter condenser.
27RP4	27GP4	Ground conductive coating.
	27NP4	None.

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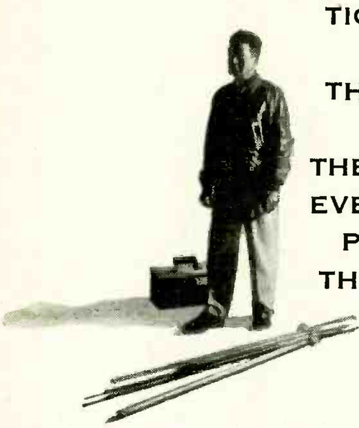
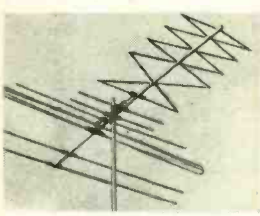
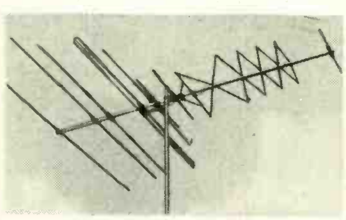
FIELD REPORT NO. 8

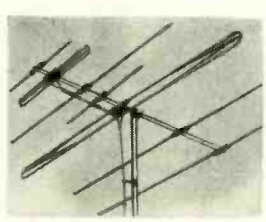
The voice of the serviceman is the voice of Experience . . .

. . . AND THESE DEALERS ARE SPEAKING FROM PERSONAL EXPERIENCE. THEY REPRESENT THOUSANDS OF ENTHUSIASTIC SERVICEMEN THROUGHOUT THE COUNTRY. THESE MEN MUST PROVIDE THEIR CUSTOMERS WITH STEADY, SHARP RECEPTION ON EVERY CHANNEL RECEIVED IN THEIR AREA. THEIR REPUTATIONS DEPEND ON THE QUALITY OF THEIR ANTENNA INSTALLATIONS. SO THEY RUN THEIR OWN FIELD TESTS. AND THEY'RE MORE THAN SATISFIED. THEY KNOW THAT THERE'S A JFD ANTENNA FOR EVERY PROBLEM, FOR EVERY PURSE. THEY'VE SEEN FOR THEMSELVES. YOU CAN, TOO.









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SX711S-96*	96" stacked	$55.00				FB500S-68†	68" wide stacked	$36.65
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*for added ch. 2-6 gain
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CARL KOWA
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MARS APPLIANCE CO.
HARTFORD, CONNECTICUT

I AM CONVINCED THAT THE STAR-HELIX ANTENNA IS THE HIGHEST GAIN ANTENNA ON THE V. H. F. CHANNELS I HAVE EVER USED IN ALL MY EIGHT YEARS IN THE BUSINESS. CUSTOMERS ARE ENTHUSED ABOUT RECEPTION FROM NEW YORK, OVER ONE HUNDRED MILES AWAY.

FRED LOREMAN
LOREMAN SERVICE
BARSTOW, CALIFORNIA

WE ARE IN AN EXTREME FRINGE AREA. WE HAVE RECENTLY PURCHASED YOUR NEW STAR-HELIX ANTENNA FROM ELECTRONIC SUPPLY CORP., RIVERSIDE, CALIF. WE ARE QUITE HAPPY WITH THEIR PERFORMANCE AND ALSO THEIR CONSTRUCTION.

AL ADAMS
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MYRTLE BEACH, SOUTH CAROLINA

WE USE AND RECOMMEND THE JFD STAR-HELIX ANTENNA IN THIS AREA AS IT NOT ONLY GIVES THE BEST PERFORMANCE POSSIBLE FROM OUR DISTANT STATIONS BUT WILL WITHSTAND EXTREME WEATHER CONDITIONS AND EFFECTS OF SALT SPRAY.

WILLIAM F. PETERSON
WANK'S FURN. & APPLIANCE MART
SOUTH HAVEN, MICHIGAN

WE LIKE THE JFD STAR-HELIX ANTENNA BECAUSE OF ITS EXCELLENT FRONT-TO-BACK RATIO. CO-CHANNEL INTERFERENCE IS LESS THAN WITH ANY OTHER ANTENNA WE HAVE TRIED. WE RECEIVE STATIONS FROM FOUR DIRECTIONS AND WE CONSISTENTLY BRING IN THE FIVE (5) CHICAGO STATIONS WHICH ARE OVER 75 AIR-MILES DISTANT. WE ALSO USE THIS ANTENNA WITH OUR COLOR RECEIVER FOR DEMONSTRATION.

H. H. PIGFORD
BURGAW RADIO & T.V. SERVICE
BURGAW, NORTH CAROLINA

I HAVE TRIED MANY DIFFERENT ANTENNAS BUT I FIND THAT THE JFD STAR-HELIX GIVES BEST PERFORMANCE IN A FRINGE AREA OVER ALL THE REST OF THE ANTENNAS I HAVE TRIED.

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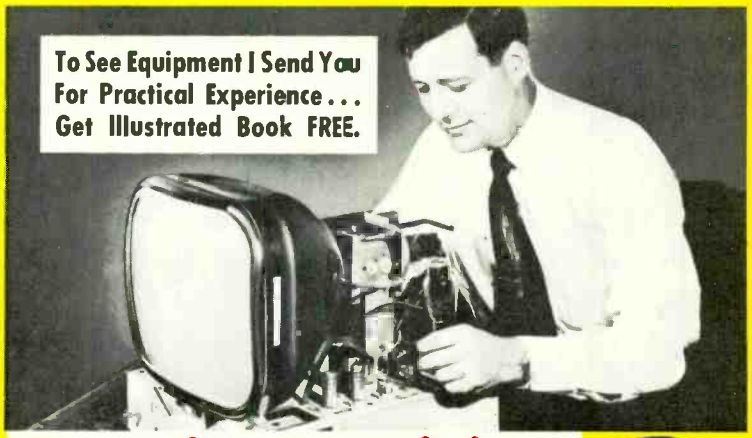

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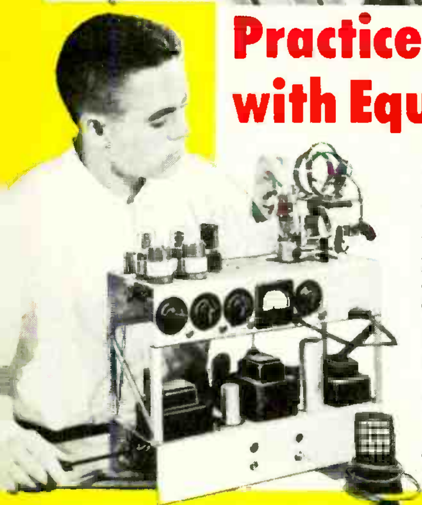

Practice Broadcasting with Equipment I Send

It's practical to train at home for good Radio-TV jobs and a brighter future. As part of my Communications Course I send you kits of parts to build the low-power Broadcasting Transmitter shown at the left. You use it to get practical experience performing procedures demanded of Broadcasting Station Operators. An FCC Commercial Operator's License can be your ticket to a better job and a bright future; my Communications Course gives you the training you need to get your license. Mail card below and see in my book other valuable equipment you build. Get FREE sample lesson.

Practice Servicing with Equipment I Send

Self-confidence, security, earning power come from knowing-how and from experience. Nothing takes the place of PRACTICAL EXPERIENCE. That's why NRI training is based on LEARNING BY DOING. You use parts I furnish to build many circuits common to Radio and Television. With my Servicing Course you build a modern Radio (shown at right). You build a Multitester, use it in conducting experiments, fixing sets in spare time starting a few months after enrolling. All equipment is yours to keep. Card below will bring book showing other equipment you build. Judge for yourself whether you can learn at home in your spare time.

Television Is Growing Fast Making New Jobs, Prosperity

More than 30 million homes now have Television sets and thousands more are being sold every week. Well trained men are needed to make, install, service TV sets and to operate hundreds of Television stations. Think of the good job opportunities here for qualified technicians, operators, etc. If you're looking for opportunity, get started now learning Radio-Television at home in spare time. Cut out and mail postage-free card. J. E. Smith, President, National Radio Institute, Washington, D. C. Over 40 years' experience training men at home.

AVAILABLE TO VETERANS UNDER G.I. BILL

Good Jobs Good Pay See Other Side

Cut out and mail card NOW!

Get My SAMPLE LESSON and 64-Page Illustrated Book BOTH FREE

This card entitles you to Actual Lesson on Servicing, shows how you learn Radio-Television at home. You'll also receive my 64-page Book, "How to Be a Success in Radio-Television." Mail card now!

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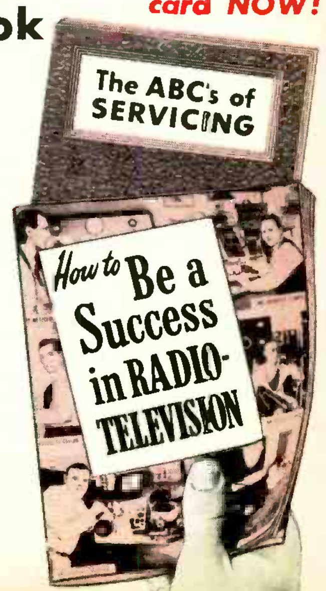
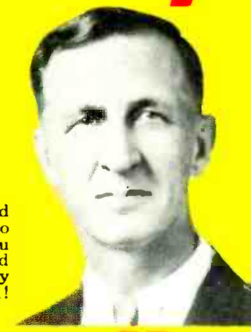


Train at Home to Jump Your Pay as a RADIO-TV Technician



J. E. Smith, *President*
National Radio Institute

The men whose messages are published below were not born successful. Not so long ago they were doing exactly as you are now . . . reading my ad! They decided they should KNOW MORE . . . so they could EARN MORE . . . so they acted! Mail card below now.

Get a Better Job—Be Ready for a Brighter Future in America's Fast Growing Industry

Training PLUS opportunity is the PERFECT COMBINATION for job security, good pay, advancement. When times are good, the trained man makes the BETTER PAY, GETS PROMOTED. When jobs are scarce, the trained man enjoys GREATER SECURITY. NRI training can help assure more of the better things of life.

Radio-Television is today's opportunity field. Even without Television, Radio is bigger than ever before. Over 3,000 Radio Broadcasting Stations on the air; more than 115 million home and Automobile Radios are in use. Television Broadcast Stations extend from coast to coast now with over 30 million Television sets already in use. Over 400 Television stations are on the air and there are channels for hundreds more. Use of Aviation and Police Radio, Micro-Wave Relay, Two-way Radio communication for buses, taxis, trucks, etc., is expanding. New uses for Radio-Television principles coming in Industry, Government, Communications and Homes.

Start Soon to Make $10 to $15 a Week Extra Fixing Sets

Keep your job while training. Many NRI students make $10, $15 and more a week extra fixing neighbors' Radios in spare time, starting a few months after enrolling. The day you enroll I start sending you special booklets that show you how to fix sets. The multitester you build with parts I furnish helps discover and correct troubles.

SEE OTHER SIDE

My Training Is Up-to-Date You Learn by Doing

Get the benefit of our 40 years' experience training men. My well-illustrated lessons give you the basic principles you must have to assure continued success. Skillfully developed kits of parts I furnish "bring to life" the principles you learn from my lessons. Read more about equipment you get on other side of this page.

More and more Television information is being added to my courses. The equipment I furnish students gives experience on circuits common to BOTH Radio and Television.

Find Out About this Tested Way to Better Pay

Read at the right how fellows who acted to get the better things of life are making out now. Read how NRI students earn $10, $15 a week extra fixing Radios in spare time starting soon after enrolling. Read how my graduates start their own businesses. Then take the next step—mail card below.

You take absolutely no risk. I even pay postage. I want to put an Actual Lesson in your hands to prove NRI home training is practical, thorough. I want you to see my 64-page book, "How to Be a Success in Radio-Television," because it tells you about my 40 years of training men and important facts about present and future Radio-Television job opportunities. You can take NRI training for as little as $5 a month. Many graduates make more than the total cost of my training in two weeks. Mailing postage-free card can be an important step in becoming successful. J. E. Smith, President, National Radio Institute, Washington 9, D. C. Training Men for Over 40 years. Approved Member, National Home Study Council.

I TRAINED THESE MEN

Lots of Spare-Time Jobs
"I do a lot of spare-time Radio and TV servicing. It was fun learning and I don't know how to thank you." B. Goede, Plainview, Minn.

Now TV Trouble Shooter
"I had only gone to 7th grade when I started course. Now have job as TV troubleshooter, also fix sets spare time." M. R. Lindemuth, Fort Wayne, Ind.

Engineer with WHPE
"Thanks to NRI. I operated a successful Radio repair store. Then I got a job with WPAQ and now am an engineer for WHPE." V. W. Workman, High Point, N. C.

NRI Course Can't Be Beat
"Am with WCOC. NRI Course can't be beat. No trouble passing 1st class Radiophone license examination." Jesse W. Parker, Meridian, Mississippi.

Quit Job for Own Business
"I decided to quit my job and do TV work full time. I love my work and am doing all right financially." William F. Kline, Cincinnati, Ohio.

Extra Money in Spare Time
"I am a police captain and also have good spare-time service business. Just opened my new showrooms and shop." C. W. Lewis, Pensacola, Fla.

My Training Leads to Jobs Like These

BROADCASTING: Chief Technician, Chief Operator, Power Monitor, Recording Operator, Remote Control Operator. **SERVICING:** Home and Auto Radios, P.A. Systems, Television Receivers, Electronic Controls, FM Radios. **IN RADIO PLANTS:** Design Assistant, Transmitter Design Technician, Service Manager, Tester, Serviceman, Research Assistant. **SHIP AND HARBOR RADIO:** Chief Operator, Assistant Operator, Radiotelephone Operator. **GOVERNMENT RADIO:** Operator in Army, Navy, Marine Corps, Coast Guard, Forestry Service Dispatcher, Airways Radio Operator. **AVIATION RADIO:** Plane Radio Operator, Transmitter Technician, Receiver Technician, Airport Transmitter Operator. **TELEVISION:** Pick-Up Operator, Voice Transmitter Operator, Television Technician, Remote Control Operator, Service and Maintenance Technician. **POLICE RADIO:** Transmitter Operator, Receiver Serviceman.

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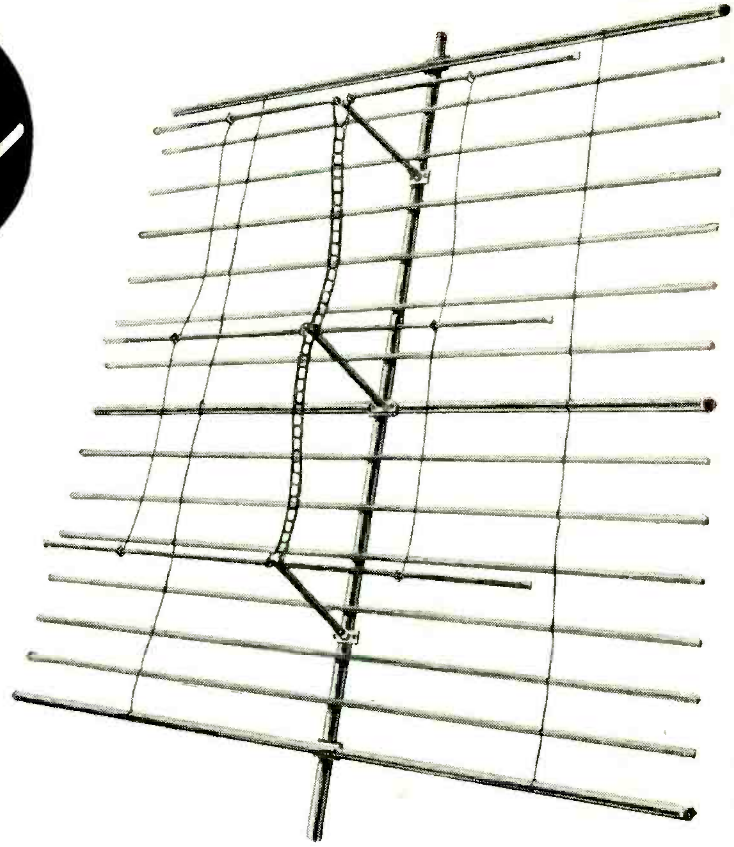

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★ The GENERAL is completely pre-assembled. By simply tightening three wing nuts, the antenna is ready to mount.

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★ The GENERAL is packed in a small carton. This makes the antenna more economical to ship, store, and handle.

★ The GENERAL sells for less than comparable products. This gives YOU a better mark up and faster moving merchandise.

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★ The GENERAL is low enough in price to use in the most competitive market and is recommended for all locations.

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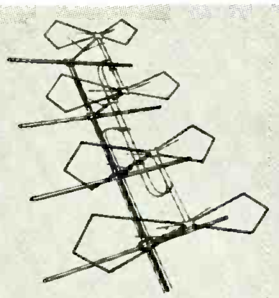

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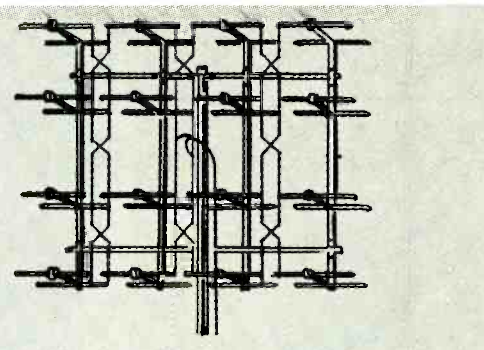

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Sure, *you* are already sold on the advantages of aluminized tubes. You know that the CBS Silver Vision aluminized screen with its silver-activated phosphors and the CBS small-spot gun mean clearer, sharper, brighter pictures.

But your woman customer (76.9% of TV service customers are women) doesn't understand electronics or CBS advanced-engineering as you do.

She does know and respect the name CBS . . . she has confidence in Garry Moore and in the Good Housekeeping Guaranty Seal. So all you have to do is take advantage of Garry's pre-selling over the CBS Television Network. Just remind her that there are no finer tubes made than CBS Silver Vision tubes . . . And, like all CBS tubes, they have the Good Housekeeping Guaranty Seal. She's already pre-sold by Garry Moore and national magazine advertising. You build profitable customer confidence and sales every time you recommend CBS Silver Vision tubes.

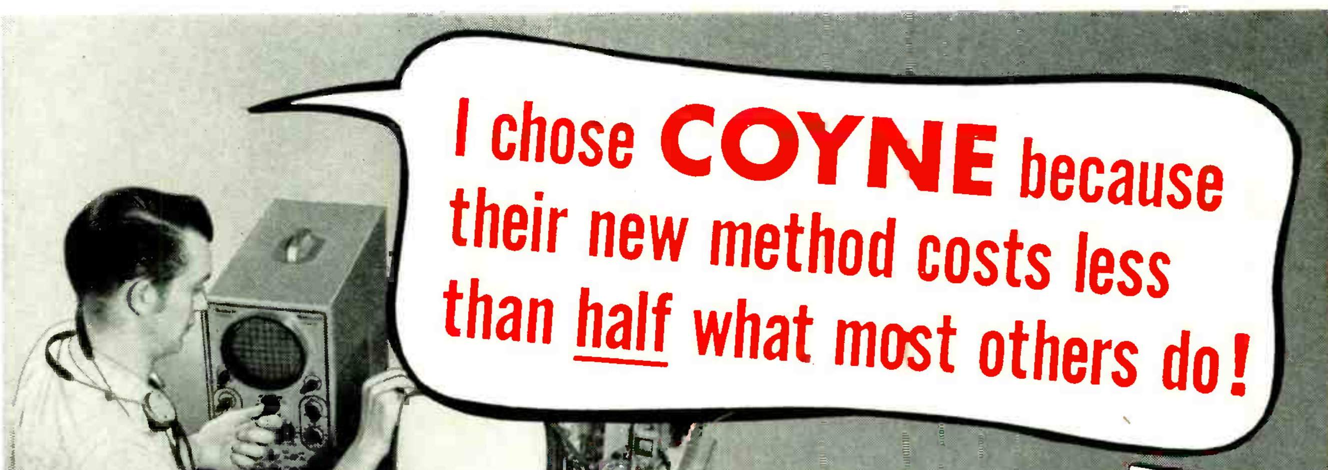
Garry Moore
famous CBS Television Star

Show the CBS carton with the Good Housekeeping Guaranty Seal

CBS-HYTRON
Danvers, Massachusetts
A DIVISION OF
COLUMBIA BROADCASTING SYSTEM, INC.

Giant opportunity field! Join the thousands Coyne Home Training is preparing for success in TV—open the door to big-pay jobs, *or* your own business! Coyne is the oldest, largest, best-known school of its kind—established 1899.

Experts call this the finest home training ever developed—to standards that have made Coyne famous. As result of Coyne's greater background, you learn TV servicing **faster, easier,** learn it **right!** No previous experience or advanced education necessary. **Coyne training includes UHF and COLOR TV.**



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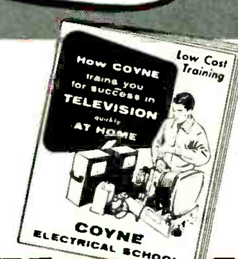

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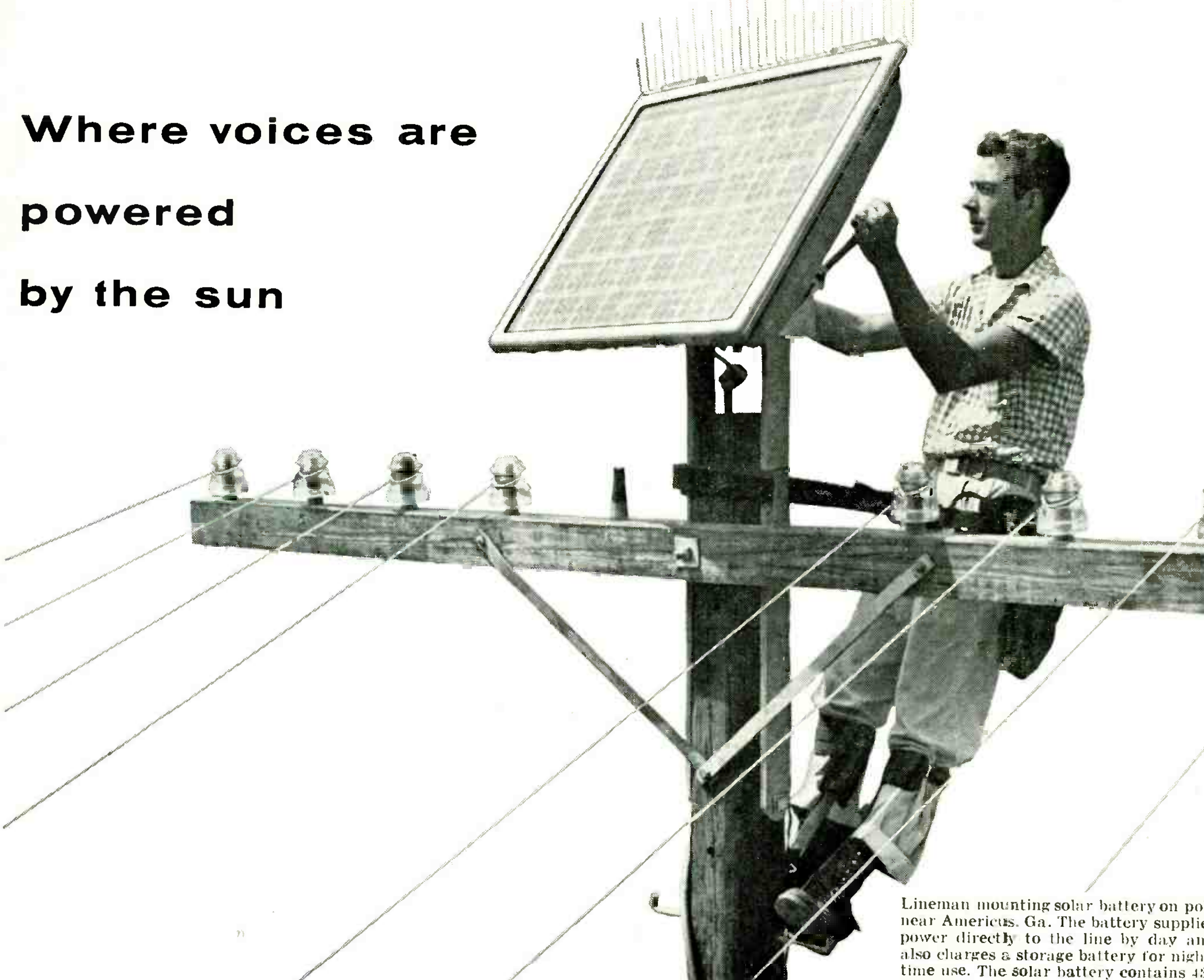
Send FREE Book and details of your Television-Radio-Electronics Home Training offer.

Name ________________

Address ________________

City __________ *State* ________

Where voices are powered by the sun



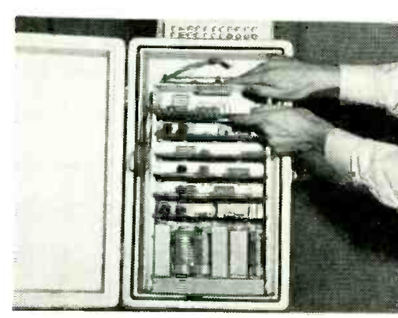
Lineman mounting solar battery on pole near Americus, Ga. The battery supplies power directly to the line by day and also charges a storage battery for night-time use. The solar battery contains 432 specially prepared silicon cells, cushioned in oil and covered by glass.

A new kind of telephone system developed by Bell Telephone Laboratories for rural areas is being operated experimentally by electric current derived from sunlight. Electric current is generated as sunlight falls on the Bell Solar Battery, which a lineman is seen adjusting in position.

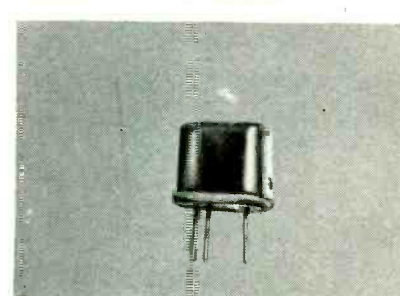
The exciting achievement is made possible by two Laboratories inventions—the solar battery and the transistor. The new system uses transistors to the complete exclusion of electron tubes.

Transistors require little power and this power can be easily supplied by the solar battery.

Compact and economical, the transistorized system can carry several voices simultaneously without interference. It has proved its ruggedness by standing up to heat, cold, rain and lightning. It promises more and improved telephone service for rural areas and it typifies the Laboratories' continuing efforts to make American telephony still better each year.



In sending and receiving terminals, transistors are used as oscillators, amplifiers and regulators, and for signaling.



One of the transistors (actual size) used in the new system. New ideas, new tools, new equipment and new methods had to be developed for this project.

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IMPROVING AMERICA'S TELEPHONE SERVICE PROVIDES CAREERS FOR CREATIVE MEN IN SCIENTIFIC AND TECHNICAL FIELDS everyone's

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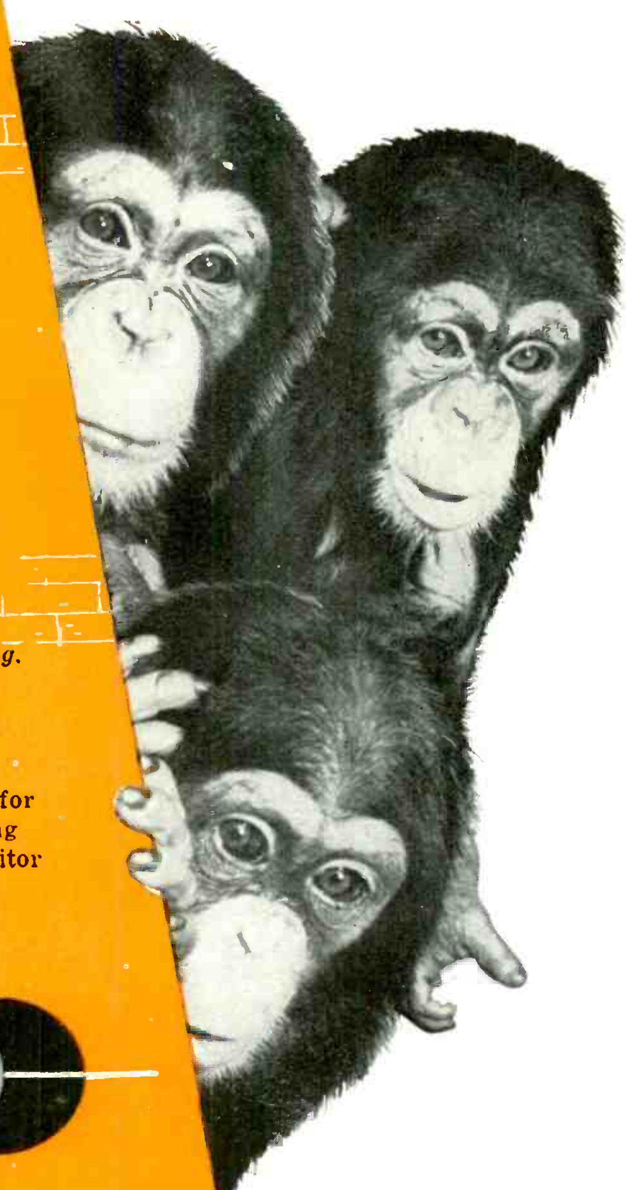
"STAMINIZED"* CAPACITORS!



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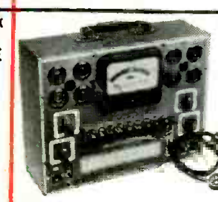

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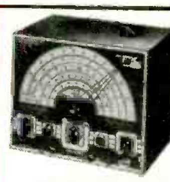

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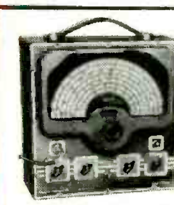

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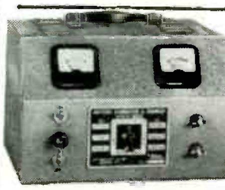

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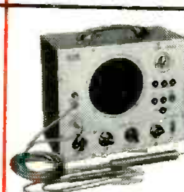

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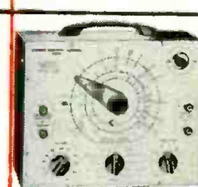

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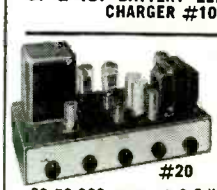

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THE FUTURE OF COLOR TV

...A glimpse and forecast of coming multichrome TV...

COLOR television has been with us for a number of years, most of them spent in the developmental stage. It has been an extraordinarliy difficult and brilliantly conducted engineering and research undertaking on which tens of millions of dollars have been expended by the industry —the lion's share certainly by RCA. 1956 seems to be slated as the first year when color receivers will be manufactured in appreciable quantities.

If no large quantities of color receivers have been manufactured up to now, the reasons are simple to find: 1. The great complexity of the sets and particularly of the color picture tube. 2. The relatively high cost of the receiver compared to black-and-white sets. 3. The scarcity of color programs on the air.

The latter reason is now being rapidly remedied. In late 1955 we already had a number of daily network programs, whereas up to October, 1955, we had only a few programs a week and no day programs.

As of Nov. 1, 1955, there was an average of 11¼ hours of color *network* studio programs per week by NBC and CBS. Of this total NBC accounted for about 10 hours per week, CBS 1¼ hours. Outdoor sports events in color are not included in these figures.

It would seem elementary that even the well-to-do would not rush to buy color sets that would have to stand idle 90% of the week as was the case in early 1955. True, while color receivers are compatible and receive black-and-white programs—or, to be accurate, bluish-black-and-white—an overwhelming percentage of TV color set owners already have black-and-white sets. Hence the color demand is not so acute as it would be if there were no TV receivers. This condition will probably continue for a while *until more people become better acquainted with color*. It is a truism that, once you have watched a color television program for several hours, your black-and-white screen appears drab and takes on qualities of an old Ford Model T.

The evolution of color receivers will parallel that of black-and-white ones in many respects. 1956 will probably *not* be a year of multimillion set sales. Up to now only RCA has made color sets in any sizable quantities. Much of the industry has sat on the sidelines content to let the pioneer take the hot chestnuts from the fire. The exceptions were Westinghouse, Motorola, Raytheon and CBS.

This situation is certain, however, to change drastically, probably before the end of 1956. It has never been the habit of the electronic industry to stay out of a good thing once it has become convinced that good opportunities are in the offing. Already one small manufacturer has announced his intention to produce a "color receiver that *could* retail for $500."—a cut of $200 below the present market. This set would use the Lawrence color picture tube, so far not manufactured in quantities. Even this price will not prevail for perhaps a year or more.

When prices of color sets reach $400 or $350—possibly in 1957 —then we will see production of tens of millions of sets a year. (There are now 40 million black-and-white TV sets in the U. S.)

Another reason why the television industry has not rushed into color-set manufacture is twofold. First there is the great complexity of manufacturing the present-day receiver and the comparative lack of know-how. Secondly, every color set *must* be installed by a factory-trained technician, inasmuch as the average service technician has had practically no experience with color. It will take them time to familiarize themselves with the new required techniques. It could not be otherwise if we reflect that up to Nov. 1, 1955, a total of only 41,500 color receivers had been manufactured. By Jan. 1, 1956, a figure of 51,500 was expected. RCA intends to sell more than 200,000 color sets in 1956.

It may be news to most service technicians that color sets are sensitive to such outside influence as, for instance, the earth's magnetic field. Hence placement of the receiver in the owner's home often poses a problem. So are ghosts much more annoying in color than in black-and-white. The owner, too, must be instructed more thoroughly in color tuning than was the case with black-and-white sets.

All this is to be expected in any new product, particularly in a truly miraculous one like color television, possibly man's greatest electronic technical triumph. We certainly are privileged to live in this age of wonders, and it therefore behooves us to overlook petty flaws.

As time goes on, we know that color television's present complexities will vanish. Already the 1955 color receiver has been simplified. It has only 26 tubes (most of them dual purpose types) against 37 tubes in 1954.

To be sure the picture tube, the heart of color TV, is still and will remain for some years the supreme technical crux. It is here that invention, engineering skill and simplification will cut the Gordian knot of manufacturing and production economics. Small wonder if we remember that today's list price of the 21-inch color tube is $175 against an average of $45 for a black-and-white one.

In the meanwhile, we should not forget that present-day color sets *are* excellent, even if the price is still somewhat high. Nor will it be too easy to buy them in 1956 in many localities. They are certain to be scarce for some time to come, and deliveries will often be slow.

Let us now turn to the future. We may be positive that in years to come a color picture tube will sell for only a fraction of today's cost. In our opinion, the present three-gun tube will not prevail. We may not even use one gun—and we will probably not scan at all the way we do now.

Take the animal eye. Look *steadily* at a color painting on the wall. Your eye does not scan. It uses no three-color "gun." It receives all the colors in the rainbow reflected by light from the picture. These color rays pass through the lens of your eye and are focused on your retina, i.e., the "screen." You perceive colors because of the difference of frequencies of the incoming light rays.

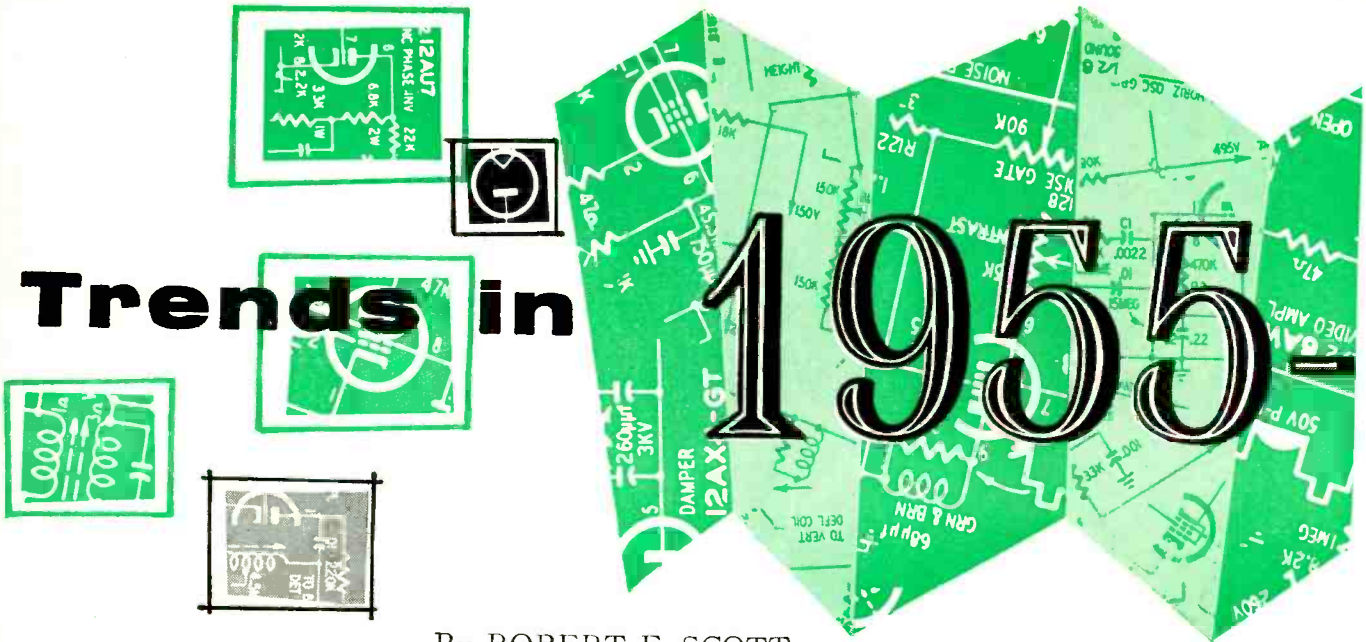
In our opinion it should be possible to eliminate all scanning and even cathode rays, in the manner in which they have been used up to now.

We can imagine a flat rectangular vacuum glass or metal-glass tube 2 to 4 inches thick. The screen on the inside will be covered with a pattern of thousands of phosphors, each of which will react to its selected color of red, green or blue. The phosphor screen is bombarded by electrons from the rear. The high-voltage supply, the sound equipment, etc., remain more or less standard television receiver procedure. The screen now lights up brilliantly and the colors appear on the front of the screen as at present.

There is no actual *direct* scanning inside of the flat picture tube, no moving cathode ray—special electron tubes or transistors do all the work in sequential or pulsing electronic switching.

The above is a rough theoretical outline of a possible future TV color screen. We know it will take many years to perfect it. *But it will come.* —*H. G.*

Trends in 1955-



By ROBERT F. SCOTT
TECHNICAL EDITOR

WE cannot foresee the various circuit innovations and improvements in TV receiver circuitry during 1956 but the chances are good that the new models will be pretty much like those produced during the latter months of the past year. This article describes some of the more novel circuits in late 1955 sets. Whether these circuits are sufficiently important to gain wide acceptance is yet to be seen. But there is always the chance that at least one of them will receive the universal acceptance accorded the flyback transformer, keyed a.g.c. and cascode r.f. amplifier.

Tuners, transformers, tubes and other components will be improved, making it possible to decrease the weight and number of tubes in a set and in some cases reduce the number of controls. For example, a number of recent sets use a high-efficiency flyback transformer and horizontal output circuit that enables the designers to eliminate the horizontal linearity and width controls.

Although many of the better TV sets have, for the last few years, included circuits designed to eliminate or attenuate noise pulses so they will not affect the stability of deflection circuits, the search is still on for simpler and more effective circuits. Usually special noise-cancelling circuits are inserted at a point between the sync take-off and the input to the deflection generators. Recently several manufacturers have developed circuits to attenuate noise in the i.f. circuits. (See "Motorola Frame-Lock Circuit," page 56, November, 1955.)

Crosley attacks noise in both the i.f. and sync circuits. Fig. 1 shows the feedback circuit used to attenuate noise in the i.f. amplifier circuits of the 466 and 467 chassis. Noise pulses appear as amplitude modulation on the video i.f. carrier. This circuit acts as a compressor to clamp the positive half-cycles of the noise signal that are strong enough to drive the grid of the third i.f. amplifier positive.

Fig. 2-a shows the video carrier envelope, with noise pulses superimposed, at the input to the third i.f. amplifier. The first five or six positive half-cycles drive the grid positive. They are rectified and produce negative pulses across the 470-ohm grid resistor (Fig. 1). These pulses are tapped off and fed through the 6.5-μh choke, 0.1-μf capacitor and the 1,500-ohm resistor to the grid of the first i.f. stage. The feedback is so fast that the pulses act as a negative bias that momentarily reduces the gain of the first i.f. stage for the remainder of the noise pulse shown in dashed lines 2-b.

The first few cycles of the noise signal that do get through to the video detector correspond to frequencies above 5 mc so they are greatly attenuated by the bandpass characteristics of the video amplifier and are considerably weaker at the sync take-off point.

Although the noise pulses are clamped at or slightly above the level of the sync tips by the i.f. feedback circuit, some may still get through and cause picture tearing and rolling. Fig. 3 shows the circuit that Crosley uses to immunize the sync circuits further against noise in the 466 and 467 chassis.

A bleeder resistor consisting of R122, R128, R176, R193 and R178 is connected between the 260-volt B-plus line

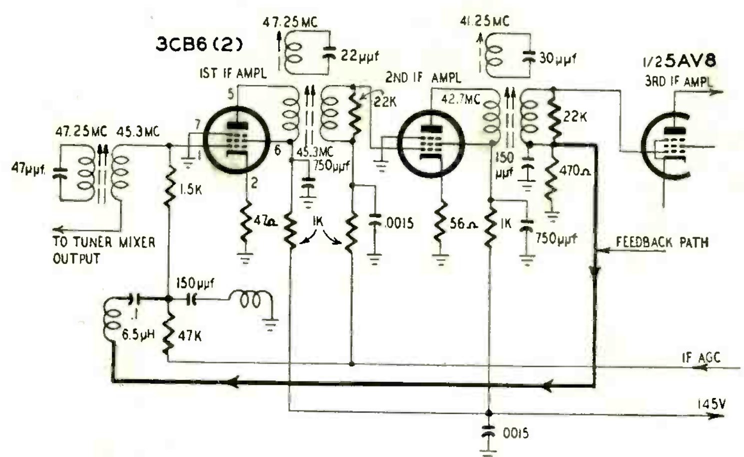


Fig. 1—Schematic of noise attenuator circuit in Crosley 466 and 467 chassis.

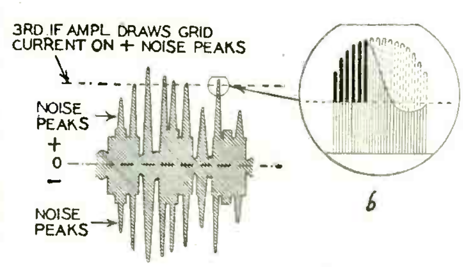


Fig. 2—Noise pulses on carrier signal

56 TV Receivers

and 24 volts negative tapped off the horizontal output tube grid resistor. The grid of the noise inverter tube is tapped on the bleeder at a point that biases it to or slightly below cutoff. The exact bias is determined by R128, the NOISE GATE control. This is set so the noise inverter is cut off for all signals below the sync tips.

The cathode of the noise inverter is fed with negative noise pulses tapped off the video detector load (R118 and R190). Its plate is tied directly to the sync take-off point where noise pulses have positive polarity. When noise pulses arrive simultaneously at cathode and plate, the tube conducts and shorts the positive pulses to ground, preventing their reaching the sync clipper.

The AREA SWITCH varies the overall sensitivity of the receiver for best operation in areas of different signal strengths. In the LOCAL position, the tuner plate voltage is taken off the arm of the LOCAL AREA CONTROL connected as a voltage divider between the 150-volt line and ground. Normally this control is set for maximum voltage and gain. But, when the signals are exceptionally strong, the tuner plate voltage is reduced so a good sharp picture can be obtained without overloading on the area's strongest signal.

When the switch is set to NORMAL, the tuner B plus line is disconnected from the variable 150-volt source and tied directly to the fixed 260-volt line. The sync noise eliminator circuit is disabled in the NORMAL and LOCAL positions of the switch by grounding the junction of R176 and R193 and allowing the noise-inverter grid to rise to cutoff (−24 volts).

In the DISTANT position of this switch, the tuner a.g.c. voltage is reduced approximately one-half and the short is removed from the junction of R176 and R193 to allow the bias on the noise-inverter grid to rise to the normal operating level set by the NOISE GATE.

This control varies the screen voltage on the video amplifier to set the clipping level and simultaneously varies the bias on the noise inverter so it conducts on noise pulses of a predetermined amplitude. The NOISE GATE control is open and out of the circuit when turned to its extreme counterclockwise position. In any other position, it controls the clipping level of the video amplifier and is highly effective in all three position of the AREA SWITCH.

Triode sound i.f. amplifiers

Set manufacturers frequently use a large number of dual-purpose tubes in a TV set to reduce the total number of tubes without impairing performance. In some instances, it is necessary to use a triode in the sound i.f. amplifier circuit. This presents a design problem because a triode will oscillate because of feedback through the grid-plate capacitance when its plate and grid

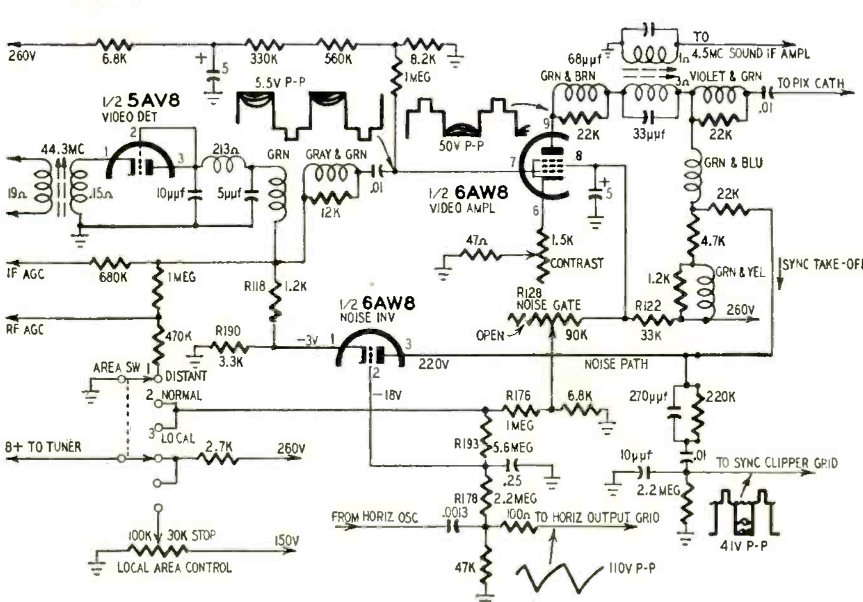


Fig. 3—Schematic of the video and noise inverter circuit in Crosley 466, 467.

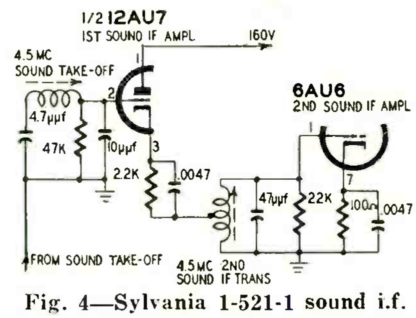


Fig. 4—Sylvania 1-521-1 sound i.f.

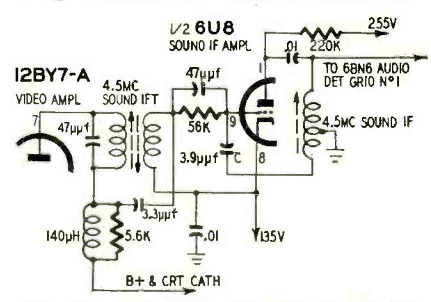


Fig. 5—Capehart CX-38S sound i.f.

are tuned to the same frequency. Fig. 4 shows the triode first sound i.f. amplifier in the Sylvania 1-521-1 chassis. In this circuit the need for neutralization is eliminated by operating the triode as a cathode follower. In the usual cathode follower circuit the output voltage is less than the input. To overcome this, Sylvania uses an autotransformer type second i.f. coil. The signal voltage developed in the cathode circuit appears between the tap and ground. A signal voltage much higher than the input is developed across the entire winding and is fed to the grid of the second i.f. amplifier.

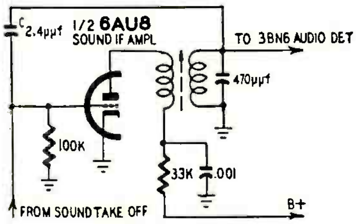


Fig. 6—Zenith T1814R sound i.f.

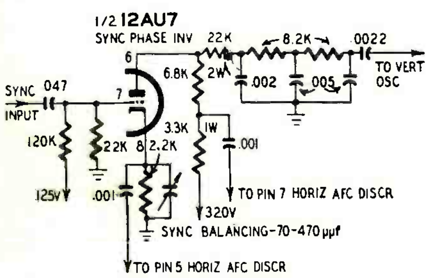


Fig. 7—Sync phase inverter circuit.

Fig. 5 shows the scheme used in the Capehart CX-38S chassis. The 4.5-mc sound i.f. signal is tapped off the plate circuit of the video amplifier by a high-impedance i.f. transformer that also acts as a sound trap in the signal circuit to the picture tube. Maximum transfer of signal to the grid of the first sound i.f. amplifier is provided by capacitive coupling through the 3.3-μf capacitor and magnetic coupling in the transformer.

In this circuit oscillation is prevented by feeding back to the grid, through an external circuit, a voltage equal to and 180° out of phase with that reaching the grid through the grid-plate capacitance of the tube. This neutralizing signal voltage is obtained from one end of the 4.5-mc sound i.f. coil common to the plate circuit of the 6U8 and the grid of the 6BN6 discriminator. Neutralization is obtained by carefully adjusting the value of C and the position of the tap on the coil. (Old-timers will recognize the neutrodyne circuit, so popular in t.r.f. radios 30 years ago.)

The triode section of a 6AU8 is used as the sound i.f. amplifier in the Zenith model T1814R in Fig. 6. Here, the neutralizing voltage is obtained from the secondary of the i.f. transformer. This winding is polarized so the voltage on the grid of the gated-beam discriminator is out of phase with that on the plate of the 6AU8. When the voltages on the primary and secondary are equal, the voltages on the grid are equal and the stage is neutralized when the capacitance of C equals the sum of the stray and internal grid-plate capacitances.

Horizontal sync balance

Positive and negative horizontal sync pulses of equal amplitude are required for proper operation of a horizontal phase detector. Conventionally, the positive pulses are taken from the plate and negative pulses from the cathode of a sync phase inverter or clipper. Vertical sync pulses are also taken from the plate circuit. The frequency responses of the plate and cathode circuits differ because of differences in stray circuit capacitance. This often makes it hard to balance the amplitudes of the sync pulses applied to the phase detector.

If the circuit is adjusted so the horizontal sync pulses balance, the differences in circuit response may unbalance the vertical sync pulses on the phase discriminator diodes and reduce the stability of the horizontal sweep circuit. Sylvania uses two schemes to balance the sync signals fed to the phase detector.

Fig. 7 shows the circuit used in the 1-520 chassis. A 70–470-$\mu\mu$f trimmer capacitor is used in the cathode circuit of the sync phase inverter to improve balance between the positive and negative sync pulses. This capacitor is set to balance the frequency responses of the plate and cathode circuits for equal horizontal pulses.

In some chassis, circuit parameters are such that this particular balancing scheme would result in a larger vertical pulse appearing on one diode of the horizontal phase detector when the horizontal sync pulses are balanced. This would reduce horizontal stability. To eliminate this trouble in the 1-521 chassis, a bifilar-wound transformer is used as a phase inverter in the cathode circuit of the sync clipper (Fig. 8). In this circuit negative sync pulses are taken from the cathode and positive pulses from the secondary of the transformer. Since the impedances of the transformer windings are equal, the negative and positive sync pulses are balanced, regardless of frequency. The transformer has a low Q so the pulses will not cause ringing or oscillation.

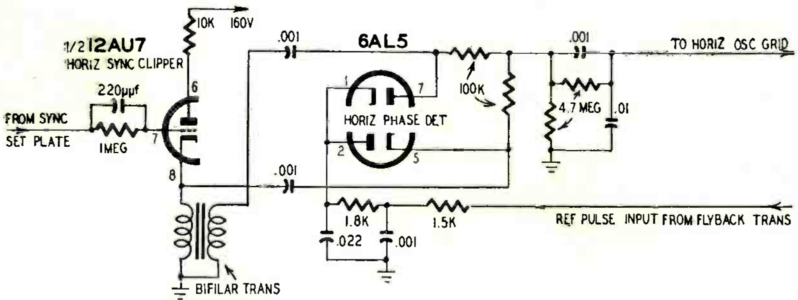


Fig. 8—Horizontal sync clipper and phase detector in Sylvania 1-521.

Beam afterglow

An intense spot of light often appears on the screen of a picture tube when the TV set is turned off. This spot can sometimes cause a permanent stain that looks something like an ion burn. After a set is turned off, the cathodes of the tubes may retain enough heat

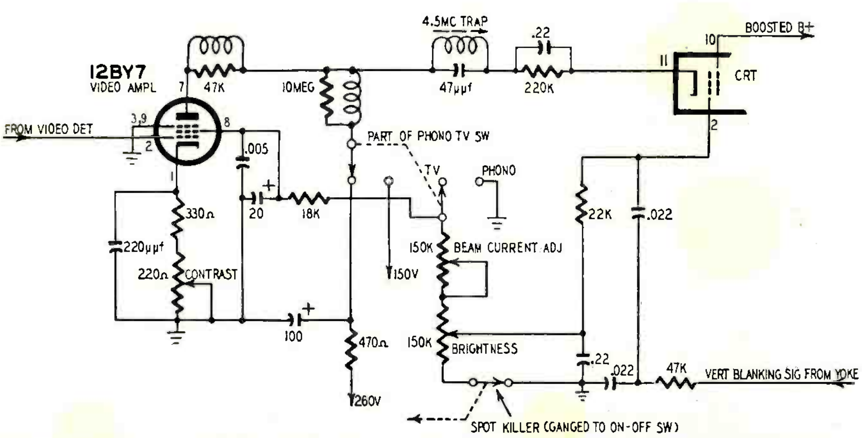


Fig. 9—Video amplifier and picture-tube input of Hoffman Mark V 415, 416.

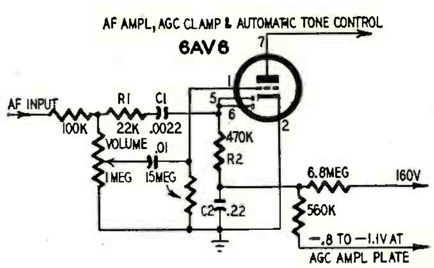


Fig. 10—The Automatic Audio Ranger.

to continue to emit electrons for 30 seconds or longer. The low-voltage filter capacitors discharge almost immediately through the various voltage dividers and bleeders and through the tubes whose cathodes are still emitting.

The high-voltage filter capacitor, usually a 500-$\mu\mu$f unit or the capacitance between the inner and outer Aquadag coatings on the picture tube, can discharge only through stray leakage and the electron beam. The time constant of this circuit is long and the spot remains on the screen until the high-voltage capacitor is discharged to the point where its voltage is not sufficient to attract electrons from the cathode. Whether a TV screen is burned by this spot of light depends on the beam intensity and the time that it remains undeflected. A high-intensity beam can strike the screen for several seconds without damaging it while a much weaker one will burn it if undeflected for a much longer period.

Fig. 9 shows the spot-killer circuit in the Hoffman Mark V 415 and 416 chassis. A switch—ganged to the on-off switch in the power line—is connected between ground and the low end of the brightness control. When this switch is opened, the grid of the picture tube is around 45 volts positive with respect to cathode. This positive grid bias accelerates the residual electron beam and causes a heavy beam current that quickly discharges the high-voltage capacitor. The high beam current does not last long enough to burn the screen.

The beam-current adjustment is another innovation in this receiver. Its purpose is to prevent blooming when the brightness control is advanced. It limits the positive voltage that can be applied to the grid of the picture tube and thus limits the loading on the high-voltage supply when brightness is turned toward maximum.

To adjust this control check the position of the ion-trap magnet, set the brightness control to maximum and then set the beam-current control for the brightest raster without blooming. This control must be readjusted each time the video amplifier, high-voltage rectifier, horizontal output or picture tubes are changed.

Automatic tone control

A high-frequency hiss or frying sound may be heard in the background of a TV receiver's audio channel when the incoming signal is not strong enough to overcome the antenna and circuit noises. To eliminate hiss in some of its chassis, Sylvania uses an automatic high-cut tone control (*Automatic Audio Ranger*) that reduces the high-frequency response of the audio circuit when signal-to-noise ratio is low. This necessarily cuts out some of the higher audio frequencies but results in a sound free from background noise.

The circuit of the *Automatic Audio Ranger* used in the 1-522 chassis is shown in Fig. 10. Fig. 11-a is a conventional high-cut type manual tone control and Fig. 11-b is the basic circuit of the electronic equivalent. In Fig. 11-a high-frequency attenuation increases as the value of R is decreased or the capacitance of C is increased.

In Fig. 11-b, the diode replaces R in Fig. 11-a. The series resistance in the tone control is controlled by varying the conduction in the diode. The diode plate is connected to a voltage divider between the a.g.c. and 160-volt B-plus lines. The circuit values are adjusted so the diode plate is slightly negative when the a.g.c. voltage is low and highly negative when signal strength and a.g.c. voltage are high.

We usually consider a diode cut off when its plate voltage is zero or negative with respect to the cathode. However, this is not the case when the plate is only a few volts negative. In this case, current flow in the tube is due to the high velocity of the electrons leaving the cathode. The graph in Fig. 12 shows the current flow with a low negative voltage on the plate. The straightness of the curve indicates that the internal resistance of the diode is comparatively linear in the negative plate-voltage region.

In the practical circuit (Fig. 10) C1 and the diode (pins 2 and 6) form the high-frequency attenuator. The voltage divider consists of the 6.8-megohm and 560,000-ohm resistors between the B-plus and a.g.c. lines. Since the a.c. signal voltage is applied to the diode plate, the internal resistance will change in step with it. R1 is added in series with C1 to increase the total resistance in the circuit and minimize the effects of resistance change with signal voltage.

If R1 is omitted, the resistance will vary greatly with signal voltage and the high-frequency end of the audio range will be distorted. C2 filters out sync buzz and prevents it from entering the audio circuit through the connection to the a.g.c. line. R2 decouples C2 from the tone-control circuit and prevents it from short-circuiting the audio signal to ground.

Deflection output circuits

The vertical and horizontal output circuits in many receivers have been greatly simplified. Fig. 13 shows the vertical output and oscillator circuit used in the Muntz 474A chassis. Feedback required for oscillation is developed in a special winding on the output transformer. Pulses for blanking vertical retrace lines are tapped off the screen grid and shaped by the .01- and .022-μf capacitors and the 47,000-ohm resistor.

Fig. 14 is the vertical oscillator and output circuit in the Crosley 445 chassis. An autotransformer couples the tube to the yoke. Vertical linearity is improved by negative feedback through the .005-μf capacitor and height control to the grid of the output stage. END

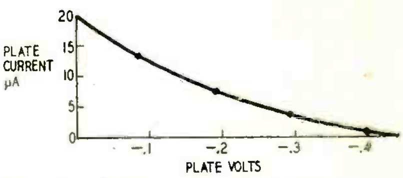


Fig. 12—Diode characteristic curve.

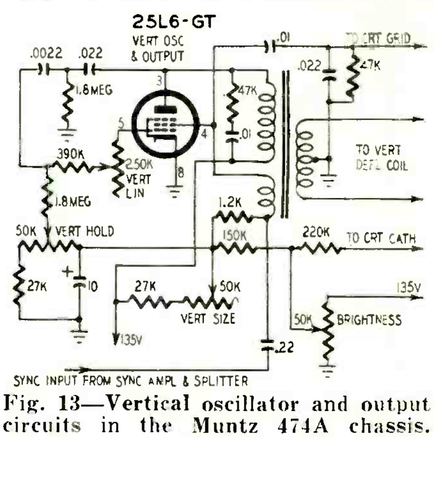


Fig. 13—Vertical oscillator and output circuits in the Muntz 474A chassis.

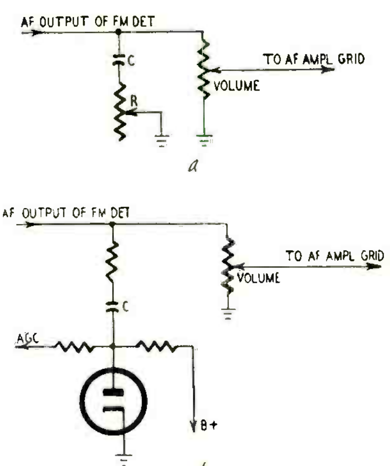


Fig. 11—High-cut tone controls.

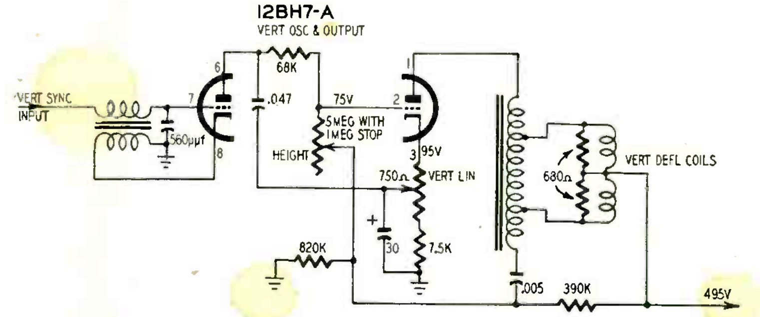
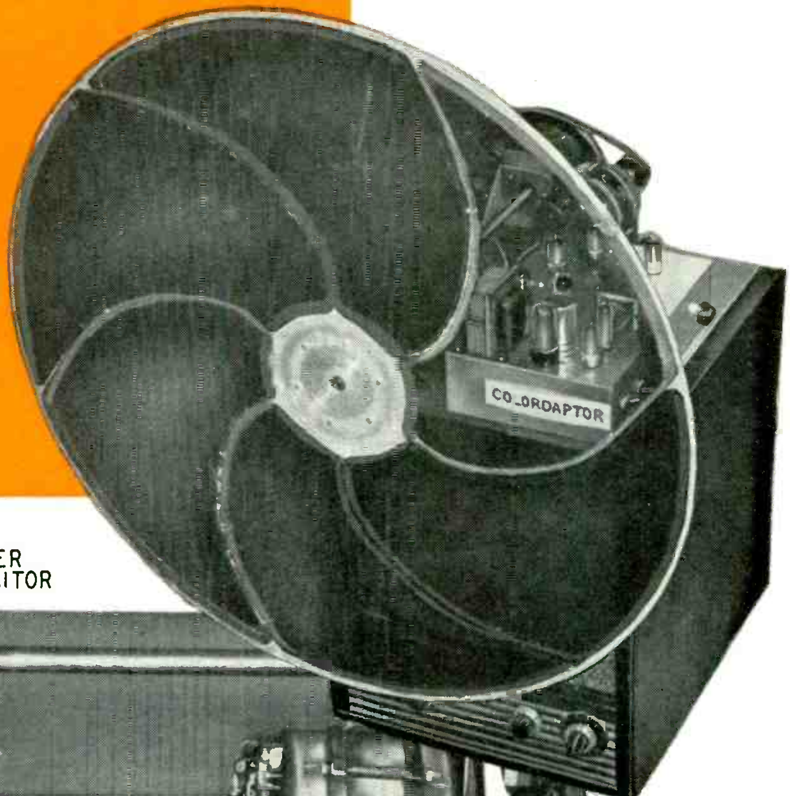


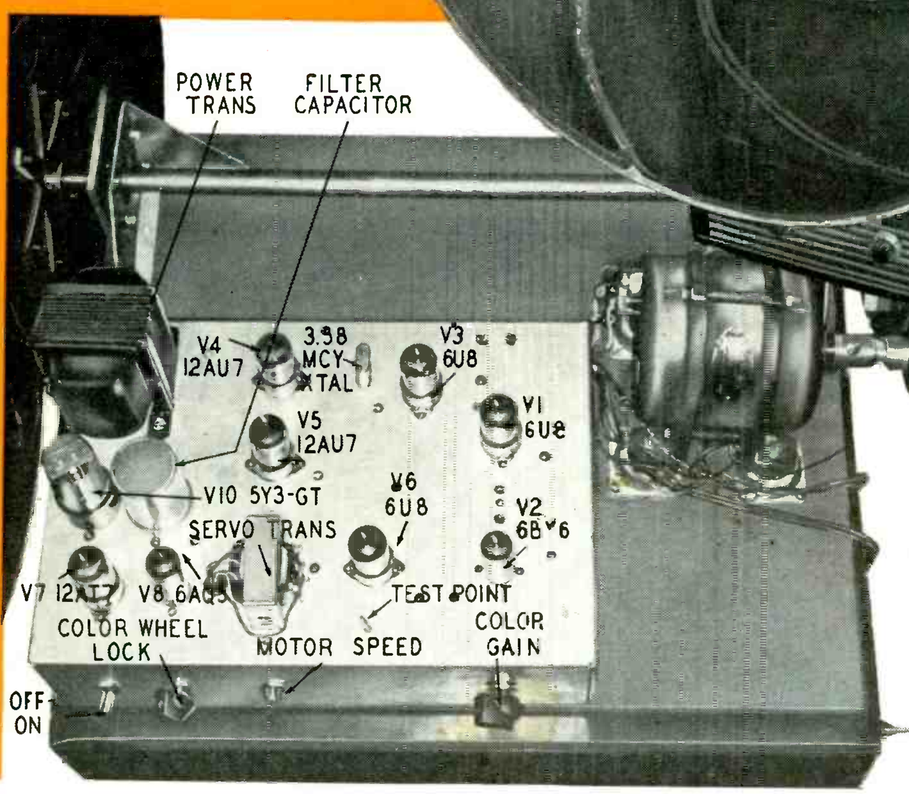
Fig. 14—Vertical oscillator and output circuits in the Crosley 445.

COLORDAPTOR

Part I—Color reception with black-and-white TV receiver for $85 and up—junkbox owner might do it for $50

By PERRY H. VARTANIAN and ROBERT W. DEGRASSE





Above, the complete Colordaptor installed. Left, top view shows major components.

ALTHOUGH rapid advances are being made in commercial color TV, as yet most circuits are complex and require expensive, difficult-to-obtain components such as the tricolor kinescope. For the experimenter interested in color TV, the Colordaptor offers a method of obtaining good color TV from present black-and-white receivers at a minimum of expense and complexity.

The Colordaptor system uses a simple nine-tube circuit and a rotating color wheel to convert any black-and-white TV set to color operation.

The decoder, with only six tubes, is the heart of the Colordaptor system. This circuit converts the NTSC compatible dot sequential color signal, now standard in the United States, into a field sequential signal. This signal is supplied to the black-and-white picture tube and, when viewed through the rotating color wheel, a full color picture results.

The Colordaptor can be built from parts most experimenters have on hand. Tubes are standard receiving types and all the coils may be handwound. The Colordaptor decoder has undergone extensive development to simplify all circuits and remove critical adjustments. The completed system has only two color adjustments, hue and saturation. An r.f. signal generator and a standard volt-ohmmeter are the only test instruments required for alignment.

The color wheel (see photo) is mounted on a removable unit on top of the TV set. The Colordaptor chassis may be permanently attached to the rear of the set since, when left connected, it does not affect normal black-and-white reception. The color wheel may be removed when desired.

The rotating color wheel, when used with standard picture tubes, eliminates the need for an expensive color tube and associated deflection and high-voltage circuits. It is driven with a 1/50- (or less) horsepower motor and is constructed of lightweight materials. A simple two-tube synchronizer circuit locks the color-wheel speed to the TV picture rate automatically.

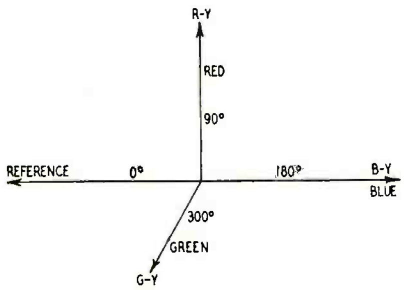
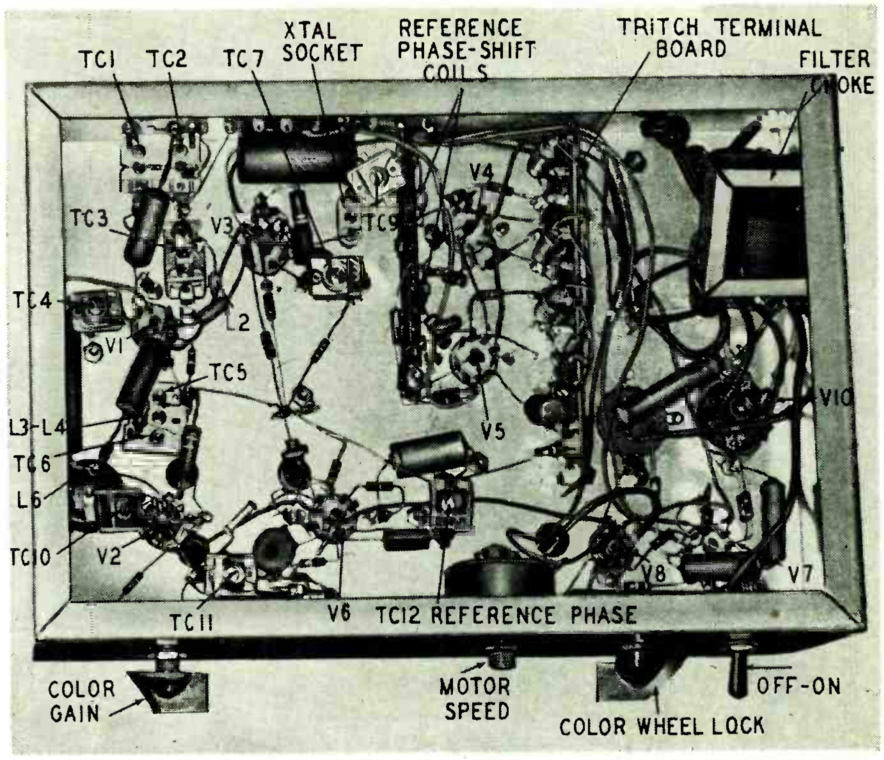


Fig. 1—Demodulator color phases.



Underchassis layout of Colordaptor. TC8 was omitted from this unit.

Numerous articles have described the NTSC compatible color television signal and the reader should be reasonably familiar with its makeup. The color signal is transmitted as sidebands of the 3.58-mc subcarrier. The color information is separated into two parts, hue and saturation. Hue is the color, saturation is the depth or dilution of color, that is, bright red as compared to pink. At the color receiver the hue of the picture is determined by the phase of the received color signal, saturation by the amplitude. The reference phase is transmitted during the horizontal retrace as an eight-cycle burst.

As is shown in Fig. 1, a certain phase angle corresponds to each of the primary colors. That is, 90° from the reference phase is the red information angle, 180° the blue and 300° the green. In the conventional color TV set, two synchronous demodulators are used which measure the amplitudes of two phases 90° apart. The I and Q system is a special choice of demodulation angles which permits a greater color bandwidth to be obtained. The most common system now used is the R − Y B − Y system. All these systems have the common characteristic that there are three color signals being produced at all times.

In the Colordaptor system only one signal at a time is required. When the red filter is in front of the TV tube, the Colordaptor demodulates along the 90° phase, for blue it switches to 180° and for green it switches to 300°. The switching operation continues automatically from red to blue to green and the color wheel is locked in with the switching operation. Consequently, a complete red picture is followed by a complete blue picture and finally a complete green picture. The switch operates at 60 cycles so that a set of three color pictures is produced each 1/20 second. The eye then superimposes these pictures to give the full color effect. That is all there is to the principles of operation of the Colordaptor (Fig. 2) system.

Operation of the Colordaptor

The video is taken off at the second detector and after going through a stage of preamplification (Fig. 3) is fed into high-gain chroma amplifier V1-a. This stage is designed to discriminate against both the low-frequency black-and-white video signal and the high-frequency 4.5-mc sound channel. The output of the chroma amplifier is fed to demodulator V2 and burst gate V3-a. The burst gate is normally biased off until the horizontal sync pulse drives it into conduction. This occurs toward the end of the horizontal flyback which is exactly when the eight cycles of 3.58-mc reference occur. Thus the burst-gate output consists of bursts of 3.58-mc reference signal. The crystal filter with associated V3-b drive tube converts these bursts into CW 3.58-mc r.f. reference voltage.

The reference phase shift network then supplies exactly the correct delay so that reference phases for the three colors, as shown in Fig. 1, are generated and fed into the tritch (tri-stable switch). The tritch, made up of triodes V4-a, -b and V5-a, is essentially a three-position rotary switch "rotating" at 20 cycles. It is triggered among its three stable conditions by the vertical sync pulse via V5-b. The output of the tritch is then 3.58 mc which has a phase of alternately 90°, 180° and 300° relative to the reference signal. After amplification and limiting in reference amplifiers V6-a and V6-b, the tritched reference signal is then applied to V2.

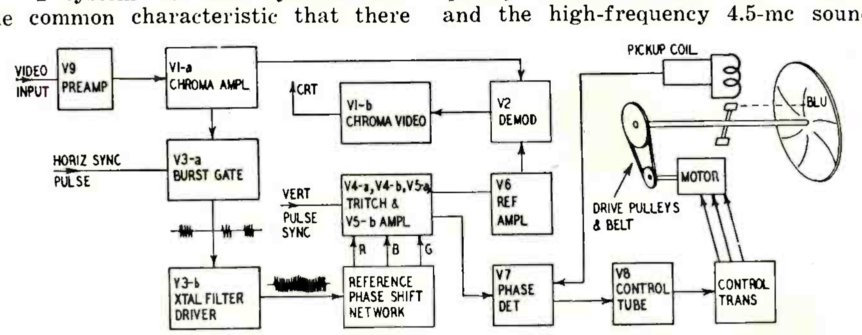


Fig. 2—Block diagram shows circuit distribution in the Colordaptor.

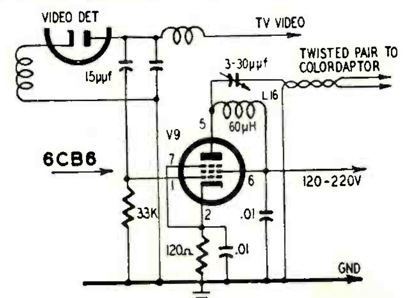


Fig. 3—Schematic of the preamplifier.

COLORDAPTER SCHEMATIC AND CONNECTIONS

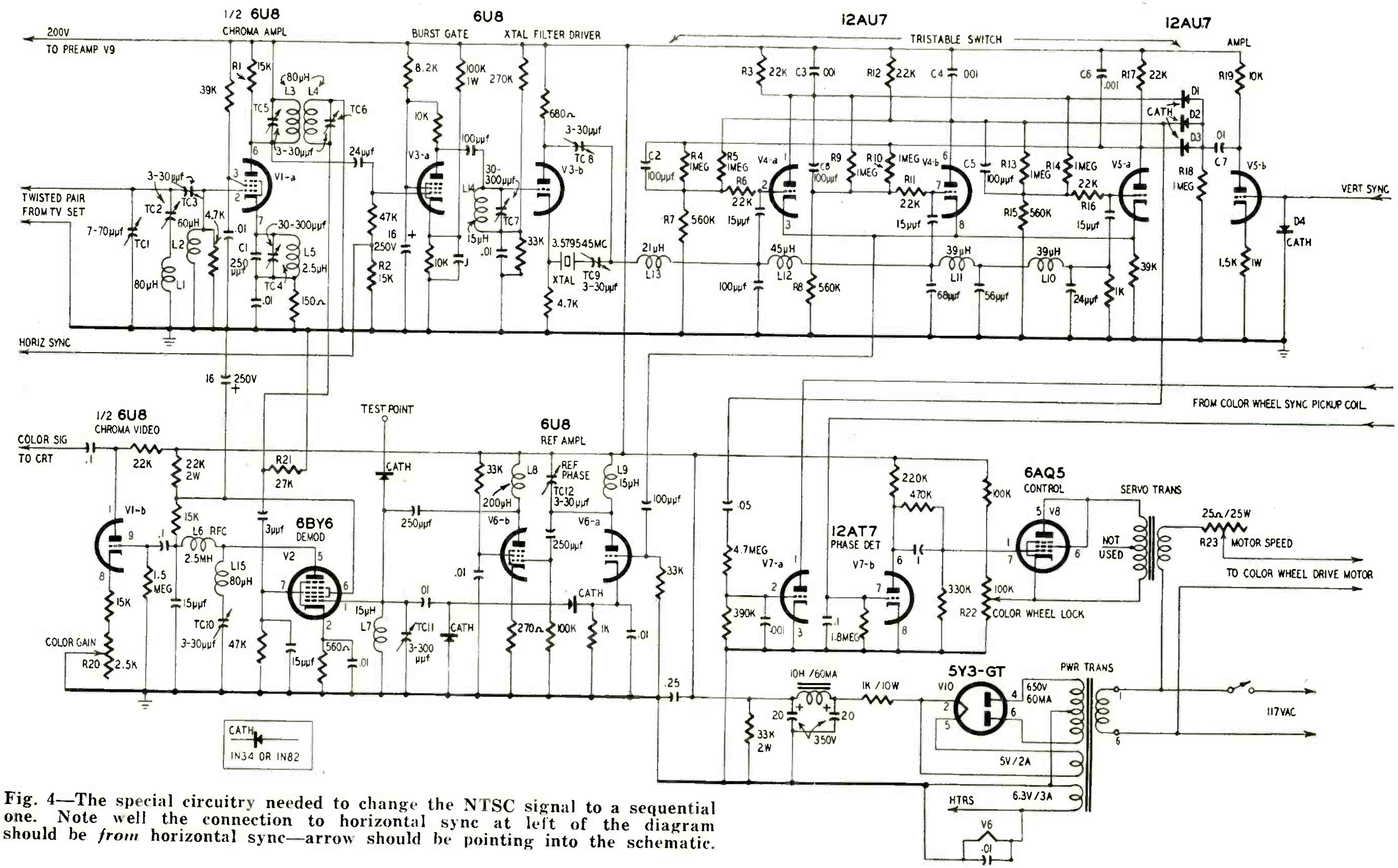


Fig. 4—The special circuitry needed to change the NTSC signal to a sequential one. Note well the connection to horizontal sync at left of the diagram should be *from* horizontal sync—arrow should be pointing into the schematic.

The output of the demodulator is then amplified in V1-b and applied to the picture-tube grid (monochrome video on the cathode) or cathode (monochrome video on the grid).

A delay line is added in the black-and-white video circuit so that the black-and-white and color signals arrive at the picture tube at the same time. Connections are made to the vertical and horizontal sweep circuits to provide synchronizing signals for the Colordaptor.

The color wheel and associated drive mechanism include a small magnetic pickup which gives a voltage pulse once for each set of red, blue and green filters. This synchronizing pulse is compared with the plate waveform of the blue tritch triode and the phase difference detected by V7. The resulting control signal is applied to control tube V8 which in turn controls the motor speed through the control transformer.

Constructing the Colordaptor

Chassis layout is shown in the photos. The circuit is shown in Fig. 4. A 3 x 12 x 8-inch chassis is large enough to hold the entire system including power supply and synchronizer.

A suggested procedure for construction is to locate all socket, transformer and trimmer capacitor holes first. After these are drilled and cleaned, mount all large components in place. Wire the tube heater leads using the chassis as common ground. The heater lead should be bypassed to ground at V6 with a .01-μf capacitor. Using tie points, run a B-plus bus.

Since most of the components associated with V4 and V5 are not critical as to wire lengths it is advisable to mount them on a terminal board (Fig. 5). Then mount the terminal board (see photo).

Mount and wire in place all inductors and trimmers. These should be placed approximately as shown in the photo. The dimensions of the coil forms are given in Fig. 6 and the winding data in the parts list. It is important that L7, L8 and L9 be well separated since oscillation is possible in the high-gain reference amplifier.

For those not wishing to wind their own coils, special machine-wound coils are available in kit form from the Colordaptor Co., 3471 Ramona, Palo Alto, Calif. The 3.58-mc color crystal is also available as well as all other components individually or in complete kit form.

If external controls are desired for the Colordaptor, COLOR GAIN R20 and REFERENCE PHASE TC12 may be located on the TV set front panel. The connection to R20 should be kept away from any high-voltage pulses, but otherwise is not critical as to length. The connection to TC12 may be run through a shielded cable for a length up to about 4 feet. The additional capacitance of the cable reduces the amount of capacitance which must then be added as the reference control. A 100-$\mu\mu$f variable capacitor should be satisfactory.

The connections which attach the Colordaptor to a TV set are shown in Fig. 7. All connections except the twisted pair and the color signal connection to the picture tube may be run in a cable.

The vertical sync pulse required is taken from the grid of the vertical output tube of the TV set. It is a negative pulse of about -10 to -30 volts.

The horizontal sync pulse is taken from the plate of the horizontal output tube. This pulse has a positive amplitude of about 3,000 to 5,000 volts, reduced in amplitude by the divider network to approximately 30 volts. An alternate connection is to wind about 10 turns of wire about the horizontal output transformer core. One side of this winding is grounded at the TV set and the other connected directly to the Colordaptor. The divider is not needed when this is done.

The chroma signal for the Colordaptor is amplified by 6CB6 V9 (Fig. 3). The power for V9 may be obtained either from the Colordaptor or, preferably, from the TV set. The addition of V9 to the set makes it possible for the Colordaptor system to operate from any standard TV since the preamplifier may be adjusted to compensate for insufficient i.f. amplifier bandwidth. The chroma preamplifier 6CB6 can be mounted on the TV chassis or on a bracket near the video detector. The trimmer should be mounted in such a manner that it is accessible for tuning when the chroma amplifiers are to be aligned.

A delay line (Fig. 8) is added to the video amplifier of the TV set in the plate circuit of the output video amplifier. This line has a delay of about 1.3 μsec and an impedance of 5,000 ohms. The delay line winding should be made about 6½ inches long. After the set is operating its length can be trimmed to align the color and black-and-white pictures accurately. Since approximately 113 turns of No. 32 enameled wire occupy 1 inch of winding length, the lathe feed is set for .0039 inch per revolution so the turns tend to overlap and form roughly two layers in a single pass of the lathe. The delay line is also available from the Colordaptor Co.

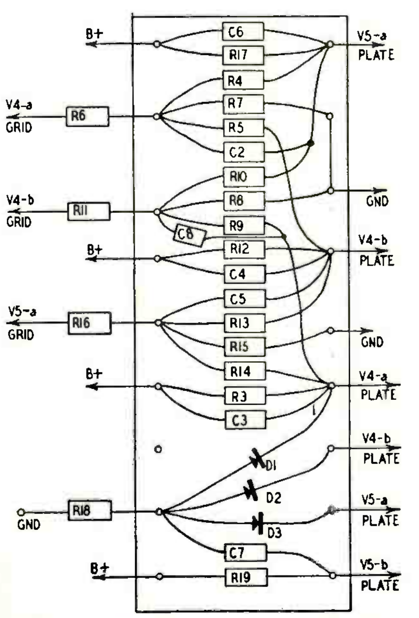


Fig. 5—The tritch terminal board.

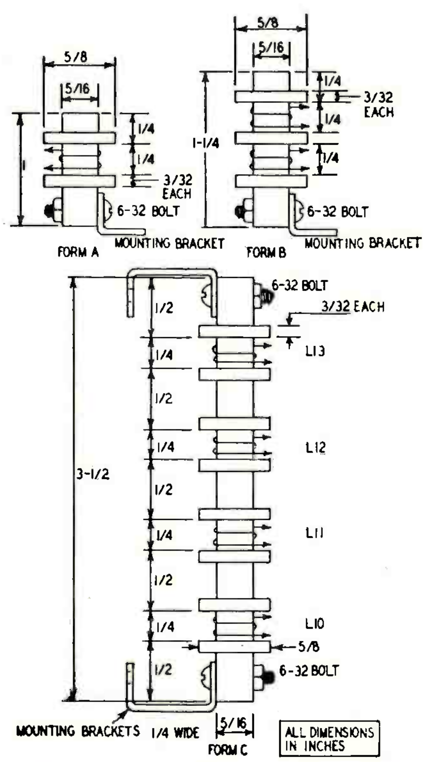


Fig. 6—Dimensions of coil forms.

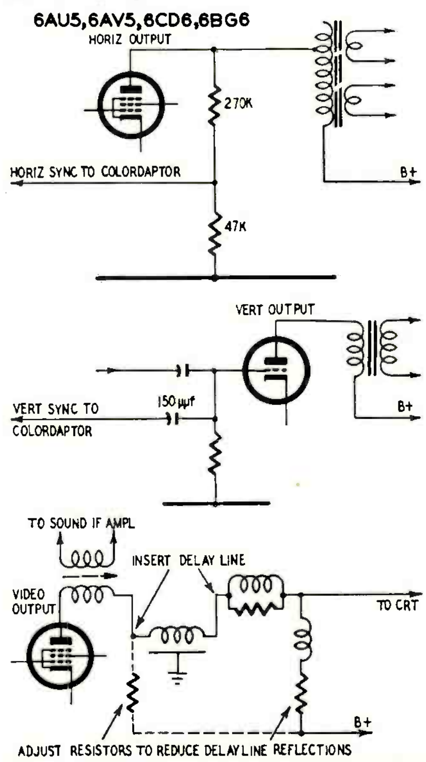


Fig. 7—The diagrams show TV receiver attachments to the Colordaptor.

In addition, vertical and horizontal retrace blanking signals are added, depending on the method of connection of the black-and-white video to the picture tube. The proper retrace connections are shown in Fig. 9. The connections shown in Fig. 9-a apply when the video is on the cathode of the picture tube; Fig. 9-b when the video is on the grid.

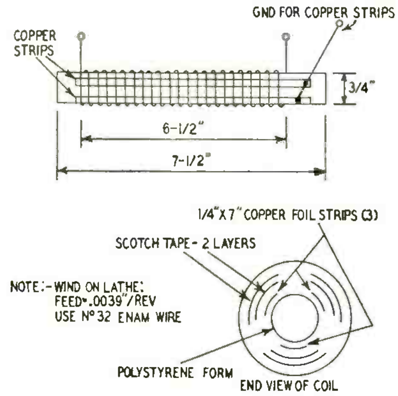


Fig. 8—Construction of delay line.

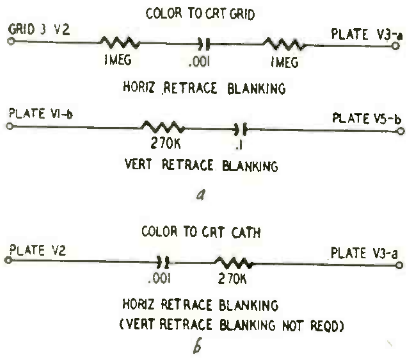


Fig. 9—Retrace blanking circuits.

Next month the color-wheel mechanism and synchronizer will be described, together with alignment and operation data. **TO BE CONTINUED**

Parts for Colordaptor

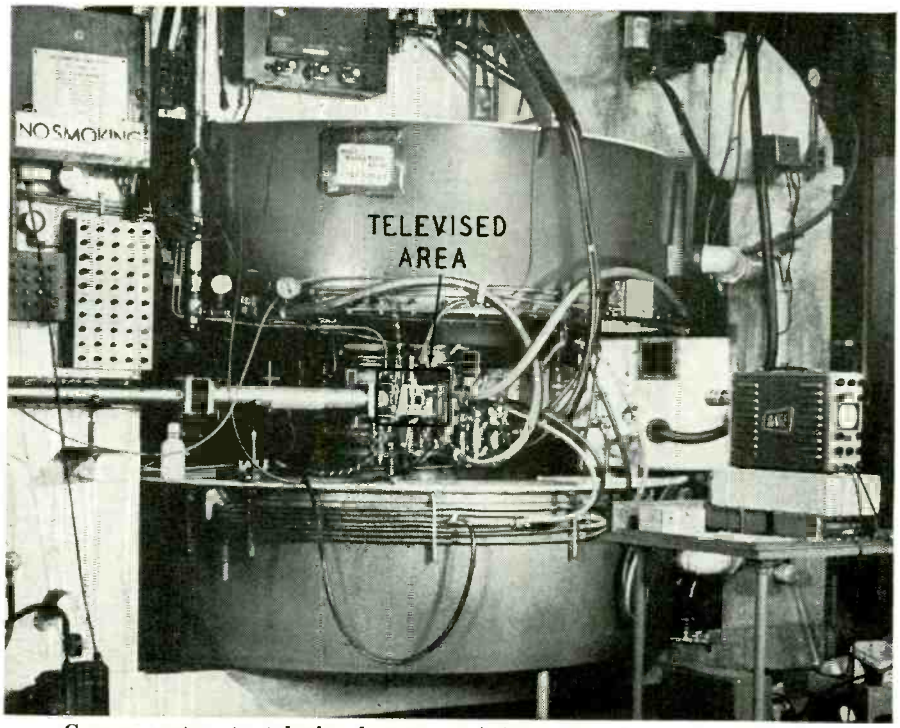
Resistors: 1—120, 1—150, 1—270, 1—560, 1—680, 2—1,000, 2—4,700, 1—8,200, 3—10,000, 4—15,000, 6—22,000, 1—27,000, 4—33,000, 2—39,000, 3—47,000, 2—100,000, 1—220,000, 1—270,000, 1—330,000, 1—390,000, 1—470,000, 3—560,000 ohms, 7—1, 1—1.5, 1—1.8, 1—4.7 megohms, ½ watt; 1—1,500, 1—100,000 ohms, 1 watt; 1—22,000, 1—33,000 ohms, 2 watts; 1—1,000 ohms, 10 watts; 1—25 ohms, 25 watts, potentiometer; 1—2,500 ohms, 1—100,000 ohms, potentiometers.

Capacitors: 1—3, 6—15, 2—24, 1—56, 1—68, 6—100, 1—150, 2—250 μμf; 4—.001, 11—.01, 1—.05, 4—0.1, 1—0.25, 1—1 μf; 2—16 μf, 250 volts, electrolytics; 2—20 μf, 350 volts, electrolytics; 9—3-30, 1—7-70, 5—30-300 μμf (shunt TC4 with 250-μμf capacitor C1).

Coils and transformers: L1, L15—80 μh, 100 turns No. 2-38 or 5-44 litz wire (form A); L2, L16—60 μh, 85 turns No. 2-38 or 5-44 litz wire (form A); L3-L4—80 μh, 100 turns each No. 2-38 or 5-44 litz wire (both on form B); L5—2.5 μh, 12 turns No. 28 enamel wire, ¼-inch diameter form; L6—2.5-mh r.f. choke; L7, L9, L14—15 μh, 40 turns No. 28 enamel wire, ¼-inch diameter form; L8—200-μh peaking coil; L10, L11—39 μh, 64 turns No. 2-38 or 5-44 litz wire (form C); L12—45 μh, 73 turns No. 2-38 or 5-44 litz wire (form C); L13—21 μh, 51 turns No. 2-38 or 5-44 litz wire (form C); 1—power transformer, 650 volts c.t. @ 60 ma, 6.3 volts @ 3 amps, 5 volts @ 2 amps; 1—choke, 10 h @ 60 ma; 1—servo transformer (Stancor A-3852 to be described in following article).

Tubes: 3—6U8, 1—6BY6, 2—12AU7, 1—12AT7, 1—6AQ5, 1—6CB6, 1—5Y3-GT.

Miscellaneous: 5—diodes, 1N34, 1N82 or other general-purpose type; 1—crystal, 3.579545-mc series-resonant type; 1—s.p.s.t. switch; 1—chassis, approximately 3 x 8 x 12 inches; 1—color wheel (to be described in following article); 6—9-pin miniature socket; 2—7-pin miniature socket; 1—octal socket.



Camera setup to televise important information from the cyclotron.

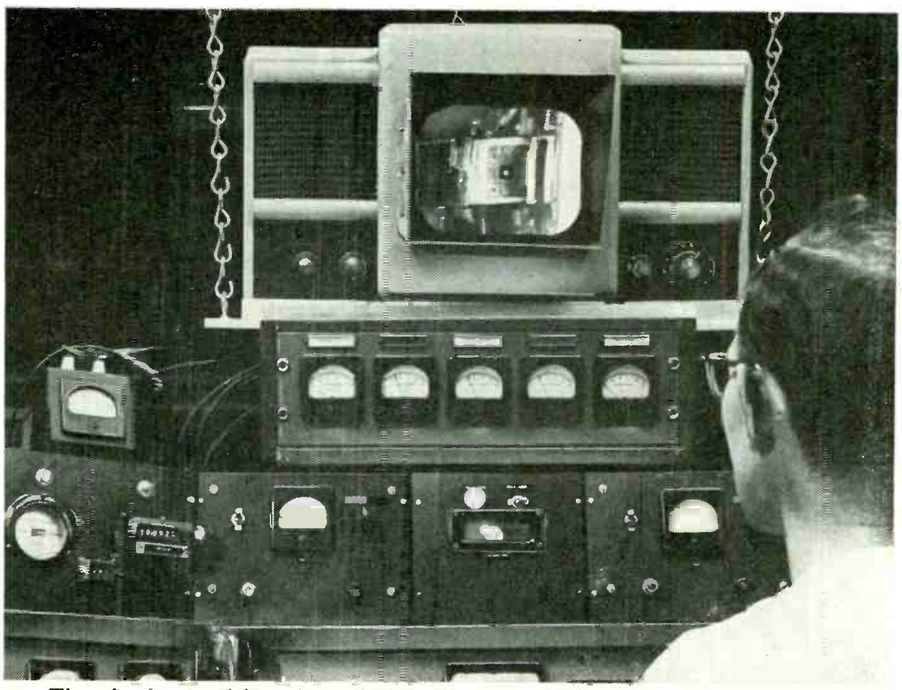
VIEWING CYCLOTRON TARGETS

By A. A. SCHULKE

An unusual application of industrial television has been made at Washington University, St. Louis. A TV camera (see photo) faces the target side of a cyclotron and is focused on the irradiation chamber containing the target. The video output of the camera is coupled to a standard TV receiver (see photo) at the control desk through a single 72-ohm coaxial cable about 180 feet long. The line is tapped at other points for monitors used in different parts of the laboratory.

The camera uses a standard movie camera lens but was equipped with a 3-inch f1.9 telephoto lens to keep it far enough away from the stray field of the cyclotron magnet and still have a close-up view of the target. A magnetic field as weak as 15–20 gausses produced objectionable picture distortion.

Initially, the scientists were concerned that the intense neutron and gamma radation from the cyclotron might cause scintillations in the camera phosphor, but that did not occur.



The viewing position. An ordinary television receiver is used as monitor.

1956
TELEVISION'S YEAR OF DECISION

By DAVID LACHENBRUCH*

TELEVISION ends its first decade of commercial existence with a success story unmatched in any industry. Starting from zero in 1946, in 10 years it has become a major industry. There are now more than 36,000,000 TV sets in the hands of the public, representing a total investment —when you count initial cost, antennas, installation, servicing—of nearly $16,000,000,000. And today well over 90% of the American population is within viewing range of at least one of the nearly 500 television stations.

Impressive as TV's report card is, it's not an all-A average. There have been failures along with the successes. Some important decisions must be made in 1956, and they may determine the extent of American television's future growth. These decisions, which will be made in Washington by the Federal Communications Commission, will directly affect the future character of television, the design of TV sets and the number of channels which will be available in your own home town or city.

This question will challenge the FCC in 1956: Is the television allocation plan a failure? The allocation plan, a blueprint for TV's growth adopted in 1952 after years of study, contains geographical assignments for more than 200 stations on 82 channels. But the rapid growth of new transmitting stations seems to be slowing down to a walk at around the 500-mark. And worse—even during TV's "boom" period, more than 50 stations have been forced to leave the air.

The "good" and "bad" channels

By 1955, it had become obvious that there were "good" and "bad" television channels. A "good" channel is a v.h.f. channel in a market with enough population to support a station of the relatively elaborate design required by the FCC.

Channels 14 to 83 in the ultra-high territory were opened to TV settlement in 1952 because the FCC realized that in television—as in any industry—there must be competition to maintain economic health. It wanted competition between stations and between networks for the viewer's favor, and it wanted to give the viewer a choice between as many channels as possible.

But this competition didn't come, in most areas—because a u.h.f. station just cannot compete with v.h.f. outlets. The public just will not bother to buy converters or new sets to receive the u.h.f. channel. It was the lesson of FM all over again, as John Q. Public demonstrated his distaste for converters, gadgets and extra installation charges. And without the big audiences made possible by mass set circulation, neither the networks nor the advertisers found it profitable to use many of the u.h.f. stations.

There have been some notable exceptions to this rule, however. U.h.f. stations were welcomed by the public wherever there was no v.h.f.—and hence no conversion problem. Some u.h.f. stations have gained a good toehold where they have one v.h.f. competitor. But where there are two or more v.h.f. stations—zowie!

In 1954, 31 ultra-high stations went broke and quit operating; in 1955 about 20 more. Nevertheless, there are still more than 100 u.h.f. outlets on the air. A recent FCC study found only 18 of these operating at a consistent profit, most of them in areas without any v.h.f. stations.

Should u.h.f. be encouraged or abandoned? Is there an available substitute for u.h.f. or is time the only cure for television's biggest headache? No one has come up with an answer.

Congress, RETMA & FCC

The problem is being tackled at three different levels. The FCC has asked for industry's advice on whether to scrap the old allocation plan and substitute a new one. With the FCC's blessing, the Radio-Electronics-Television Manufacturers Association set up its Frequency Allocation Study Committee to investigate the whole allocations situation and advise the FCC. In a preliminary report, RETMA's study committee urged the commission to save u.h.f. and refuse to scrap the allocation plan. Serving on this committee are seven top executives of TV transmitter and receiver manufacturers, under the chairmanship of General Electric's electronics vice president, Dr. W. R. G. Baker. He is known for his work as chairman of the first and second National Television System Committees, which devised the present standards for both black-and-white and color TV.

Attacking the problem from the engineering standjoint is the Allocations Engineering Study Committee, headed by Prof. Edward Bowles of MIT and comprising the industry's top engineers. This committee was established by Senator Warren G. Magnuson, chairman of the Senate Interstate and Foreign Commerce Committee. He has promised full-scale hearings on allocations early in 1956.

While a number of proposed solutions have been advanced, they all boil down to three basic plans. The FCC must choose between them or perhaps select a combination. Each has its drawbacks.

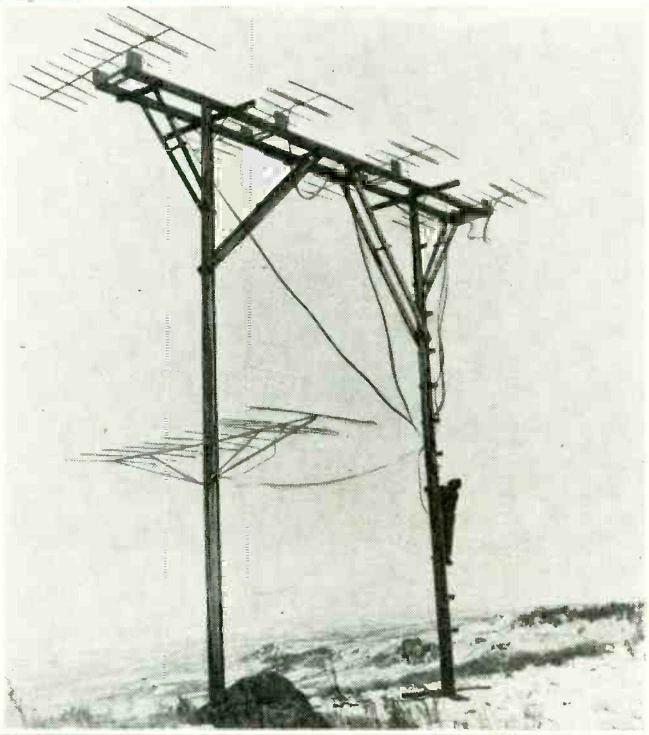
Solution by "de-intermixture"

Proponents of "de-intermixture" point out that there's nothing wrong with u.h.f. except when it's placed in *direct competition* with v.h.f. Their proposal: Rejigger the allocation plan so that each market is either all u.h.f. or all v.h.f.

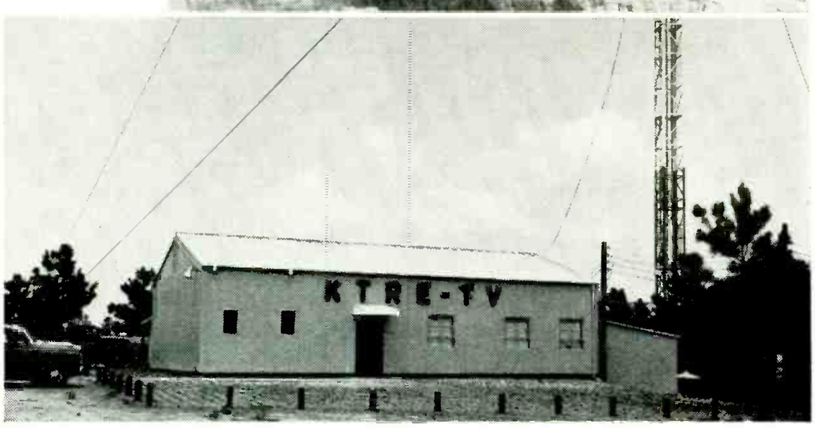
Opponents of this proposal say that to be effective it would require a completely new allocation plan, with tremendous expense to the public and to existing stations—and that even then it wouldn't work very well, because there will always be areas where high-

*Associate editor, *Television Digest With Electronic Reports*

This unlicensed booster serves Bridgeport, Wash. Note complete transmitter on pole.



This array of Yagis cut to Spokane's frequency feeds illegal booster transmitter.



KTRE-TV, channel 9 Lufkin, Tex., one of the country's most elaborate repeaters. A satellite of KPRC-TV of Houston, its power is 25 kw, antenna height 540 feet.

powered v.h.f. signals will come barging into "u.h.f.-only" territories. For example: Though Allentown, Pa., might be a "u.h.f.-only" area, a good signal from "v.h.f.-only" Philadelphia could easily be received there.

The FCC has already rejected all pending petitions to "de-intermix" individual areas, insisting that de-intermixture should not be attempted on a piecemeal basis.

New v.h.f. channels?

Another school of thought—which has two of the seven FCC commissioners as adherents—argues that the only long-term solution is to abandon u.h.f. and get hold of more v.h.f. channels. They would pick up part of the spectrum immediately above channel 13, and carve out anywhere from 12 to 40 new v.h.f. channels. They argue that this band is largely occupied by Government and public service radio, much of which could be moved to the u.h.f. band.

Experts on military radio say this plan is doomed. FCC has no direct control over Government use of the radio spectrum and it is almost inconceivable that the Armed Forces would let go of their v.h.f. channels, which are becoming increasingly useful to national defense as a result of the development of new ultra-reliable long-distance v.h.f. radio communications techniques. Another strong argument against the "new channels" plan is that it would have the same major drawback as u.h.f.: existing receivers would have to be converted to get the new television channels.

Nevertheless, leaving no stone unturned, the FCC has already asked the Office of Defense Mobilization how many v.h.f. channels the military can spare—if any.

A proposal which has gained some favor recently is the "v.h.f. drop-in" or "shoe-horn" plan. This would involve putting more stations on the current 12 v.h.f. channels, squeezing them into locations where they are not now assigned. To minimize interference with existing stations, the "drop-ins" would be forced to use low power, directional antennas and perhaps vertical antenna polarization. Existing v.h.f. outlets wouldn't be changed, but existing u.h.f. stations might be given first priority on the new v.h.f. "shoe-horn" assignments.

Some drawbacks are apparent in this plan, too. It would almost certainly mean writing off u.h.f. as dead. Stations on the same channel would be located nearer to each other than at present—and there would be an interference problem. There still would be no equality among stations, since the newer "dropped-in" stations would be limited to powers as low as 5 kw, while the older outlets could continue at maximum power. But perhaps the plan's biggest deficiency is that it wouldn't provide enough channels to give most viewers a choice between three different stations.

Boosters and satellites

As a partial answer to the problems of u.h.f. and the demand for television service in areas too small to support full-fledged stations, the FCC in 1955 paved the way for small "repeater" stations which can be set up for a fraction of the cost of a complete TV station.

For the first time, it authorized "satellite" stations—outlets which don't have their own studios but pick up the signals of a "mother" station and rebroadcast them on another channel at effective radiated powers as low as 100 watts. Satellites are now permitted on both the v.h.f. and u.h.f. bands. A handful have already gone on the air in relatively sparsely settled areas. A slow but steady increase in satellites may account for the larger part of TV station expansion in 1956.

An even less expensive type of repeater service has been proposed by the FCC and may be inaugurated within the next few months. This is the "booster station" or "amplifying transmitter," which rebroadcasts on the same frequency as the mother station (see "Booster Transmitter Increases TV Station Range" RADIO-ELECTRONICS, January, 1954). To help u.h.f. stations, the FCC has proposed that boosters be used to fill in holes and shadow areas within normal coverage circles of u.h.f. outlets only.

Boosters and satellites may be the key to a new TV expansion boom—into the smaller towns. A complete booster station will sell for as little as $12,500, as compared to about $100,000 for a not-very-elaborate full-fledged TV station equipped with studio, live cameras, etc.

One leading manufacturer estimates that nearly 1,400 low-power repeaters may be built in the next five years—including 375 satellites with powers up to 10 kw or more, 600 of 100–200 watts, and another 140 low-powered boosters.

"Unlicensed radiator" headache

There's no question that low-priced and low-powered boosters have a tremendous potential. Proof is easily found in the epidemic of "unlicensed radiators," which have sprung up in the far Northwest. Though the FCC has tried to crack down on these tiny TV boosters, they continue to multiply like rabbits—and it's a good guess that there are now as many as 200 of them in operation in Washington and Oregon alone.

A typical illegal booster might be found on a hilltop near a small isolated town and might consist of a Yagi receiving antenna, a small low-power transmitter (often less than 1 watt and of the type used by wired community TV systems) and a transmitting antenna—just enough to pull the signal over the mountain top and aim it at town. They operate completely unattended.

Their origin is in the desire of people in small and remote communities to have television. They are generally operated by public-spirited citizens; often they are financed by community subscription.

So important have these "TV coffeepots" become that Senators and Congressmen from the far Northwest are spearheading a drive to legalize them. The FCC argues, however, that these stations can't be licensed because they are operating on frequencies not allocated to their areas, they may be causing interference to other radio services and they don't conform to the high engineering standards required of TV stations.

Pay-as-you-see television

The FCC is determined to try to cure its allocation headache before it gets around to such issues as subscription television—which, despite heavy publicity, isn't considered a particularly pressing item on the agenda. But because the whole idea of fee TV is highly controversial, it may well be decided in Congress rather than by the FCC. At any rate, this issue isn't likely to be decided this year.

A colorful 1956

Though allocations problems may well slow down television's expansion into new outlets in 1956, another dimension of expansion will be just beginning. After several false starts, color TV may really begin to roll by the end of the year.

More than 75% of the population is now within range of a color TV signal, and the networks are providing more than two hours of color programming a day. This should be enough to spur the traditional American demand for something better.

The high price tag on color sets is the major barrier. While sales of color sets in 1956 won't be impressive except by comparison with 1955, they will be sufficient to make possible real mass production. As a result, prices of color receivers should drop to more realistic levels in 1957.

As 1955 closes and 1956 begins, television's biggest problems rest squarely on the shoulders of the FCC. The industry's past has been impressive and its future looks colorful. But the pattern of television's expansion into a multiple-channel service for all the towns and villages of America is due to be determined in 1956 by the regulators in Washington. END

UNUSUAL SYNC TROUBLE

THE set was a Motorola TS88. The owner phoned and said that his set worked well except for the picture tube going blank intermittently. This would occur once or twice an evening for a period of about 30 seconds. All horizontal sweep circuit tubes were replaced, including the damper and high-voltage rectifier. A few days later the owner reported the same trouble, and the set was removed to the shop.

Routine voltage measurements revealed nothing out of the ordinary. The set was allowed to run, and the next day the screen went blank. Touching the cap of the 1B3 indicated very little high voltage, and before any other checks could be made the picture returned. At least, this ruled out an intermittent picture tube.

I then checked the voltage at the grid of the 6BQ6—it matched that indicated in the service information. A few minutes later the trouble recurred and I noticed the 6BQ6 grid voltage increased (became more negative) 8 volts while the screen and cathode voltages remained normal. I suspected the trouble might be in the flyback transformer. This was replaced and a careful check was made of the deflection yoke and its associated components. The set played 2 days and then it happened again.

Deciding to move the chassis to the work bench, I removed the antenna—instantly the picture appeared. I then connected the antenna and the picture disappeared. As I repeated this procedure several times, the picture came on and off as if controlled by a switch.

Fortunately, this time the intermittent lasted for a few minutes, long enough to determine that, when the set was tuned to an unused channel, the picture would appear; when tuned to an active channel, the screen would go blank. Since the trouble occurred with a signal, it appeared that the sync circuit might be affecting the horizontal oscillator.

A scope was placed at the grid of the 6BQ6 with the antenna connected. Picture and waveform were normal. When the intermittent occurred, the horizontal sweep frequency rose to about three times its normal rate; switching to an unused channel restored normal waveform. It was apparent that the defect was in or applied to the horizontal oscillator.

This set uses a 6AL5 phase detector. The scope was applied to pins 5 and 7—only one had the sync signal. I then checked the plate and cathode of the preceding sync splitter—both had sync signals. The trouble had been found. The coupling capacitors from the sync splitter to the phase detector were replaced and the picture was perfect.

Out of curiosity, the capacitors were tested on a capacitor bridge. They checked very well except one would cause the 6E5 "eye" to flicker occasionally. The increase in horizontal frequency was so great that the flyback transformer functioned poorly, developing very little high voltage. Had I observed the grid of the 6BQ6 with a scope instead of making voltage measurements with a v.t.v.m., a great deal of time would have been saved.—*Henry S. Connolly*

new "rainbow" tuner

Circuitry and analysis of Standard Coil's new color TV tuner

By E. D. LUCAS, Jr.

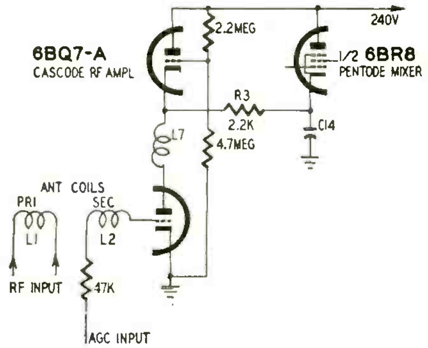


Fig. 1—Simplified schematic diagram of the Standard Coil Rainbow tuner.

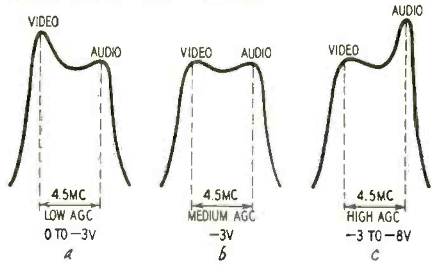


Fig. 2—Diagram shows the tilt characteristics of earlier tuner designs.

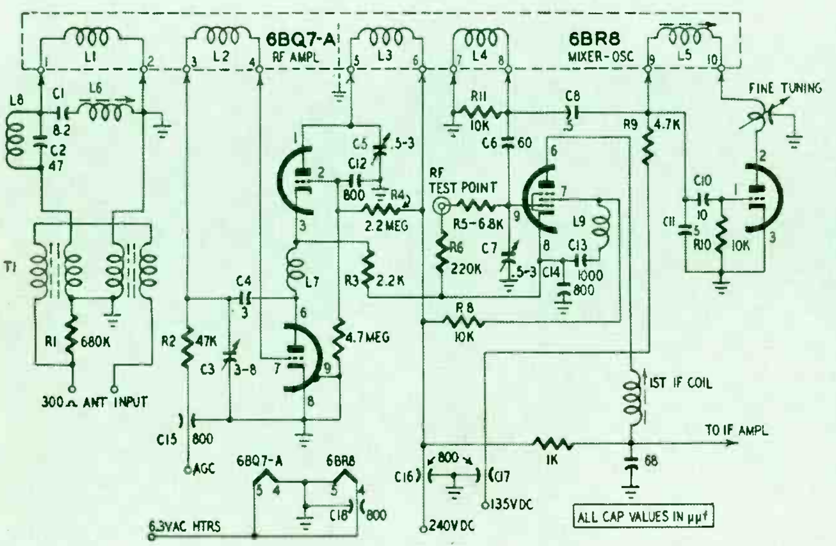


Fig. 3—Schematic diagram of the Standard Coil type TD-B Rainbow tuner.

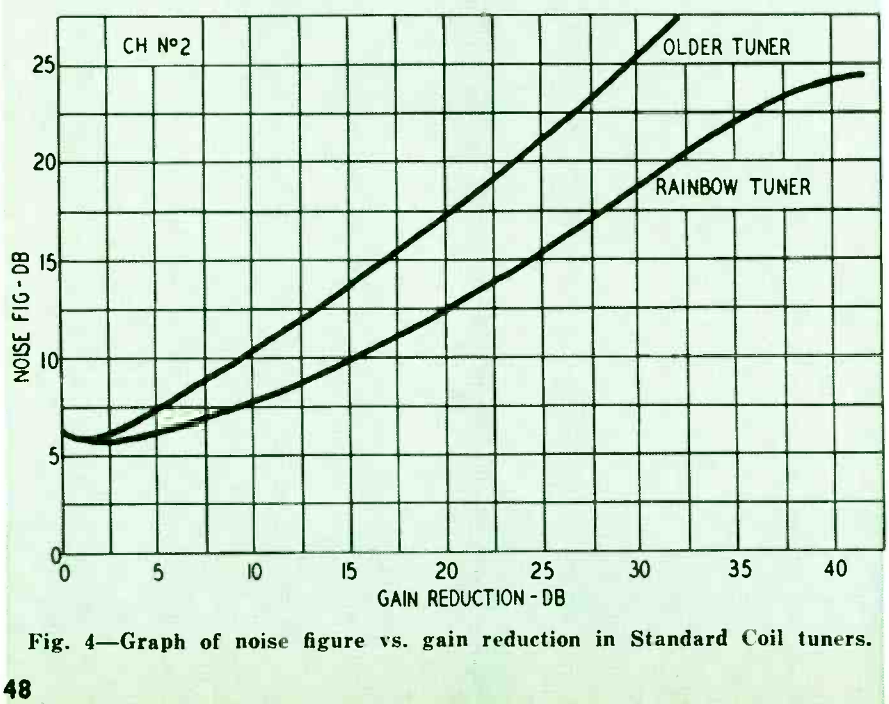


Fig. 4—Graph of noise figure vs. gain reduction in Standard Coil tuners.

FRONT ends of television receivers have long been identified by colorful code names both within the industry and in consumer advertising. Thus it is no surprise that Standard Coil Products should introduce a new TV tuner called the "Rainbow."

What is surprising is that just one simple refinement in the well known cascode tuner circuitry should achieve such notable improvements in performance. There are many engineering advances in the Rainbow design. But the major feature is a novel circuit which ties the cathode of the second triode of the cascode amplifier to the cathode of the pentode mixer stage (Fig. 1) so that the two stages operate in parallel so far as d.c. level is concerned and in series with the first input triode of the 6BQ7-A cascode amplifier. As a result, a.g.c. applied directly to the grid of this first triode is also applied indirectly to both the second triode and to the mixer.

The r.f. signal input from the secondary of the antenna coil strip (L2) and the a.g.c. voltage are both applied to the grid of the first triode. As the amount of a.g.c. voltage is increased, over a range from about 0 to −8 volts, the plate voltage of this triode rises while the amplification or gain of this stage is reduced. Since this first triode plate is tied through L7 to the cathode of the second cascode triode and thence through R3 to the cathode of the pentode mixer section of the 6BR8, the two cathodes will also rise in voltage. Consequently the voltage across both the second triode and the pentode will be reduced and the gain of these two stages lowered in proportion.

Thus the basic advances in the Rainbow circuitry consist of relatively simple modifications which result in the indirect application of a.g.c. voltage for gain reduction of both the second cascode stage and the mixer.

Advantages of new circuit

1. Improved tilt characteristic over the entire a.g.c. range. Fig. 2 shows typical response curves of previous

tuner designs. With a low level of a.g.c. signal, less than −3 volts, there has been a tendency to peak the video carrier as indicated by the left hump of Fig. 2-a. At the typical alignment bias level of −3 volts there is the desired response characteristic (Fig. 2-b) with two minor peaks for video and audio carriers. Still higher a.g.c. voltage has produced a response like that of Fig. 2-c where there is a marked tilt at the audio end of the curve.

Specifications of color TV receivers require that the amount of tilt be held to within ±15% over the entire range of a.g.c. voltages. As indicated in Fig. 2 conventional tuner designs have met this specification only in the middle of the a.g.c. range, with resulting deterioration of color reception in areas having either very strong (maximum a.g.c.) or weak (minimum a.g.c.) signals.

The Rainbow circuit limits tilt with bias so that the response curve is maintained well within the required 15% limits. This is accomplished because the new circuit maintains better loading on the first triode grid over the full a.g.c. bias range. Thus, the frequency of the first tuned circuit is not shifted nearly as much as in previous cascode or pentode circuits.

While the Rainbow circuit is among the first to meet the frequency response requirements of good color TV reception, it also has advantages in black-and-white reception, especially where there are wide variations in signal level.

2. Improved voltage standing wave ratio vs. a.g.c. Maintaining a low v.s.w.r. is important; particularly in color reception. Installations with long antenna lead-ins often make the problem of receiving acceptable color pictures acute, since the bandpass characteristics of the receiver's front end may be badly distorted by reflections.

A separate antenna primary coil L1 is tuned for minimum v.s.w.r. and noise. As shown on the detailed schematic (Fig. 3) separate primary and secondary antenna coils L1 and L2 are used and the loading is increased by 47,000-ohm damping resistor R2. Another achievement is maintenance of better v.s.w.r. with high, medium and low a.g.c. bias.

Tests indicate that the v.s.w.r. of the new design does not exceed 3 to 1 at any a.g.c. bias, while at most signal levels the ratio is no greater than 2.5 to 1. This is helpful not only in maintaining good response to color signals but also in eliminating the smear often apparent in black-and-white reception with changes in signal strength.

3. Improved noise figure vs. gain reduction. This measurement of a tuner's performance is considered by leading engineers to represent a better yardstick than the more frequently used criterion of noise figure vs. a.g.c. The novel a.g.c. circuit in the new Rainbow makes possible lower noise values as the bias increases. With conventional a.g.c. action it has been apparent in cases where the r.f. signal input level was 500 to 1,000 microvolts, for example, that the noise figure of the tuner has increased too rapidly as more a.g.c. is applied—that is, under typical conditions where signal levels are fluctuating and stronger signals result in the appearance of more noise while increased a.g.c. voltage is applied. The Rainbow circuit, by applying a.g.c. not only to the first cascode triode but also indirectly to the second cascode stage and the mixer, limits the noise level so that the noise figure does not rise nearly as rapidly with gain reduction as in previous tuners. (See Figs. 4 and 5.)

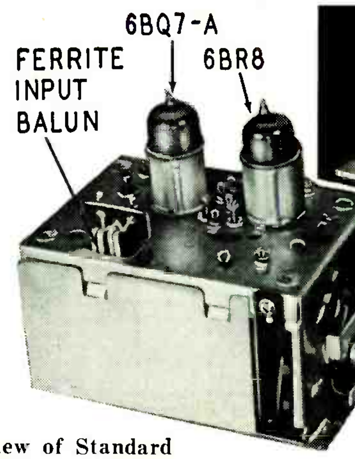
This advance helps produce cleaner pictures in both black-and-white and color, except possibly in deep fringe areas.

4. Improved a.g.c. characteristic and much higher maximum gain reduction. With TV stations increasing their effective radiated power, one problem in receiver design has been to maintain good reception characteristics where the signals are extremely strong. Expressed somewhat differently, while TV reception has been pushed out into fringe areas, much emphasis has been on increased sensitivity, high gain and low noise of the receiver front end. Now the same tuner must be capable of handling very high signal levels for receivers close to transmitters which have stepped up their power.

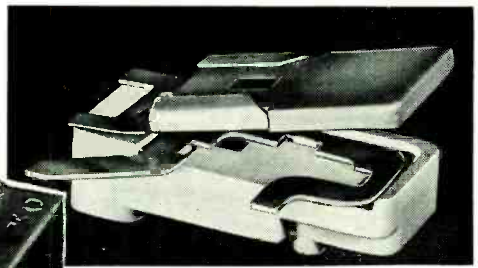
Previous tuners have been able to produce a maximum gain reduction of about 54 db with maximum a.g.c. signal applied. By comparison, the Rainbow circuit with a.g.c. applied to both parts of the cascode and the mixer achieves a gain reduction of 80 db and higher. (See Figs. 5 and 6.)

In a recent test with a popular 1956 television receiver, the i.f. a.g.c. was deliberately shorted and a relatively tremendous input signal of 0.2 volt r.f. (200,000 microvolts) was fed into two identical receivers, identical except that one tuner was conventional and the other the new Rainbow. With the old-style tuner this signal level literally swamped the picture, sync was lost and the set was completely overloaded. The Rainbow presented a clean picture.

One advantage which Standard Coil



Overall view of Standard Coil's Rainbow television tuner.



Standard Coil's "book" fine tuner.

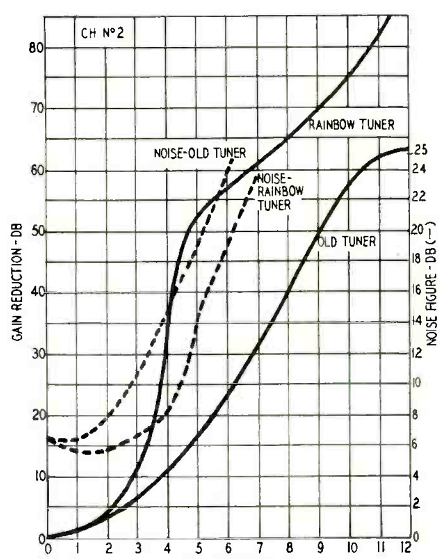


Fig. 5—Gain reduction and noise figure vs. a.g.c. in Standard Coil tuners.

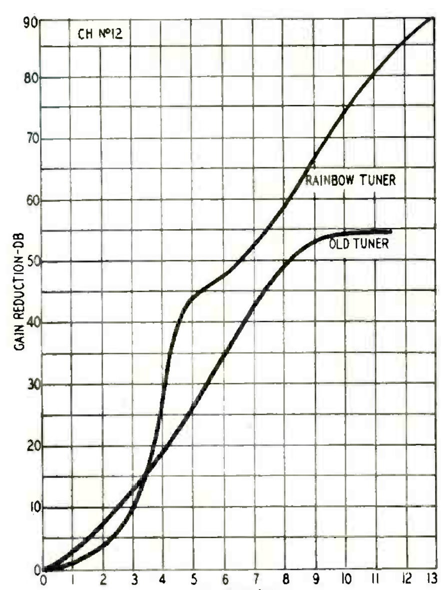
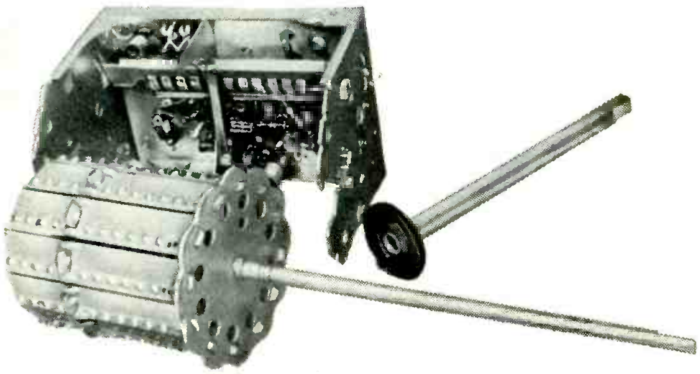
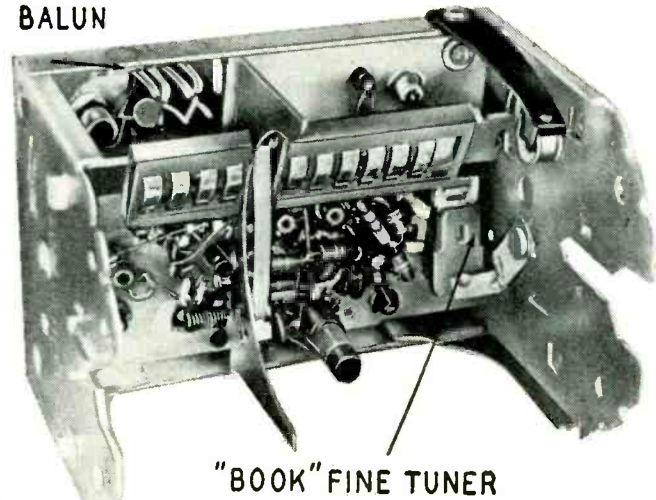


Fig. 6—Graph of gain reduction vs. a.g.c. in Standard Coil tuners.

Below—Underside of Rainbow tuner showing the coil drum and fine-tuning control.

Right—Closeup of the Rainbow underchassis.





engineers believe will result from this feature of increased maximum gain reduction is that TV set manufacturers can probably simplify their i.f. amplifier design. While it has not been desirable to use a two-tube i.f. amplifier strip because a.g.c. can be applied only on the first stage, and hence very strong signals have overloaded the previous tuners and two-stage i.f. designs, the fact that the Rainbow offers up to 80 db or more of gain reduction in the presence of extremely high inputs means that it should now be possible to get good reception with a two-stage i.f. strip.

5. Elimination of delayed a.g.c. in receiver i.f. design is now possible because of the marked improvement in noise figure vs. gain reduction achieved by the Rainbow circuit.

Design details

Starting with the antenna input (Fig. 3), the input circuit consists of a novel ferrite balun—from the 300-ohm balanced antenna lead-in to an unbalanced 300-ohm input to the tuner. This circuit provides isolation from d.c. voltages or 60-cycle a.c. without the need for additional capacitors. Hence it is particularly useful with a.c.–d.c. receivers. (Standard Coil is now supplying the industry in quantity with similar ferrite baluns for 300-ohm balanced to 75-ohm unbalanced lines for coaxial cable installations such as community TV systems.)

From the input balun the signal goes through improved 41-mc i.f. traps, the parallel circuit of C1 and L6 and series circuit C2 and L8.

There is a separate antenna primary coil L1, for each channel.

Separate primary and secondary antenna coils L1 and L2 are inductively coupled so as to obtain the best v.s.w.r. and noise figure. The r.f. signal from secondary L2 is fed to the grid of the first cascode triode, pin 7 of the 6BQ7-A, along with the a.g.c. signal coming through grid damping resistor R2 and bypassed by C15, a bypass capacitor that prevents radio frequencies from feeding back into the i.f. a.g.c. circuit.

Neutralizing capacitor C4 is used in this first triode stage to obtain an improved noise figure and to maintain minimum tilt with bias. Trimmer C3 compensates for variations in the input capacitance of the tube.

Peaking coil L7, connected between the plate (pin 6) of the first triode and the cathode (pin 3) of the second cascode triode, is used to obtain optimum gain on the high v.h.f. channels.

Isolating resistor R3 couples the cathode of the second triode with the cathode of the pentode mixer. Capacitor C14 grounds the mixer cathode for r.f. signals. Here is the circuitry which represents the major advance of the Rainbow design: the second cascode triode and mixer are in parallel so far as d.c. voltage is concerned, and the two are then in series with the first triode.

In the grid circuit of the second triode, R4 is a 2.2-megohm dropping resistor from B plus and an additional 4.7-megohm resistor is connected between the grid and ground to form a voltage divider. This second resistor was added to reduce the gain of the tuner more sharply with increase in a.g.c., since now this grid (pin 2) becomes negative with respect to the cathode (pin 3) when the cathode voltage exceeds about 164.

Bypass capacitor C12 grounds the grid of the second cascode stage for r.f. Trimmer C5 is similar in function to C3; it compensates for variations in output capacitance of the tube.

The coupling circuit, coils L3 and L4, provides inductive overcoupling controlled to obtain optimum bandpass characteristics. The signal from L4 goes through coupling capacitor C6 to the first grid (pin 9) of the pentode mixer, part of the 6BR8. This tube is a specially rebased 6U8 designed to facilitate the tuner wiring layout.

While discussing tubes, a version of the Rainbow tuner is being produced with the 4BQ7-A and 5BR8 instead of the 6BQ7-A and 6BR8, respectively, for TV receiver chassis with 600-ma series-heater circuits.

Loading resistor R11 in parallel with L4 is used to limit the peak-to-valley ratio of the response curve of the cascode amplifier output.

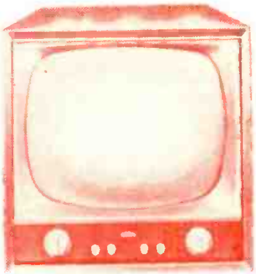
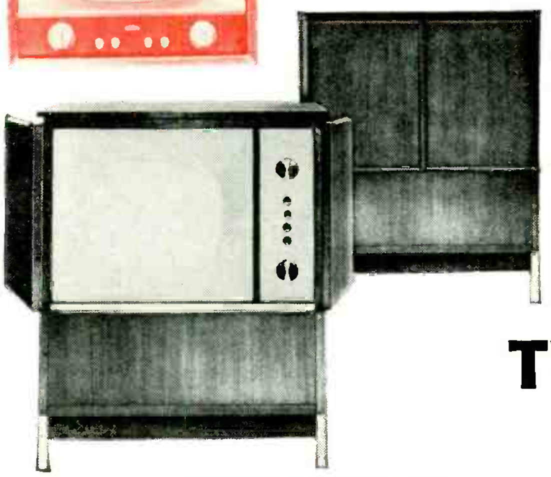
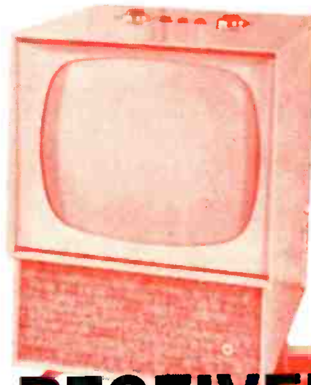
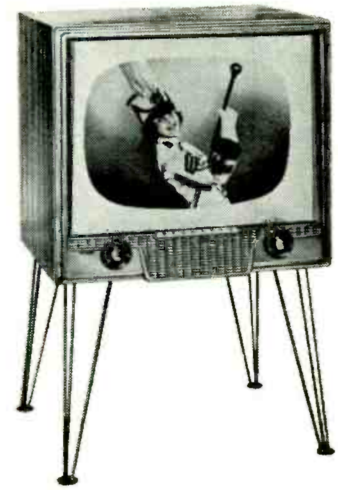
Resistors R5 and R6 form a voltage divider for the r.f. test point, to see this response curve. When looking at the r.f. bandpass at this test point, it is essential to use an 80-μf electrolytic capacitor connected between the pentode mixer cathode and ground—that is, in parallel with C-14—to eliminate hum and distorted 60-cycle response, Capacitor C7, like C3, is a trimmer to compensate for varying input capacitance.

In the pentode screen grid circuit, C13 is a bypass capacitor for r.f. while L9 is an inductance that raises the input impedance of the mixer grid on high-band v.h.f. signals.

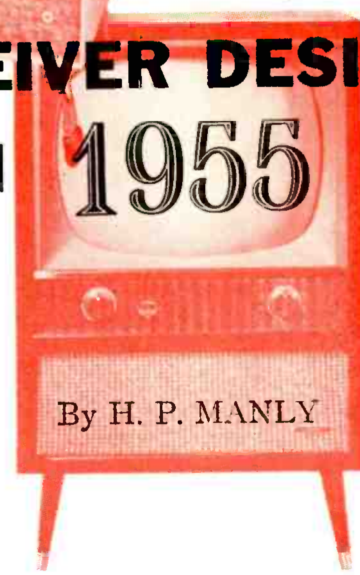
The B-plus supply for the oscillator is 135 volts instead of about 240. Compensating capacitors C10 and C11 in the grid circuit maintain a minimum of oscillator drift. The well-known slug-tuned oscillator coil L5, is adjustable from the front for each channel.

An innovation is the "book" type fine tuner (so called because it appears to open and close like a book, with its loop and flap) which provides both inductive and capacitive tuning (see photo). It is in the tuner chassis, and three finger springs are grounded on the center disc so that local oscillator radiation is maintained well within RETMA specifications. Another important advantage in performance is that, by providing both inductive and capacitive tuning, the book fine tuner has a range of 2.5 to 3.5 mc per channel over the whole v.h.f. band from channel 2 to 13. The inductance is particularly useful in restricting the fine-tuning range on the high channels; the capacitance helps restrict the fine-tuning range on the lows.

The author wishes to thank Robert Eland, chief engineer—research, for assistance with the text, and James Brown, chemical engineer, Standard Coil Products, Inc., for the photographs illustrating this article. END

TV RECEIVER DESIGNS IN 1955

By H. P. MANLY

THE accompanying bar graphs show a cross-section of monochrome television receiver design in 1955. Lengths of bars correspond to relative importance or popularity of 165 types of circuits and components.

The graphs are derived from chassis marketed as 1955 models by 28 major manufacturers. Where the same maker produced chassis with numerous important differences in design the types are considered separately. In arriving at percentages for picture tubes, tuners and some other features, consideration has been given to various kinds offered on either the same or different chassis. The minimum number of models analyzed for any one classification in the table is 60 and for some classifications the number of models approaches 100.

The number of times each design feature appears is represented as a percentage of the total number of chassis and by the length of a graph bar. Bars not so joined relate to minor features. Percentages are to the nearest values which avoid fractions.

In many classifications variations are not separately listed. As examples: Most a.g.c. rectifiers are tubes but some are crystal diodes. There are a number of varieties of plate-grid-coupled multivibrators for vertical deflection, differing in connection of hold and linearity controls as well as in other details.

There are simplified circuit diagrams for a number of features referred to. These illustrate easily recognized or distinctive characteristics but are not complete operative circuits. Numbered notes explain the meanings of some classifications.

It is interesting to pick out the most used design or component in each group, or for each function, and thus arrive at what might be called the average television receiver of 1955. A listing of designs least used might add up to the most obsolete composite or else the one most advanced, depending on whether the features are on the way out or in.

It is interesting also to look for once-familiar designs which have disappeared or nearly so. A few of these are shown by zero percentages. Even more important to the service technician or student is the appearance or the growth in popularity of designs looked upon as novelties not too long ago. These include such things as contrast control on the picture-tube input, new sound take-offs and gated-beam demodulators, pentagrid tubes in the sync section and many others.

DESIGN FEATURES	Percentages
Picture Tube	
Nominal size	
14 inches	2
17 inches	18
21 inches	69
24 or 27 inches	11
Envelope	
All glass	99
Metal cone	1
Face shape	
Rectangular	100
Round	0
Face plate	
Spherical	91
Cylindrical	9
Viewing screen	
Aluminized, metal-backed	50
Others	50

DESIGN FEATURES	Percentages
Focus	
Electrostatic	
Fixed voltage	36
Voltage choice (Note 1)	18
Adjustable voltage	10
Magnetic (Note 2)	36
Small Tubes (Exclusive of Power Rectifiers)	
Number of tubes	
14 to 16	48
17 to 20	44
21 or more	8
Sections in tubes (Note 3)	
18 to 21	24
22 to 25	50
26 to 30	26
Tuners	
Channel selection	
Turret	58
Incremental or switch	42
Frequency bands	
V.h.f. only	46
V.h.f. and u.h.f. (Note 4)	54
R.f. amplifiers	
Cascode	79
Pentode	21
Triode	0
Mixers (Note 5)	
Pentode	67
Triode	33

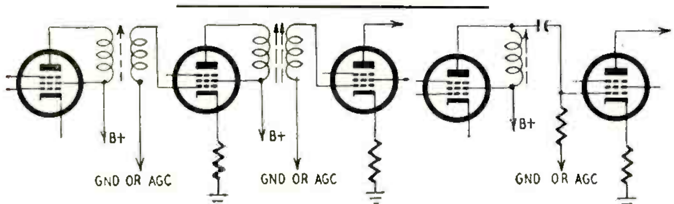


Fig. A—Types of interstage coupling.

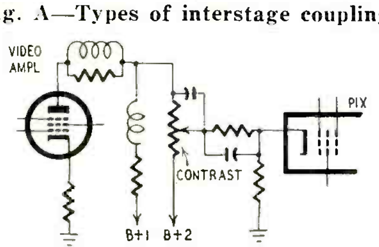


Fig. B—Contrast in input circuit.

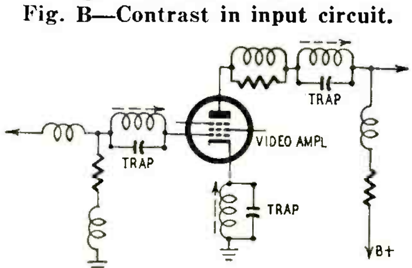


Fig. C—Various 4.5-mc parallel-resonant traps in grid, cathode and plate circuits.

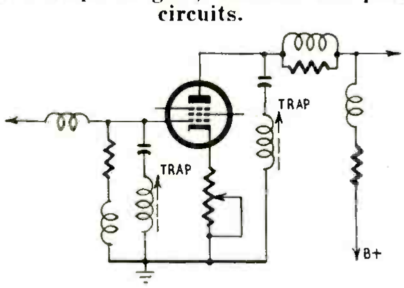


Fig. D—Diagram shows series traps.

DESIGN FEATURES	Percentages
I.f. Amplifier Section	
Number of amplifier tubes	
Two	2
Three	90
Four	8
Interstage couplings (Note 6, Fig. A)	
Trans., single-tuned	77
Trans., double-tuned	6
Single coils, impedance	2
More than one type	15
Intermediate frequencies (mc)	
40 to 50	75
20 to 30	25
Trap type (Note 7)	
Accompanying sound	41
Adjacent sound	48
Adjacent video	11
Traps, total per receiver	
None	15
One	39
Two	26
Three	15
Four	3
Five	2
Automatic Gain Controls	
Voltage obtained from:	
Video detector load	48
Keyed or gated a.g.c. tube	40
A.g.c. rectifier	10
Ratio detector capacitor	2
Auxiliaries	
Clamp or delay (Note 8)	32
Sensitivity adjustment	17
Video Section	
Video detector	
Crystal diode	59
Diode tube (Note 9)	41
Video amplifier stages	
One	80
Two	20

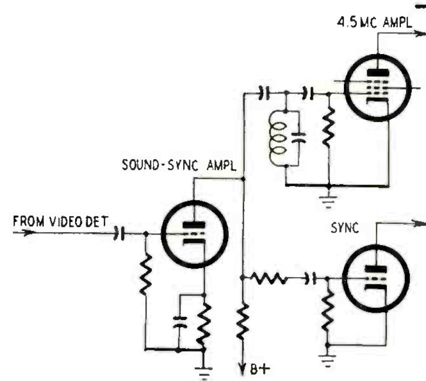


Fig. E—Sound-sync amplifier circuit.

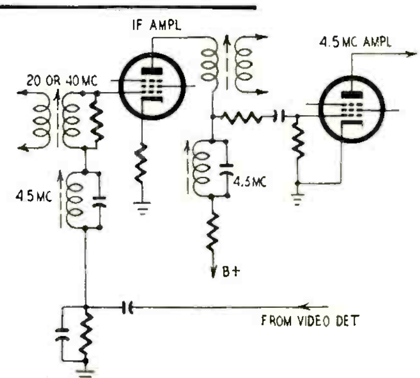


Fig. F—I.f. amplifier reflex circuit.

Notes

1. Convenient terminals are provided for connection of the focus anode to either of two or more voltages for obtaining optimum performance.

2. The great majority of magnetic focusing devices are of the adjustable permanent-magnet type.

3. The distinction between number of tubes and number of tube functions is desirable because of numerous dual and twin types built into a single envelope. For example, a diode-pentode is one tube and is so counted, but this one tube serves two functions: it may be a video detector and also an i.f. amplifier. As a further example, a receiver might have a total of 18 small tubes, but if 5 of these are dual or twin types, these 5 tubes may serve 10 functions. Then the total number of tube functions in that receiver will be 23, made up of 10 functions served by the 10 duals plus 13 functions served by the remaining single-section tubes.

4. Classification refers to u.h.f. tuners or u.h.f. sections of v.h.f. tuners used as standard equipment. A given chassis with u.h.f. tuning often serves for one group of models; a chassis otherwise similar except without u.h.f. tuning may be used for other models.

5. A pentode mixer in present-day sets usually is one section of a dual tube whose other section is a triode r.f. oscillator. A triode mixer ordinarily is one section of a dual-triode whose other section is a triode r.f. oscillator.

6. References are to couplings between i.f. amplifier tubes and from the final i.f. amplifier to the video detector.

7. Percentages are based on a count of the total number of each kind of trap in all the receivers taken together. This indicates that there are more i.f. traps for adjacent-sound than for other interferences. But in any particular receiver there might be no adjacent-sound trap while other i.f. traps would be present. In a given receiver there may be almost any combination of kinds of traps.

8. A tube or a tube section commonly called either a clamp or a delay most often is a diode, but sometimes a triode. In most cases the purpose is to maintain a suitable bias on the r.f. amplifier more or less independently of a.g.c.

DESIGN FEATURES	Percentages
Contrast control	
Video ampl. cath. resistor	87
Pix-tube signal input (Fig. B)	13
Peakers	
Adjustable	5
Nonadjustable	95
D.c. restorer tube	3
Picture-tube signal input	
To cathode	80
To control grid	20
4.5-Mc Traps	
Parallel resonant (Fig. C)	
Video amplifier plate	44
Video amplifier grid	5
Video amplifier cathode	2
Series resonant (Fig. D)	
Video amplifier plate	2
Video amplifier grid	13
Sound take-off transformer (Note 10)	29
No 4.5-mc trap	5
Sound Take-off	
Transformer (Note 11)	
Video amplifier plate	25
Video amplifier cathode	2
Video detector	2
Capacitor or direct from	
Video amplifier output	34
Video detector output	29
Sound-sync amplifier tube (Fig. E)	5
Reflex in i.f. amplifier (Fig. F)	3
Intercarrier Sound Section	
Amplifiers, 4.5 mc	
None	2
One triode	6
One pentode	64
Two pentodes	28
Demodulators	
Ratio detector	62
Gated beam (Fig. G)	36
Discriminator	2

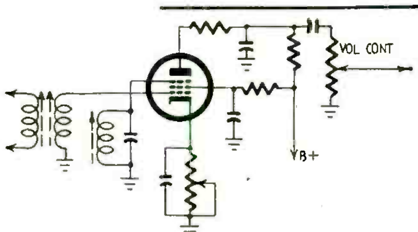


Fig. G—Gated-beam demodulator circuit.

bias on i.f. amplifiers, especially during reception of weak signals.

9. A triode with grid and plate connected together is classed as a diode. Also, a triode in which cathode and grid are used as a diode is classed as a diode. Other diode tube detectors include one section of twin-diodes and the diode section of a diode-pentode.

10. There is trap action in the primary of a sound take-off transformer connected in series with a video amplifier plate lead. Both primary and secondary are tuned to 4.5 mc.

11. The primary of the sound take-off transformer is in series with the tube elements. The secondary connects to the signal input of the 4.5-mc sound amplifier.

12. Other than pentagrid tubes listed below, nearly all sync tubes are twin-triodes or are triode section of other multisection tubes. This classification refers to the total number of such triode sections per receiver.

13. Pulses for horizontal retrace blanking may be obtained from a tap on the horizontal output transformer. Sometimes these pulses pass through an amplifier-inverter tube. Horizontal blanking pulses may be applied to any of the picture tube elements listed for vertical pulses.

DESIGN FEATURES	Percentages
Audio Section	
Amplifiers	
Beam power tube only	43
Triode and beam tubes	57
Speakers	
Permanent magnet	93
Field coil	7
Sync Section	
Triodes, total sections (Note 12)	
One	5
Two	47
Three	13
Four	5
Five	2
Pentagrid tube (Fig. H)	
With one triode	24
Used alone	4
Take-off for triodes	
Video amplifier output	82
Video detector output	9
Sound–sync amplifier (Fig. E)	7
D.c. restorer plate	2
Vertical Deflection System	
Blocking oscillator (Fig. I)	
Plate trans. feedback	41
Cathode trans. feedback	11
Others	2
Multivibrator oscillator	
Plate-grid-coupled Fig. J)	38
Cathode-coupled	8
Height control	
Oscillator plate voltage	100
Output amplifier	
Triode	75
Beam or pentode	25
Linearity control	
Amplifier cathode resistor	84
Amplifier grid (Fig. K)	13
Others	3
Output transformer	
Autotransformer	77
Insulated secondary	23

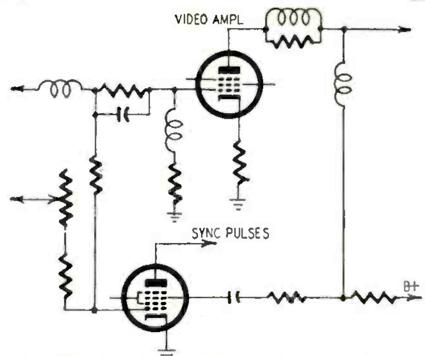


Fig. H—Partial pentagrid sync circuit.

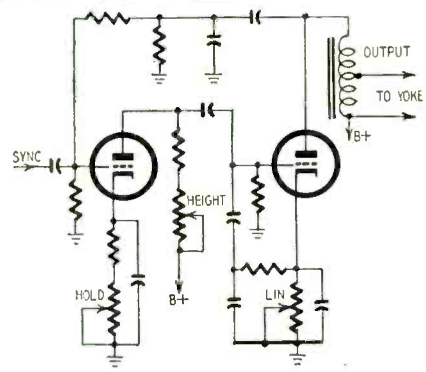


Fig. J—Plate-grid-coupled oscillator.

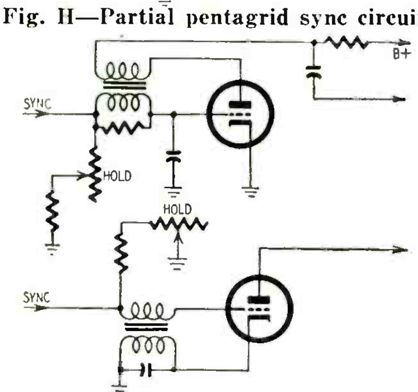


Fig. I—Vertical blocking oscillators.

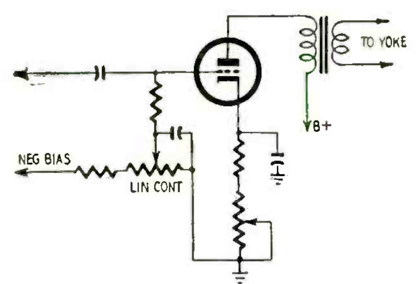


Fig. K—Grid circuit linearity control.

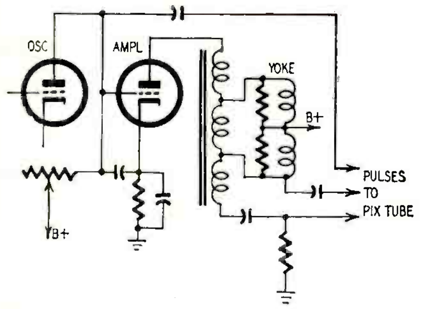


Fig. L—Take-off for retrace blanking.

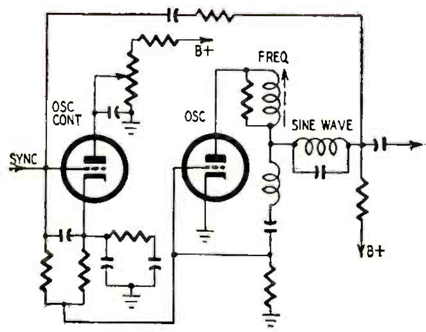


Fig. N—Variable-pulse-width a.f.c.

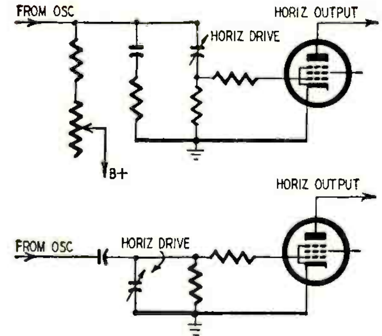


Fig. O—Horizontal drive controls.

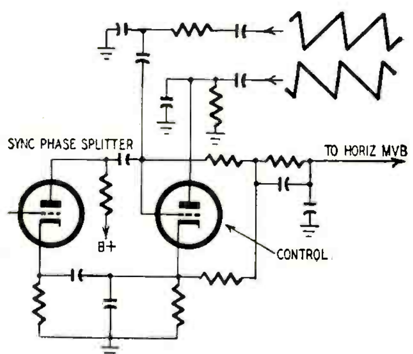


Fig. M—A triode phase detector.

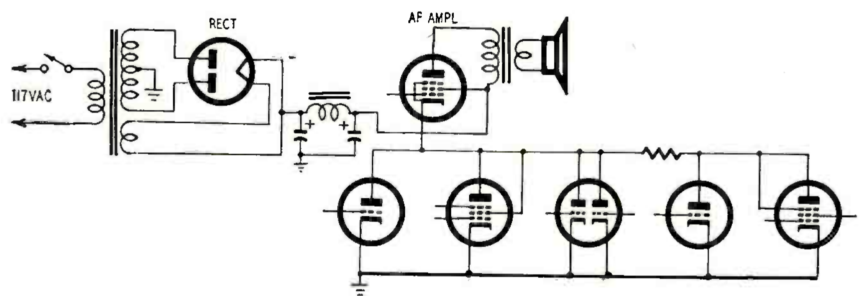


Fig. P—Series type B distribution.

DESIGN FEATURES	Percentages
Retrace Blanking	
Traces blanked:	
Only vertical	95
Vertical and horizontal (Note 13)	5
Take-off for vertical (Fig. L):	
Yoke coil	63
Output transformer tap	10
Amplifier circuit	14
Oscillator circuit	13
Vertical pulses to	
Picture-tube cathode	21
Picture-tube first grid	68
Picture-tube second grid	11
Horizontal Deflection System	
Automatic frequency control	
Phase det. diodes	33
Phase det. triode (Fig. M)	24
Phase det., reactance (Note 14)	5
Variable pulse-width (Fig. N)	38
Oscillator	
Multivibrator	57
Blocking	38
Hartley	5
Drive control (Fig. O)	
Voltage-divider capacitors	21
Series capacitor to ampl.	10
Oscillator plate voltage	4
Negative peaking resistor	3
No separate control	62
Output transformer	
Autotransformer	90
Insulated secondary	10
Width control	
Inductor on output trans.	48
Amplifier screen voltage	8
Various others	10
No separate control	34

DESIGN FEATURES	Percentages
Linearity control	
Induction damper circuit	33
Others	5
No separate control	62
High-Voltage Supply	
Type	
Flyback or pulse	100
Radio-frequency	0
Rectifier tube	
Octal	74
Miniature	26
Anode kv (approx.)	
12 to 14	29
14 to 16	56
16 to 18	11
18 to 20	4
Low-Voltage Supply	
Power rectifier tubes	
One	44
Two, paralleled	17
Two, different voltages	3
Selenium power rectifiers	
One	5
Two, voltage doubler	31
Power filter	
Choke	84
Spkr. field or focus coil	8
Resistance–capacitance	8
B current distribution	
Direct to all tubes	46
Series plates–cathodes (Fig. P)	54
Tube heaters	
Parallel on power trans.	64
Parallel on heater trans.	10
Series, ordinary tubes	6
Series, controlled warmup (Note 15)	20

14. This method is similar to the earlier one using a discriminator, reactance tube, Hartley oscillator and discharge tube, but has a phase detector instead of a discriminator for correction voltage.

15. This classification includes tubes designed especially for series heater strings. All cathodes reach normal emission within approximately the same time after voltage is applied. END

By GUY SLAUGHTER

it's a matter of Psychology

I COULD hardly believe my eyes when Buzz Maloney walked into my shop. We'd been swapping Christmas cards ever since we got out of service, but we hadn't seen much of each other in all that time. Right now, his face was as long as a channel-2 dipole. He was wearing a sharp-looking tweed suit, but his shoulders drooped under the padding.

"What brings you to my town?" I asked, after the first greetings were over, "and what's eating you?"

"I'm dead, Sid," Buzz informed me, pushing a TV chassis aside and sitting down on my bench. He stared at me mournfully. "An hour ago I got off the train a happy and carefree advertising man. Now I'm a bum and I'm dead."

"Okay," I said, reaching for a cigarette and hoisting myself onto my high stool. "When you get around to it fill me in and we'll both weep."

"Please, no comedy," Buzz moaned. "I'm not in the mood. You familiar with the Mister Typical TV Tech promotion?"

I told him I was. Every radioman in the country had entered the thing a couple of months ago. It was written up in all the technical magazines and the prizes were worth trying for. There was service equipment, hi-fi apparatus, ham gear and even a trip to Hawaii for the winner, if winner is the right word. It seems that all the entries were to be run through IBM analyzing machines and qualifications of the entrants averaged. Then the one guy in the United States who most nearly represented a compromise among all TV technicians in age, height, weight, background, education and a hundred other things—a sort of root mean square of the industry—would be crowned Mr. Typical TV Tech and win the jackpot.

"It was my brainchild," Buzz said. "I dreamed it up and sold the idea to my own agency and then to all the major electronic manufacturers in the country." As a promotion, he went on, up to now it had been a huge success, one of those naturals that—according to Buzz—comes along just once in an advertising man's lifetime! The only trouble was, now that the payoff was in sight, it had pooped out!

The preliminary campaign had been completed, entries received from the forty-eight states, the statistical work done and the winner determined. His name had been released to the sponsoring organizations as well as to the newspapers, magazines, TV and radio news bureaus and even the wire services. All the vast machinery of publicity had been set in motion. The press releases were dated this very day and inside of a few hours the name of Mr. Typical TV Tech would be a household word.

An uncooperative winner

Buzz—the guiding genius of the whole thing—had just called upon the winner to advise him of his good fortune and to prepare him for the ceremonies coming up tomorrow and had got what amounted to a kick in the stomach. Because the guy, Buzz said, had thought about it for a minute, then coolly announced he didn't want any.

"So here I am," Buzz finished, almost choking by now. "I'm a bum, because the minute the word gets out my agency'll can me. And I'm dead, because every sponsor and every magazine in the country will blacklist me!

"I don't blame 'em," I said. "Everybody involved'll be the laughing stock of the century. Who ever heard of a contest winner refusing his prizes?" I thought about it a minute. "But why? He must be nuts. What reason did he give?"

"It's the trip, mainly," Buzz explained. "He claims he can't take three weeks off because he's got sets to fix."

"He's got a point, there," I said. And I went on to explain how it is with us shop owners. You've got a good business, you have to take care of it. Get a few customers teed off at you for slow service and pretty soon you're out picking up crumbs with the chickens.

Buzz said he could understand that so he'd promised to hire a technician for the guy and see that business went on as usual in the shop while Mr. Typical TV Tech spent a few days receiving awards and getting his picture taken a couple hundred times and then went off on his trip. But it didn't work. The joker, Buzz sputtered, just insisted he didn't want any other man doing his work and wasn't interested in going to Hawaii anyway. When I suggested they drop the trip and just give the guy the other prizes, Buzz nixed that idea. It was an all-or-nothing deal, he said. Sort of a package affair.

Suddenly I thought of something. "Hey!" I exclaimed. "If all this happened in the last hour and you're here now, this clown must be a local boy. Who is he?"

"Character named George Myers. He's got a shop over on third . . ."

"Yeah, yeah," I cut him off. "I know George casually. He'd rather fix TV sets than eat. Really loves his work." I thought about that for a minute, and then I grinned. "You know what, Buzz? I think I can solve your problem. All we have to do is make him change his mind."

"Sure," Buzz said grimly. "That's all. But I got the impression he's like a three-legged baby. Awful hard to change."

"Leave it to me," I declared. "It's going to cost you some money, though. You've got to hire some people to carry TV sets into George's shop and pay some repair bills that may run into a little moola."

Buzz looked me squarely in the eye for a minute. Then, for the first time since he'd been there, he grinned at me. He said, "Old buddy, I don't know what's running through that nasty mind of yours but if it'll work I'll pay through the nose."

"You probably will at that," I said. "Go hire half a dozen people while I fix up some repair jobs."

While Buzz was gone I rounded up some of the table-model loaners and trade-ins I had in the place and looked them over with a speculative eye. Then I started pulling chassis and gimmicking them. Inside the first one, I soldered a bypass from plate to ground of the second i.f. stage. The next one I modified by carefully dripping a blob of solder between the grid and cathode terminals of the high-frequency oscillator tube socket. I studied the third one for a little while, then removed the can from one of the video i.f. transformers, soldered a jumper between the B plus and plate lugs inside and replaced the can. Inside the high-voltage compartment of the next set, I drew a line with a soft lead pencil across the ceramic between the hot and ground terminals of the filter condenser. I tore into the vertical integrating network in the next chassis, interchanged two resistors and two leads. I took the back off a sixth set, sprayed insulating compound inside the controls along the rear apron and replaced the back.

". . . soldered a jumper between B plus and plate leads and replaced the can."

By the time I had all the chassis back in their cabinet, Buz showed up with a string of people in tow. There were four men and two women. I briefed them carefully, assigned them definite times, half an hour apart, to carry their respective sets into George's shop and told each one to absolutely insist on waiting for his set to be repaired then and there. If George told them he couldn't handle it that way, they were to make a scene, raise the devil and stalk out. They were to report back here with their sets as soon as they finished their assignments. Buzz fixed each of them up with twenty bucks for repair money, promised them generous rewards when they returned and shooed them out the door. Then he turned to me.

Frustration the answer

"Okay, master mind, what's the gimmick? This George joker refused the jackpot because he had too much work to do. So why do we give him more?"

"Relax, junior," I said, grinning. "We're using psychology on the lad. Do you know what frustration is?"

"Do I know what frustration is?" Buzz bit off, looking sour. "What you suppose this deal has done to me, given me an ego lift?"

"This is different," I assured him. "Give a TV man a coupla dog jobs in a row, it goofs him up. He'll poke around trying to find the trouble and the more he looks the less he finds and the more frustrated he gets. By and by, if he doesn't solve the problem, he's ready to cut his throat. You offer a guy in a spot like that a trip to Hawaii, he'll grab it. Believe me, I know."

"I get it," Buzz said. He looked at me with awe in his eyes. "And those six sets we're sending him are dogs?"

"They're dogs," I said. "Real bow-wows. A sharp bench man could fix them all in good time. But likely George'll go batty with six of them lined up on the bench and six customers out front pacing the floor."

"Sid," Buzz said with feeling. "You're a pal." He stuck out his hand, shook mine solemnly.

"Yeah," I said. "Ain't I though? Now you get the heck out of here and hire that helper you promised George, while I get some of my own work done. When you find a man, go offer George that trip again. And this time he'll break his neck accepting."

Buzz left and I dove into my bench work, whistling. It makes you feel pretty good to come up with an idea in the clutch that helps a buddy out of a spot.

I was still feeling good a couple of hours later when Buzz stalked in again. The six fake customers had come in during the interim, one at a time, and I had just waved them into chairs in the front of the shop, not even taking time to talk to them. Now Buzz walked up to me and shook his fist under my nose. I could see his plate current was zooming.

"Thanks a million," he was snarling, his voice thick with sarcasm. "Boy, what a brainy idea that was! I should have known better than to listen to you. Now I'm *really dead.*"

"Hey, wait a minute. You mean it didn't work? George didn't fall all over himself accepting when you showed up again?"

"You bet he didn't," Buzz shouted. "He said he'd been tempted to change his mind right after I left the first time. But he had so much fun and cinched himself so many new customers this afternoon that he wouldn't think of going anywhere now."

"Hold it," I said, sticking up my hand like a traffic cop. "Calm yourself, junior. You mean he . . . he didn't blow his cork over those six dog jobs?"

In answer, Buzz jerked his thumb at the four men and two women just going out my front door. They had left my six sets in a neat pile in the middle of the room. It seems Buzz had paid them off and dismissed them. It seems, too, that each of them had got his particular set fixed while he waited and that altogether George had collected nearly a hundred bucks of Buzz's money from them. Buzz slammed down the repair bills George had made out. I leafed through them, my mouth open —high-voltage filter condenser, plus 14-minute service charge, $12 . . . new i.f. transformer, 11 minutes; $10.90 . . . Six controls replaced, 35 minutes; $18.75. I laid down the bills, tried to grin at Buzz, didn't make it.

"So thanks for nothing," Buzz was saying. He glowered at me a minute, then spun on his heel and headed for the door.

"Hey," I called. "Where you going?"

"Outer Mongolia, where else?" He grabbed the knob, not looking back, stalked out into the street.

I ran after him. I caught him at the corner, held him by one padded shoulder until he stopped trying to shake free. Then I tried to grin at him again. This time I made it.

"Okay, so I fumbled. I merely underestimated this character, that's all. And you boys missed the boat, too. He's no more an average TV man than you are."

That got Buzz's attention. He looked at me kind of funny, said, "Hunh?"

"Oh, he may be average age," I went on. "And average height and average everything else in the tangible things. But he's head and shoulders above most of us in the upstairs department evidently. That boy's a real technician, maybe the best there is."

Buzz found his voice. "Great," he said without enthusiasm. "And that helps me a lot, doesn't it?"

"Maybe," I answered. "Maybe it does, at that. I didn't know George well enough to realize he was such a hot bench man. Apparently he thrives on tough ones, just loves to work on them."

"Obvious, so I'm dead. He won't leave his work for fear he'll miss some fun. So excuse me while I go bury myself."

Changing strategy

"Hold it, junior," I said. "Now we know how our boy operates, we can figure it better. I got the deal for you this time."

"Hah!" Buzz looked at me coldly. "Forget it. I dropped a wad of dollars out of my own pocket on your last brainstorm. And real soon my salary stops. Thank you, friend, but no more ideas, please."

"Look, Buzz," I pleaded. "I know TV men. They fall into two general categories, the lazy and mediocre ones like me, and the eager geniuses like this George character. You go along with me on this thing and I guarantee he'll accept your Mr. Typical TV Tech title *and* the trip to Hawaii. I guarantee it!"

That got him. I led him back still hooked to the shop, briefed him on how many people to hire this time and what instructions to give them. Then I started taking the backs off every operating TV set in the place. I dug up a carton full of discarded tubes, shuffled through them looking for 6SN7's and sorted them into a pile. Then I started switching tubes. I took one out of each set, replaced it with one from the discard pile. When I finished and put the backs on, I had 17 TV sets lined up in front of me. I sat down on my tall stool, lighted a cigarette and waited for Buzz to come back with his little army.

★ ★ ★

I had dinner with Buzz that evening. His face shone like an indirectly lighted dial and he radiated happiness like WLW does r.f.

"So tomorrow morning," he finished, "when the photogs and PR men move in, George'll be ready for them."

"And the Hawaiian jaunt?" I asked.

"All set. He leaves next Saturday."

". . . trip to Hawaii—as spectacular a change as any soul could long for."

Buzz leaned back in his chair, and grinned. "Tell me the gimmick."

"Same gimmick, different twist. My psychology was sound on that first try, but I didn't know my subject well enough. When I found out what kind of a guy he was, I just had to change strategy a little bit."

"Okay, okay," Buzz responded sweetly. "And pray what was this new tactic that turned the trick?"

"Same tactic, different method. Frustration was the answer, like I said. But this guy is different from most of us and doggy sets don't goof him up. So I figured routine would."

"I don't know what you're talking about," Buzz said. "But rave on, Macduff."

"Routine," I repeated. "Monotony. You know, one-two-three-kick. I sent him 17 TV sets to fix—dull jobs."

"Dull jobs?"

"The dullest," I said. "At least for that type of eager genius. Every set had the same symptoms, which in itself might be interesting. But every one had the same cure, too, and that's the dullest kind of routine. None of the sets had any horizontal deflection. And a new tube cured each one. To *any* technician 17 consecutive sets with a single and obvious tube defect are dull—to this particular one—downright frustrating! And as I pointed out before, frustration craves change and a free trip to Hawaii is as spectacular a change as any soul could long for."

Buzz sat silent for a long moment. Then he grinned. "You know," he said, finally, "All you TV guys are nuts."

"We don't have to be," I grinned back. "But it helps, Buzz." END

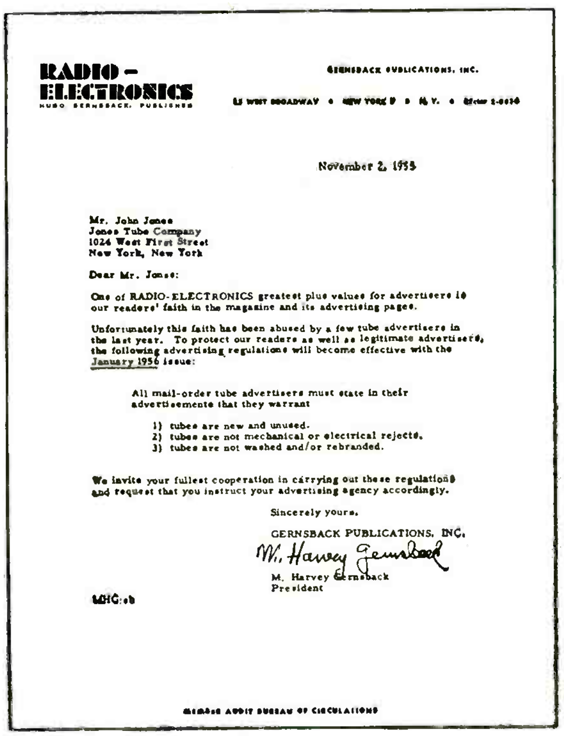
RADIO-ELECTRONICS readers
FOR YOUR PROTECTION—

We will not knowingly permit the advertising pages of RADIO-ELECTRONICS to be used to deceive you! Our success depends on your faith and confidence. Unfortunately, within the past year that confidence has been abused by a few mail-order advertisers.

Therefore, to protect our readers, and the overwhelming majority of honest advertisers who use space in RADIO-ELECTRONICS, this letter was recently sent to all mail-order tube advertisers. It advised them that effective with the January 1956 issue, all their advertising copy must warrant that tubes advertised are

1) New and unused
2) Not mechanical or electrical rejects
3) Not washed and/or rebranded

These regulations will be strictly upheld. We will not accept advertising which fails to comply. We ask the cooperation of both readers and advertisers in calling to our attention any abuses.



RADIO-ELECTRONICS
HUGO GERNSBACK, PUBLISHER

GERNSBACK PUBLICATIONS, INC.

November 2, 1955

Mr. John Jones
Jones Tube Company
1024 West First Street
New York, New York

Dear Mr. Jones:

One of RADIO-ELECTRONICS greatest plus values for advertisers is our readers' faith in the magazine and its advertising pages.

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1) tubes are new and unused.
2) tubes are not mechanical or electrical rejects.
3) tubes are not washed and/or rebranded.

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Sincerely yours,

GERNSBACK PUBLICATIONS, INC.

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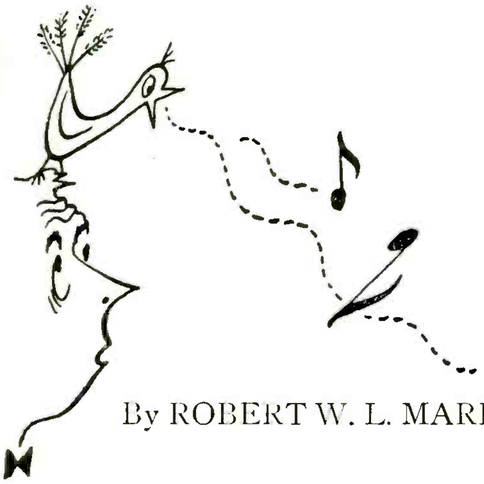
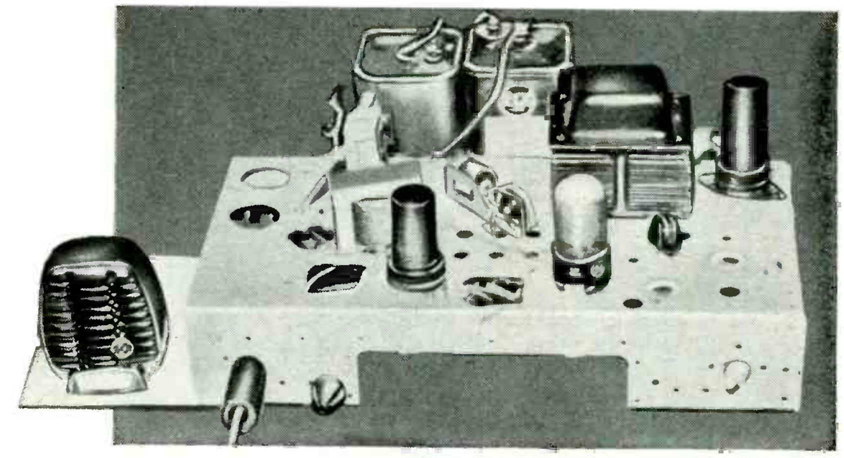




By ROBERT W. L. MARK

HAVE you often wanted to turn off those commercials without having to get out of your comfortable chair to do it? If you have—and who hasn't—here is an electronic remote-control device that will do just that. Give a short whistle and the audio on your set ceases; another short whistle brings it back. This amazingly sensitive device is a source of considerable pleasure and fun.

A crystal mike is placed on top of your TV set facing away from the loudspeaker and toward the audience. In back of the set on a small table or chair sits the electronic device that does the trick. (To make operation more amazing the mike can be placed off to one side so as to be practically hidden.)

The microphone picks up your whistle, which should have a pitch of between 950–1,050 cycles, and amplifies it to operate a relay in the last stage of the set. This relay activates another which makes and breaks a connection to the TV loudspeaker (see diagram).

The remote control device has a resonant audio circuit (L1–C1) between the first and second stages (V1 and V2-a) which makes it respond to the proper pitch of whistle and not to other sounds in the room or from the TV set itself. L1 is the primary of a universal a.f. output transformer. Adjust the value of C1 for good tone discrimination.

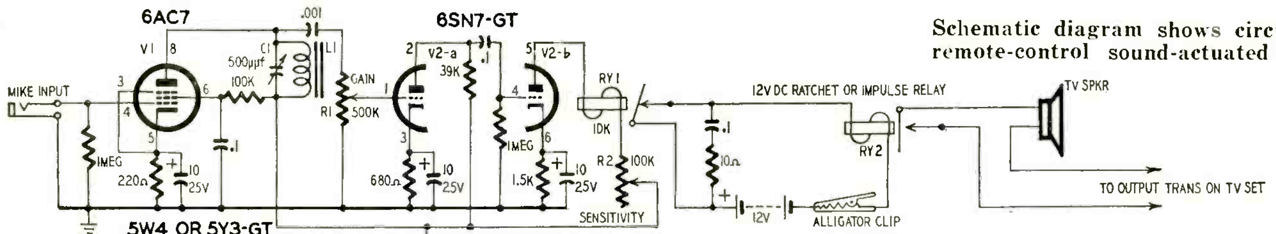
The control unit may be built on an old receiver chassis approximately 12 x 6 inches and parts may be placed where most convenient. The mike may be an inexpensive, high-impedance crystal type.

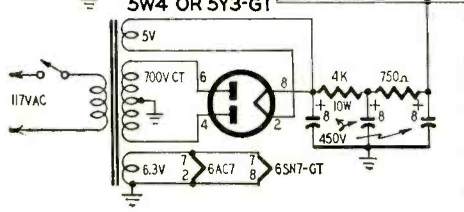
Two controls are all that need adjusting: R1 for the mike input; R2 for current through RY1. Current through RY1 should be set for around 2 ma, just enough to make the relay close when the unit is turned on. The microphone input should be set to open, with a whistle of the proper pitch, from a distance of 15–30 feet. It may take a little experimenting to get the relay working O.K. The relay contacts may need adjusting too; the closer they are, the more sensitive. If they are too close, though, the relay may chatter.

The plate relay is a Potter & Brumfield type LM5. It has a 10,000-ohm coil and will close on approximately 3 ma and open on anything less than that. The ratchet relay is a 12-volt d.c. type. The contacts on it are connected so that when it moves the ratchet, the loudspeaker connection is alternately made and broken. Two lantern type 6-volt batteries are hooked in series to provide the 12 volts. (If a.c. type relay is used, power may be obtained from transformer.) They will last a long time since current is taken from them only during each whistle.

One precaution is necessary. The batteries are hooked up so that when relay RY1 is open, current is drawn and the ratchet moves. Since RY1 is normally open, except when the remote control device is turned on and warms up, the batteries will draw up the ratchet relay and hold it there, draining the batteries, unless some way is provided to disconnect them except when the unit is in operation. An alligator clip on one battery terminal will make an easy way to open or close that circuit. Relay RY1 will not close until the power is turned on and all voltages reach their proper level.

To adjust RY1, turn up R2 until the relay closes. By adjusting the screw on the relay it can be made to close on as little as 1.5 ma and open on anything less than that. Mine is set to close on 2 ma, and the action is firm and sure. END





Schematic diagram shows circuitry of remote-control sound-actuated switch.

Parts for a.c. remote unit

Resistors: 1—10, 1—220, 1—680, 1—1,500, 1—39,000, 1—100,000 ohms, 2—1 megohm, ½ watt; 1—750, 1—4,000 ohms, 10 watts; 1—100,000, 1—500,000 ohms, potentiometers.

Capacitors: 1—500 μμf, 1—.001 μf, mica; 3—0.1 μf, 400 volts; 3—10 μf, 25 volts, electrolytics; 3—8 μf, 450 volts, electrolytics.

Relays: 1—single-pole single-throw normally closed, 10,000-ohm coil, approximately 3-ma sensitivity (Potter & Brumfield LM5 or equivalent); 1—ratchet type, 6 or 12 volts d.c. d.p.d.t. (Potter & Brumfield AP11D or equivalent. Suitable 12-volt ratchet relays may be obtained from Lionel Corp.)

Miscellaneous: 1—6AC7, 1—6SN7, 1—5W4, tubes; 3—octal sockets; 1—open-circuit microphone jack; 1—high-impedance crystal microphone; 1—power transformer, 700 volts ct. @ 30 or more ma, 5 volts @ 2 amps, 6.3 volts @ 2 amps; 1—s.p.s.t. switch; 1—500-ohm 14,000-ohm impedance audio coil (primary winding of a Stancor A-3823 output transformer or equivalent); 1—chassis.

COLOR TV Receiving Tubes

By JEROME KASS
ASSOCIATE EDITOR

DEVELOPMENT of improved receiving type tubes has long been the prime factor in the design of better-performing radio receivers. However, during its long years of development, AM broadcast radio had a comparatively small and low range of frequencies to contend with. Radio-frequency amplifiers and oscillators operated below 2 mc; i.f. amplifiers operated below 0.5 mc.

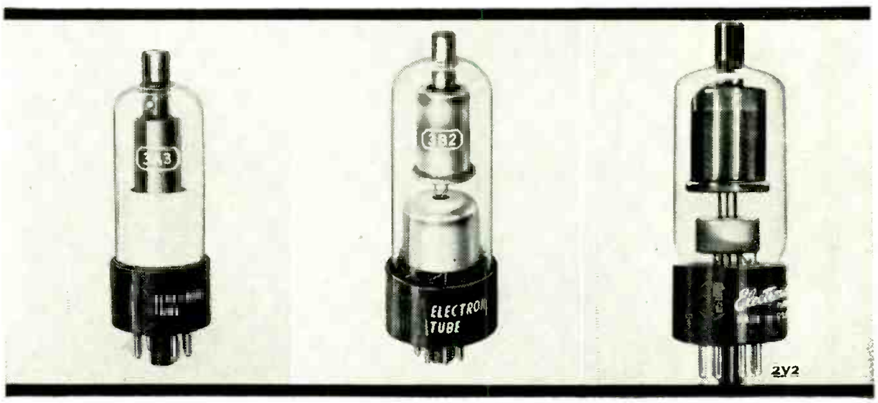
After simmering for many years, television boiled over suddenly in 1948, making great demands on then-existing receiving type tubes. The original 13-channel v.h.f. band encompassed an r.f. range of 44 to 216 mc. TV receivers used i.f.'s in the 21-mc range, video amplifiers had to pass a band of frequencies 4 mc wide, 30-tube sets put a heavy burden on the power supply, highly critical circuits demanded more specialized tubes, power supplies delivering voltages of 9,000 or so were required.

To satisfy these demands many radio receiving type tubes were pressed into service. Most of these have now been replaced by "service-designed" models with only a relatively few tube types used in 1948 still included in the complement of 1955 black-and-white receivers.

The gradual transition from black-and-white to color television has been less severe on receiving type tubes. The major portion of today's color receiver consists of conventional black-and-white circuitry, slightly modified to meet the more exacting bandpass requirements. However, the r.f., i.f. and video frequencies are essentially the same.

It is the color TV picture tube that has produced the greatest change in color TV receiving tubes. Four popular types have appeared: the 15GP22, 15HP22, 19VP22 (CBS 205) and the 21AXP22.

These tubes with their tremendous high-voltage and high-current requirements have made necessary wholesale changes in TV high-voltage supplies. With the 15-inch tubes requiring a second-anode potential of approximately 20,000 volts at 600 microamperes



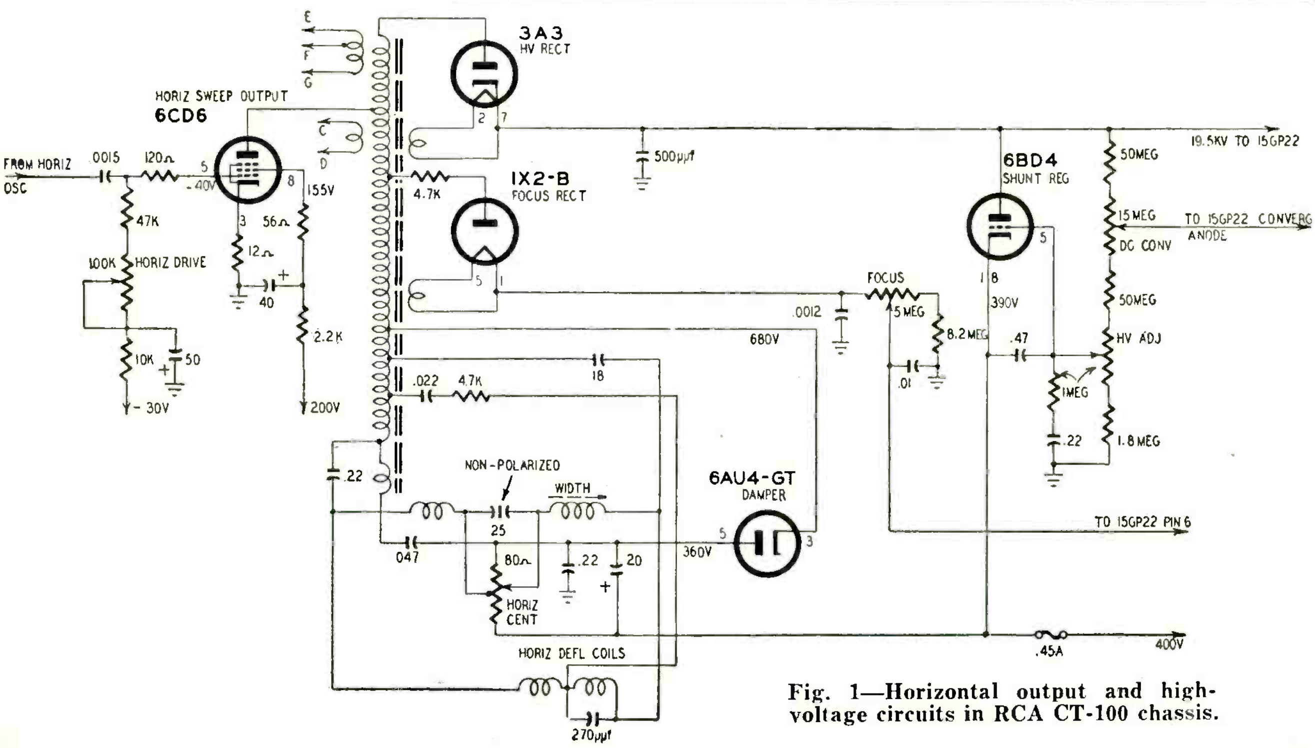


Fig. 1—Horizontal output and high-voltage circuits in RCA CT-100 chassis.

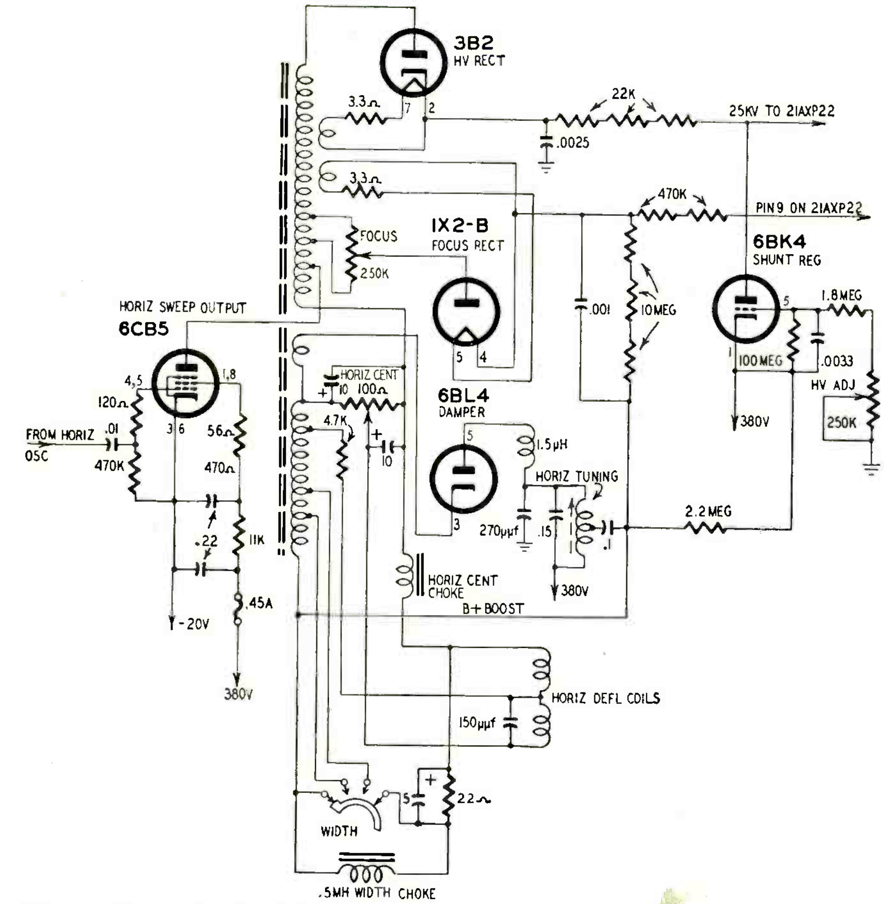


Fig. 2—New tubes in high-voltage circuit of the RCA model 21-CT-661U set.

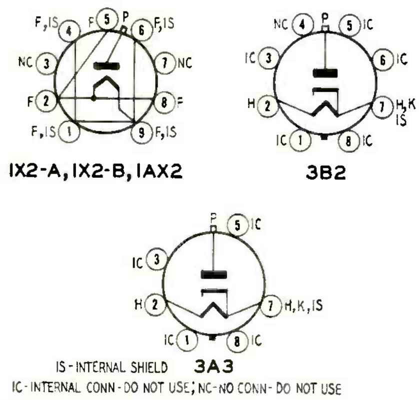


Fig. 3—Diagrams of new high-voltage and focus rectifiers for color TV sets.

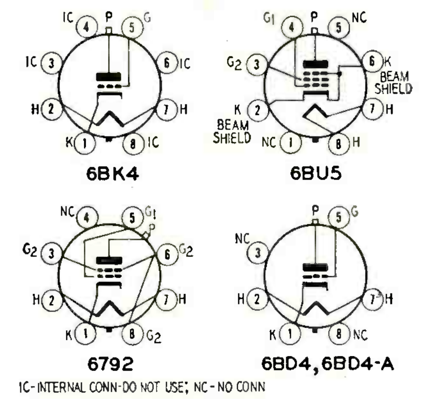


Fig. 4—New high-voltage regulators.

and the larger tubes needing approximately 25,000 volts at 800 microamperes, the heretofore dependable 1B3-GT has given way to newer, more rugged types. In addition, it is very important that this high voltage remain fairly constant (good regulation) during beam current variations from cutoff to maximum brightness. This adds a new circuit to the high-voltage power supply, the shunt regulator. Another newcomer to this section is the focus rectifier, supplying a somewhat smaller high voltage.

High-voltage tubes

Some early (if we may call 1954 early) TV color receivers such as the Westinghouse model H-840CK15 (chassis V-2284-15), using the 15GP22, obtained high voltage with voltage-doubler circuits using tubes such as the 1B3, 2V2 and 3A2. These had peak inverse voltage ratings of 21,000, 21,000 and 18,000 at a d.c. output current of 0.5, 1 and 1.5 ma, respectively. Fig. 1 shows the horizontal output and high-voltage circuits in the pioneer of color sets, the RCA CT-100 (chassis CTC2).

Appearing in the later larger-screen sets, the color-TV-designed 3A3 and 3B2 have taken over the task of supplying high voltage for 19- and 21-inch picture tubes. Fig. 2 shows the horizontal output and high-voltage circuits of the most recent RCA color set, the 21-CT-661 (chassis CTC4).

The 3A3 half-wave rectifier has a peak inverse plate voltage rating of 30,000 and can supply an average plate current of 1.5 ma. The base pins (see Fig. 3) fit a standard octal socket. To reduce corona, the socket terminals for pins 1, 3, 5 and 8 may be connected to pin 7. The heater of the 3A3 requires 3.15 volts and draws 220 ma.

A still more rugged half-wave vacuum-tube rectifier is the 3B2, used in the high-voltage power supply of Fig. 2. This tube is rated to withstand a maximum peak inverse plate voltage of 35,000 while delivering a maximum average plate current of 1.1 ma. The base pins (Fig. 3) of the 3B2 also fit a standard octal socket.

To aid in corona reduction in the 3B2, pins 1, 3, 5 and 7 may be connected together. In addition, pins 2, 6 and 8 may be tied together, pin 4 may be connected either to pins 2 or 7 or used as a tie point for a heater voltage-dropping resistor. Pin 4 cannot be used as a low-potential tie point. Like the 3A3, the 3B2 has a 3.15-volt 220-ma heater. With present picture-tube design, it is very likely that the 3B2 will become the 1B3 of color television.

High-voltage regulators

Used to stabilize the high-voltage output in color receivers, high-voltage regulators are connected in circuits shunting the power supply. Since TV high-voltage regulation is a relatively new function, only a few types have appeared—the 6BU5, 6BD4, 6BD4-A and 6BK4.

The 6BU5, a beam pentode (see Fig. 4), was used in the General Electric model 15CL100, an early color set using the 15GP22 picture tube. The tube is a low-current high-voltage pentode designed primarily for use as a shunt voltage regulator in color TV receivers. Its maximum ratings include a plate voltage of 20,000 and a plate dissipation of 20 watts. The plate lead is brought out of a top cap that has a

circular groove insuring a firm connection. The maximum cathode current rating for this sharp-cutoff pentode is 2.5 ma. Heater requirements are 6.3 volts at 150 ma.

A much more popular (though very expensive) type is the 6BD4, used in the RCA CT-100, Westinghouse H-840CK15, Arvin 15-550KB and Stromberg-Carlson K-1. This tube is a sharp-cutoff beam triode specifically designed for the regulation of high-voltage low-current d.c. supplies. The 6BD4 has a maximum d.c. plate voltage rating of 20,000 and a plate dissipation rating of 20 watts.

The double-ended tube will pass a plate current of 1.5 ma and has an amplification factor of 1,650. The heater of the 6BD4 requires 6.3 volts at 600 ma. The 6BU5 and 6BD4 have similar electrical characteristics but the 6BD4, being a triode (Fig. 4) and making for simpler circuitry, has been much more widely used.

The 6BD4-A is similar to the 6BD4 with the exception of a few maximum ratings. It is interchangeable with the 6BD4. Its plate voltage is rated at a maximum of 27,000; maximum plate current is 1.5 ma. The plate carries a dissipation rating of 25 watts. The amplification factor of the 6BD4-A is 1,650. This tube, with its higher plate-voltage rating, is found in the CBS-Columbia 205 chassis using the 19VP22.

The most recent of the regulator type sharp-cutoff beam triodes is the 6BK4, used in the RCA 21-CT-661. Announced in late 1954 and designed specifically for color TV receivers, the tube has maximum ratings of: plate voltage, 25,000; d.c. plate current, 1.5 ma; plate dissipation, 25 watts. Its advantages over the 6BD4-A are its amplification factor of approximately 2,000 and its smaller heater requirement of 6.3 volts at only 200 ma (and its much lower cost).

Base pins 3, 4, 6 and 8 of the 6BK4 (Fig. 4) should not be used for tie points. The tube may show a blue glow on the upper half of the inner surface of the bulb wall under normal operating conditions—this is caused by fluorescence and should not be assumed to be the result of gas. This characteristic is also typical of the 6BD4 and 6BD4-A.

not reveal any unusual capabilities as compared to the previously mentioned types. However, the fact that it can be connected as either a triode or tetrode extends its characteristics and control features over a wide range. Thus, this tube type should be included among those the service technician will most likely come in contact with.

Focus rectifier

The d.c. focus voltage for color TV picture tubes varies from 4,000 to 8,000, depending upon the tube and its associated circuitry. While occasionally a 1B3-GT, 2V2 or 3A3 will be found in this application, the trend appears to be toward the almost exclusive use of the 1X2-B. This tube has evolved from an old standby, the 1X2 which has a maximum peak inverse voltage rating of 15,000 and a maximum d.c. output current of 1 ma.

The 1X2-A, having higher ratings than the 1X2, was designed specifically for use in television sets as a high-voltage rectifier in flyback type power supplies and became a sort of poor relative of the popular 1B3. The 1X2-A has a maximum peak-inverse plate voltage rating of 20,000 and carries a maximum d.c. output current rating of from 0.5 to 1.1 ma, varying with manufacturer's specifications.

The final product of this design to date, the 1X2-B, is rated to withstand a maximum peak inverse plate voltage of 22,000 and can supply a maximum average plate current of 0.5 ma. The basing connections of the 1X2-B (Fig. 3) are the same as for the 1X2-A. Pins 3 and 7 of this double-ended nine-pin miniature half-wave rectifier may be connected to the filament. The filament voltage of the 1X2-B is 1.25; the filament current, 200 ma.

In late 1954 still another high-voltage

pioneer damper in color TV circuitry. Virtually every 15-inch color set used this octal type half-wave vacuum rectifier that was first announced in late 1953 for use with 90° picture tubes. Its only competitor was the 6AX4-GT used (two in parallel) in the Westinghouse H-840CK15.

Reason for the choice of the 6AU4 over the 6AX4 can be seen in their comparative ratings. The maximum peak inverse plate voltage rating of the 6AU4 is 4,500 as against 4,000 for the 6AX4; maximum peak plate current 1.05 amperes as against 600 ma; maximum d.c. plate current 175 ma as against 125 ma for the 6AX4. Each tube requires a heater supply of 6.3 volts with the 6AU4 drawing 1.8

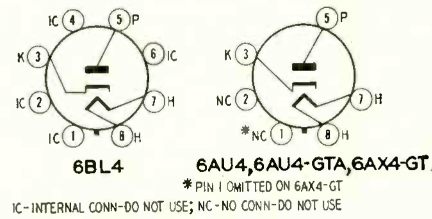
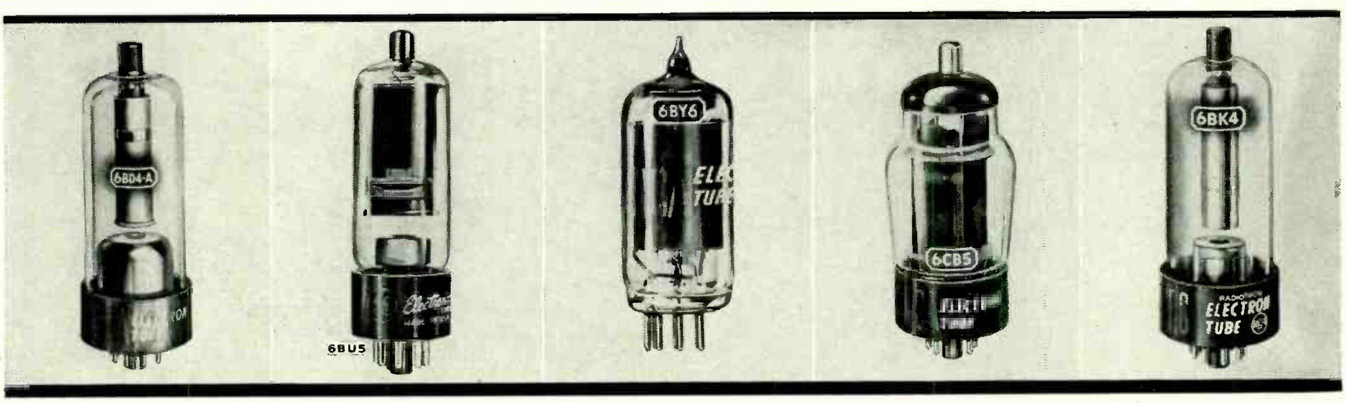


Fig. 5—New damper tubes for color TV.

amperes and the 6AX4 1.2 amperes. The socket connections (Fig. 5) for both tubes are identical.

The socket terminals for pins 1, 2, 4 and 6 should not be used for tie points, and the socket clips for these pins should be removed to reduce the possibility of arc-over and minimize leakage.

With the development of large-screen color TV, RCA announced the 6BL4 in late 1954. This extremely rugged tube was especially designed for use as a damper diode (Fig. 2) in color TV receivers. While having a peak inverse plate voltage rating of 4,500, the same as for the 6AU4, the 6BL4 can supply



Announced by CBS-Hytron in late 1955, the 6792 (Fig. 4) is the most recent development in the field of high-voltage regulator types. The 6792 is a beam tetrode designed for voltage stabilization from 3,000 to 25,000 volts and can be triode- or tetrode-connected.

Maximum ratings for the tube include: plate voltage, 25,000; plate dissipation, 25 watts; plate current, 1 ma; amplification factor, 1,515; heater, 6.3 volts at 450 ma.

The maximum ratings of the 6792 do

half-wave rectifier made its appearance. Used as a focus rectifier in the Westinghouse chassis, the 1AX2 may well give the 1X2-B some competition. Having the same base connections as the 1X2-B, the 1AX2 has a maximum peak inverse plate voltage rating of 25,000 with the usual average plate current rating of 0.5 ma. However, the 1.4 filament draws 650 ma.

Damper diode

The 6AU4-GT stands alone as the

a maximum peak plate current of 1.2 amperes and a maximum d.c. plate current of 200 ma. Furthermore, it carries a plate dissipation rating of 8 watts as against 6 watts for the 6AU4.

The price paid for using this tube is its heater consumption: 6.3 volts at 3 amperes, a husky 19 watts. The socket connections for the 6BL4 (Fig. 5) are the same as for the 6AU4.

A tube with a bright future in color TV is the 6AU4-GTA, an improved version of its namesake, the 6AU4-GT.

Both are identical in all respects except for two slightly higher ratings of the "GTA"—a maximum peak plate current of 1,150 and a maximum d.c. plate current of 190 ma. Thus while not as muscular as the 6BL4, its high ratings together with its comparatively low heater current of 1.8 amperes will probably make it a widely used tube. (In later production runs of the RCA 21-CT-661 this tube has replaced the 6BL4.)

Horizontal output

The horizontal-deflection and high-voltage circuits in 15-inch color receivers required no driving power that couldn't be supplied by tubes used for monochrome reception—in parallel. Stromberg-Carlson and General-Electric used two 6CD6's, Westinghouse and Arvin two 6BG6-G's. In the CT-100, RCA drove a 6CD6 very hard and managed to turn the trick with

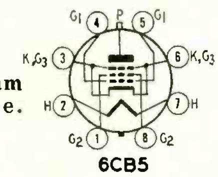


Fig. 6—Base diagram of the 6CB5 tube.

one tube. These beam-power tubes are very rugged, having maximum positive pulse plate voltage ratings of 6,600; a plate dissipation rating of 20 watts for the 6BG6-G and 15 watts for the 6CD6-G. Either could supply the driving power for the 15-inch color tubes, but not with ease.

In the recent CBS-Columbia 205 color TV chassis using the 19VP22, the horizontal sweep circuit is driven by two 6CU6's in parallel. This tube is a slightly heavier version of the 6BQ6-GT. It has a maximum positive pulse plate voltage rating of 6,000 but a plate dissipation rating of only 11 watts.

voltage rating of − 1,500. The tube (Fig. 6) has a 6.3-volt heater drawing 2.5 amperes; a high mutual conductance of 8,800 micromhos; high operating ratio of maximum plate input wattage to screen wattage (150 to 3.6 watts); a plate resistance of 5,000 ohms. The 6CB5 will very likely become a widely used horizontal output tube in color TV receivers.

The synchronous detector

No one tube has as yet dominated this application—various diode, triode and pentodes have been used. This circuit, receiving signals from the bandpass and subcarrier oscillator circuits, has mostly made use of the 6AS6 in early color receivers. The 6AS6 is a sharp-cutoff pentode designed so that grids 1 and 3 can each be used as independent control electrodes and has long found use in gated amplifier and mixer circuits.

Another tube commonly used in this application is the 6BY6, the I and Q demodulator in the RCA CT-100 and CBS-Columbia receivers. This tube is a pentagrid amplifier and its popularity seems to be gaining momentum. Announced by RCA in late 1953, the 6BY6 (Fig. 7) is a seven-pin miniature type intended especially for use as a gated amplifier in monochrome and color TV receivers. While presently being used as a demodulator (Fig. 8), it may very well find use as a combined sync separator and sync clipper.

Grids 1 and 3 have separate base terminals and can be used independently as control electrodes, each having sharp-cutoff characteristics. Grid 3 is designed to minimize secondary emission and the resultant possibility of blocking. Heater voltage is 6.3; current is 300 ma.

A considerable improvement in tube design for synchronous detection has been made with G-E's sheet-beam tube,

tive to variations in oscillator amplitude over a wide range. Its characteristics also made it useful in the burst gate circuit of color sets. Fig. 9 shows a typical application.

The heater of the 6AR8 requires 6.3 volts at 300 ma. In normal application, positive d.c. voltages are applied to the accelerator and plates.

The Westinghouse-designed 6DB6, intended for use as a color demodulator, was announced in 1954 but as yet has not made an appearance in color sets. It is a pentode capable of being driven harder and giving greater output than the 6AS6. The sharp-cutoff tube is a seven-pin miniature unit using grids 1 and 3 for signal application. The tube's output is linear for high levels of grid-3 drive. It features a minimum of interaction between the grids 1 and 3 circuits. The 6DB6 has a 6.3-volt, 300-ma heater.

The d.c. restorer

Appearing within a few months of each other are the 6BC7 of RCA and

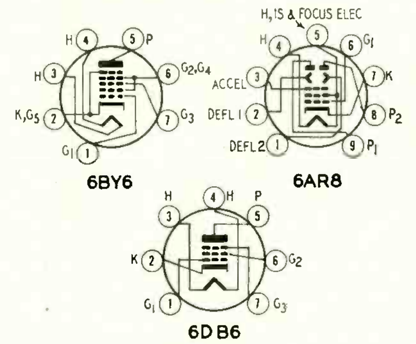
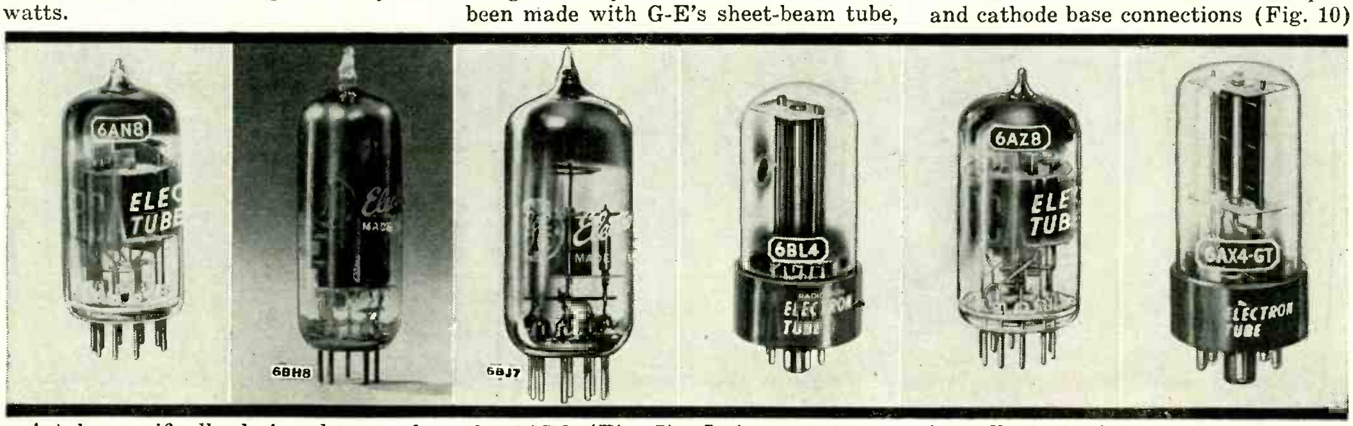


Fig. 7—Bases of new color detectors.

the 6BJ7 of G-E, triple diodes widely used as d.c. restorers in color TV receivers. Both are nine-pin miniature units containing three high-perveance diodes. Each diode has its own plate and cathode base connections (Fig. 10),



A tube specifically designed to supply the necessary 20 watts of regulated high-voltage power for the 21AXP22 is the 6CB5. This high-perveance beam-power tube was developed in late 1954 as a horizontal-deflection amplifier tube for color TV receivers—it does the job alone (Fig. 2).

The 6CB5 has a positive pulse plate voltage rating of 6,800 and a maximum plate dissipation of 23 watts. In addition, it has a peak negative-pulse plate

the 6AR8 (Fig. 7). It is a miniature double-plate unit having a pair of balanced deflectors to direct the electron beam to either of the two plates and a control grid to vary the intensity of the beam. This characteristic makes the 6AR8 especially suited as a synchronous detector in color TV sets.

The tube requires low oscillator injection power, is free from space-charge coupling effects common in dual-control pentodes and heptodes and is insensi-

is well shielded from the other units and either diode can be used independently.

The 6BC7 is somewhat more robust than the 6BJ7, having a peak inverse plate voltage rating of 300, a peak plate current per plate of 54 ma and a d.c. output current per plate of 12 ma.

The 6BJ7, while having a slightly higher peak inverse plate voltage rating of 330, has a peak plate current rating of only 10 ma and a d.c. output current

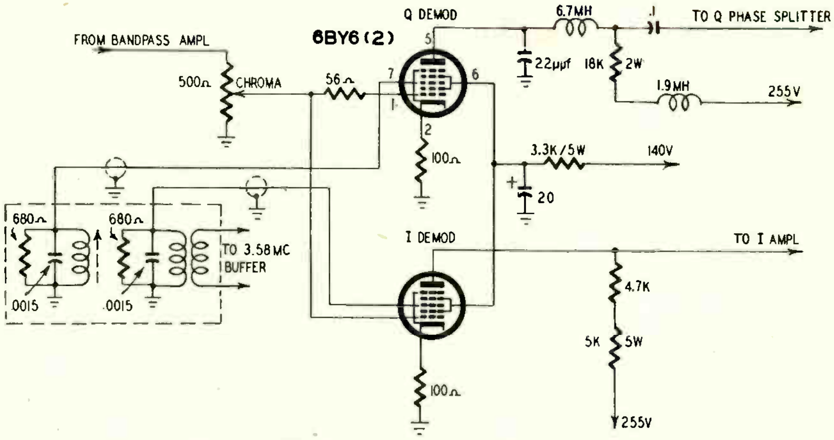


Fig. 8—6BY6's as I and Q demodulators.

rating of 1 ma. Fig. 11 shows 6BC7 circuitry in the CBS-Columbia 205 color chassis. Pin 3, connected to the internal shield, is grounded. The heater of each tube operates at 6.3 volts and 450 ma.

Power pentode

The 6CL6 (a miniature tube similar to the old 6AG7 metal), originally designed as a power pentode for use in the video output stage of TV receivers and as a wide-band amplifier tube for industrial equipment, saw comparatively little use in black-and-white TV. Not in its favor were its high heater requirements, 6.3 volts at 650 ma. However, as the first video amplifier in color TV sets it has come into its own. As such, it has the very responsible position of driving the second video (Y) and bandpass amplifiers.

The 6CL6 (Fig. 10) has a very high transconductance of 11,000 micromhos and provides a voltage gain of from 40 to 45 in wide-band video circuits. In typical operation in 4-mc-wide video amplifier circuits, the 6CL6 will provide an output voltage (peak to peak) of 132 with a control grid signal (peak to peak) of 3 volts. In some receivers the 6CL6 is also used as the second video amplifier.

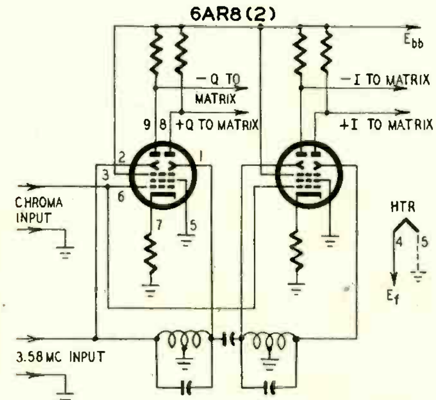


Fig. 9—6AR8 synchronous detectors.

General-purpose 6AZ8

This medium-mu-triode–semiremote-cutoff-pentode is fast becoming an electronic Available Jones. Announced in early 1955, it is one of many now appearing containing dissimiliar units within one envelope, thus reducing the number of tubes in TV receivers. The 6AZ8 was intended for a wide variety of applications in monochrome and color sets; it is a nine-pin miniature type and has proven highly versatile. In the RCA 21-CT-661, four 6AZ8's function as a second sync and second video i.f. amplifier, a vertical oscillator and first video i.f. amplifier, a bandpass amplifier and color killer, a 3.58-mc oscillator and B−Y amplifier.

The pentode unit has a high transconductance—6,000 micromhos—and its semiremote-cutoff characteristic minimizes cross-modulation effects and overload distortion in video i.f. stages. There are separate base pins for the cathodes. The suppressor grid and internal shield are connected to one of the heater leads.

The basing arrangement (Fig. 10) and internal construction of the 6AZ8 are designed so that coupling between the triode and pentode is virtually eliminated. Heater requirements are 6.3 volts and 450 ma.

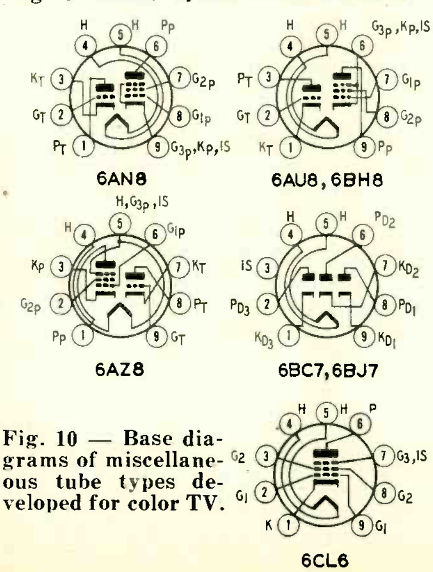


Fig. 10 — Base diagrams of miscellaneous tube types developed for color TV.

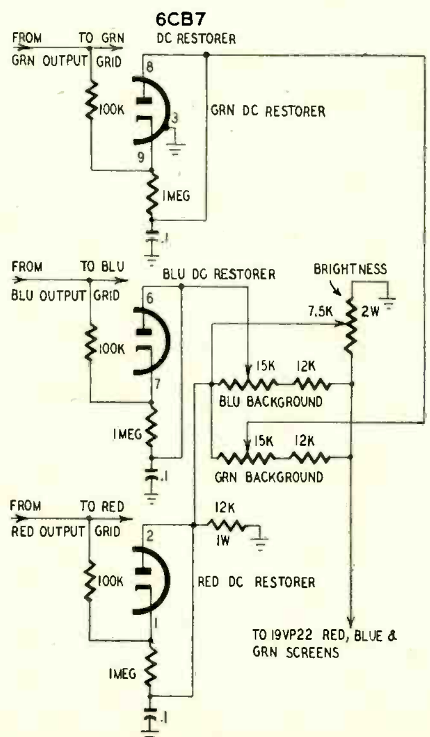


Fig. 11—Triple-diode d.c. restorer in the CBS-Columbia 205 color TV chassis.

General-purpose 6AN8

Staying right with the 6AZ8 as an all-around tube is the 6AN8, a medium-mu-triode–sharp-cutoff-pentode. The CBS-Columbia chassis uses six 6AN8's in such diverse applications as a reactance tube and 3.58-mc oscillator, I amplifier and I phase splitter, second video amplifier and Q phase splitter, a.g.c. amplifier and horizontal sync separator, 3.58-mc buffer and a.g.c. clamp, bandpass amplifier and color killer.

Intended for color TV receivers, the pentode section has a high transconductance of 6,200 micromhos. As with the 6AZ8, the coupling between the triode and pentode is virtually eliminated and their heater requirements are the same—their base connections (Fig. 10) are not.

Odds and ends

A major casualty of color TV has been the low-voltage rectifier tube. The very large B currents necessary have brought on the use of 600–700-ma selenium rectifiers in voltage-doubler circuits. Of course, color TV is not all to blame—the same trend exists in black-and-white television.

At this writing 600-ma series-string types are beginning to appear. Tubes such as G-E's 6AU8 and 6BH8, general-purpose sharp-cutoff-pentode–medium-mu-triodes (see diagram) are among the first of the controlled-warm-up units to be announced for color TV use. Certainly many more will follow. Base diagrams of these types are shown in Fig. 10.

Many old-timers still remain in the most recent of color sets. Units such as the 12BH7, 12BU7, 6U8, 6BL7, 6CB6 and 6AL5 perform important functions in color circuits. However, as color circuitry becomes standardized, it is more than likely that many of these will be replaced by units especially designed for color TV. END

improving your TV AUDIO

Using feedback and multiple speakers for better-quality sound

By NORMAN H. CROWHURST

THE televiewer is naturally more concerned about having a good picture to look at than about the quality of the sound that goes along with it. This fact seems to have been overemphasized in the minds of TV designers during the past several years, as shown by the audio section of the average TV receiver which has failed to keep pace with progressing audio techniques. True, some of the more recent models are now going to push-pull outputs and are feeding more than one loudspeaker, which *is* an improvement over the much more common single-ended output stage.

But designers seem reticent about making progress toward really high quality by introducing feedback which would reduce output stage distortion and provide better damping characteristics for feeding the loudspeaker. Sometimes even a little better speaker unit would produce considerable improvement. In other cases the addition of feedback, involving only one or two extra resistors and maybe a capacitor, will considerably improve sound-reproduction quality.

Many readers are high-fidelity enthusiasts as well as televiewers, and would appreciate knowing how to improve the audio quality of their own TV receivers. A number of things can be done. Your choice will depend on your facilities, how much work you want to put in and how much improvement you really want.

An improvement can be made simply by using a good external loudspeaker. This merely entails locating the connection to the voice coil of the speaker in the set, disconnecting it and connecting a better speaker in its place. If the speaker in the set uses a field coil, do not disconnect it as it also serves as a filter choke in the receiver.

Using your hi-fi system

For the man with a high-fidelity setup a very simple method of bettering TV sound reproduction is to feed the audio through the hi-fi system in place of, or in addition to, the existing TV sound. To do this connect a two-wire conductor from the outside pair of terminals on the set's volume control (Fig. 1), using shielded lead, to the "radio" input of your preamplifier or hi-fi amplifier. (It must be a high-impedance input.)

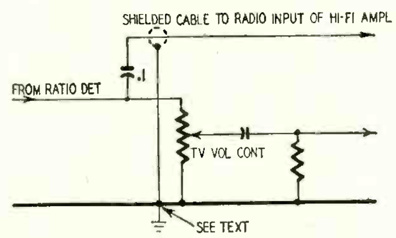


Fig. 1—Sound take-off from TV set.

(If the TV set uses a voltage-doubler in the B supply or has a series heater string with one end connected to the chassis or B minus, connect a small 600-volt blocking capacitor between the low end of the volume control and the shield on the audio cable. Ground the braid only at the amplifier end of the cable.—*Editor*)

The volume control on the hi-fi system will then control the level from the system speaker; the set's volume control will determine the volume coming from the set. This gives independent control of volume from each. Leave the set control off, and all the sound will come from the hi-fi system. Adjust balance, and pleasing effects can be obtained.

Many will not want to tie up their hi-fi system in this way but will prefer to improve the quality delivered by the set's loudspeaker. Practically all television receivers have a two-stage single-ended audio amplifier using a triode for the first stage and a pentode for the output stage. The principal fault with this arrangement is that the pentode has a plate resistance of about 10 times its optimum load resistance. Hence the loudspeaker is fed from an amplifier having a damping factor of about 0.1. This means that the natural resonance of the loudspeaker with its enclosure—in this case the television cabinet—tends to be emphasized considerably. The rise at the high-frequency end of the response, due to the voice coil inductance, is usually offset to some extent by an equalizing capacitor connected across the primary of the output transformer.

Applying feedback

The best way to step up performance is to apply feedback so as to improve this damping factor, in which case the equalizing capacitor connected across the output transformer can be removed —feedback will take care of this function much more effectively.

If we apply enough negative voltage feedback to change the damping factor from 0.1 to some value greater than 1, the audio chain will have insufficient gain because the change will reduce gain over 20 db. But remember that positive current feedback, as well as negative voltage feedback, has the effect of *reducing* source impedance. Positive current feedback increases the gain; negative voltage feedback reduces it. If we use the same amount each of positive current and negative voltage feedback, we shall end up with the same gain we started with and improve the damping factor twice over.

Assume that we adjust the current feedback to give a gain just 4 times the original and then apply voltage feedback to reduce it again to its original value. This will increase the damping factor by 16 times which will considerably improve the response and performance of the loudspeaker in its enclosure. As the voltage feedback is over a longer loop than the current feedback, the distortion will show overall reduction too.

While audio circuits are very similar in all recent TV receivers, there are three principal variants that require separate consideration on how to apply this method, so we will take each in turn. The first thing to do in each case is to remove the capacitor connected across the output transformer primary.

Variant one

This is represented by the typical circuit in Fig. 2 and uses a 6V6, 25L6, 6K6 or 6AQ5 in the output stage, preceded by a 6AV6, 6SQ7, 6T8, 6AT6 or half of a 12AX7 or 6SL7 in the first audio stage. All these are high-slope tubes with an amplification factor of 70 or 100, and usually the circuit uses contact bias provided by a very large resistance (R1) in the grid circuit, the cathode being grounded.

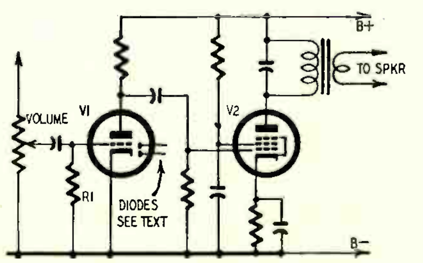


Fig. 2—Schematic diagram of the audio output circuit for variant one.

Most of these first audio stage tubes include diodes using the same cathode as the triode section. If these diodes are used for some other purpose in the circuit, consideration will need to be given as to what arrangements can be made to take care of their function. In many circuits, however, particularly those using the 6AV6, the diodes are not used, being either grounded along with the cathode or left unconnected. In these circuits no problem arises about the diodes. But where the diodes are used the problem is discussed after variant two, which is similar in this respect.

The output tube (V2) in this variant uses a cathode bias resistor; in some instances it will have a bypass capacitor connected across it. To apply current feedback we want to use the cathode resistor unbypassed; so if a bypass capacitor is used, it should be removed.

Next, insert a 470-ohm resistor (Fig. 3) between the cathode of V1 and ground. This will produce a small bias voltage, but less than the full operating bias of the tube. So now the value of R1 can be reduced and the operating bias is correct. Probably a value of

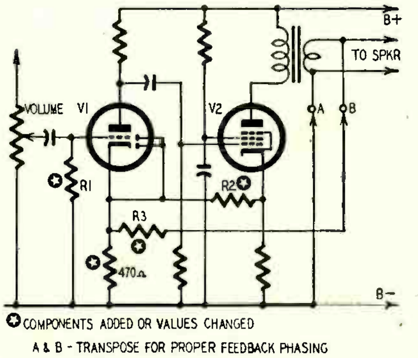


Fig. 3—Fig. 2 modified for positive current and negative voltage feedback.

2 or 3 megohms will suit in place of the 6.8 or 10 megohms used previously. The correct value can be checked by measuring the plate voltage on this tube which should be the same as in the original circuit.

Now we are ready to apply current feedback. Calculating the resistance value required is a little involved and the easiest method is: Connect a potentiometer of, say, 100,000 ohms between the two cathodes in the position shown as R2 in Fig. 3; adjust this pot until the amplifier just goes into oscillation. If oscillation starts as soon as the potentiometer is connected and adjustment will not stop it, put another fixed resistor of, say, 47,000 ohms in series with the pot and adjust until the oscillation stops. Then reduce the resistance until it just starts. Next, carefully remove the variable resistor (with the fixed one if used), taking care not alter its setting and measure its value (the two in series where a fixed one is added). This value causes oscillation. The value for positive feedback to give approximately four times the gain without feedback will be three-quarters of the value measured.

Obtain a resistor of this calculated value and connect it in the position shown as R2 (Fig. 3). For example, if the resistor that caused oscillation measured 90,000 ohms, the value required will be about 68,000 ohms. A close-tolerance component should be used or else the values selected with an ohmmeter or bridge to be as close as possible to the desired value.

We are now ready to apply the negative voltage feedback. This should be taken from the secondary of the output transformer by connecting one side of it to B minus and the other side, through a suitable resistor (R3), to the cathode of V1. The same variable resistor can be used to find the correct value by adjusting it until the gain is the same as without feedback connected. But first be sure the phase is correct: if *reducing* the feedback resistor *increases* gain instead of reducing it, or if the set oscillates in any position of the resistor, the phasing is wrong—reverse the secondary connections. Then adjust to give the same gain with both feedbacks connected as without either.

This adjustment can be made by unsoldering the two return points on the cathode of V1 (R2 and R3) connecting them, and tapping them both onto the cathode together; then adjust the variable (R3) until there is no change when the feedback resistors are contacted to the cathode—no change in level, that is. There may be an improvement in quality—in fact there should be! This will find the condition when voltage and current feedback are equal. Finally the resistance can be measured and the nearest standard value of fixed resistor wired in its place. The value of R3 is not as critical as that of R2, but the nearest standard preferred value should be used.

Variant two

The remaining two variants both use the output stage to provide a regulated voltage tapping for other points in the receiver, usually in the region of 125 to 150 volts (the exact voltage varies with individual receivers). This voltage is obtained from the cathode of the output stage and some method has to be used to insure that the d.c. grid

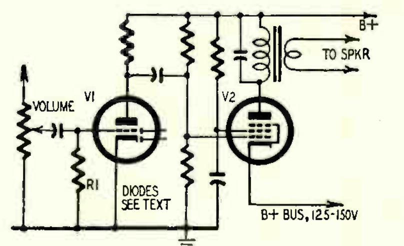


Fig. 4—V2 grid voltage established by voltage divider from B plus and ground.

voltage is just a few volts negative of the required cathode voltage, because this is what controls it. The difference between the remaining two variants is in the method of setting this d.c. grid voltage.

In the circuit of Fig. 4, this voltage is set by connecting the grid of V2 to the junction of two close-tolerance resistors connected from B plus to ground. The audio signal is then capacitively coupled from the plate of V1. In this circuit the tube used for the output stage is either a 6AS5, 6V6, 6W6 or 6Y6, and the first audio stage is usually one of the same group as for the first variant.

The first thing to do in this case, after disconnecting the capacitor on the output transformer primary, is to insert a cathode resistor in the output stage to provide current feedback and at the same time adjust the circuit so the voltage fed to the rest of the circuit is still correct. Values suggested for cathode resistor R5 in Fig. 5 are: 150 ohms for high-slope tubes such as 6W6, 25L6 or 6Y6; 330 ohms for the 6AS5 or 6V6. This resistor does not serve as

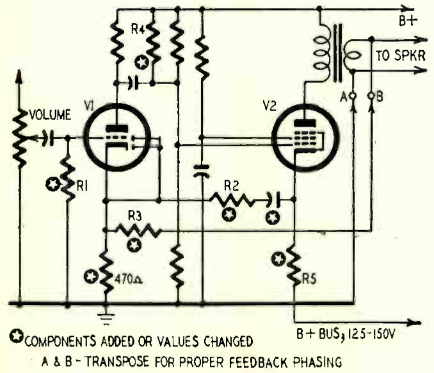


Fig. 5—Schematic diagram of the audio output circuit for variant two.

the normal bias resistor but provides an audio potential for current feedback.

Having inserted this resistor in the cathode return, the top end of the voltage divider arrangement should be shunted with a high-value resistance R4 of about 10 megohms. This is to raise the voltage at the grid of V2 so that the voltage at the bottom end of R5 is the same as the original cathode voltage. In this way the rest of the circuit gets the right working voltage, but the cathode and grid voltage on V2 have to be a little higher.

The first stage can now be modified in the same way as for the first variant by inserting a 470-ohm resistor in the V1 cathode return and modifying the grid resistor so the plate voltage is approximately the same as in the original circuit. This was described in variant one.

In connecting the current feedback for this and the final variant, a blocking capacitor is needed in series with R2 because the cathode of V2 is more than 100 volts higher in voltage than the cathode of V1. The value of this capacitor is not likely to prove critical. For good low-frequency response when the circuit is completed, a 4-μf 200-volt electrolytic capacitor may be used.

The same method as described before can be used to find the correct resistance value. One observation, though: If oscillation, like motorboating, starts at a very low frequency it is due to a low-frequency phase shift effect and a different value blocking capacitor should be tried. But this is unlikely. The oscillation usually starts at a frequency somewhere in the middle of the audio band and is of rather poor waveform, indicated by a rough sound.

Finally, negative voltage feedback can be applied from the output transformer secondary to the cathode of V1 as described in variant one and the finished circuit will be as at Fig. 5.

The diode problem

In both the foregoing variants, the first stage use a grounded cathode. And in many instances diodes, using the same cathode of V1, perform the a.g.c. or some other function in the set. The d.c. voltage drop and also the audio component caused by inserting the 470-ohm resistor between cathode and ground will interfere with the correct operation of these diodes, so some other arrangement will have to be made to take their place.

The exact replacement that can be made will depend upon the component values in the rest of the circuit to which the diodes are connected. Sometimes the two diodes are strapped together in parallel, so as to perform as only one diode. Then, of course, only one diode will be necessary to replace the original two.

In some circuits a crystal diode could be used, either one of the high-back-resistance germanium types such as a 1N63 or 1N65 or else a 1N21 silicon type. In fact, one of these or another should prove successful for most receivers. But in some cases even the high back resistance of these types will not be high enough for the rest of the circuit, so a leakage will upset the operation of the set.

In such cases a thermionic diode (tube) must be substituted. The problem then is where to put it and how to connect in its heater. If the set uses parallel heaters on 6.3 volts, a 6AL5 or 6AN6 should serve, provided the transformer will supply the extra 0.2 or 0.3 ampere necessary in addition to its present load. TV heater windings have to be liberal to supply the large number of tubes in the set, but there is a breaking point. The best way to check is to measure the voltage on the heaters and see if connecting the diode drops it seriously. The cathode should be connected to ground and the diodes to the wires removed from the original diodes. If a 6AL5 is used, both cathodes must be tied to ground. If a 6AN6 is used, two diodes can be strapped together to each wire.

If the set uses a series-connected heater arrangement, a suitable point will have to be found to connect in a heater for the diode, using a type with the correct heater current to suit the chain, such as a 12AL5 or 5AL5. The extra voltage required by this heater will mean that the other tubes will be running a shade low in heater volts. Check that this does not drop by more than a volt per tube (except for the heaters with a big voltage drop where a larger drop is permissable).

The miniature types mentioned can be hung in the wiring—or rather the socket can—if it is not possible to find space to make an additional hole or if you do not have facilities for making holes. If the set has to be transported at any time, it would be a good idea to find some way of tying the tube down so it cannot break loose. The subminiature types are even easier to hang in the wiring and the British Mullard type EA50, taking a heater supply of 6.3 volts at 0.15 ampere, would serve excellently.

Variant three

The final commercial circuit we shall consider here uses a different method of controlling the voltage on the grid of V2, shown in Fig. 6. First audio stage V1 is usually a 6AV6, 6C4 or half of a 6SN7 and is biased by a cathode resistor. The value of bias resistor, in conjunction with the plate resistor, controls the plate voltage reliably, and the grid of V2 is fixed by being direct-coupled to the plate of V1. Sometimes the cathode resistor of V1 is bypassed by a capacitor. If used, it will have to be removed before applying current feedback.

Some of these circuits also have a low-value resistor in the cathode circuit of V2 which will prove convenient for picking off the current feedback. However, sometimes this too has a bypass capacitor which will have to be removed. If no such resistor is provided, a suitable value will have to be inserted and the grid voltage adjusted so the bottom

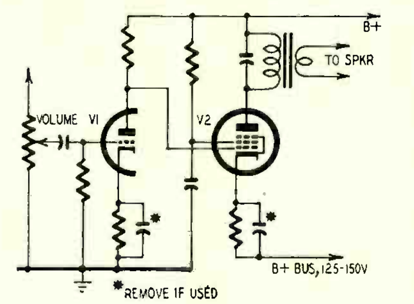


Fig. 6—V2 grid voltage established by direct coupling to plate of V1.

end of R4 (Fig. 7) shows the same voltage as the cathode of V2 did in the original circuit. This is done by connecting a high-value resistance R1 in parallel with the existing V1 plate resistor. Adjust the value until the right voltage appears at the bottom end of R4. A suitable value for R4 in this circuit is 150 ohms if V2 is a 6W6, 25L6 or 6Y6; 330 ohms for a 6AS5, 6V6 or 6K6.

The diode problem does not arise in

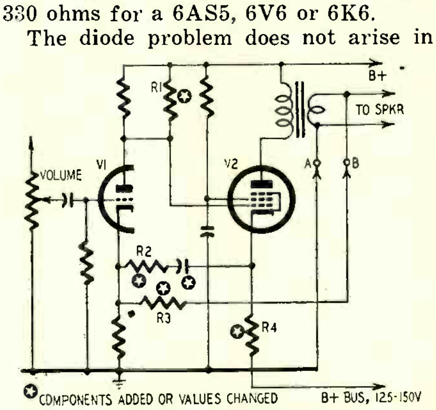


Fig. 7—Schematic diagram of the audio output circuit for variant three.

this circuit—the 6C4 and 6SN7 do not have diodes and where a 6AV6 is used for V1 its diodes are either tied to ground, cathode or left unconnected.

Positive current feedback is next applied as described for variant one, using the blocking capacitor as in variant two. Finally the negative voltage feedback is applied from the output transformer secondary as described in variant one.

What improvement?

The foregoing discussion covers the great majority of television receivers at present in service, and the changes described will better the sound quality of the set. But it is nice to know just what sort of improvement to expect.

Most TV receivers have two very marked resonances in their response: one in the lower frequencies due to the resonance of the loudspeaker diaphragm with the cabinet acting as an enclosure; the other at a higher frequency due to the parallel resonance of the equalizing capacitor across the output transformer primary with the voice coil inductance. In TV audio designer's parlance, these resonances provide the "pleasing bass" and the "treble brilliance." But no hi-fi enthusiast is deceived!

The changes described in the foregoing three variants will give a true wide-range response in place of this phony two-resonance imitation because the speaker damping factor will be raised from the region of 0.1 to about 2.

But what about harmonic and intermodulation distortion? The current feedback will not appreciably increase this because its effect is to modify the operation of the output tube so that more second harmonic and less third are produced—which at least reduces the annoyance factor of the distortion. Then the voltage feedback brings the actual distortion value to a lower figure than the original. But an effect that normal distortion measurements will not show up is the reduction in the emphasis which the straight pentode circuit places on higher harmonics, both in program and distortion. This is caused by the speaker impedance characteristic in conjunction with the tube characteristic when no feedback is used, but the improved damping factor eliminates it to all intents and purposes.

If the loudspeaker is correctly matched to the output stage this modification should also result in considerably more output being apparent before overloading begins. By correct matching, we mean that its impedance in the region from 600 to 1,000 cycles should be matched to the optimum load value for the output tube. But often, to avoid producing distortion at the dominant frequencies (the pleasant bass and brilliant treble!), the impedance of the speaker at its low-frequency resonance and the dynamic impedance produced by tuning the voice coil inductance with the primary shunt capacitor, is what is matched to the optimum load for the tube. In this case, further improvement by way of increased output can be achieved by changing the matching.

Multiple speakers

A convenient way of killing two birds with one stone here is to add an extra speaker, identical to the one already in the set, and connect it in series with the existing one. This will give the advantage of two speakers in improved realism, increase the effective sound output and correct the matching at the same time.

Where the existing speaker is mounted in one side of the cabinet, the additional one can be mounted in the opposite side (Fig. 8). This will give balance to the reproduction and a surprising approach to stereophonic effect. Then the TV sound will be far more realistic than it ever was with the inferior reproduction over a single unit. But the question of phase comes in here. The extra unit must be connected properly to give correct phase in the combined reproduction.

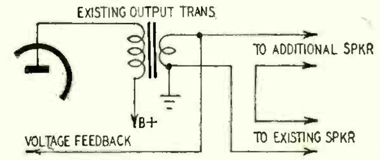


Fig. 8—Adding another loudspeaker.

With the loudspeakers mounted in opposite sides of the cabinet there is not a very ready way of checking phasing; the best way is to judge from the effect it produces on program presentation. Incorrect phasing will give the sound an unnatural effect, as if it has nothing to do with the picture—although, of course, it will be synchronized. Correct phasing will give sound that seems to "fit the picture" better. Try it for a while with the extra speaker connected each way and decide which is best after careful listening.

A better method of connection, from the viewpoint of loudspeaker operation, is to connect the two units in parallel rather than in series. But this requires the use of a different output transformer. However, if you really want to go to town on improvement, you could use two slightly larger speakers than the 5-inch one the set probably came with. Then install a new output transformer designed to match the optimum load of the output tube to the impedance of the two units in parallel. Don't forget to check for phasing here also.

If you decide to change the speaker-matching arrangement by making any of these additions, the adjustment of current and voltage feedback, as described earlier, should be conducted *after* the new transformer and loudspeaker units have been installed—the loading of the output stage will alter both current and voltage feedback and throw the values out of balance.

When you have gone through this routine once, you will be familiar with it, so having made the set work successfully with the existing speaker, you will probably want to go on and try the effect of better speakers or speaker arrangement. As you have already the spare potentiometer with which you made the adjustment the first time, there will be no problem in going over the whole procedure again and setting the values to suit the new speaker arrangement.

The improvements described in this article will be found to be considerable when one considers the limitations imposed by having to get them into the existing set. END

CASE OF THE SELF-TURNING TRIMMERS

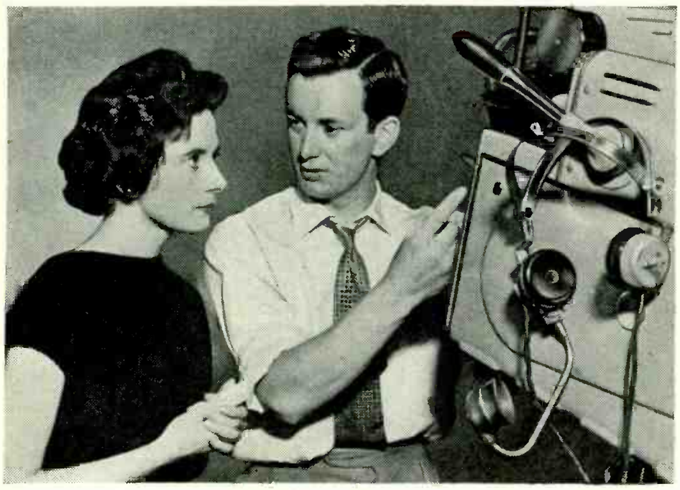
THE owner of a nondescript table model a.c.–d.c. receiver came into the shop complaining of its sensitivity and selectivity. I went out to his house to inspect the five-tuber. With the volume control full on I could hear some local stations but that was about all. It looked like a case of bad alignment, and after taking the chassis from the cabinet I noticed that the iron slugs in the two i.f. transformers were turned down—nowhere near their correct setting.

Fortunately, the oscillator was in the truck and I aligned the receiver. The difference in performance was amazing and I made a slightly vinegary remark about tampering with the screws as I left.

I was very surprised the next day when the customer called to say that the set had played well for most of the previous evening but had become gradually weaker and was now as bad as ever. I made my way back to the house expecting to find a bad tube. Instead, when I removed the chassis, I found the i.f. cores screwed all the way down. My thoughts were quite unprintable, but I was assured that the chassis was not touched.

About this time, I was struck by an awful thought and gingerly screwed the nearest slug up again with my fingers—the darned thing was loose as that. Up it came, first through one peak, then out of resonance again as it passed through the winding, then to the other and proper peak. I followed the same course with the other slug and then turned the volume up. The slugs, almost imperceptibly but very surely, began to dance themselves down with the vibration from the speaker. I fixed the trouble with a lump of paraffin.

Never again would I align a receiver without sealing the cores and trimmers when finished.—*George R. Anglado*



BRITAIN TAKES ON COMMERCIAL TV

By T. W. DRESSER

Camera operator explains equipment to girl video mixer

TOLL TV, pay TV or whatever you like to call it, has for the past two years occupied the attention of the American public to the exclusion of many other important things. Over the same period the British public has been just as absorbed in the reverse of the same thing—whether the country should have free TV — TV paid for by the advertisements it carries. Britain has heard the same acrimonious debates and arguments that pay TV has roused in the States, the same gloomy forecasts that it would kill the entertainment business and the same threats that if it came about this and that organization would not touch it, which would automatically insure its failure. But, despite all the eloquence expended on the subject, Britain for the first time in its radio or TV history has been looking at and liking commercial programs.

In the States much depends, as far as pay TV is concerned, upon the FCC. If that body is agreeable, pay TV is on the air. In Britain it requires an act of Parliament. Only after that has gone through can the postmaster general grant frequency channels to a new broadcasting organization. Commercial TV was sanctioned on July 30, 1954.

The bill was put through only after a bitter debate in the House of Commons, in which the Socialist Party made it quite plain that if they secure power at a future election they will promptly remove the act from the statute book and kill commercial TV forthwith! Generally this is considered an idle threat. The fact that the people like it and now demand it would deter any politician from such a step.

The setup for the commercial network is considerably different from either current American practice or that of the BBC, which had a monopoly of all radio and TV services before the organization responsible for the new programs was formed. The Act of July 30, 1954 created a semi-official body named the Independent Television Authority, which is responsible for putting the programs on the air and used Government funds to the tune of $8,000,000 to commence operations. The act stipulated that this loan has to be repaid over the next 5 years. By its charter the ITA is empowered to:

1. Plan the overall setup of commercial TV in the country.
2. Insure the widest possible access to the new service in order to prevent the rise of another monopolistic body like the BBC.
3. Choose *program contractors.*
4. Design, build and operate the transmitters for the new service. These will remain the property of the ITA and neither the Government nor the program contractors have any hold on them.
5. Supervise the ethics and general standards of the programs originated by the contractors.

The ITA has nothing whatever to do with the origination of programs or the medium by which the video signals are piped to the transmitter building. These functions are solely the province of the program contractors who deal directly with the advertisers. These contractors originate the programs and while they have a free hand to a large extent they are prevented by law from devoting more than six minutes in every hour of program time to actual advertising material. Moreover, it is stipulated that advertising matter can be inserted only at the beginning and end of programs and during "natural breaks." Still further, advertisers have no say in the main program material whatever. They can stipulate the time they wish their ad to appear, and the actual advertising material — usually a 30-second or 1-minute film run — is largely left to them if it conforms to ITA's code of ethics. That is all they are permitted.

The charge for time has been fixed arbitrarily by all the contractors at around $2,800 a minute for peak viewing hours with pro rata figures for off-peak times. Contractors have lined up a glittering galaxy of talent for their shows, including most of the top-flight American stars as well as all the leading figures in British show business. When the service first commenced, there was a prospect the BBC service would go off the air due to the pirating of their program stars as well as technicians by the commercials contractors.

One notable result of the opening of commercial service was this wholesale importation, on film, of popular American programs and personalities and the adaptation of anglicized versions of other U. S. shows, says the British Information Service in a release intended for American circulation. "I Love Lucy," "Dragnet," Roy Rogers and Liberace are well on the road to fame in London. The giveaway program, too, is creeping in. "Double Your Money," run by a lively young Canadian, Hughie Green, has a top prize for general knowledge answers rising to nearly $3,000. "People Are Funny" has also migrated from Hollywood and, while its brash practical joking annoys some professional newspaper critics, there are grave suspicions that sections of the public enjoy it. Certainly the victims accept washing machines and TV sets as gifts with marked equanimity.

Problems of conversion

The country was well blanketed with publicity advertising these attractions prior to the opening of the service but for some time public interest was difficult to assess. There were a number of reasons for the apparent apathy. To begin with, to convert his equipment to cover commercial TV as well as the BBC service involved John Citizen in a not inconsiderable financial outlay. He wanted to be sure he would get value for his money before he committed himself to that. The 14 BBC stations, ranging in power from 10 to 100 kw (ERP), all carry the same program. As a result TV receiver manufacturers have turned out only fixed-tuned models to cover the nearest station to the area in which they were to be sold.

These BBC stations operate in band I (41–65 mc). While the high-powered ones radiate a vertically polarized signal, the low-powered are horizontally polarized. The commercial stations, each of 100 kw, operate in band III (176–214 mc) and all use vertical polarization. Therefore the prospective viewer of commercials has either to purchase a converter (cost $15 to $30) or buy one of the new 13-channel receivers at $180 to $240. In both instances he would also need an additional antenna at a cost of $18 upward. If he also wished to get the new BBC FM transmissions in band II (87.5–100 mc) due to come into service this month, he would require still more elements tagged on to the weird erection surmounting his roof. His home, which used to be reckoned his castle, would begin to look more like a space ship than a miniature baronial hall!

Evidence that John Citizen was holding off came from a research survey—designed to test public enthusiasm—which came up with the following figures for the London area:

Receivers ready for the new service 19%

Viewers prepared to convert for commercial TV 25%

Waiting to see if programs are worth the cost of conversion 38%

Will not convert 17%

Three days before the London commercial station was due on the air these figures were made meaningless by a sudden rush on the part of the public to have their TV's converted for the new service. To date the dealers still have a backlog of two to three months' work on present orders.

The transmitting net

The first two of the commercial stations serve the London and Birmingham areas. The London antenna tower is 500 feet high and will be shared with the BBC, each party having a separate antenna mounted on it. A further station—to serve northwest England, parts of Wales and the Midlands—is scheduled for service next month or early March. This station will cost $560,000 and the studios to feed it, which will be built in Manchester, will run away with another $2,800,000. Like the Birmingham station, it will provide a program for something like 7,000,000 viewers. Other transmitters due to come into operation this year will extend the service to cover all thickly populated areas.

Eventually a network of 25 stations will cover the country from Land's End to John O'Groats, but the ITA does not propose to stop there. According to Sir Robert Fraser, ITA chief, they do not intend restricting competitive TV to one alternative to the BBC program. As long as advertisers believe in the medium of TV (and the tremendous success of American commercial TV shows no slacking off) there is no reason why there should not be two, three or even more commercial TV stations for each area of Britain, competing with the BBC and with each other, but all of them under the wing of the ITA.

The transmitters, antennas and most of the studio and film projection equipment of the commercial studio centers and transmitter buildings are of Marconi, EMI or Pye manufacture. A considerable amount of RCA apparatus has been purchased by Associated-Rediffusion, Monday-through-Friday program contractor for London and one of the biggest organizations in the business. This firm also uses four outside broadcast vehicles, or remote telecast units as they term them (two of Marconi manufacture, one Pye and one RCA), all of them three-camera units. These vehicles require 8 kw of power for operation. This can be taken either from the nearest utility supply or from a mobile generator trailer.

Since the new service was first mooted a remarkable degree of cooperation has grown up between the program contractors and the TV dealers. Week by week until the commencement of the programs the contractors furnished new material for dealers' counters and displays. In addition, they advertised in towns in the service area extremely effectively. The dealers reciprocated by supplying the contractors with figures for receiver conversions and new installations which enabled them to form a fair estimate of the probable number of prospective viewers on opening day. A similar degree of cooperation has also been a feature of the relations between equipment manufacturers and contractors. As late as last May the only source from which the contractors could secure trained studio and outside broadcast van (truck) technicians was the BBC. Wholesale pirating from that source would have jeopardized that service (as indeed it did for a time about the middle of last year).

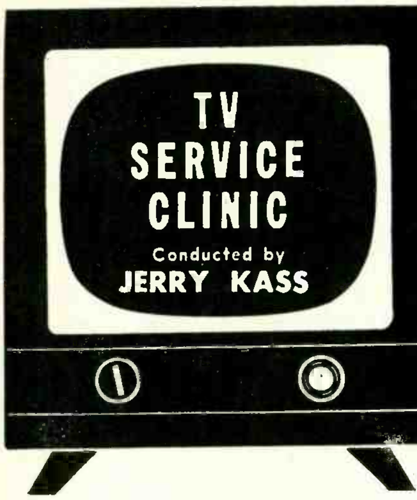
The alternative was to train their own crews under actual "on the air" conditions, but at that time there was neither a suitable place nor available spare equipment for the purpose. The Marconi Co., principal suppliers of equipment to the program people, filled the gap by furnishing a former theatre with cameras, control gear, mikes, trucks and sets and installing a typical control room set-up. This Marconi TV center with its stage of 2,000 square feet has since been used for training over 100 technicians for such jobs as video and sound mixing, camera and boom operation, floor management and lighting engineering. These technicians—selected from some 4,000 applicants—have been given an intensive course in practical operation of TV gear. They have worked as teams in the studio, in the control room, on the film projection apparatus and with the mobile telecast van. As a result they went on the air for the first time like old hands, with the confidence which comes from familiarity with one's equipment, although a few short weeks before they had been complete greenhorns.

The commercial programs were welcomed from the first as good competition for the BBC and likely to stir that august body into some semblance of life. Apart from that the majority of British viewers kept an open mind, preferring to wait and see what sort of a show the commercials made before passing judgment. Now, it can be safely said that viewers are all for them. They provide a refreshing change to the BBC programs, although under the spur the latter have improved enormously. They have brought Burns and Allen and have started modest give aways with the maximum prize of a camera and scored a big success over their rivals by securing an Anglo-Russian boxing match. But the commercials can give viewers a wealth of varying programs it would be impossible for the BBC to put out on its restricted budget. And all this from the proceeds of advertising! The commercials get nothing out of the $8.40 per annum each British viewer pays for the privilege of looking at TV; the BBC still gets it all. The viewer is happy though; for the first time in his life he is getting something for nothing (he thinks) and many figure that there is a chance, given time, of the commercials taking over completely and then it would all be for free.

As Roland Gillet, program chief of Associated-Rediffusion, succinctly put it, "The public are the bosses. If they like our programs, we go on. If they don't, we go off. But we'll take care that they do."

So far they do. The commercial audience increases each day and TV manufacturers have quit making fixed-tuned television receivers. Nobody wants them; they won't pick up the commercials! END

A view of the control room in Associated-Rediffusion's Wembley studio. The operators are—left to right—the program producer and vision mixer.



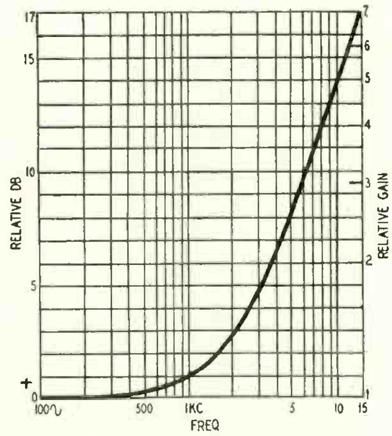


Fig. 1—Standard 75-microsecond pre-emphasis curve for FM and TV sound.

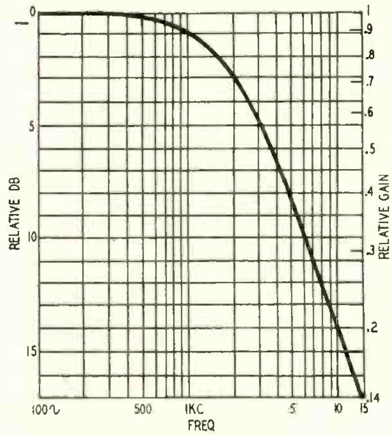


Fig. 3—An ideal de-emphasis curve.

THE audio-frequency range transmitted on the FM sound carrier of a television broadcast is considerably wider than that used in conventional AM broadcasting. Many local TV stations transmit an audio range of 50 to 15,000 cycles. (Cross-country lines carrying network programs will have a much lower audio range due to the frequency limitations of these cables.)

The higher audio frequencies are generally of lower amplitude than the low frequencies and thus produce comparatively little frequency deviation (in FM, frequency swing is proportional to the amplitude of the audio signal). Thus, interference (atmospherics and transmitter noise) would produce the greatest noise-to-signal ratio at the higher audio frequencies. To counteract this condition, FCC standards provide at each transmitter for a pre-emphasis network consisting of a high-pass filter having a time constant of 75 microseconds.

The amount of pre-emphasis applied at the transmitter ranges from a gain of 1 at 50 cycles to a gain of 7 at 15,000 cycles (Fig. 1). The rise is very slow to about 500 cycles; from there it increases rapidly. This pre-emphasis increases carrier swing at higher frequencies and minimizes the effects of atmospheric and transmitter noise reaching the receiver.

This procedure introduces tone distortion which, if not compensated for in the television receiver, produces accentuated treble. However, compensation consisting of a de-emphasis network — a low-pass R-C filter — also having a time constant of 75 microseconds is applied in the TV receiver.

De-emphasis can be applied at any point in the audio amplifier, but general practice has been to install the R-C filter at the output of the sound detector. This attenuates the higher audio frequencies immediately and reduces the possibility of regeneration in the sound section of the set.

The exact values of the R-C de-emphasis network vary with different receivers. With the low-pass filter connected across the output of the sound detector, the time constant must also include the various shunt capacitances in the circuit. Thus, while a 75-microsecond time constant is used, the physical values of R and C vary with different receivers. In each case, however, the low-pass filter shunts the higher audio frequencies to ground to a greater extent than the lower ones.

Thus, the amplitude of the higher audio frequencies, that were increased before modulation at the FM transmitter to increase the signal-to-noise ratio, are now attenuated to the same extent.

It might appear that the pre-emphasis–de-emphasis arrangement is of no advantage because it leaves us where we started—however, that is just the idea. Since noise reaching the FM receiver is generated during and after modulation, pre-emphasis is applied at a low-level audio stage before the interference is produced. Thus, the signal-to-noise ratio of the higher-frequency audio signals transmitted is increased. When the audio-frequency signals and noise are reduced by the de-emphasis network in the television receiver, the signal is restored to its original value while the noise is reduced to a below-normal value.

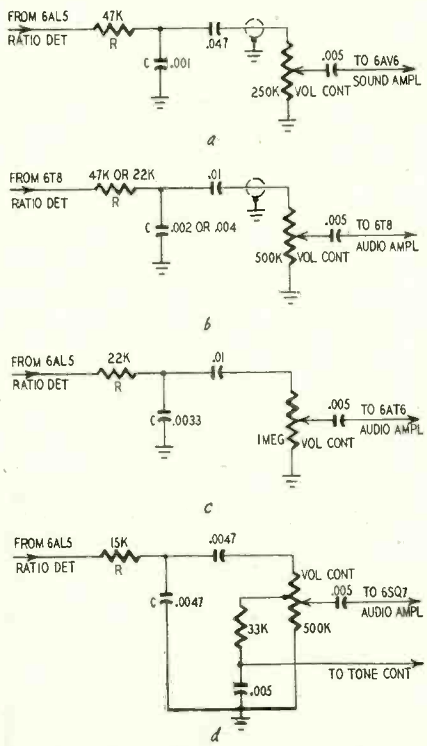


Fig. 2—De-emphasis networks in some Admiral, G-E, Du Mont and Hoffman TV sets are shown in circuits *a* through *d*, respectively.

Commercial circuits

Fig. 2 shows several de-emphasis networks used in the audio section of present-day television receivers. Fig. 2-a is the circuit used in the Admiral chassis 21B1. Resistor R is 47,000 ohms, capacitor C is .001 μf. Fig. 2-b is the circuit used in the G-E model 21C225. R is either 22,000 or 47,000 ohms, C is .004 or .002 μf. Fig. 2-c is the network used in the Du Mont RA-166 chassis. Here R is 22,000 ohms and C .0033 μf. Still another de-emphasis network, used in the Hoffman 195 chassis, is shown in Fig. 2-d. The resistor is 15,000 ohms and the capacitor .0047 μf.

While the various resistance and capacitance values appear to be approximately the same, they vary considerably percentage-wise. The resistance values in the Fig. 2 examples ranged from 15,000 to 47,000 ohms and the capacitance .001 to .0047 μf. These values are determined by the desired voltage output from the network and the distributed circuit capacitances.

Many readers have inquired as to the best sound takeoff point for feeding the audio signal from a TV receiver into a high-fidelity amplifier. Theoretically, it is the output of the de-emphasis network since the response of this network should reverse the pre-emphasis curve.

However, the vast majority of television sets work into small speakers, so the receiver's audio amplifier usually has a frequency response well below the range of the transmitted audio signal. Because of this, and to avoid possible regeneration in the audio amplifier and interference from the horizontal sweep, high-frequency suppression of most de-emphasis networks is excessive.

Thus, a better solution is this: Connect a switch to remove the de-emphasis shunt capacitor and following circuitry from the circuit. With the audio cable connected to the hi-fi amplifier, feed the output of the de-emphasis resistor into the input of the cable. Connect a new de-emphasis capacitor of slightly lower value at the input to the audio cable. Now feed the input of the de-emphasis network with a signal from an audio signal generator, varying the frequency every 500 cycles from 500 cycles to 15 kc, maintaining a constant input voltage. Connect an oscilloscope or a.c. v.t.v.m. across the input circuit to the high-fidelity amplifier. Then vary the resistance and capacitance values (while observing the v.t.v.m. or scope at each check point) in the new de-emphasis network until the Fig. 3 response is obtained.

Shorted yoke

A Crosley chassis 431-2 came in with no vertical deflection. A resistance check revealed a short in the vertical deflection coils. When I removed the yoke, I noticed that the trouble was mechanical in that the vertical winding had broken through the insulation. I returned the deflection yoke to the Crosley distributor and he claimed that the yoke was improperly installed and that the yoke itself was not defective.

The unit appears as if it can be taken apart and possibly repaired. Who is responsible for the trouble and can the yoke be repaired?—J. C., Los Angeles, Calif.

The mechanical defect described sounds very much like the result of pressing the deflection yoke hard against the bell of the picture tube. Whoever installed the yoke may have pushed it forward in the hope of getting greater width. The insulation between the vertical winding and the core of the yoke will often break under these conditions.

If the yoke has not been damaged through overheating, it could probably be repaired as follows: Remove the yoke from its bracket. Then remove the core clamp and the four iron-core sections. Wrap a few turns of Scotch tape around the winding. This done, replace the cores and wrap more tape around them. Finally, replace the core clamp and tighten. When you replace the yoke in the bracket, do not apply too much pressure against the bell of the picture tube. This is a good rule to follow for all deflection yokes.

Insufficient width

I have a CBS-Columbia 1601 chassis about 1 inch shy in width. This set has no width control so I tried increasing the voltage on the screen grid of the horizontal output tube. The width increased but the picture was very nonlinear. The set doesn't have a linearity coil either and with all my checking I can't seem to obtain the additional width. Would installation of some sort of drive control help? At present there is a 100-μμf capacitor from the grid of the horizontal output tube to ground.—N. L., Erie, Pa.

You did not mention whether you replaced any tubes. If not, replace the horizontal oscillator and output tubes. If this doesn't help, remove the 100-μμf capacitor from the grid of the horizontal output tube to ground. Most likely this will give you more than enough width. If so, replace this capacitor with a trimmer with a range of about 25 to 100 μμf. It will act as a drive control and can then be adjusted for proper width.

High-voltage fuse trouble

A very bothersome condition exists in a Du Mont model RA-166. A ¼-amp fuse in the high-voltage section blows about every two weeks. I have replaced several fuses and have had it in the shop twice. All components check good and all voltages check with the manufacturer's service notes. Some component is probably critical but still good enough to check O.K. I would appreciate any service notes covering this trouble.—M. S., Fort Wayne, Ind.

Intermittent high-voltage and horizontal sweep troubles that blow this fuse are difficult to pin down, and I know of no characteristic trouble in this chassis causing this. Occasionally it is good service technique to increase the line voltage so as to hasten the breaking down of the defective component. However, this places a burden on all the circuits and may do some harm.

A better plan in this receiver is to remove the 6W6-GT audio amplifier tube. With this tube out, the horizontal sweep pulse, the boost voltage and the high voltage increase. Thus, increased voltages are placed on the circuits with the possible defective component without increasing the B-plus voltage.

It is just possible that the fuse is blowing as the result of harmless voltage fluctuations. Try using a ¼-amp slow-blowing fuse.

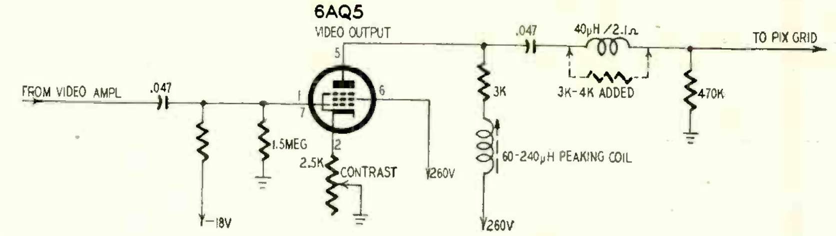


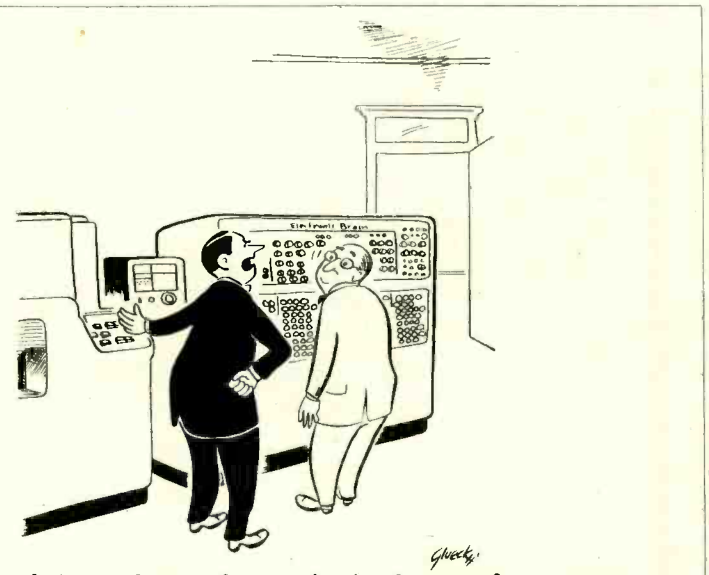
Fig. 4—Video output of Philco R-191. Addition of resistor prevents ringing.

Oscillations in picture

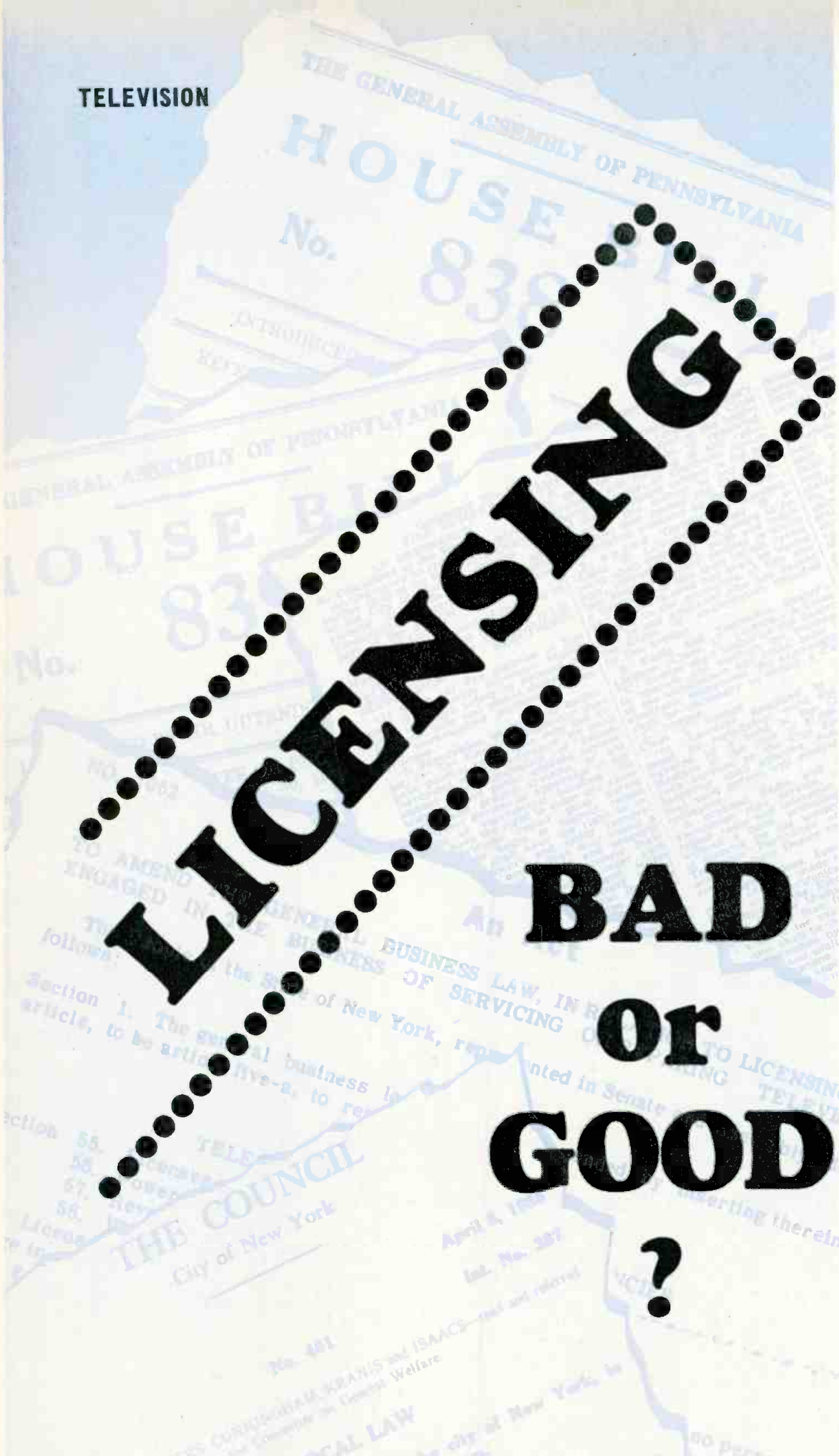
The complaint on a Philco R191, D191 was that when the contrast control was varied, various types of wavy lines would appear on the picture. I checked the video signal on the picture-tube grid and found that at certain settings of the contrast control oscillations would appear on the picture-tube grid and I got erratic readings. I then replaced every component in the video output stage—but still no improvement.—F. T., Fort Worth, Tex.

This circuit contains a 40-μh peaking coil between the plate of the 6AQ5 video output tube and the picture tube. See Fig. 4.

Generally, the oscillation you describe is caused by insufficient dampening of this peaking coil. You can probably clear up the trouble by shunting the coil with a resistance of about 3,000–4,000 ohms. END



"I just asked it what my chances for a raise in the next few years were—I'm quitting."



LICENSING BAD or GOOD?

By JOHN A. WHEATON*

LET'S summarize some of the arguments for and against licensing and see who has or who wants licensing—and why. First, various points raised *against:*

Possibility of regimentation

Possibility of bureaucratic interference

Will not prevent fraud and malpractice

Will raise the service costs

Next, various points expounded *for:*

If a license law is written *correctly* and enforced properly,

it establishes a minimum standard of qualification of competency;

it tends to raise the standards in the service business;

it provides an official body to deal with fraud and malpractice;

it tends to reduce fraud and malpractice by deterring persons for fear of losing a license.

At present, the only license law which provides a measure of the points itemized *for* licensing is that of Madison, Wis. It has been in effect since the early Forties. However, shortcomings are indicated in an inquiry made by the writer as secretary of National Electronic Technicians & Service Dealers Association (NETSDA). Ten shops in Madison were queried. Four answers were received. These mentioned the lack of apprenticeship provisions in the license law and pointed out that *anyone* was permitted to work for a licensed man. On the good side, indications were that malpractice was reduced and that a lot of part-timers with no genuine interest were discouraged from service activity.

Several groups around the country are pressing for a license law. Perhaps the longest in point of activity is the license law before the Council of the City of New York, sponsored and supported by Associated Radio Television Servicemen of New York (ARTS-NY) and their mentor, Max Liebowitz. More recently, Television Service Association in Detroit has been sponsoring a bill in that city.

On the state level, the Utah Association of Radio & Television Servicemen is trying to get a bill passed in Utah; the Radio-Electronic Technicians Associations of the South is trying for one in Louisiana and the Middle Tennessee Television Technicians Association is encouraging the passage of a bill for Tennessee. Several California groups are supporting a bill for that state.

Several of these bills have been reviewed and even reprinted in magazines as well as association papers. The *Guild News,* monthly publication of the Radio Television Guild of Long Island, published the New York City bill in toto, and also shortly thereafter published an article of mine comparing the Madison law and the Louisiana, Utah and the New York City bills. Sufficient response developed from this brief comparison to make it bear repeating.

To begin with, let's examine the purposes expressed in each of the four:

Madison (in effect): To provide minimum regulation to insure safety to persons and property, safe and stable design, and good workmanlike methods of construction.

*Secretary, National Electronic Technicians & Service Dealers Associations.

Utah: To regulate practice of servicing TV and radio receiving apparatus.

Louisiana: To protect public welfare by providing competent service technicians in all fields.

New York City: For correcting TV service contracting abuses.

The next point: who is required to have licenses? (Fees required vary from $5 to $25 per year)

Madison: Three licenses issued:
- Radio and electronic technicians (all electronic devices)
- Sound technicians (limited to devices operating on less than 100,000 cycles)
- Radio and TV dealers

Utah: Four licenses:
- Service contractor
- Service dealer
- TV–radio technician
- TV–radio apprentice

Louisiana: Four licenses:
- Technician, class B (specialty technician, must state service field in application)
- Technician, radio and TV, class A (applicants must be qualified for radio and TV, public-address and intercommunications servicing)
- Technician, industrial electronic
- Technician, medical electronic

New York City: Three licenses, one permit and one temporary permit:
- Television service contractor
- Television service dealer
- Television service technician
- Television service apprentice

The type of license indicates the range of occupations covered by each: Madison covers servicing of radio and television as well as other electronic devices, sound cars and trucks, installation of various types of equipment. Utah adds the service contractor and apprentice groups to those required to have a license. Louisiana provides a more complete service technicians' requirement—in separating the licenses for the various fields of radio and TV industrial equipment and medical equipment servicing. New York City is chiefly concerned with TV servicing.

Common to all bills is the creation of an examining board to administer and regulate the license:

Madison: Five members, the first three having a two-year term:
- a holder of both a radio and TV technician's license; radio and TV dealer's license and engaged in that business;
- a holder of a radio and TV technician's license and an employee in that business;
- a communications engineer;
- the city radio technician;
- the city electrical inspector.

Utah proposes to create a board of five members who shall have a two-year term. The makeup of the board is not specified in the bill, but is suggested by the Utah Associated Radio–TV Servicemen (ARTS):
- an attorney from the state's legal department;
- a member of the board of education;
- a service contractor with a license under the bill;
- a service dealer with a license under the bill;
- a person engaged in business or occupation of servicing TV or radio equipment for two years preceding and with a license under the bill.

Louisiana goes a step further than any of the others: a State Board of Registration of seven members is to be created under the bill. Five of these would be selected from the general radio and television field, all duly licensed under the act. The other two must have at least six years' experience continuously as technicians in all phases of electronics and also be licensed under the act. They would serve a four-year term but no more than two to be replaced each year. The members of the board are to be selected by the Governor from nominees proposed by the Radio & Electronics Technicians Associations of New Orleans and Baton Rouge, sponsors of the bill, and any other state-chartered association.

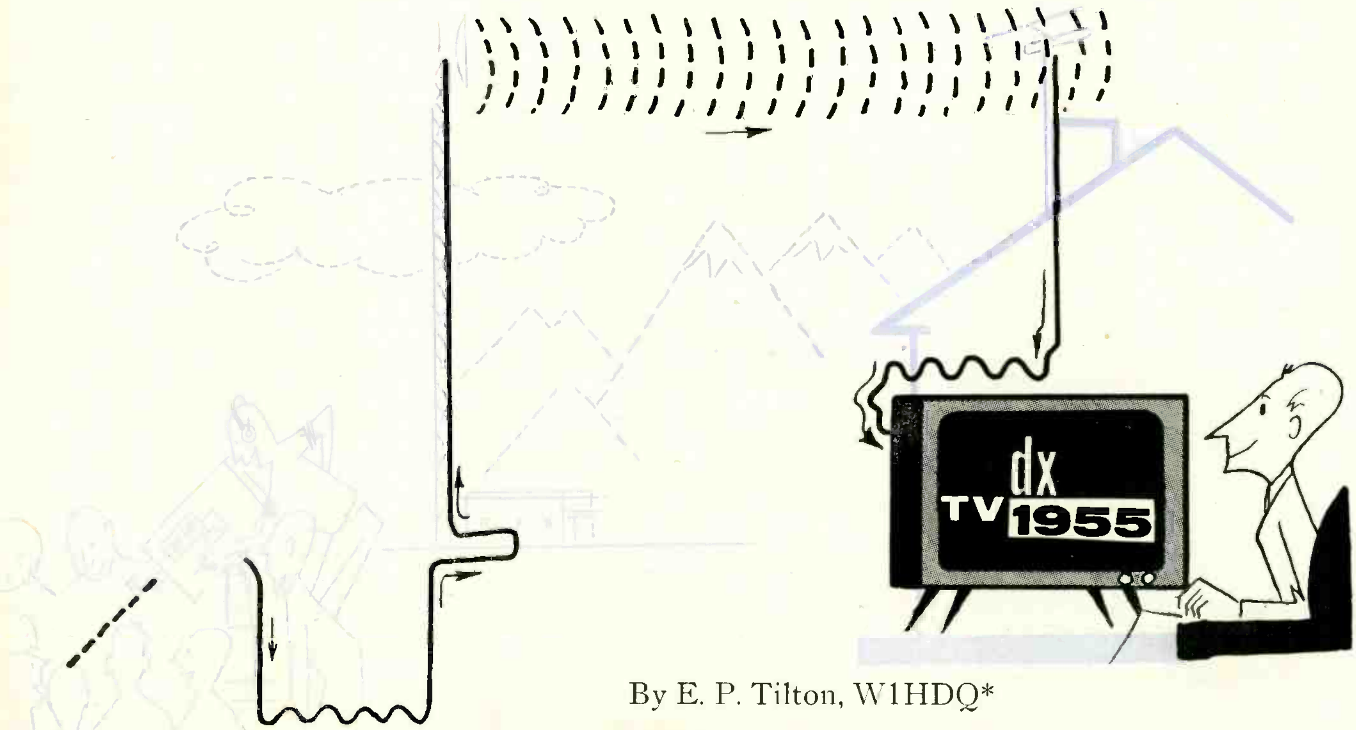
New York City provides in its proposed license bill for an eight-man board more complete and diversified than the others, but indicates only the occupation of each:
- a member of the Board of Education and designated by the Superintendent of Schools;
- a person with a baccalaureate degree in physics or electrical engineering, and a member of the IRE engaged in electronics for five years previous to appointment;
- a technician who has serviced electronic products for ten years and TV receiving apparatus the last three years;
- a service contractor;
- a service dealer;
- a television distributor's service manager;
- a distributor; the above four to have been in the business for three years prior to appointment.

All these bills have as their main purpose a desire to serve the public interest; they also express—between the lines—the desire of the electronic service technician to raise the standards of his profession and obtain a measure of prestige which does not exist to any degree at the present time. That many men in the business realize that fact is evidenced by the changing attitude of various groups during the last few years. NETSDA for some years has taken the stand that licensing was a local problem and offered assistance to any member association on whichever side that particular association might find its best interests lay; the National Alliance of Television & Electronic Service Associations (NATESA) for a time not committed either way, has for some period now taken an identical stand. The National Appliance & Radio Dealers Association (NARDA) although at one time very definitely against licensing, now also has turned to a position of local option. The Empire State Federation of Electronic Technicians Associations (ESFETA) has for several years held that, if licensing became necessary, it would be preferred on the state level. As recently as last April ESFETA supported a decided trend toward licensing at a Consumer's Counsel discussion called by Governor Harriman of New York State and offered assistance to the state's legislative bodies in drawing up such a measure. The Federation of Radio Servicemen's Associations of Pennsylvania (FRSAP) has favored a state license and is supporting one, as are other state groups previously mentioned.

Some groups prefer an industry-sponsored accreditation program, evolved through a system of approved courses. The Minnesota Television Service Engineers group has formed a working arrangement with the Bureau of Apprenticeship of the State of Minnesota, with courses designed to raise the standards of service. The long-range benefits of such programs are obvious. But they do not provide immediate benefit beyond, perhaps, indicating to those who have the opportunity to take the courses the best way to run their business as well as to increase their knowledge of servicing.

As a sidelight on the aspects of licensing, consideration might be given to a license law which has been in effect in New York State since 1921 and concerns an occupation which might, like ours, be classified as a semiprofession: that of real estate brokers and salesmen. That it has benefitted the public as well as the sellers of real estate cannot be disputed. This law also provides for a board of men licensed under the act to advise the Secretary of State, under whose jurisdiction this law comes. It also provides for examination, as well as stipulating the field of activity in which real estate brokers and salesmen are permitted to work. To be worthy of support of all those engaged in a given activity, a licensing law must meet these minimum requirements: an examining board on which the licensed profession is represented, an examination to provide at least a minimum qualification of licenses and provision for all classifications of activity of the particular field to be licensed, with limitations provided for apprentice classifications. Any license law which omits any of these minimum requirements should be questioned.

As has been pointed out in *Guild News*, if any person (or group) says — without reference to a particular piece of legislation — that he is for or against licensing, he is committing themselves to an unknown quantity. Consideration must be given to all aspects, and the specific type of licensing proposed, before making a decision. END



By E. P. Tilton, W1HDQ*

IT is probably too early to say whether it was the result of the rising curve of the new sunspot cycle we're just entering, but 1955 was a banner year for TV dx enthusiasts. The winter period ran longer and produced more dx per day and the summer season held on for weeks later than in some past years. There was more multiple-hop dx and more reception of South American stations than ever before.

* V.h.f. editor, *QST*.

At least three of our regular reporters now have identified 200 or more TV stations. Robert Seybold (Dunkirk, N. Y.) tops the list with a total of 259. Bob has logged 45 of the 48 states and 6 countries. In his odd moments he has managed to photograph identifications of more than 150 of his catches!

Bedford Brown, Jr., Hot Springs, Ark., has received stations in 42 states and 9 countries in running up his 228-station list.

In addition to the tropospheric bending associated with weather, sporadic-E skip and other forms of propagation discussed many times in these pages, our sharper observers are finding that "burst" reception offers fine opportunities for catching new and difficult stations. Such bursts may come as the result of reflections from high-flying

Champion dx-er Louis Matullo's antenna system and some veris photographed by Matullo himself.

aircraft, from ionized regions near lightning discharges or from the ionized trails left by meteors as they pass through the E region of the ionosphere, to name some of the more likely sources.

Some typical catches (see photos) by veteran TV dx-er Louis Matullo, Washington, Pa., are: Cuban CMQ and KFDX, Wichita Falls, Tex. (received by sporadic-E skip); WMBV, channel 11, Green Bay, Wis., 500 miles and WBKB, channel 7, Chicago, 450 miles (high-band tropospheric dx); WIN-T, channel 15, Waterloo, Ind., 200-mile u.h.f. reception (also tropospheric in nature). The antennas used are broadbanded Yagis for the high and low bands, with 12 bowties in phase stacked between the two bays. Matullo has photographed identifications of 136 of the 194 stations he has logged to date.

Distances over which burst reception is possible range from a few hundred miles to perhaps 1,500 miles or more. Individual bursts are usually of no more than a few seconds' duration, but several may overlap making possible reception of a signal for several minutes at a time. Several observers say that they get best results in burst hunting by turning their antennas in a likely direction and then simply monitoring a blank channel where a distant station is known to be operating. Western observers try this in the early morning hours before their local stations come on the air. As the average level of burst signals—particularly those of the meteor-scatter variety—is low, effective work of this kind calls for a sensitive receiver, a large antenna, a quiet location and not a little patience. But it does wonders for one's totals! Observer Schafer of Kenmore, N. Y., has added 19 stations that way.

The fall hurricane season along the Atlantic and Gulf coasts produced plenty of dx. (Practical example of ill winds blowing good!) The air circulation pattern associated with a tropical storm may set up sharp temperature and humidity gradients in the upper atmosphere for hundreds of miles around the storm. A hurricane in the West Indies, for example, may mean fine tropospheric dx for TV enthusiasts and v.h.f. hams from the Carolinas to Nova Scotia. It happened again and again in the fall of 1955 and observer Frank Greene, Roswell, N. M., reports that the weather fronts associated with tornado conditions in the West Texas plains bring similar results for him.

Reception of South American stations is increasing, with Venezuelan, Brazilian and Argentine stations being logged in nearly all parts of the country. Not only are more Latin American stations coming on the air, but the increasing sunspot activity is very likely helping things along. From the more southerly parts of North America, particularly, it will become increasingly easy to pick up our South American friends as the solar cycle rises higher. If it follows amateur experience in the 50-mc band, South American TV reception should be most frequent in the afternoon and early evening hours of the spring and fall months, becoming more common in the next few years. This will be in addition to the multiple-hop sporadic-E skip that peaks in June and July.

Observer Machado of Mendoza, Argentina, reports almost daily reception of Caracas, Venezuela, on channel 2 in February, March, April, October and November. As will be seen, these periods do not coincide with our twice-yearly sporadic-E seasons. They do, however, check with 50-mc amateur observations in these countries taken during the higher part of the previous sunspot cycle. South Americans are worth plenty of watching!

Over 50 TV DX Club

NAME	LOCATION	TOTAL	UHF	BEST DX (miles)
Robert Seybold	Dunkirk, N. Y.	259	28	4,900
Bedford Brown, Jr.	Hot Springs, Ark.	228		5,200
Dorsey W. Akers	Charleston, W. Va.	202		1,200*
Louis A. Matullo	Washington, Pa.	194	35	2,000
Art Collins	Buffalo, N. Y.	175	28	
Delwin D. Whitt	Grand Prairie, Tex.	171		
Fred Von Gunten	Berne, Ind.	154	20	
Robert Weems, Jr.	State College, Miss.	144	1	
John Betterworth	State College, Miss.	139		1,800
Richard Lowry	Temple, Tex.	135		5,800
Russell Ashworth	New Bedford, Mass.	121	22	
Gary Ehresman	South Bend, Ind.	121	7	5,400
Bob Cooper	Fresno, Calif.	118	8	6,600
Raymond Sloss	Baton Rouge, La.	117		
Billy Don Sevier	Corpus Christi, Tex.	115	2	
Joseph Rombach	Arabi, La.	113	4	
F. E. DeGroat	Salamanca, N. Y.	112		
Kingdon P. Schafer	Kenmore, N. Y.	108		
Edward Rugel	Independence, Kan.	108		
Parrissa C. Cox	Visalia, Calif.	103		2,400
Michael O'Rourke	Mesick, Mich.	103		
Roger Anderson	Madison, S. D.	99	26	
Tommy Larkins	Clarksville, Tenn.	97		
Paul Swartz	Gibsonburg, Ohio	90		
Sam Brooks	Boston, Ga.	90		
M. W. DeGeer	Tulsa, Okla.	88		
Gordon Simkin	Ft. Lee, Va.	88	9	
Douglas Bryan	Otey, Tex.	86		
Walter Owens, Jr.	Springfield, Ohio	85		
Ronn DeNeuf	Ithaca, N. Y.	83	12	
Ernest J. Smith	Bennettsville, S. C.	83		2,300
Alton Caldwell	Brockton, Mass.	81	4	
Paul Mitschler	Marysville, Kan.	81		
Toby Chambers	Miami, Fla.	76	1	
B. H. Rauch	Peoria, Ill.	76		1,750*
Dick Mason	Menasha, Wis.	75		
Larry Vehorn	Indianapolis, Ind.	73	14	1,460
G. P. Oberto	Richmond, Va.	73		4,700
Joe Foyer	Westville, Ill.	72	15	
Mrs. Wm. Callan	Altoona, Pa.	72		
Clyde C. Barber	Okmulgee, Okla.	71		
Kenneth C. Bush	Buffalo, N. Y.	71		
James M. Homan	Biloxi, Miss.	70		
D. B. Middleton	Sanford, Fla.	68		4,800
Larry Nash	Monte Vista, Calif.	68		
Ross Brown	Tupperville, Ont.	66		
George A. Quay	Allentown, Pa.	66		
Danny Startzman	Bennington, Kan.	64		
Edward Fournier, Jr.	Bradford, R. I.	64		
Stanley Brown	Barstow, Calif.	63		2,400
R. A. Wilson	Detroit, Lakes, Minn.	62		
Frank Greene	Roswell, N. M.	62		
Carl F. Lupton	Shelbyville, Ill.	61		
Barry Rossum	Mohall, N. Dak.	61		
Don Martin	De Ridder, La.	60		
Donald G. Sanford	Viola, Wis.	59		
F. H. Schnakenburg	Honesdale, Pa.	59		
Harry Wieskamp	Holland, Mich.	58	14	
Dennis Smith	Wasco, Calif.	55	7	2,200
Kenneth M. Neal	Hamlin, Tex.	55		
Neil Stone	University Hts., Ohio	55	11	
Irvin Englander and Tommy Mayo	Boston, Ga.	54		
Larry D. Whiting	Ilderton, Ont.	53		
Karl Kleintop	Bowmantown, Pa.	52	8	
Richard Gleitz	York, Pa.	52	11	
W. C. Stallard	Chambersburg, Pa.	50		
W. C. Sherman	Sinton, Tex.	50		

*high band.

Once again we thank the hundreds of dx-ers who have taken the trouble to report their reception. The list is too long to permit running all names, so we list the more outstanding. If you report regularly and have more than 50 stations logged, include your total with each report and you'll automatically become a member of our "Over 50" clubs. END

INTERMITTENT FOLDOVER

By CHARLES E. THOMAS

THE complaint was "slow widening out." The set was an RCA model TC165, chassis KCS40. When I turned it on, a picture about 6 to 8 inches wide appeared on the 16-inch screen. The picture had a foldover right up and down the center of the screen, while the part of the picture on either side of the wrinkle was apparently normal in proportion. I had never seen anything like it. The beam moved across the screen in the normal manner until it got about halfway. Then it reversed, traveled back to the left a distance of about 2 inches where it again reversed itself and swept on to the right. You can imagine what such a picture looked like.

I took it to be horizontal output or horizontal oscillator trouble. The customer explained that the picture had been coming on this way each time the set was turned on but after a short while would suddenly snap out to full width. The foldover remained this way long enough for me to substitute a new 6W4, 6BG6, and 6SN7. No help.

I took the set into the shop and started checking with the scope. Every waveform from the input to the horizontal oscillator control tube to the plate of the horizontal output tube was distorted. I checked the sync input to the horizontal oscillator control tube—it was O.K. (I didn't check the peak-to-peak value of this pulse, but the shape was normal.) Since a part of the signal on the grid of the control tube is fed back from the output of the oscillator, I reasoned the trouble could still be anywhere in this circuit. One at a time each capacitor was substituted with a new one, each resistor was checked, and the horizontal oscillator transformer was replaced. Since the trouble was an intermittent one, this was a time-consuming job.

I consulted television books, service notes, and back issues of RADIO-ELECTRONICS for more information on this circuit. Some information was found but nothing gave me a clue to the trouble.

The next day the set refused to act up, and since other work was beginning to accumulate, I set the job aside for a time. When I resumed work on this set, I noticed a variation in the amplitude of the sync separator output. When it was larger than normal, the foldover appeared. This was traced to the sync limiter. This tube would open up occasionally, increasing the sync amplitude applied to the input of the control tube, the result being a distorted waveform from there to the deflection yoke. END

STATION LIST

Correct to Dec. 1, 1955

Compiled by IRIS FENSTER

Alabama
- 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

Arizona
- KVAR Mesa (Phoenix) 12
- KOOL-TV Phoenix 10
- KPHO-TV Phoenix 5
- KTVK Phoenix 3
- 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
- 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
- KBET-TV Sacramento 10
- KCCC-TV Sacramento 40
- KCRA-TV Sacramento 3
- KSBW-TV Salinas-Monterey 8
- KFMB-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 Denver 4
- KFXJ-TV Grand Junction 5
- 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
- WITV Fort Lauderdale 17
- WINK-TV Fort Myers 11
- WJHP-TV Jacksonville 36
- WMBR-TV Jacksonville 4
- WGBS-TV Miami 23
- WTHS-TV Miami 2
- WTVJ Miami 4
- WDBO-TV Orlando 6
- WJNO-TV Palm Beach 5
- WJDM Panama City 7
- WEAR-TV Pensacola 3
- WPFA-TV Pensacola 15
- WSUN St. Petersburg 38
- WFLA-TV Tampa 8
- WTVT Tampa 13
- WEAT-TV W. Palm Beach 12
- WIRK-TV W. Palm Beach 21

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
- WTOC-TV Savannah 11
- WCTV Thomasville 6

Hawaii
- KHBC-TV Hilo 9
- KGMB-TV Honolulu 9
- KONA Honolulu 11
- KULA-TV Honolulu 4
- KMAU Wailuku 3

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

Illinois
- WBLN Bloomington 15
- WCIA Champaign 3
- WILL-TV Champaign-Urbana 12
- 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
- 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
- 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
- KEDD Wichita 16

Kentucky
- 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
- KNOE-TV Monroe 8
- WDSU-TV New Orleans 6
- WJMR-TV New Orleans 61
- KSLA 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

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
- WTAO-TV Cambridge 56
- WHYN-TV Holyoke 55
- WWLP Springfield 22

Michigan
- WPAG-TV Ann Arbor 20
- WNEM-TV Bay City-Saginaw 5
- WWTV Cadillac 13
- WJBK-TV 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
- WTOM-TV Lansing 54
- 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
- WJTV Jackson 25
- 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
- KHOL-TV Kearney 13
- KOLN-TV Lincoln 10
- KUON-TV Lincoln 12
- KMTV Omaha 3
- WOW-TV Omaha 6
- KSTF Scottsbluff 10

Nevada
- KLRJ-TV Henderson 2
- KLAS-TV Las Vegas 8
- KZTV 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
- KSWS-TV Roswell 8

New York
- WROW-TV Albany 41
- WNBF-TV Binghamton 12
- WBEN-TV Buffalo 4
- WBUF-TV Buffalo 17
- WGR-TV Buffalo 2
- WCNY-TV Carthage-Watertown 7
- WKNY-TV Kingston 66
- 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
- WIRI Plattsburg 5
- 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
- WDAY-TV Fargo 6
- KNOX-TV Grand Forks 10
- KCJB-TV Minot 13
- KXJB-TV Valley City 4

Ohio
- WAKR-TV Akron 49
- WICA-TV Ashtabula 15
- WCET Cincinnati 48
- WCPO-TV Cincinnati 9
- WKRC-TV Cincinnati 12
- WLWT Cincinnati 5
- WEWS Cleveland 5
- WNBK Cleveland 3
- WXEL 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
- WSPD-TV Toledo 13
- WFMJ-TV Youngstown 21
- WKBN-TV Youngstown 27
- WHIZ-TV Zanesville 18

Oklahoma
- KTEN Ada 10
- KGEO-TV Enid 5
- KSWO-TV Lawton 7
- KTVX Muskogee 8
- KTVQ Oklahoma City 25
- KWTV Oklahoma City 9
- WKY-TV Oklahoma City 4
- KOTV Tulsa 6
- KVOG-TV Tulsa 2

Oregon
- KVAL-TV Eugene 13
- KBES-TV Medford 5
- KLOR Portland 12
- KOIN-TV Portland 6
- KPTV Portland 27

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
- WPTZ Philadelphia 3
- KDKA-TV Pittsburgh 2
- WENS Pittsburgh 16
- WQED Pittsburgh 13
- WHUM-TV Reading 61
- WARM-TV Scranton 16
- WGBI-TV Scranton 22
- WTVU Scranton 73
- WBRE-TV Wilkes-Barre 28
- WILK-TV Wilkes-Barre 34
- WNOW-TV York 49
- WSBA-TV York 43

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
- WAIM-TV Anderson 40
- WCSC-TV Charleston 5
- WUSN-TV Charleston 2
- WCOS-TV Columbia 25
- WIS-TV Columbia 10
- WNOK-TV Columbia 67
- WBTW Florence 8
- WFBC-TV Greenville 4
- WGVL Greenville 23

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

Tennessee
- WDEF-TV Chattanooga 12
- WDXI-TV Jackson 7
- WJHL-TV Johnson City 11
- WATE Knoxville 6
- WTVK Knoxville 26
- WHBQ-TV Memphis 13
- WMCT Memphis 5
- 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
- KBMT Beaumont 31
- KFDM-TV Beaumont 6
- KVDO-TV Corpus Christi 22
- KRLD-TV Dallas 4
- WFAA-TV Dallas 8
- 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
- KTVE Longview 32
- KCBD-TV Lubbock 11
- KDUB-TV Lubbock 13
- KTRE-TV Lufkin 9
- KMID-TV Midland 2
- KTXL-TV San Angelo 8
- KCOR-TV San Antonio 41
- KENS-TV San Antonio 5
- WOAI-TV San Antonio 4
- KCEN-TV Temple 6
- KCMC-TV Texarkana 6
- KLTV Tyler-Longview 7
- KANG-TV Waco 34
- 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
- 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
- WTVR Richmond 6
- WDBJ Roanoke 7
- WSLS-TV Roanoke 10

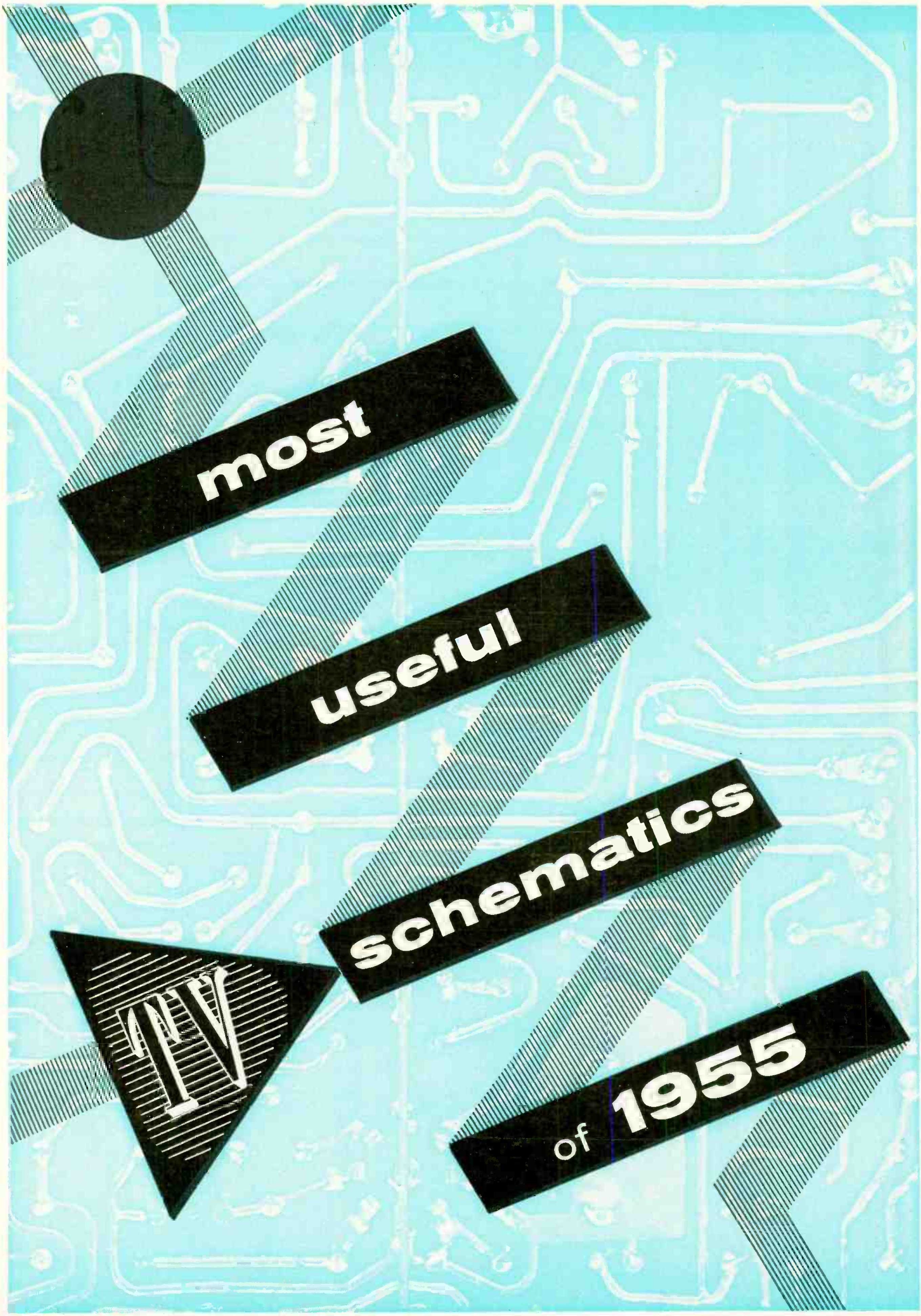
Washington
- KVOS-TV Bellingham 12
- KEPR-TV Pasco 19
- KCTS Seattle 9
- KING-TV Seattle 5
- KOMO-TV Seattle 4
- KHQ-TV Spokane 6
- KREM-TV Spokane 2
- KXLY-TV Spokane 4
- KTVW Tacoma 13
- KTNT-TV Tacoma 11
- KIMA-TV Yakima 29

West Virginia
- WHIS-TV Bluefield 6
- WCHS-TV Charleston 8
- WJPB-TV Fairmont 35
- 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
- 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

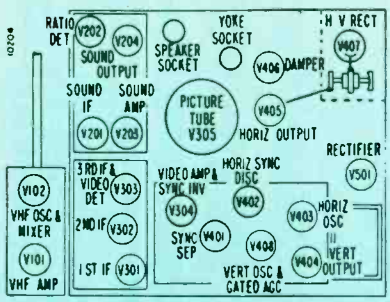
Wyoming
- KFBC-TV Cheyenne 5

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
- CBHT Halifax, N.S. 3
- CJCB-TV Sydney, N.S. 4
- CJON-TV St. John's, Nfld. 6
- CKVR-TV Barrie, Ont. 3
- CHCH-TV Hamilton, Ont. 11
- CKWS-TV Kingston, Ont. 11
- CKCO-TV Kitchener, Ont. 13
- CFPL-TV London, 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
- CBLT Toronto, Ont. 9
- CKLW-TV Windsor, Ont. 9
- CKNX-TV Wingham, Ont. 8
- CBFT Montreal, Que. 2
- CBMT Montreal, Que. 6
- CFCM-TV Quebec City, Que. 4
- CJBR-TV Rimouski, Que. 3
- CKCK-TV Regina, Sask. 2
- CFQC-TV Saskatoon, Sask. 8

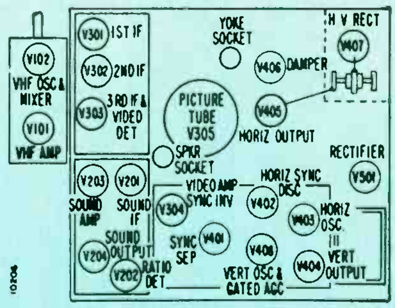

most
useful
TV
schematics
of 1955

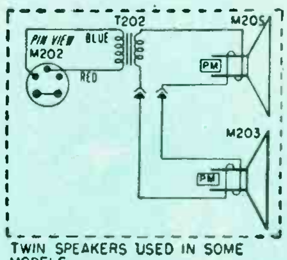
ADMIRAL 20Y4- CHASSIS

Rear View 20Y4B Chassis.



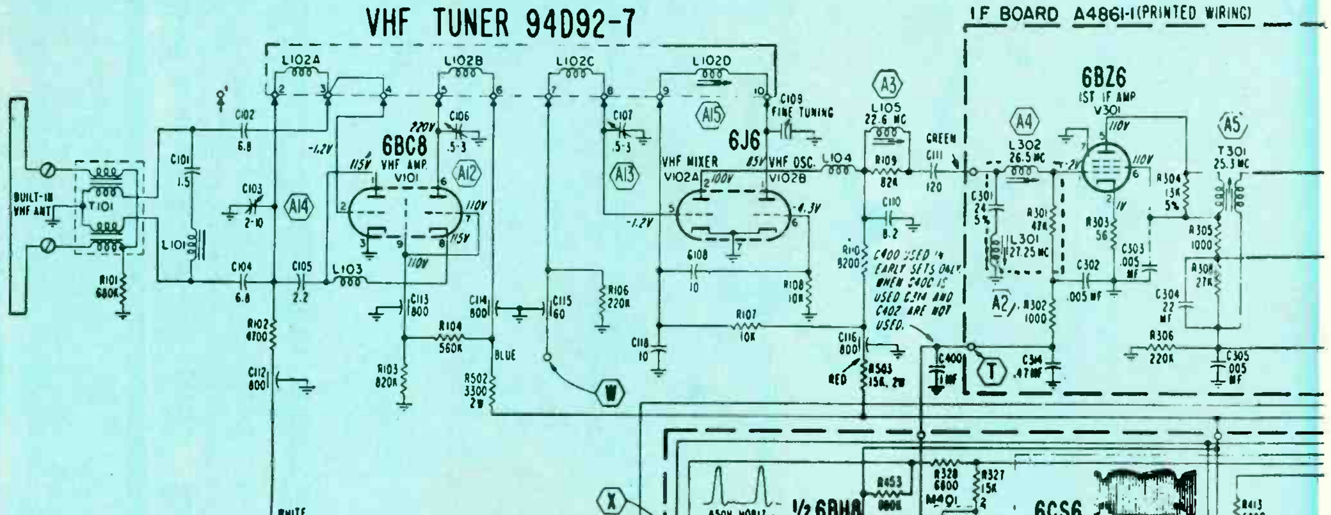
Rear View 20Y4E, 20Y4F, 20Y4L Chassis.

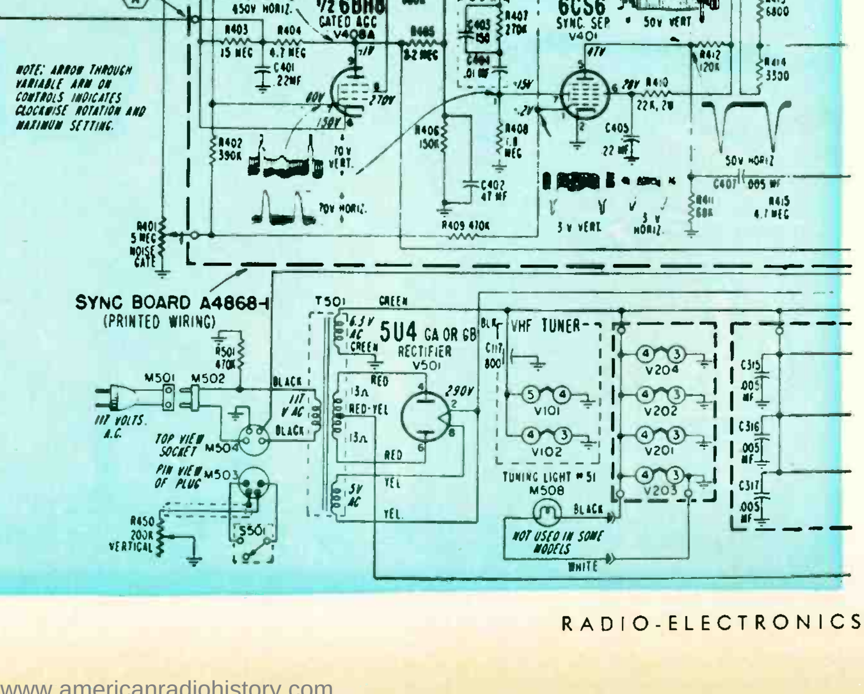




TWIN SPEAKERS USED IN SOME MODELS

V101–6BC8
V102–6J6
V201–6AU6
V202–6AL5
V203–6AV6
V204–6BF5
V301–6BZ6
V302–6BZ6
V303–6AM8
V304–6AW8
V305 21ALP4A (20Y4B, 20Y4E, 20Y4L) 24DP4A (20Y4F)
V401–6CS6
V402–6AL5
V403–12AU7
V404–6S4
V405–6CU6
V406–6AU4GT
V407–1B3GT
V408–6BH8
V501–5U4GA or 5U4GB





SCHEMATIC NOTES:

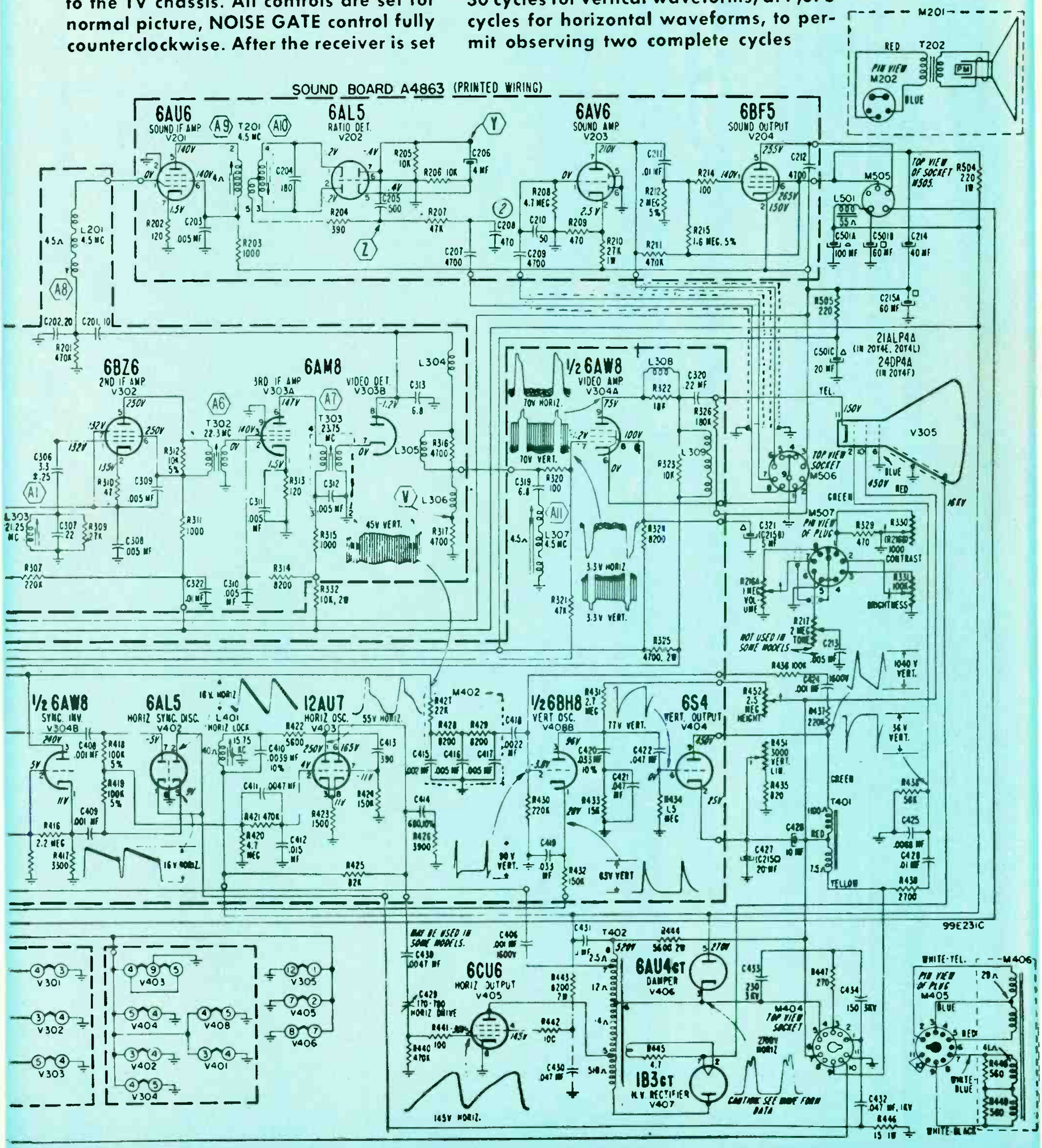
Letters and numbers shown within hexagons indicate points that are adjusted during alignment and test points to facilitate voltage measurements and connecting the scope

Voltages are measured with the antenna disconnected, the antenna terminals shorted and the channel selector turned to an unused channel. The contrast control is turned fully clockwise. All other controls are fully counterclockwise. Do not disturb the horizontal lock and drive adjustments

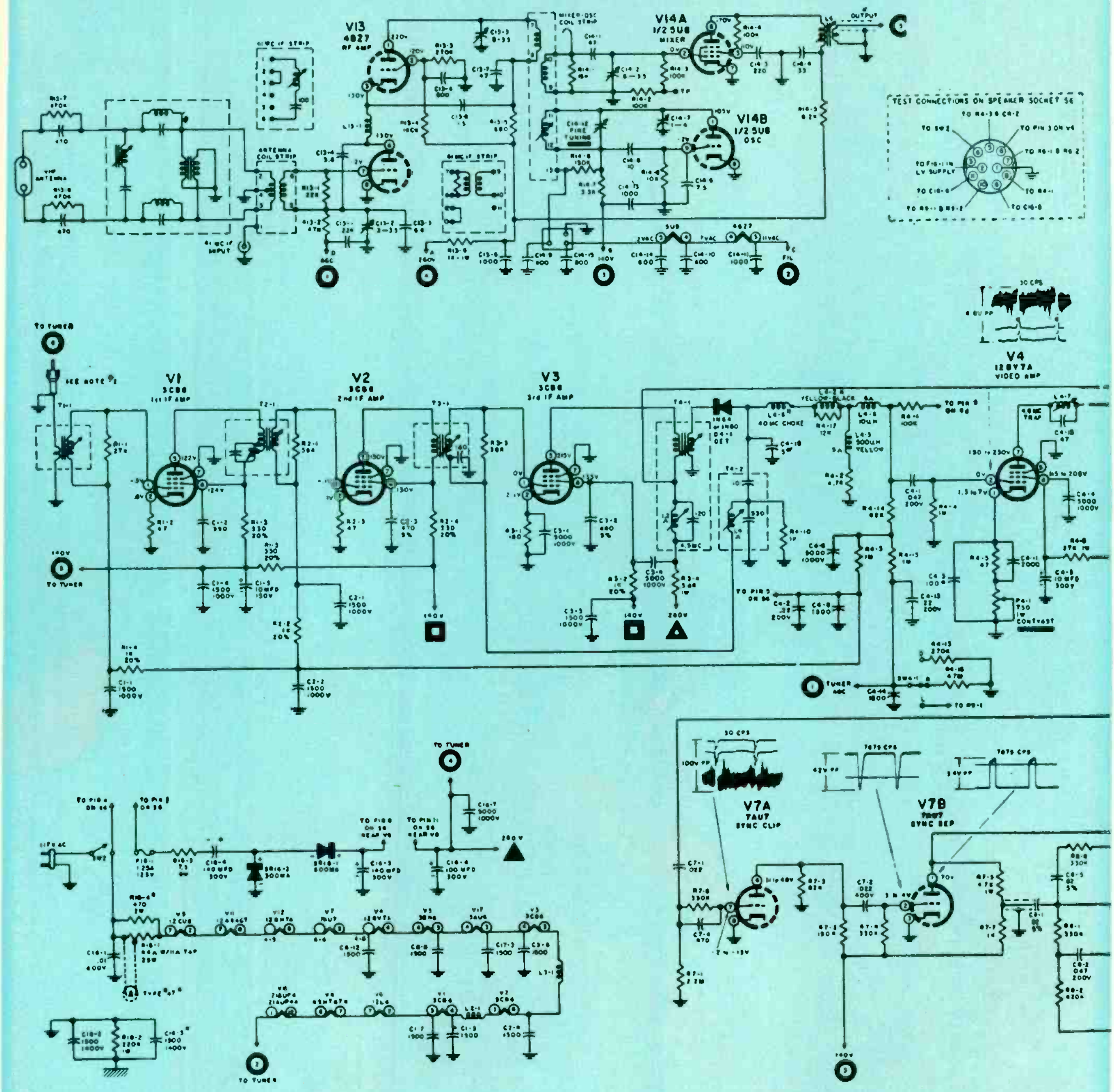
D.c. voltages are measured between the socket terminal and chassis unless otherwise indicated. Use an adapter to measure tuner socket voltages from the top of the chassis with the tubes in place

Schematic for 20Y4B, 20Y4E, 20Y4F, 20Y4L Chassis

Conditions for Viewing Waveforms: Waveforms are taken with a signal input to the TV chassis. All controls are set for normal picture, NOISE GATE control fully counterclockwise. After the receiver is set for normal picture, turn CONTRAST control fully clockwise. Set scope sweep at 30 cycles for vertical waveforms, at 7,875 cycles for horizontal waveforms, to permit observing two complete cycles



CBS-COLUMBIA 1610 and 1611



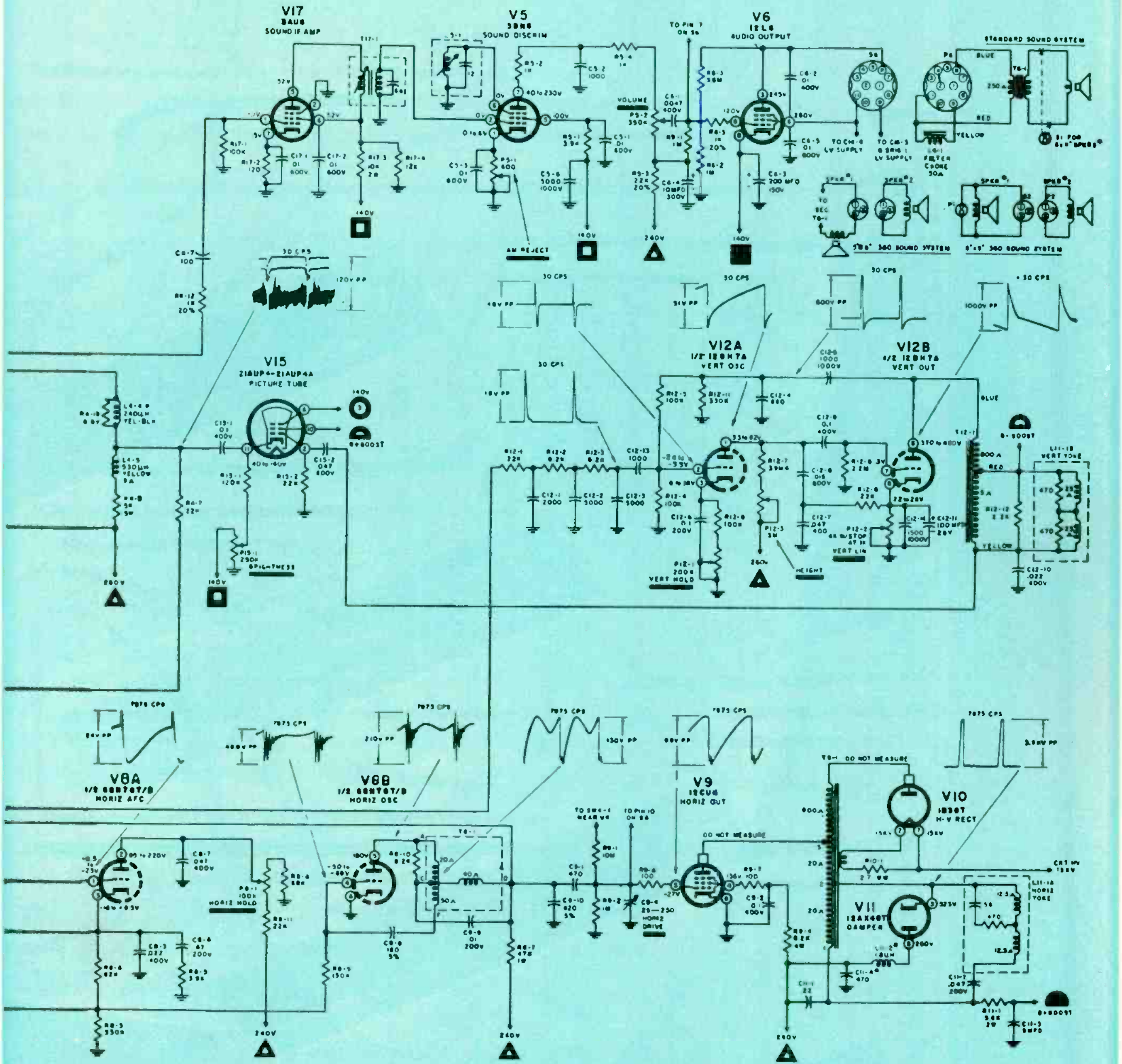
Schematic notes:

On the 1610 chassis, the i.f. input plugs into the tuner. In the 1611, a shielded lead that is a part of the tuner is soldered to the first i.f. transformer T1-1

Some chassis use the General Industries tuner (part 69 000 692) shown in the diagram. Others may have a GI tuner of the same general type (part 69 000 711) with the 41-mc i.f. strip, i.f. input jack, u.h.f. power receptacle and R14-6 omitted. The remainder will have a Standard Coil tuner (part 69 000 721) using a 4BQ7-A cascode r.f. amplifier and a 5AT8 mixer-oscillator

The solid geometric figures such as the black triangle at the 260-volt line on the B plus supply at lower left and the solid square on the cathode return lead of the 12L6 audio output tube are B plus voltage sources. Similar open symbols indicate points to which the voltage is applied. Numbered circles are terminals for the various tuner leads

All d.c. voltages are measured with a v.t.v.m. between the socket terminals and chassis with the channel selector set between channels and the area control switch (SW4-1) set to NORMAL. When voltages depend on settings of the various controls, two readings are shown at pertinent points. One value is for clockwise and the other for counter-clockwise



positions of the controls

All waveforms and peak-to-peak voltage measurements are taken on the strongest signal available with the vertical and horizontal hold controls in their normal positions and the contrast control set to maximum

An asterisk next to a component indicates a circuit change. For example, in the 1611 chassis, the 470-ohm 2-watt line-dropping resistor (R16-4) and the .0015-uf 1,400-volt capacitor (C16-3) between chassis and B minus have been omitted

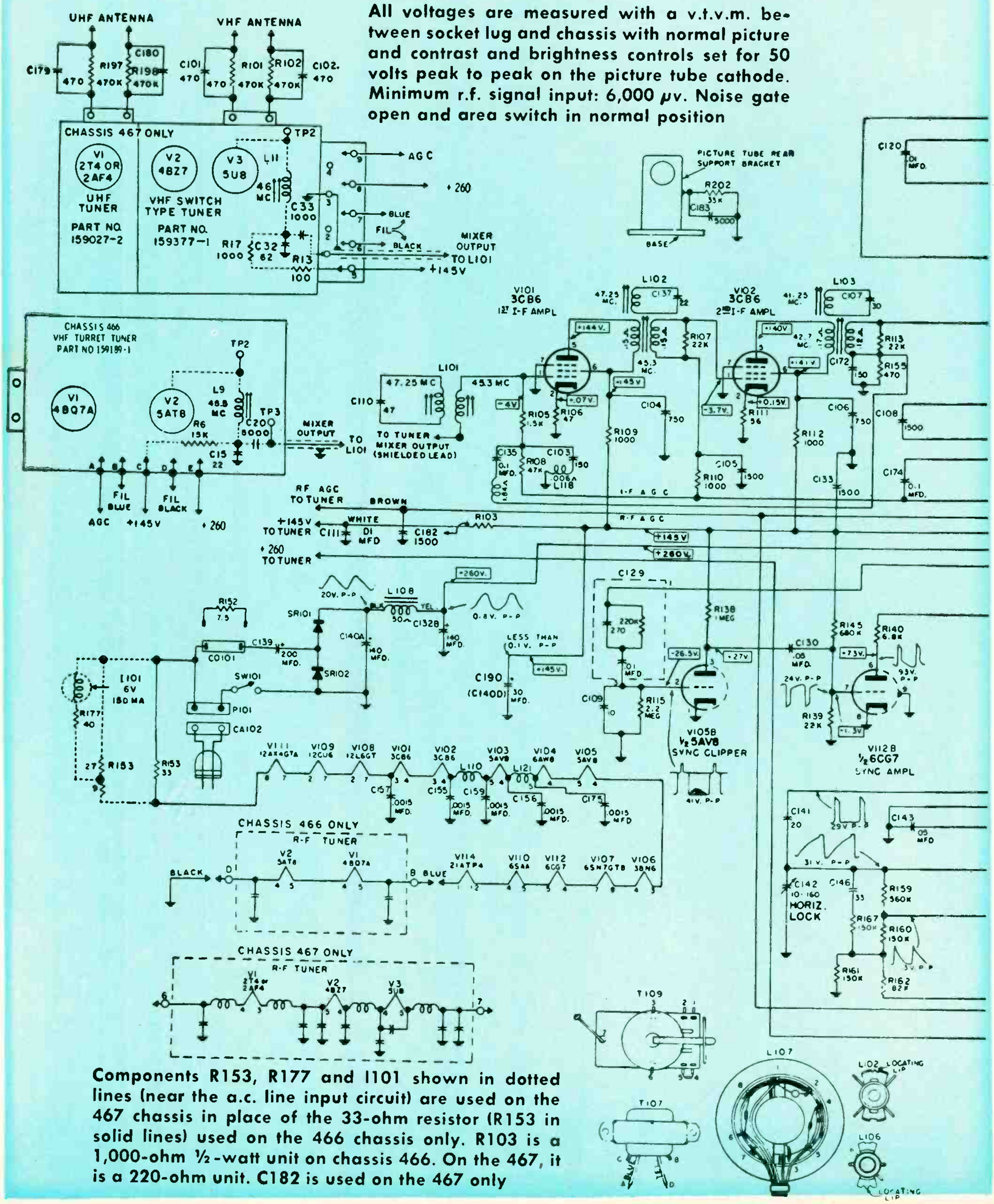
In some chassis, video detector peaking coil L4-2 is part 16 001 362 and R4-18, in the plate circuit of the video amplifier, is 18,000 ohms. In others, peaking coil L4-4 in the video amplifier plate circuit is a type 16 001 362 and R4-17 in the video detector circuit is 8,200 instead of 12,000 ohms

The 40-mc resonant choke (L4-8) in the video detector circuit may be omitted, chassis bypass C16-3 may be added and the video amplifier cathode bypass capacitor (C4-3) may be 220 $\mu\mu f$

In other sets, L4-8 is added, C16-3 is omitted and C4-3 is 100 $\mu\mu f$. The r.f. choke L11-2 connected to the plate of the damper tube is omitted as is the associated bypass capacitor (C11-4)

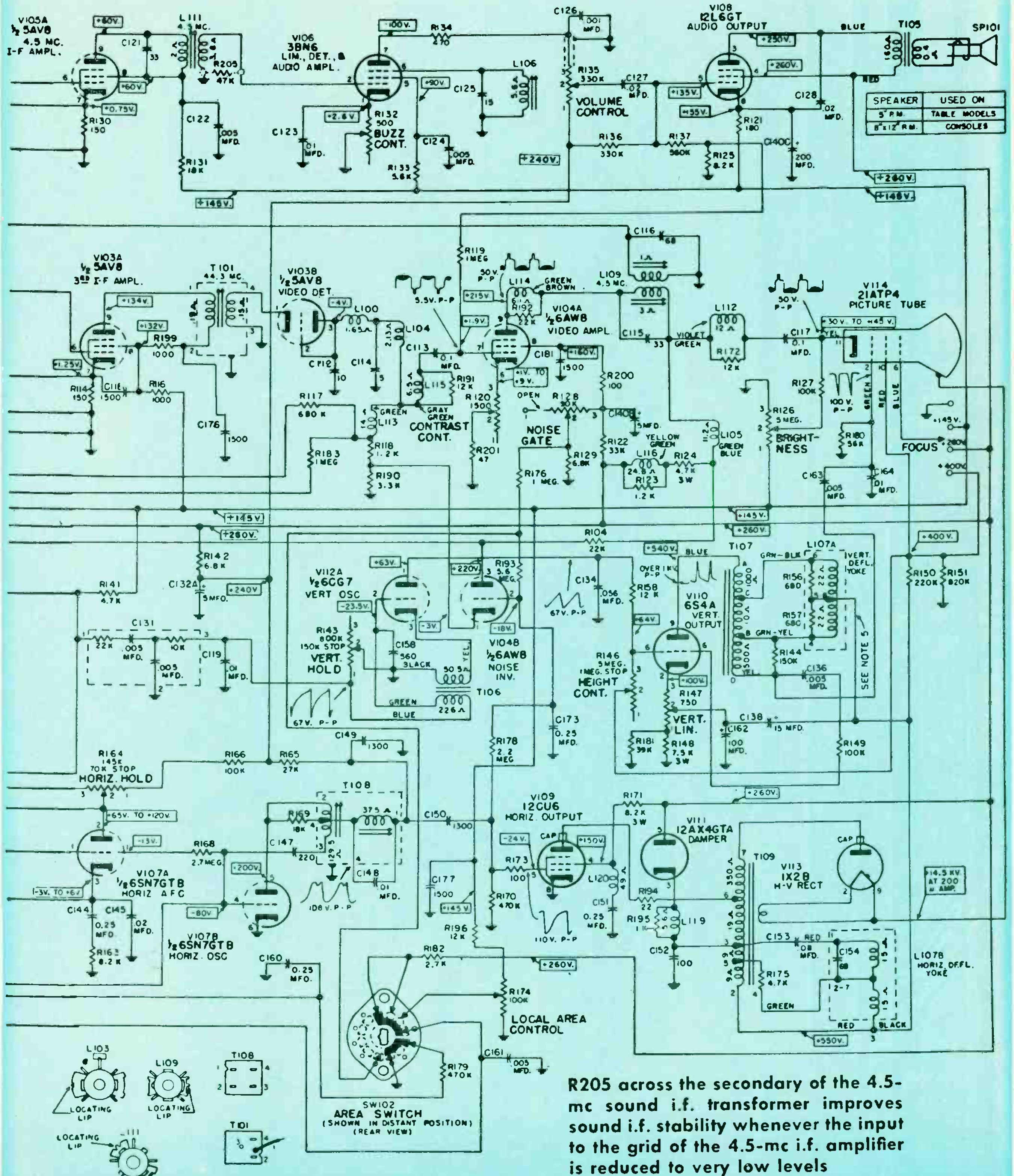
CROSLEY CHASSIS 466 and 467 (Codes A and A1)

All voltages are measured with a v.t.v.m. between socket lug and chassis with normal picture and contrast and brightness controls set for 50 volts peak to peak on the picture tube cathode. Minimum r.f. signal input: 6,000 μv. Noise gate open and area switch in normal position



Components R153, R177 and I101 shown in dotted lines (near the a.c. line input circuit) are used on the 467 chassis in place of the 33-ohm resistor (R153 in solid lines) used on the 466 chassis only. R103 is a 1,000-ohm ½-watt unit on chassis 466. On the 467, it is a 220-ohm unit. C182 is used on the 467 only

Models (466) H-21CKBF, H-21CKMF, H-21HKBF, H-21HKMF, H-21TKBF, H-21TKMF (467) H-21CKBU, H-21CKMU, H-21HKBU, H-21TKBU, H-21TKMU

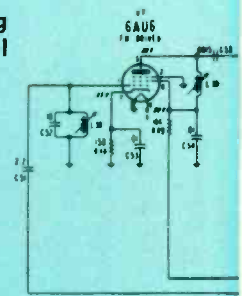


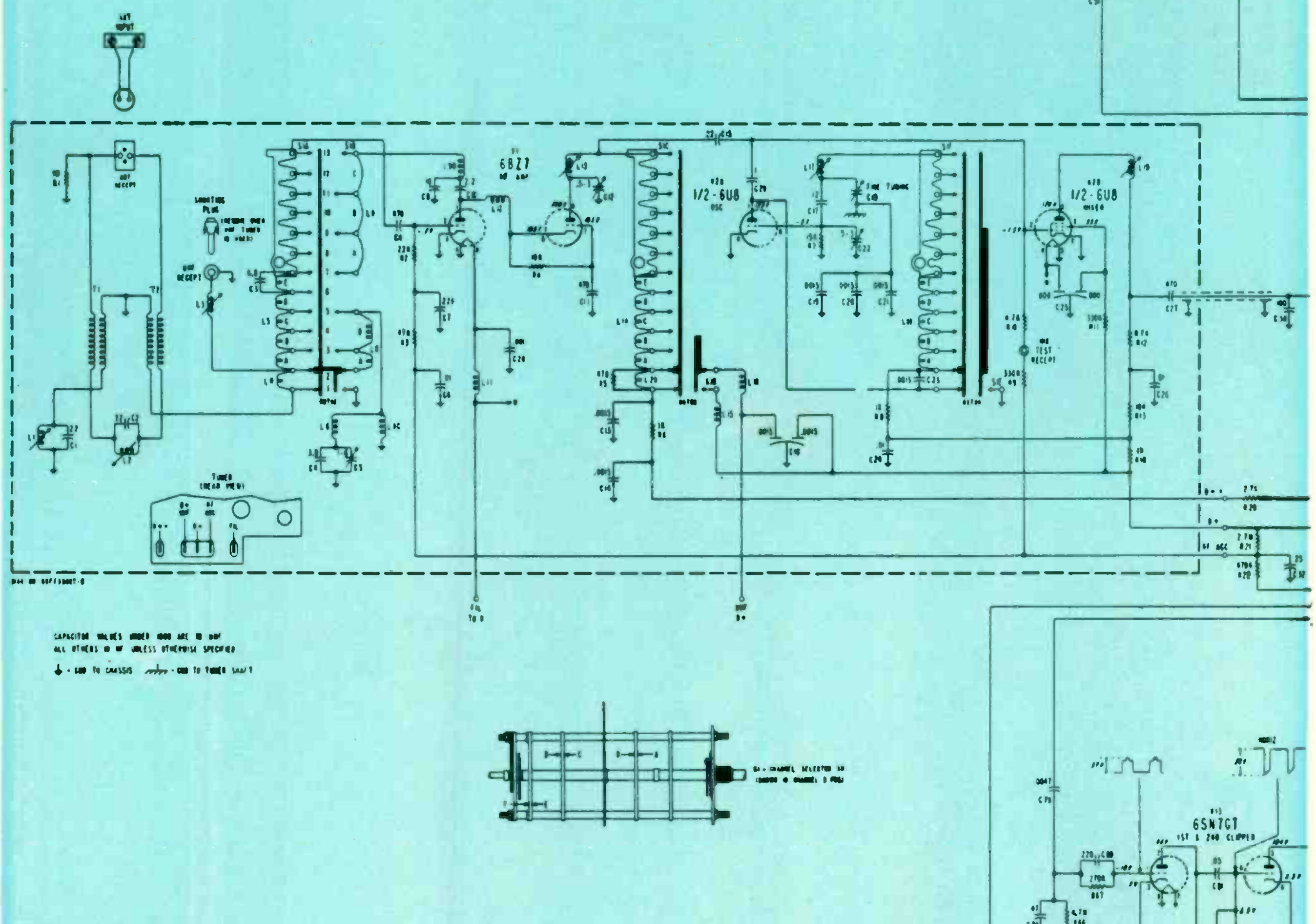
R205 across the secondary of the 4.5-mc sound i.f. transformer improves sound i.f. stability whenever the input to the grid of the 4.5-mc i.f. amplifier is reduced to very low levels

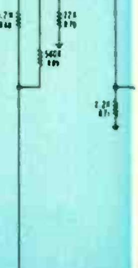
MOTOROLA TV TS-525 SERIES

VOLTAGE MEASUREMENTS:

1. Made with v.t.v.m. from point indicated to chassis
2. Line voltage 117
3. Antenna disconnected
4. Channel selector switch on channel which develops less than 1 volt noise at pin 3 of test receptacle
5. Contrast control maximum clockwise position
6. All other controls in normal operating position
7. Voltages associated with circuits having variable controls may vary with control settings





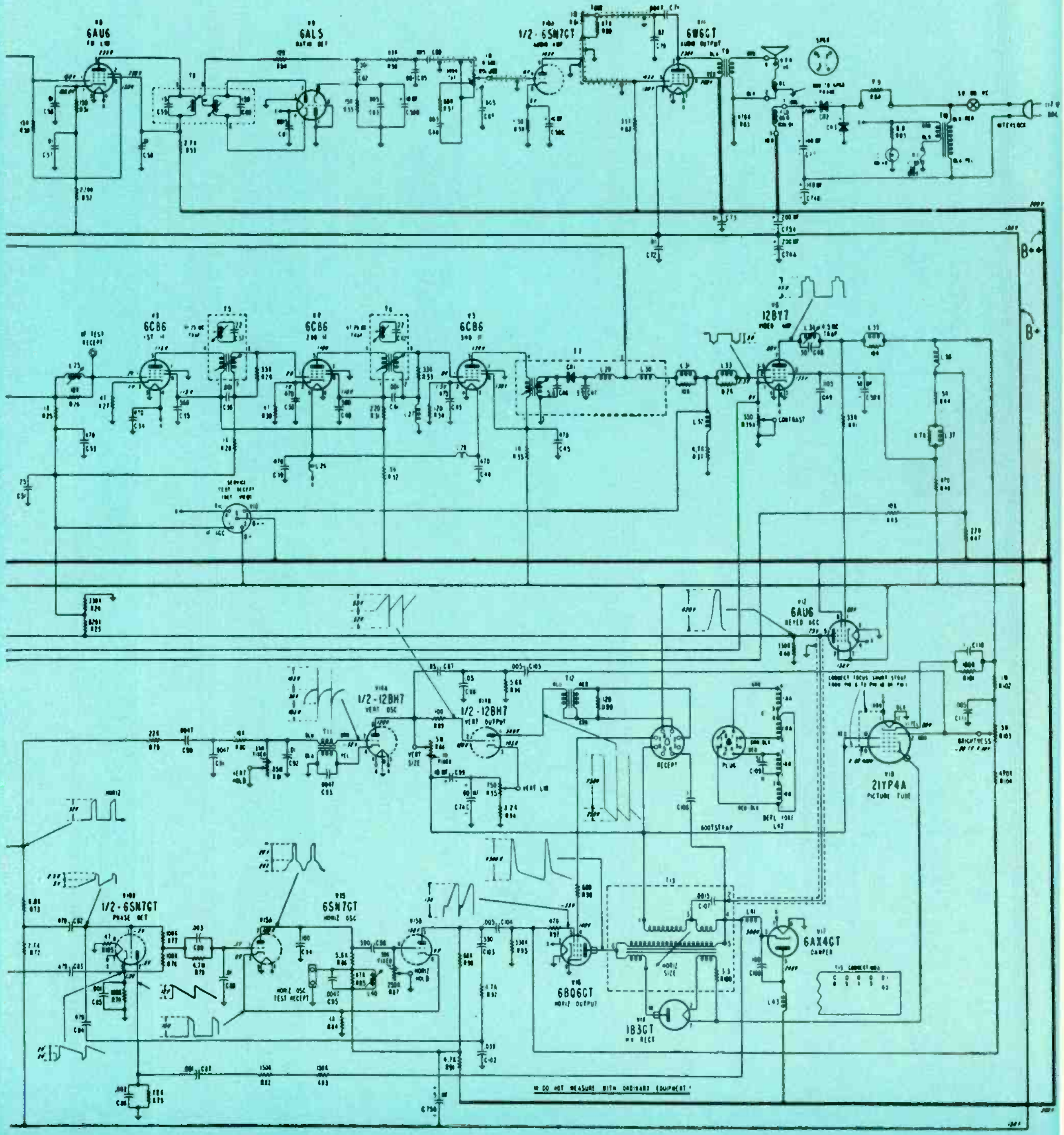


WAVEFORMS:

1. Observed on Du Mont 241 oscilloscope
2. Contrast control set for signal of 45 volts peak-to-peak at plate of video amplifier tube
3. All other controls in normal operating position
4. Horizontal output tube removed to eliminate high-voltage pulse interference from scope when observing all waveforms except those from phase detector through horizontal circuit

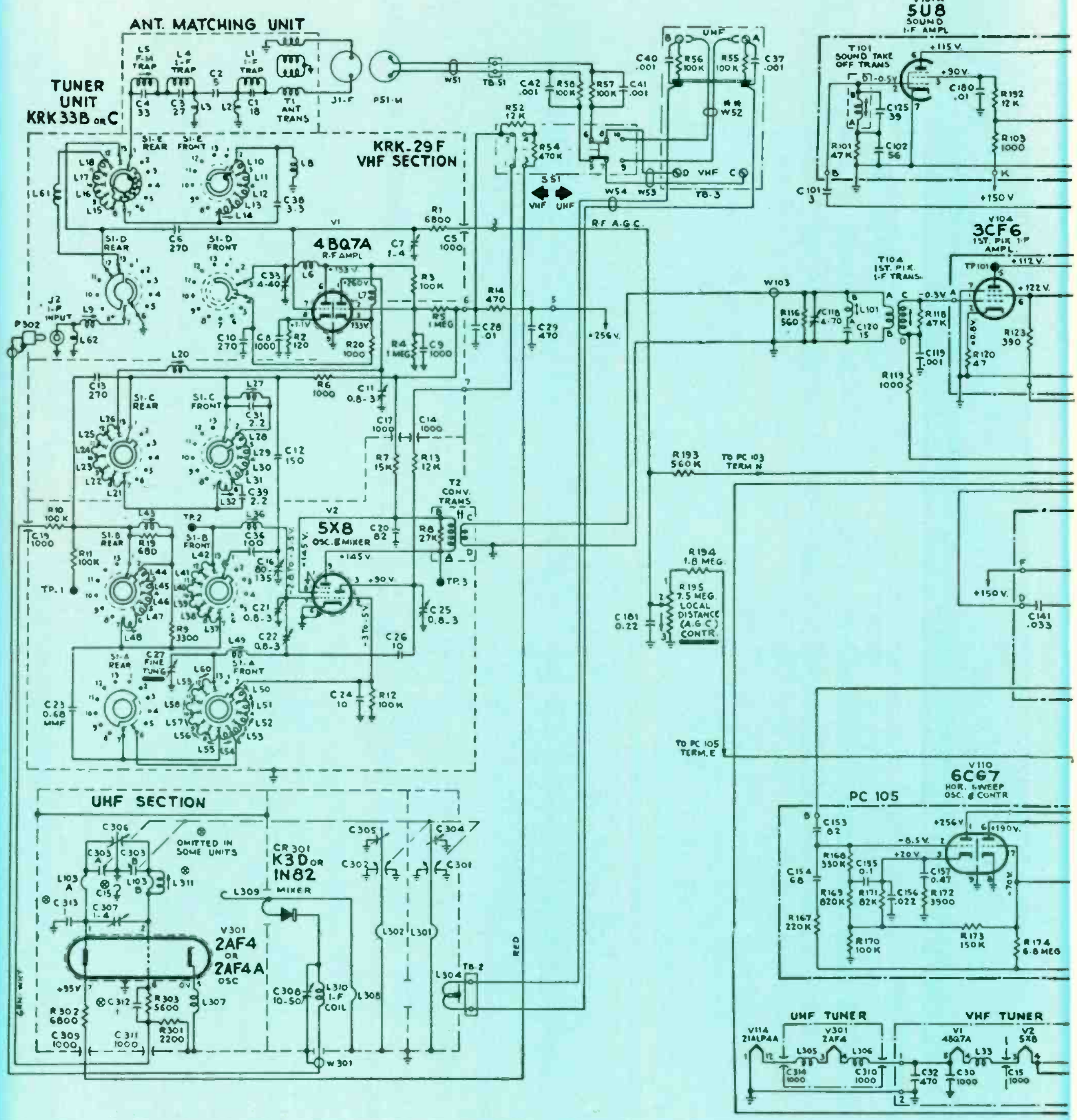
Models 21K20, 21K20B, 21T18, 21T18B etc.

(Basic models have suffix -00.) First *minor* change makes the number 01. Example: 21K20A-01. First *major* electrical change changes suffix letter. Example: 21K20B. Additions to prefix indicate mechanical changes. Chassis TS has 21ALP4A 90° tube, RTS has 21YP4A 70° tube and WTS is same as RTS except picture tube is tilted 5%



RCA VICTOR CHASSIS KCS95B, -C

(Chassis 95 and 95A identical except that they have KRK32B v.h.f. tuner)

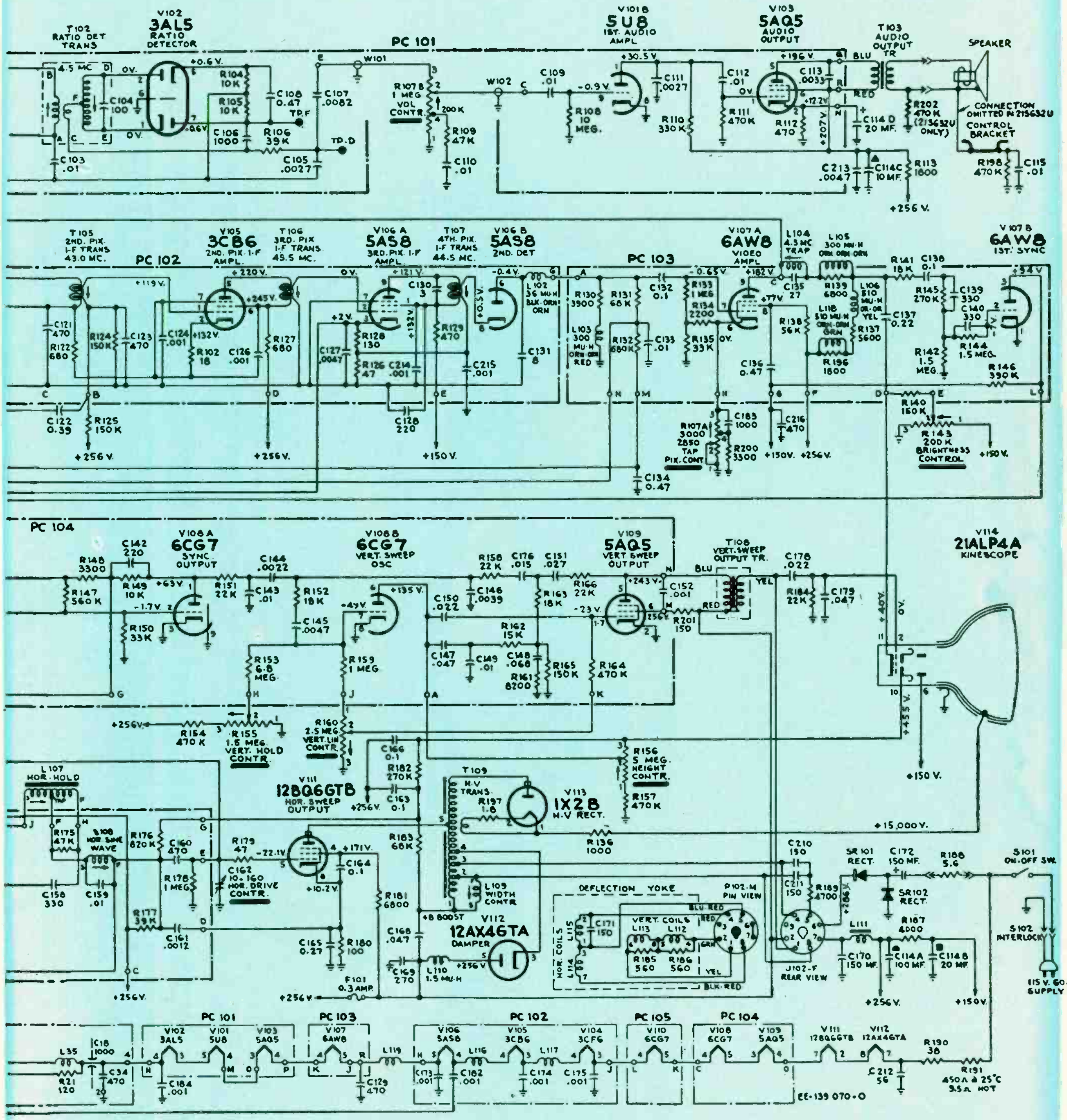


IMPORTANT WIRING NOTICE

Many of the wiring connections in these receivers employ a new type solderless wire-wrap connection. These connections consist of six or seven turns of tightly machine-wrapped wire around special square studs. They are both electrically and mechanically equal or superior to conventional soldered connections and should not be considered to require soldering. However, where rewiring is required or the original tightly wrapped connection has once been unwound, conventional soldering methods must be used.

Models 21-S-6052, 21-S-6052U, 21-S-6053 21-S-6053U, 21-S-632, 21-S-632U

(Models with suffix "U" are v.h.f.-u.h.f. receivers.)



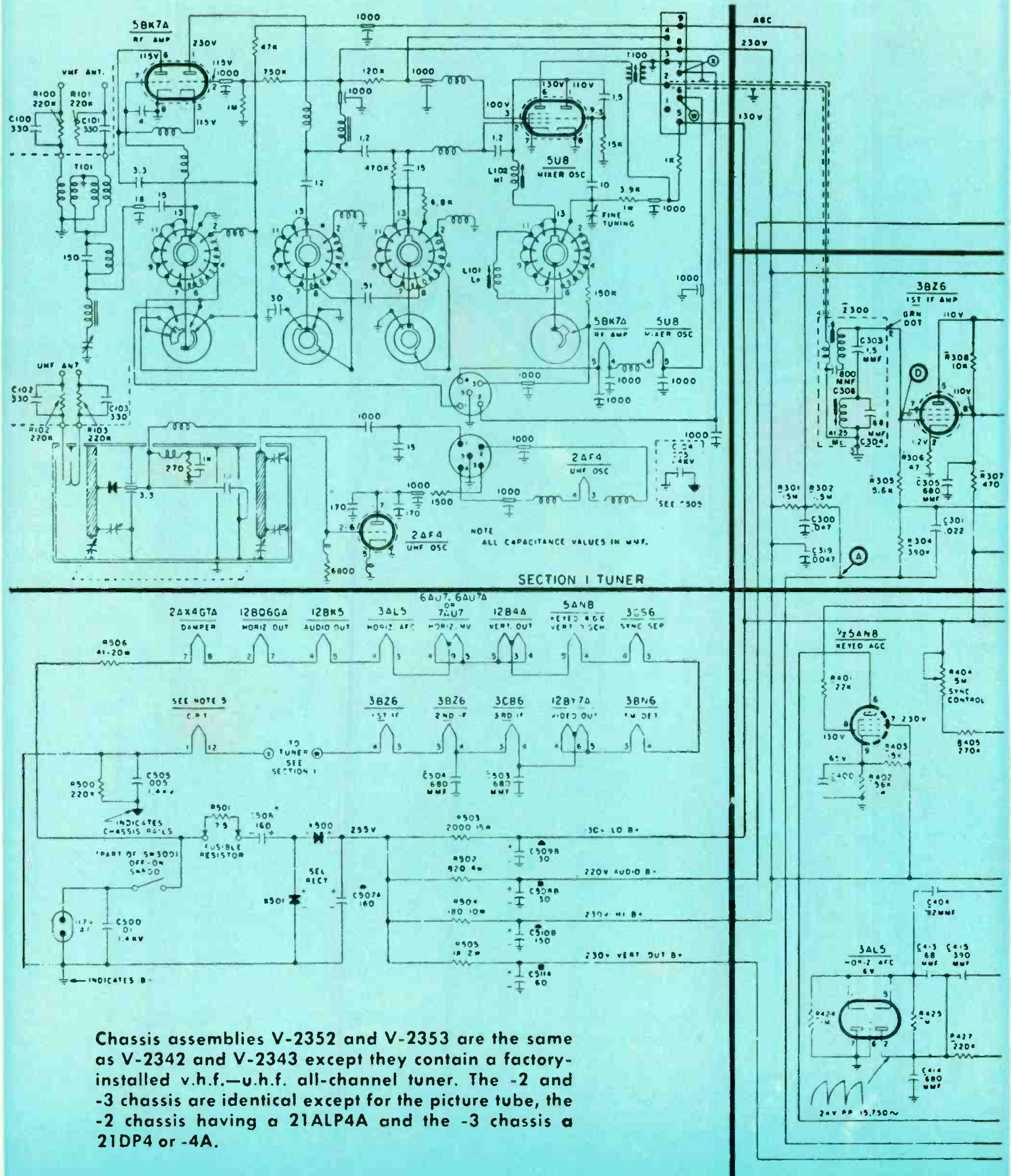
Note 1:

When using combination v.h.f.-u.h.f. antenna, connect transmission line to v.h.f. terminals. For separate v.h.f. and u.h.f. antennas, disconnect W52 and connect transmission lines to their respective terminals.

Note 2:

The channel selector switch is shown in the channel 2 position with both front and rear sections shown as viewed from the front.

WESTINGHOUSE V-2342, V-2352 V-2343, V-2353



Chassis assemblies V-2352 and V-2353 are the same as V-2342 and V-2343 except they contain a factory-installed v.h.f.—u.h.f. all-channel tuner. The -2 and -3 chassis are identical except for the picture tube, the -2 chassis having a 21ALP4A and the -3 chassis a 21DP4 or -4A.

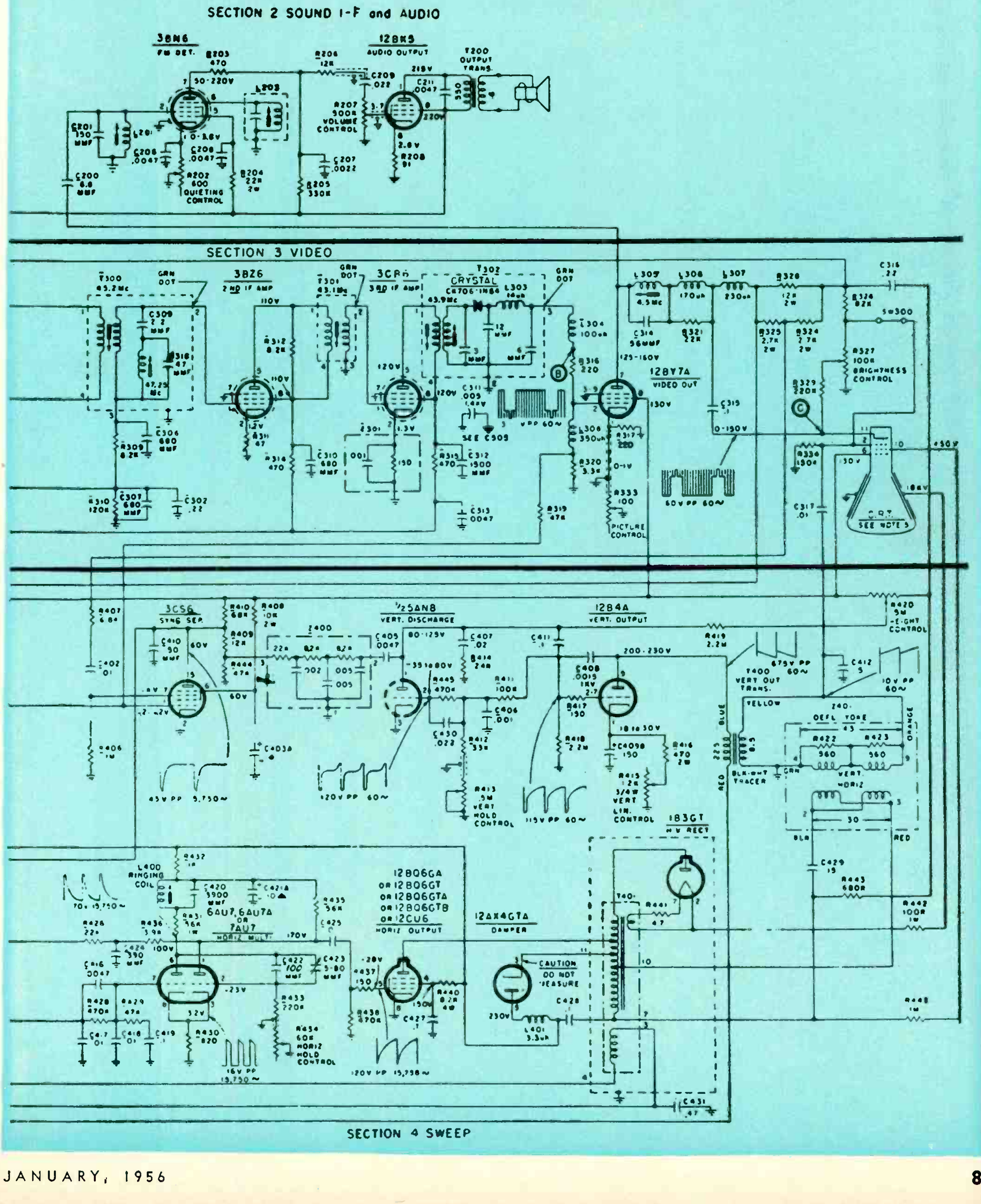
Notes:

D.c. voltages measured from B minus with a v.t.v.m. and no signal applied. Peak-to-peak waveforms are taken with the picture control set for a 60-volt peak-to-peak signal at the picture tube cathode. All other controls set for a normal picture.

All capacitance values µf, all resistance values in ohms and all resistors ½ watt, unless otherwise specified.

A line above or below a code indicates the location of the part. Example: R305 is located on the i.f. board; R304 is on the sweep board. R505 (no line) indicates the part is located elsewhere.

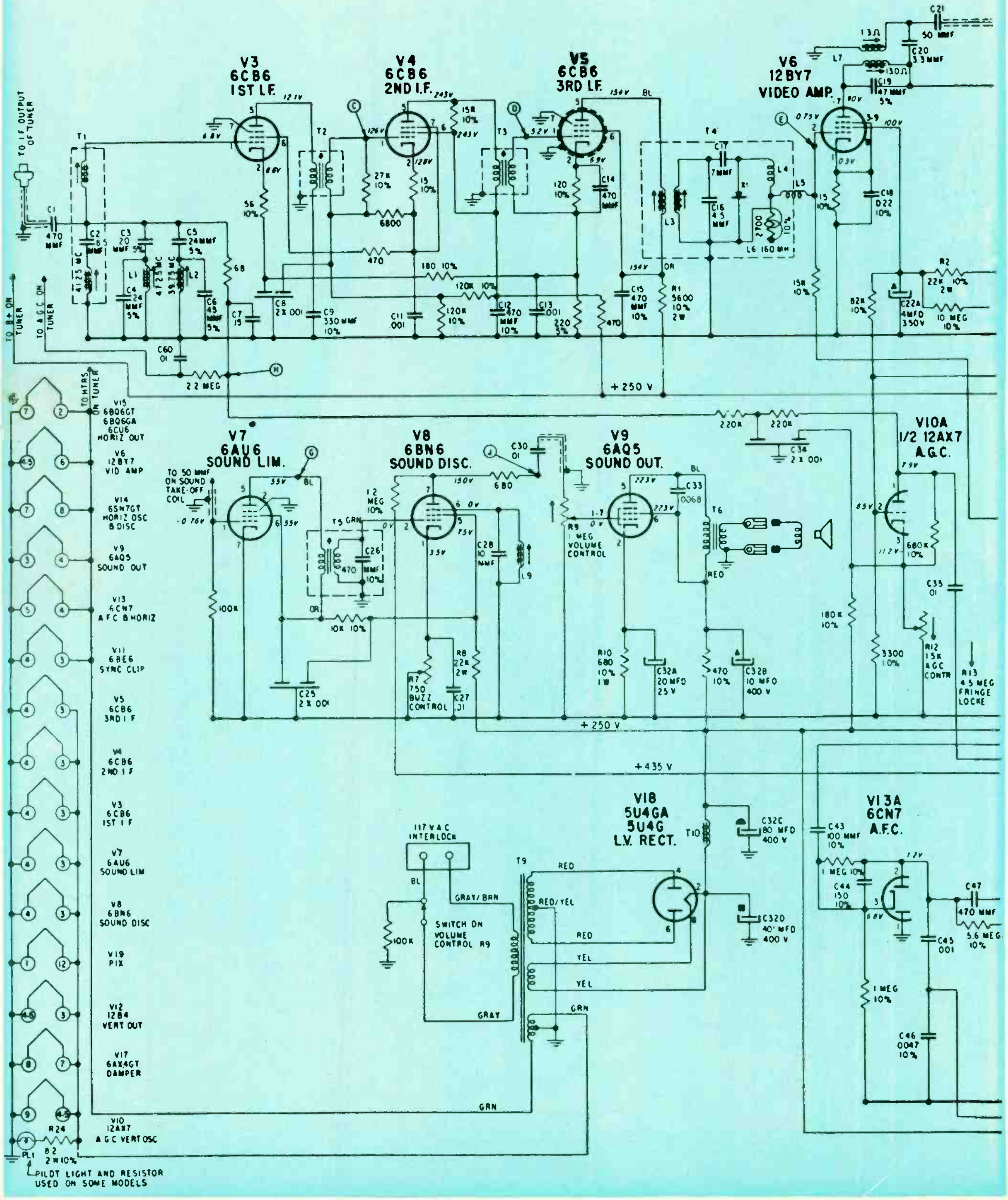
Use 21ALP4 on V2342-14, V2352-104; 21ALP4A on V2342-24, V-2352-204; 24DP4 on V2343-14, V2353-104 and 24DP4A on V2343-24, V2353-204 chassis.



ZENITH 19X21

Suffix U following any model number indicates a receiver equipped with the Zenith continuous tuner.

Suffix Q following any model number indicates a receiver equipped with Zenith *Flash-Matic* remote control.



Used in Models X2229R, X2230E,R, X2256E,R

NOTES

All voltages d.c. unless specified and measured from chassis to points indicated with a vacuum-tube voltmeter having 11 megohms input resistance.

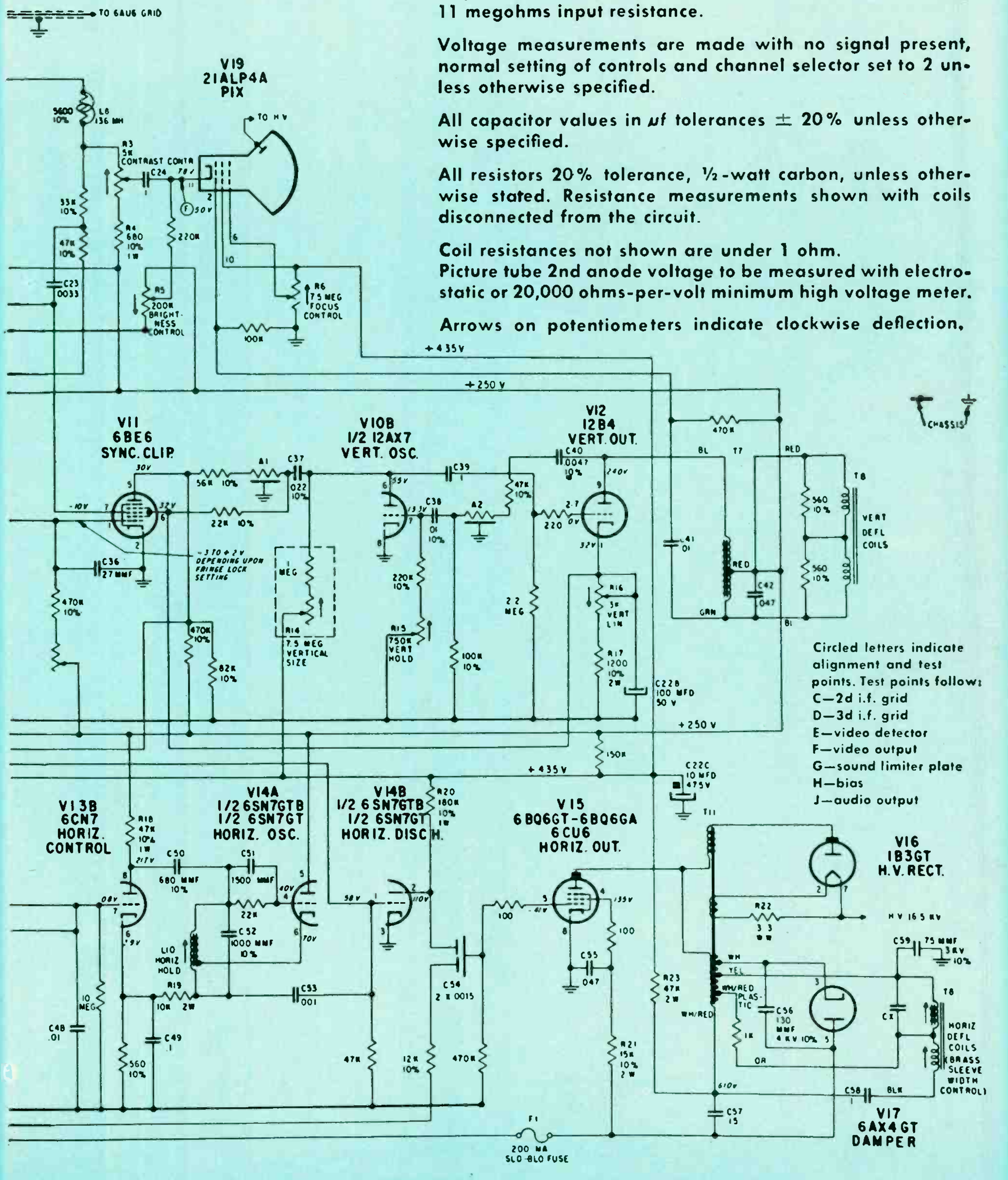
Voltage measurements are made with no signal present, normal setting of controls and channel selector set to 2 unless otherwise specified.

All capacitor values in µf tolerances ± 20% unless otherwise specified.

All resistors 20% tolerance, ½-watt carbon, unless otherwise stated. Resistance measurements shown with coils disconnected from the circuit.

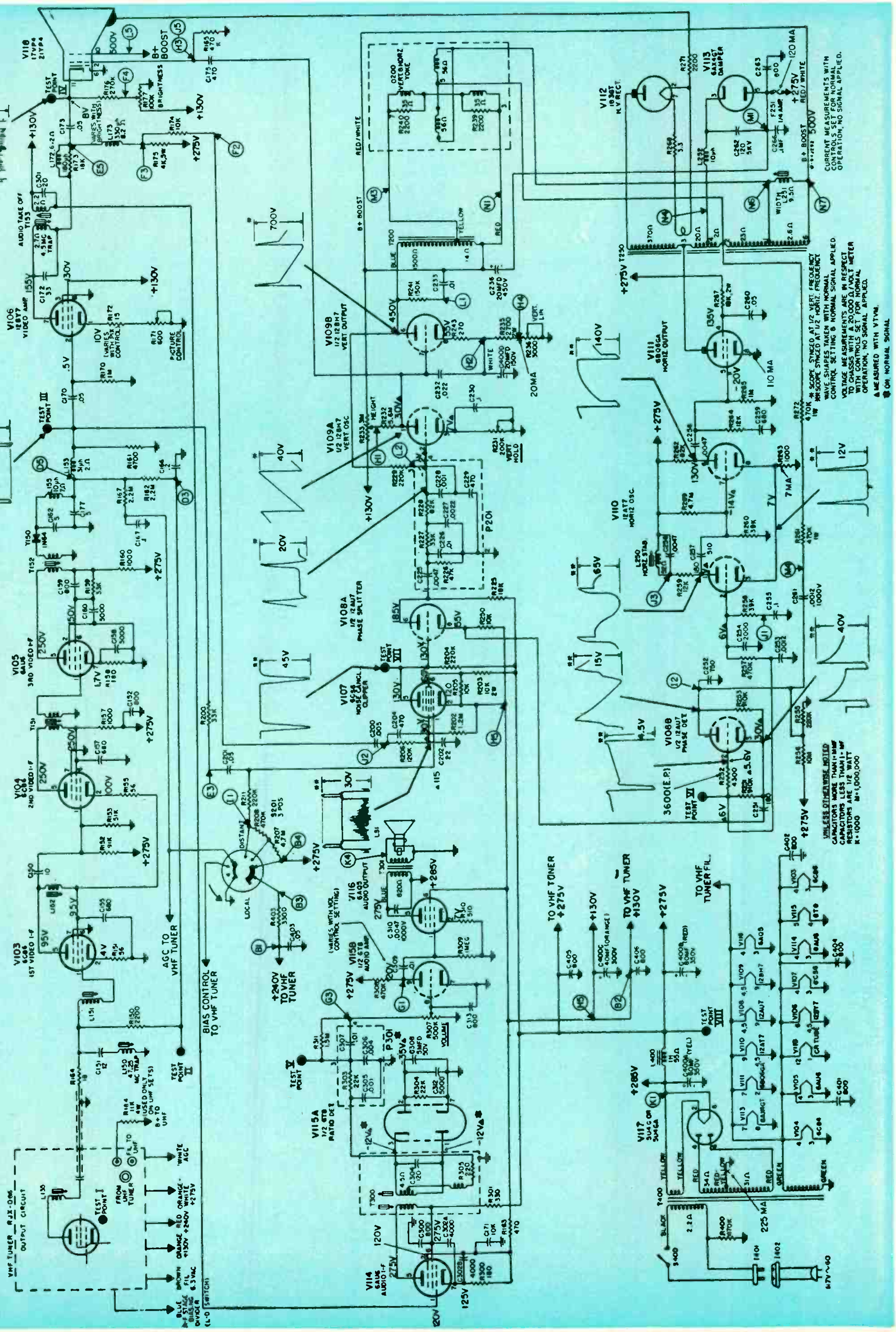
Coil resistances not shown are under 1 ohm.
Picture tube 2nd anode voltage to be measured with electrostatic or 20,000 ohms-per-volt minimum high voltage meter.

Arrows on potentiometers indicate clockwise deflection.



Circled letters indicate alignment and test points. Test points follow:
C—2d i.f. grid
D—3d i.f. grid
E—video detector
F—video output
G—sound limiter plate
H—bias
J—audio output

GENERAL ELECTRIC ER-S-K55



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O-10 LABORATORY TYPE OSCILLOSCOPE: The world's largest selling oscilloscope kit, and the most successful oscilloscope in history. Designed especially for color and black-and-white TV service work. Its 5 megacycle bandwidth and new 500 Kc sweep generator readily qualify it for laboratory applications. Features easy-to-assemble etched metal circuit board construction.

WA-P2 HIGH FIDELITY PREAMPLIFIER: This is the world's largest selling hi fi preamplifier kit. Features complete equalization, 5 separate switch-selected inputs with individual pre-set level controls, beautiful modern appearance, high-quality components.

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- *High Quality Standard Components for Long-Life Service.*

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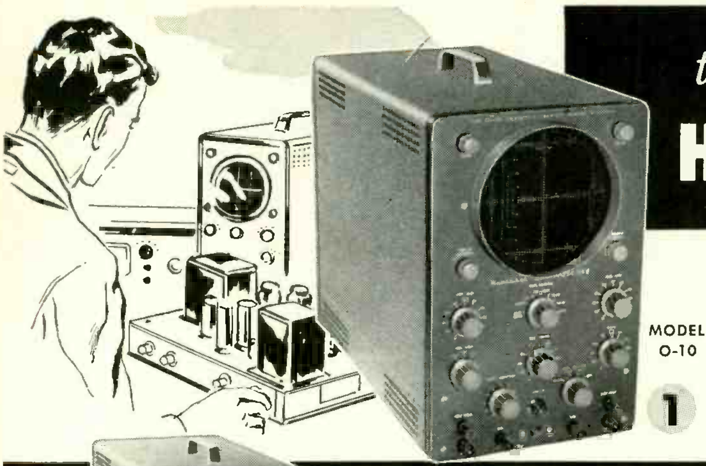

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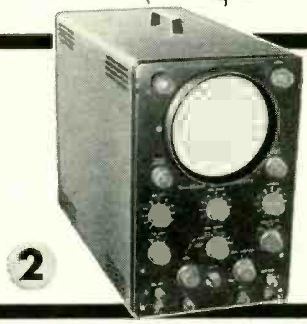

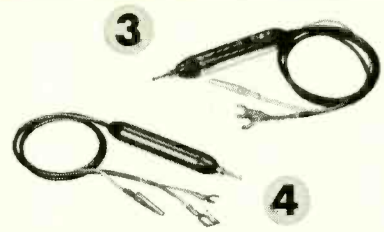

❶ *Heathkit* ETCHED CIRCUIT COLOR-TV 5″ OSCILLOSCOPE KIT

This deluxe quality oscilloscope has proven itself through thousands of operating hours in service shops and laboratories. Features the best in components—and the best in circuit design.

Features amplifier response to 5 Mc for color TV work, and employs the radically new sweep circuit to provide stable operation up to 500,000 cps. In addition, etched metal, pre-wired circuit boards cut assembly time almost in half, and permit a level of circuit stability never before achieved in an oscilloscope of this type.

Vertical amplifiers flat within +2 db −5 db from 2 cps to 5 Mc, down only 1½ db at 3.58 Mc. Vertical sensitivity is 0.025 volts, (rms) per inch at 1 Kc. 11 tube circuit employs a 5UP1 CRT.

Plastic molded capacitors used for coupling and bypass—preformed and cabled wiring harness provided.

Features built-in peak-to-peak calibrating source—retrace blanking amplifier—push-pull amplifiers and step-attenuated input.

MODEL O-10 **$69.50** *Shpg. Wt. 21 lbs.*

❷ *Heathkit* ETCHED CIRCUIT 5″ OSCILLOSCOPE KIT

This is a general purpose oscilloscope for the more usual applications in the service shop or lab, yet is comparable to scopes costing many dollars more.

Features full size 5″ CRT (5BP1), built-in peak-to-peak voltage calibration—3 step input attenuator—phasing control—push-pull deflection amplifiers—and etched metal prewired circuit boards.

Vertical channel flat within ±3 db from 2 cps to 200 Kc, with 0.09 V. rms/inch, peak-to-peak sensitivity at 1 Kc. Sweep circuit from 20 cps to 100,000 cps. A scope you will be proud to own and use.

MODEL OM-1 **$49.50** *Shpg. Wt. 21 lbs.*

❸ *Heathkit* LOW CAPACITY PROBE KIT

Scope investigation of circuits encountered in TV requires the use of special low capacity probe to prevent loss of gain, circuit loading, or distortion. This probe features a variable capacitor to provide correct instrument impedance matching. Also the ratio of attenuation can be controlled.

NO. 342 **$3.50** *Shpg. Wt. 1 Lb.*

❹ *Heathkit* ETCHED CIRCUIT SCOPE DEMODULATOR PROBE KIT

Extend the usefulness of your Oscilloscope by observing modulation envelope of R.F. or I.F. carriers found in TV and radio receivers. Functions like AM detector to pass only modulation of signal and not signal itself. Applied voltage limits are 30 V. RMS and 500 V. DC.

NO. 337-C **$3.50** *Shpg. Wt. 1 Lb.*

❺ *Heathkit* ETCHED CIRCUIT 3″ OSCILLOSCOPE KIT

This compact little oscilloscope measures only 9½″ H. x 6½″ W. x 11¾″ D., and weighs only 11 lbs! Easily employed for home service calls, for work in the field or is just the ticket for use in the ham shack or home workshop. Incorporates many of the features of the Model OM-1, but yet is smaller in physical size for portability.

Employing etched circuit boards, the Model OL-1 features vertical response within ± 3 db from 2 cps to 200 Kc. Vertical sensitivity is 0.25 V. RMS/inch peak-to-peak, and sweep generator operates from 20 cps to 100,000 cps. Provision for r.f. connection to deflection plates for modulation monitoring, and incorporates many features not expected at this price level. 8-tube circuit features a type 3GP1 Cathode Ray Tube.

MODEL OL-1 **$29.50** *Shpg. Wt. 14 lbs.*

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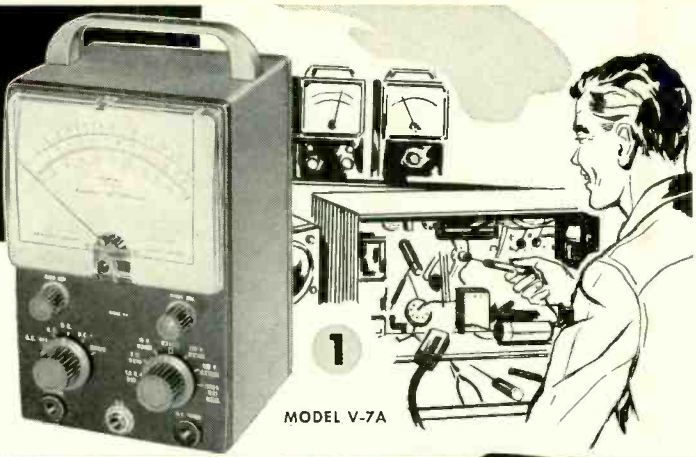
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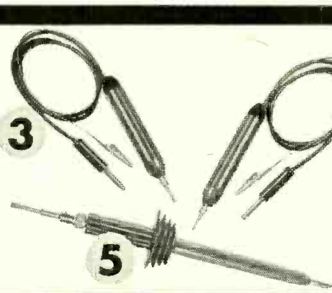
MODEL V-7A


2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6

❶ *Heathkit* ETCHED CIRCUIT VACUUM TUBE VOLTMETER KIT

Besides measuring AC (rms), DC and resistance, the modern-design V-7A incorporates peak-to-peak measurement for FM and television servicing.

AC (rms) and DC voltage ranges are 1.5, 5, 15, 50, 150, 500, and 1500. Peak-to-peak AC voltage ranges are 4, 14, 40, 140, 400, 1400, and 4000. Ohmmeter ranges are X1, X10, X100, X1000, X10K, X100K, and X1 megohm. Also a db scale is provided. A polarity reversing switch provided for DC measurements, and zero center operation within range of front panel controls. Employs a 200 μa meter for indication. Input impedance is 11 megohms.

Etched metal, pre-wired circuit board for fast, easy assembly and reliable operation is 50% thicker for more rugged physical construction. 1% precision resistors for utmost accuracy.

MODEL V-7A **$24.50** Shpg. Wt. 7 Lbs.

❷ *Heathkit* 20,000 OHMS/VOLT MULTIMETER KIT

The MM-1 is a portable instrument for outside servicing, for field testing, or for quick portability in the service shop. Combines attractive physical appearance with functional design. 20,000 ohms/v. DC, and 5000 ohms/v. AC. AC and DC voltage ranges are 0-1.5, 5, 50, 150, 500, 1500 and 5000 volts. Direct current ranges are 0-150 μa., 15 ma., 150 ma., 500 ma., and 15 amperes. Resistance ranges are X1, X100, X10,000 providing center scale readings of 15, 1500 and 150,000 ohms. DB ranges cover −10 db to +65 db.

Features a 4½" 50 μa. meter. Provides polarity reversal on DC measurements. 1% precision resistors used in multiplier circuits. Not affected by RF fields.

MODEL MM-1 **$29.50** Shpg. Wt. 6 Lbs.

❸ *Heathkit* ETCHED CIRCUIT RF PROBE KIT

The Heathkit RF Probe used in conjunction with any 11 megohm VTVM will permit RF measurements up to 250 Mc with ± 10% accuracy. Uses etched circuits for increased circuit stability and ease of assembly.

NO. 309-C **$3.50** Shpg. Wt. 1 Lb.

❹ *Heathkit* ETCHED CIRCUIT PEAK-TO-PEAK PROBE KIT

Now read peak-to-peak voltages on the DC scale of any 11 megohm VTVM with this new probe, employing etched circuit for stability and low loss. Readings made directly from VTVM scales, from 5 Kc to 5 Mc. Not required for Heathkit Model V-7A VTVM.

NO. 338-C **$5.50** Shpg. Wt. 2 Lbs.

❺ *Heathkit* 30,000 VOLT D.C. HIGH VOLTAGE PROBE KIT

For TV service work or similar application for measurement of high DC voltage. Precision multiplier resistor mounted inside plastic probe. Multiplication factor of 100 on the ranges of Heathkit 11 megohm VTVM.

NO. 336 **$4.50** Shpg. Wt. 2 Lbs.

❻ *Heathkit* HANDITESTER KIT

The Model M-1 measures AC or DC voltage at 0-10, 30, 300, 1000, and 5000 volts. Measures direct current at 0-10 ma. and 0-100 ma. Provides ohmmeter ranges of 0-3000 (30 ohm center scale) and 0-300,000 ohms (3000 ohms center scale). Features a 400 μa. meter for sensitivity of 1000 ohms/volt. Because of its size, the M-1 is a very handy portable instrument that will fit in your coat pocket, tool box, glove compartment, or desk drawer. Makes a fine standby unit in the service shop when the main instruments are in use, or is ideal for the hobbyist or beginner. An unusual dollar value.

MODEL M-1 **$14.50** Shpg. Wt. 3 Lbs.

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Heathkit TV ALIGNMENT

GENERATOR KIT

The Model TS-4 features a controllable inductor for all-electronic sweep, improved oscillator and automatic gain circuitry, high RF output, center sweep operation, and improved linearity. It sets a new high standard for sweep generator operation, and is absolutely essential for the up-to-date service shop doing FM, black-and-white TV, and color TV work.

Voltage regulation and effective AGC action insure flat output over a wide frequency range. Electronic sweep insures complete absence of mechanical vibration. Sweep deviation controllable from 0 up to 40 Mc, depending upon base frequency. Effective two-way blanking.

Fundamental output from 3.6 Mc to 220 Mc in 4 bands. Crystal marker provides markers at 4.5 Mc and multiples thereof. Crystal included with kit. Variable marker covers from 19 Mc to 60 Mc on fundamentals, and up to 180 Mc on harmonics. Provision for external marker.

MODEL TS-4 **$49.50** Shpg. Wt. 16 Lbs.

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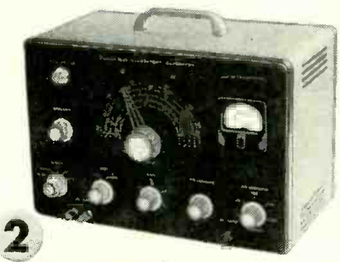

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❶ *Heathkit* LINEARITY PATTERN GENERATOR KIT

The new-design Model LP-1 produces vertical or horizontal bar patterns, a cross-hatch pattern, or white dots on the screen of the TV set under test. No internal connections required. Special clip is attached to the TV antenna terminals. Instant selection of the pattern desired for adjustment of vertical and horizontal linearity, picture size, aspect ratio, and focus. Dot pattern presentation is a *must* for color convergence adjustments on color TV sets.

Extended operating range covers all television channels from 2 to 13. Produces 6 to 12 vertical bars or 4 to 7 horizontal bars.

MODEL LP-1 **$22.50** Shpg. Wt. 7 Lbs.

❷ *Heathkit* LABORATORY GENERATOR KIT

The Heathkit Model LG-1 Laboratory Generator is a high-accuracy signal source for applications where metered performance is essential It covers from 100 Kc to 30 Mc on fundamentals in 5 bands. Modulation is at 400 cycles, and modulation is variable from 0-50%. RF output from 100,000 μv. to 1 μv. 200 μa. meter reads the RF output in microvolts, or percentage of modulation. Fixed step and variable output attenuation provided.

Features voltage regulation, and double copper plated shielding for stability. Provision for external modulation. Coaxial output cable (50 ohms).

MODEL LG-1 **$39.50** Shpg. Wt. 16 Lbs.

❸ *Heathkit* CATHODE RAY TUBE CHECKER KIT

This new-design instrument holds the key to rapid and complete picture tube testing, either in the set, on the work-bench, or in the carton. Tests for shorts, leakage, and emission. Features Shadowgraph test (a spot of light on the screen) to indicate whether the tube is capable of functioning.

The Model CC-1 tests all electromagnetic deflection picture tubes normally encountered in television servicing. Supplies all operating voltages to the tube under test, and indicates the condition of the tube on a large "GOOD-BAD" scale. Features spring loaded test switches for operator protection.

The CC-1 is housed in an attractive portable case and is light in weight — ideal for outside service calls.

MODEL CC-1 **$22.50** Shpg. Wt. 10 Lbs.

❹ *Heathkit* DIRECT READING CAPACITY METER KIT

Not only is this instrument popular in the service shop, but it has found extensive application in industrial situations. Ideal for quality control work, production line checking, or for matching pairs.

Features direct reading linear scales from 100 mmf to .1 mfd full scale. Necessary only to connect a capacitor of unknown value to the insulated binding posts, select the correct range, and read the meter. The CM-1 is not susceptible to hand capacity, and has a residual capacity of less than 1 mmf.

MODEL CM-1 **$29.50** Shpg. Wt. 7 Lbs.

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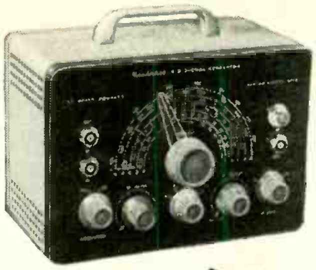
Heathkit SIGNAL GENERATOR KIT



MODEL SG-8 **$19.50** Shpg. Wt. 8 Lbs.

This is one of the biggest signal generator bargains available today. The tried and proven Model SG-8 offers all of the outstanding features required for a basic service instrument. High quality components and outstanding performance.

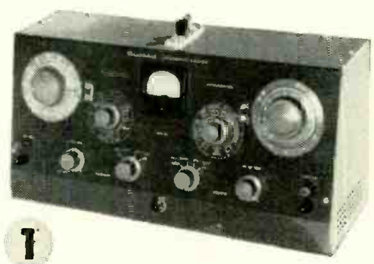
The SG-8 covers 160 Kc to 110 Mc on fundamentals in 5 bands, and calibrated harmonics extend its usefulness up to 220 Mc. The output signal is modulated at 400 cps, and the RF output is in excess of 100,000 uv. Output controlled by both a continuously variable and a fixed step attenuator. Also, audio output may be obtained for amplifier testing. Don't let the low price deceive you. This is a professional type service instrument to fulfill the signal source requirements in the service lab.

❶ *Heathkit* . . . IMPEDANCE BRIDGE KIT

The IB-2 features built-in adjustable phase shift oscillator and amplifier, and has panel provisions for external generator. Measures resistance, capacitance, inductance, dissipation factors of condensers, and storage factor of inductance.

D, Q, and DQ functions combined in one control. ½% resistors and ½% silver-mica capacitors especially selected for this instrument. A 100-0-100 microammeter provides null indications. Two-section CRL dial provides 10 separate "units" with an accuracy of .5%. Fractions of units read on variable control.

MODEL IB-2 **$59.50** Shpg. Wt. 12 Lbs.



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❷ *Heathkit* "Q" METER KIT

The Heathkit Model QM-1 will measure the Q of inductances and the RF resistance and distributed capacity of coils. Employs a 4½" 50 microampere meter for direct indication. Will test at frequencies of 150 Kc to 18 Mc in 4 ranges. Measures capacity from 40 mmf to 450 mmf within ± 3 mmf. Indispensible for coil winding and determining unknown condenser values. A worthwhile addition to your laboratory at an outstandingly low price. Useful for checking wave traps, chokes, peaking coils, etc. Laboratory facilities are now available to the service shop and home lab.

MODEL QM-1 **$44.50** Shpg. Wt. 14 Lbs.

2

❸ *Heathkit* 6–12 VOLT BATTERY ELIMINATOR KIT

This modern battery eliminator will supply 6 or 12 volt output for ordinary automobile radios as well as 12 volts for the new models in the latest model cars. Output voltage is variable from 0-8 volts DC, or 0-16 volts DC. Will deliver up to 15 amperes at 6 volts, or up to 7 amperes at 12 volts. Two 10,000 microfarad filter capacitors insure smooth DC output. Two panel meters monitor output voltage and current. Will double as a battery charger. Definitely required for automobile radio service work.

MODEL BE-4 **$31.50** Shpg. Wt. 17 Lbs.

3

❹ *Heathkit* DECADE RESISTANCE KIT

Twenty 1% precision resistors provide resistance from 1 to 99,999 ohms in 1 ohm steps. Indispensible around service shop laboratory, ham shack, or home workshop. Well worth the extremely low Heathkit price.

MODEL DR-1 **$19.50** Shpg. Wt. 4 Lbs.

❺ *Heathkit* VIBRATOR TESTER KIT

Tests vibrators for proper starting and indicates the quality of the output on a large "GOOD-BAD" scale. Checks both interrupter and self-rectifier types in 5 different sockets. Operates from any battery eliminator delivering variable voltage from 4 to 6 volts DC at 4 amps. Ideal companion to the Model BE-4.

MODEL VT-1 **$14.50** Shpg. Wt. 6 Lbs.

❻ *Heathkit* DECADE CONDENSER KIT

Provides capacity values from 100 mmf to 0.111 mfd in steps of 100 mmf. ± 1% precision silver-mica condensers used. High quality ceramic switches for reduced leakage. Polished birch cabinet. Extremely valuable in all electronic activity.

MODEL DC-1 **$16.50** Shpg. Wt. 3 Lbs.

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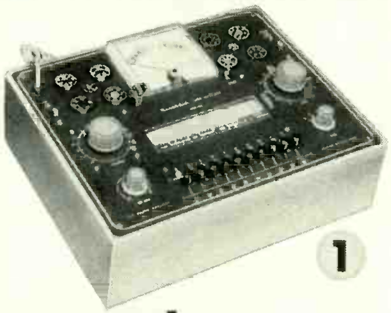
Heathkit
TUBE CHECKER KIT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1 The Heathkit Model TC-2 is an emission type tube tester that represents a tremendous saving over the price of a comparable unit from any other source. At only $29.50, you can have a tube tester of your own, even if you are an experimenter, or only do part time service work. Extremely popular with radio servicemen, it uses a 4½" meter with 3-color meter face for simple "GOOD-BAD" indications that the customer can understand. Will test all tubes commonly encountered in radio and TV service work.

Ten 3-position lever switches for "open" or "short" tests on each tube element. Neon bulb indicates filament continuity or short between tube elements. Line adjust control provided. The roll chart is illuminated.

Sockets provided for 4, 5, 6, and 7-pin, octal, and loctal tubes, 7 and 9 pin miniature tubes, and the 5 pin Hytron tubes. Blank space provided for future socket addition. Tests tubes for opens, and shorts, and for quality on the basis of total emission. 14 different filament voltage values provided.

MODEL TC-2
$29.50
Shpg. Wt. 12 Lbs.

2 *Heathkit* PORTABLE TUBE CHECKER KIT

The Model TC-2P is identical to the Model TC-2 except that it is housed in a rugged carrying case. This strikingly attractive and practical two-tone case is finished in proxylin impregnated fabric. The cover is detachable, and the hardware is brass plated. This case imparts a real professional appearance to the instrument. Ideal for home service calls, or any portable application.

MODEL TC-2P
$34.50
Shpg. Wt. 15 Lbs.


3
2

3 *Heathkit* TV PICTURE TUBE TEST ADAPTER

The Heathkit TV picture tube test adapter is designed for use with the Model TC-2 Tube Checker. Test picture tubes for emission, shorts, and thereby determine tube quality. 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.

4 *Heathkit* . . . CONDENSER CHECKER KIT


4

Use this Condenser Checker to quickly and accurately measure those unknown condenser and resistor values. All readings taken directly from the calibrated panel scales without any involved calculation. Capacity measurements in four ranges from .00001 to 1000 mfds. Checks paper, mica, ceramic and electrolytic condensers. A power factor control is available for accurate indication of electrolytic condenser efficiency. Leakage test switch—selection of five polarizing voltages, 25 volts to 450 volts DC to indicate condenser operating quality under actual load conditions. Spring-return test switch automatically discharges condenser under test and eliminates shock hazard to the operator.

Resistance measurements can be made in the range from 100 ohms to 5 megohms. Here again, all values are read directly on the calibrated scales. Increased sensitivity coupled with an electron beam null indicator increases overall instrument usefulness.

For safety of operation, the circuit is entirely transformer operated. An outstanding low kit price for this surprisingly accurate instrument.

MODEL C-3
$19.50
Shpg. Wt. 7 Lbs.

5 *Heathkit* VISUAL-AURAL SIGNAL TRACER KIT


5

This signal tracer is extremely valuable in servicing AM, FM, and TV receivers, especially when it comes to isolating trouble to a particular stage of the circuit under test.

This visual-aural tracer features a high gain RF input channel to permit signal tracing from the receiver antenna input clear through all RF, IF, detector, and audio stages to the speaker. Separate low-gain channel provided for audio circuit exploration. Both visual and aural indication by means of a speaker or headphone, and electron beam "eye" tube as a level indicator. Also incorporates a noise locater circuit for DC noise checks, and a built-in calibrated wattmeter (30-500 watts). Panel terminals provided for "patching" output transformer or speaker into external circuit for test purposes. Designed especially for the radio and TV serviceman. Cabinet size: 9½" wide x 6½" high x 5" deep. A real test equipment bargain.

MODEL T-3
$23.50
Shpg. Wt. 9 Lbs.

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BENTON HARBOR 20, MICHIGAN

MODEL HD-1

Shpg. Wt. 13 Lbs. **$49.50**

Used with a sine wave generator, the Model HD-1 will check the harmonic distortion output of audio amplifiers under a variety of conditions. Reads distortion directly on the meter as a percentage of the input signal. Operates between 20 and 20,000 cps. High impedance VTVM circuit for initial reference settings and final distortion readings. Ranges are 0-1, 3, 10, and 30 volts full scale. 1% precision resistors. Distortion scales are 0-1, 3, 10, 30 and 100% full scale. Requires only .3 volt input for distortion test.

Heathkit HARMONIC DISTORTION METER KIT

❶ *Heathkit* AUDIO ANALYZER KIT

This instrument consists of an audio wattmeter, an AC VTVM, and a complete IM analyzer, all in one compact unit.

Use the VTVM to measure noise, frequency response, output gain, power supply ripple, etc. Use the wattmeter for measurement of power output. Internal loads provided for 4, 8, 16, or 600 ohms. VTVM also calibrated for DBM units. High or low impedance IM measurements made with built-in 6KC and 60 cps generators. VTVM ranges are .01, to 300 volts in 10 steps. Wattmeter ranges are .15 mw. to 150 w. in 7 steps. IM scales are 1% to 100% in 5 steps.

MODEL AA-1 **$59.50** Shpg. Wt. 13 Lbs.

❷ *Heathkit* AUDIO GENERATOR KIT

This new Heathkit Model features step-tuning from 10 cps to 100 Kc with three rotary switches that provide two significant figures and multiplier. Less than .1% distortion. Frequency accurate to within ± 5%.

Output monitored on a large 4½" meter that reads voltage or db. Both variable and step-type attenuation provided. Meter reads zero-to-maximum at each attenuator position. Output ranges (and therefore meter ranges) are 0-.003, .01, .03, .1, .3, 1, 3, 10 volts. Step-tuning provides rapid positive selection of the desired frequency, and allows accurate return to any given frequency.

MODEL AG-9 **$34.50** Shpg. Wt. 8 Lbs.

❸ *Heathkit* AUDIO OSCILLATOR KIT

(SINE WAVE — SQUARE WAVE)

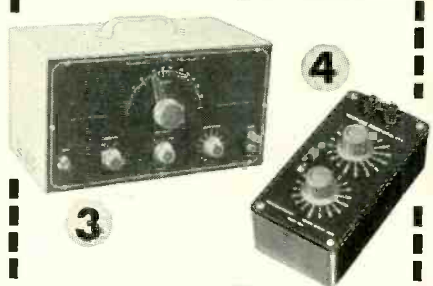
The Model AO-1 features sine wave or square wave coverage from 20-20,000 cps in 3 ranges. It is an instrument specifically designed to completely fulfill the needs of the serviceman and high fidelity enthusiast. Offers high level output across the entire frequency range, low distortion and low impedance output. Features a thermistor in the second amplifier stage to maintain essentially flat output through the entire frequency range. Produces an excellent sine wave for audio testing, or will produce good, clean, square waves with a rise time of only 2 microseconds.

MODEL AO-1 **$24.50** Shpg. Wt. 10 Lbs.

❹ *Heathkit* RESISTANCE SUBSTITUTION BOX KIT...

Provides switch selection of 36 RTMA 1 watt standard 1% resistors ranging from 15 ohms to 10 megohms. Numerous applications in radio and TV work, and essential in the developmental laboratory.

MODEL RS-1 **$5.50** Shpg. Wt. 2 Lbs.



❺ *Heathkit* AC VACUUM TUBE VOLTMETER KIT...

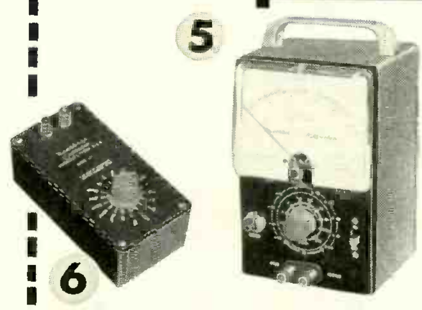
The Heathkit AC VTVM features high impedance, wide frequency range, very high sensitivity, and extremely wide voltage range. Will accurately measure a voltage as small as 1 mv. at high impedance. Excellent for sensitive AC measurements required by laboratories, audio enthusiasts and experimenters. Frequency response is substantially flat from 10 cps to 50 Kc. Ranges are .01, .03, .1, .3, 1, 3, 10, 30, 100, and 300 v. RMS. Total db range −52 to + 52 db. Input impedance 1 megohm at 1 Kc.

MODEL AV-2 **$29.50** Shpg. Wt. 5 Lbs.

❻ *Heathkit* CONDENSER SUBSTITUTION BOX KIT...

Very popular companion to Heathkit RS-1. Individual selection of 18 RTMA standard condenser values from .0001 mfd to .22 mfd. Includes 18" flexible leads with alligator clips.

MODEL CS-1 **$5.50** Shpg. Wt. 2 Lbs.



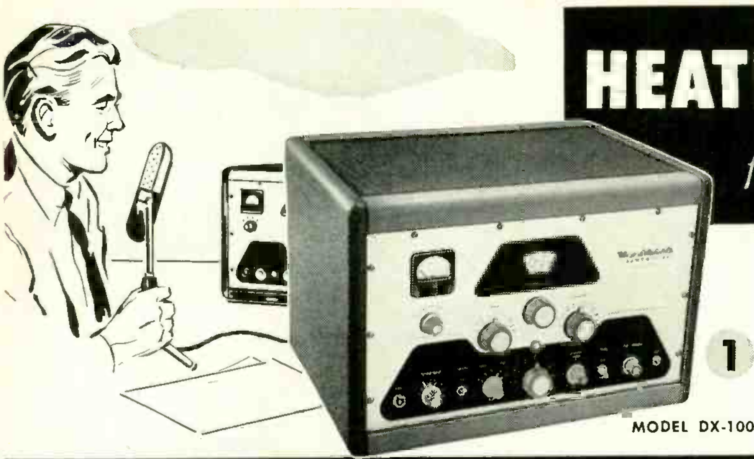
HEATH COMPANY

A SUBSIDIARY OF DAYSTROM INC.

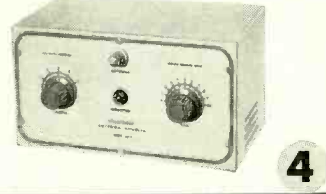
BENTON HARBOR 20, MICHIGAN

HEATHKIT HAM GEAR

for high quality at moderate cost



DOLLAR VALUE: *You get more for your Heathkit dollar because your labor is used to build the kit instead of paying for someone else's. Also, the middleman's margin of profit is eliminated when you deal directly with the manufacturer.*



❶ *Heathkit* DX-100 PHONE & CW TRANSMITTER KIT

The reception given this amateur transmitter has been tremendous. Reports from radio amateurs using the DX-100 are enthusiastic in praising its performance and the high quality of the components used in its assembly. Actual "on the air" results reflect the careful design that went into its development.

The DX-100 features a built-in VFO, modulator, and power supplies, and is completely bandswitching for phone or CW operation on 160, 80, 40, 20, 15, 11, and 10 meters. All parts necessary for construction are supplied in the kit, including tubes, cabinet, and detailed step-by-step instructions. Easy to build, and a genuine pleasure to operate.

Employs push-pull 1625's modulating parallel 6146's for RF output in excess of 100 watts on phone and 120 watts on CW. May be excited from the built-in VFO or from crystals (crystals not included with kit). Features five-point TVI suppression: (1) pi network interstage coupling to reduce harmonic transfer to the final stage; (2) pi network output coupling; (3) extensive shielding; (4) all incoming and outgoing circuits filtered; (5) inter-locking cabinet seams to eliminate radiation except through the coaxial output connector. Pi network output coupling will match 50 to 600 ohm non-reactive load. Illuminated VFO dial and meter face. Remote control socket provided.

The chassis is made of extra-strong #16 gauge copper-plated steel. It employs potted transformers, ceramic switch and variable capacitor insulation, solid silver loading switch terminals, and high-grade well-rated components throughout. Features a pre-formed wiring harness, and all coils are pre-wound.

High-gain speech amplifier for dynamic or crystal microphones, and restricted speech range for increased intelligence. Plenty of audio power reserve. Measures 20⅞" W. x 13¾" H. x 16" D. Schematic diagram and complete technical specifications on request.

MODEL DX-100
$189.50
Shpg. Wt. 120 Lbs.

Shipped Motor Freight Unless Otherwise Specified
$50.00 Deposit Required on C.O.D. Orders

❷ *Heathkit* VFO KIT

The Model VF-1 covers 160-80-40-20-15-11 and 10 meters with three basic oscillator frequencies. Better than 10-volt average RF output on fundamentals. Features illuminated and pre-calibrated dial scale. Cable and plug provided to fit crystal socket of any modern transmitter.

Enjoy the convenience and flexibility of VFO operation at no more than the price of crystals. May be powered from plug on the Heathkit Model AT-1 transmitter, or supplied with power from most transmitters. Measures: 7" H. x 6½" W. x 7" D.

MODEL VF-1
$19.50
Shpg. Wt. 7 Lbs.

❸ *Heathkit* CW AMATEUR TRANSMITTER KIT

The Model AT-1 is an ideal novice transmitter, and may be used to excite a higher power rig later on.

This CW transmitter is complete with its own power supply, and covers 80, 40, 20, 15, 11, and 10 meters. Features single-knob bandswitching, and panel meter indicates grid or plate current for the final amplifier. Designed for crystal operation or external VFO. Crystal not included in kit. Incorporates such features as key click filter, line filter, copper-plated chassis, pre-wound coils, 52 ohm coaxial output, and high quality components throughout. Instruction book simplifies assembly. Employs a 6AG7 oscillator, 6L6 final amplifier. Operates up to 35 watts plate power input.

MODEL AT-1
$29.50
Shpg. Wt. 15 Lbs.

❹ *Heathkit* . . . ANTENNA COUPLER KIT

The Model AC-1 will properly match your low power transmitter to an end-fed long wire antenna. Also attenuates signals above 36 Mc, reducing TVI. 52 ohm coax. input—power up to 75 watts—10 through 80 meters—tapped inductor and variable condenser—neon RF indicator—copper plated chassis and high quality components. Ideal for use with Heathkit AT-1 Transmitter.

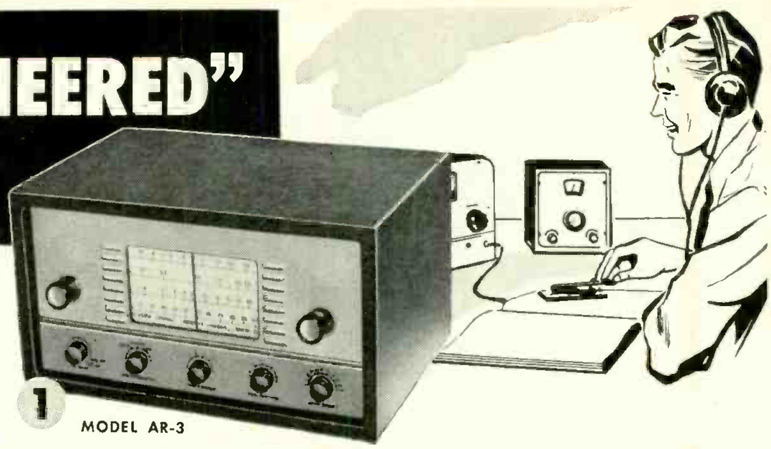
MODEL AC-1
$14.50
Shpg. Wt. 4 Lbs.

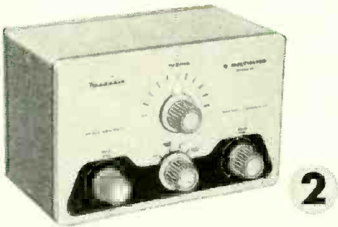
HEATH COMPANY *A Subsidiary of Daystrom, Inc.* **BENTON HARBOR 20, MICHIGAN**

"AMATEUR-ENGINEERED"

Equipment For The Ham

MODERN DESIGN: *You can be sure of getting all the latest and most desirable design features when you buy Heathkits. Advanced-design is a minimum standard for new Heathkit models.*





❶ *Heathkit* COMMUNICATIONS-TYPE ALL BAND RECEIVER KIT

The new Model AR-3 features improved IF and RF performance, along with better image rejection on all bands. Completely new chassis layout for easier assembly, even for the beginner

Covers 550 Kc to 30 Mc in four bands. Provides sharp tuning and good sensitivity over the entire range. Features a transformer-type power supply–electrical bandspread–separate RF and AF gain controls–antenna trimmer–noise limiter–AGC–BFO–headphone jacks–5½" PM speaker and illuminated tuning dial.

CABINET: Fabric covered cabinet with aluminum panel as shown. Part No. 91-15, shipping weight 5 lbs. $4.50.

MODEL AR-3
$27.95
Shpg. Wt. 12 Lbs. (Less Cabinet)

❷ *Heathkit* "Q" MULTIPLIER KIT

Here is the Heathkit Q Multiplier you hams have been asking for. A tremendous help on the phone and CW bands when the QRM is heavy. Provides an effective Q of approximately 4,000 for extremely sharp "peak" or "null." Use it to "peak" the desired signal or to "null" an undesired signal, or heterodyne. Tunes to any signal within the IF band-pass of your receiver. Also provides "broad peak" for conditions where extreme selectivity is not required.

Operates with any receiver having an IF frequency between 450 and 460 Kc. Will not function with AC-DC type receivers. Requires 6.3 volts AC at 300 ma. and 150 to 250 VDC at 2 ma. Derives operating power from your receiver. Uses a 12AX7 tube, and special High-Q shielded coils. Simple to connect with the cable and plugs supplied. Measures only 4-11/16"H.x7⅜"W.x4⅛"D. A really valuable addition to the receiving equipment in your ham shack.

MODEL QF-1
$9.95
Shpg. Wt. 3 Lbs.

❸ *Heathkit* VARIABLE VOLTAGE REGULATED POWER SUPPY KIT

Provides well filtered DC output, variable from zero to 500 volts at no load and *regulated* for stability. Will supply up to 10 ma. at 450 VDC, and up to 130 ma. at 200 VDC. Voltage or current monitored on front panel meter. Also provides 6.3 VAC at 4A. for filament. Filament voltage isolated from B+, and both isolated from ground. Invaluable around the ham shack for supplying operating potentials to experimental circuits. Use in all types of research and development laboratories as a temporary power supply, and to determine design requirements for ultimate power supply.

MODEL PS-3
$35.50
Shpg. Wt. 17 lbs.

❹ *Heathkit* ANTENNA IMPEDANCE METER KIT

Use in conjunction with a signal source for measuring antenna impedance, line matching, adjustment of beam and mobile antennas, etc. Will double as a phone monitor or relative field strength indicator. 100 μa. meter employed. Covers the range from 0-600 ohms. An instrument of many uses for the amateur.

MODEL AM-1
$14.50
Shpg. Wt. 2 lb.

❺ *Heathkit* GRID DIP METER KIT

This is an extremely valuable tool for accomplishing literally hundreds of jobs on all types of equipment. Covering from 2 Mc to 250 Mc, the GD-1B is compact and can be operated with one hand. Uses a 500 μa. meter for indication, with a sensitivity control and headphone jack. Includes prewound coils and rack. Indispensable instrument for hams, engineers, or servicemen.

MODEL GD-1B
$19.50
Shpg. Wt. 4 lbs.

HEATH COMPANY *A Subsidiary of Daystrom, Inc.* **BENTON HARBOR 20, MICHIGAN**

Heathkits PROVIDE THE "CONSTRUCTIVE" APPROACH TO HIGH-FIDELITY

EASY TO BUILD: *The assembly instructions supplied with Heathkits are so complete and detailed that anyone can assemble the kits without difficulty. Plenty of pictorial diagrams and step-by-step instructions. Information on resistor color codes, soldering, use of tools, etc. Build-it-yourself with confidence!*

❶ *Heathkit* ADVANCED-DESIGN HIGH FIDELITY AMPLIFIER KIT

The 25 Watt Model W-5 is one of the most outstanding high fidelity amplifiers available today—at any price. Incorporates the very latest design features to achieve true "presence" for the super-critical listener.

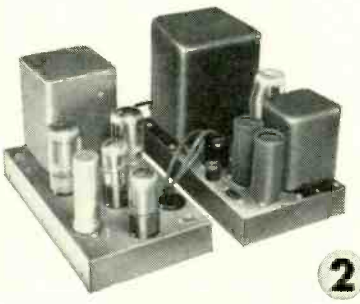
Features a new-design Peerless output transformer, and KT66 output tubes handle power peaks up to 42 watts. The unique "tweeter-saver" suppresses high frequency oscillation. A new type balancing circuit results in closer "dynamic" balance between output tubes. Features improved phase shift characteristics and frequency response, with reduced IM and harmonic distortion. Color styling harmonizes with the Heathkit WA-P2 Preamplifier and the FM-3 Tuner.

Frequency response—within ± 1 db from 5 cps to 160 Kc at 1 watt. Harmonic distortion only 1% at 25 watts, 20-20,000 cps. IM distortion only 1% at 20 watts, using 60 and 3,000 cps. Output impedance 4, 8, or 16 ohms. Hum and noise—99 db below rated output. Uses two 12AU7's, two KT66's and a 5R4GY.

KIT COMBINATIONS:

W-5M Amplifier Kit: Consists of main amplifier and power supply, all on one chassis. Complete with all necessary parts, tubes, and comprehensive manual. Shpg. Wt. 31 lbs. Express only. **$59.75**

W-5 Combination Amplifier Kit: Consists of W-5M Amplifier Kit listed above *plus* Heathkit Model WA-P2 Preamplifier Kit. Complete with all necessary parts, tubes, and construction manuals. Shpg. Wt. 38 lbs. Express only. **$79.50**



❷ *Heathkit* DUAL-CHASSIS WILLIAMSON TYPE HIGH FIDELITY AMPLIFIER KIT

This is a very popular high fidelity amplifier kit that features dual-chassis type construction. The resulting physical dimensions offer an additional margin of flexibility in installation. It features the famous Acrosound TO-300 "ultra-linear" output transformer, and has a frequency response within ± 1 db from 6 cps to 150 Kc at 1 watt. Harmonic distortion only 1% at 21 watts. IM distortion at 20 watts only 1.3% at 60 and 3,000 cps. Rated power output is 20 watts. Output impedance 4, 8, or 16 ohms. Hum and noise—88 db below 20 watts. Uses two 6SN7's, two 5881's, and a 5V4G.

KIT COMBINATIONS:

W-3M: Consists of main amplifier and power supply for separate chassis construction. Includes all tubes and components necessary for assembly. Shpg. Wt. 29 lbs., Express only. **$49.75**

W-3: Consists of W-3M Kit listed above *plus* Heathkit Model WA-P2 Preamplifier described on opposite page. Shpg. Wt. 37 lbs., Express only. **$69.50**

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This is the lowest priced Williamson type amplifier ever offered in kit form, and yet it retains all the usual features of the Williamson type circuit. Main amplifier and power supply combined on one chassis, and uses a new-design Chicago output transformer. Frequency response—within ± 1 db from 10 cps to 100 Kc at 1 watt. Harmonic distortion only 1.5% at 20 watts. IM distortion at rated output, 2.7% at 60 and 3,000 cps. Rated power output is 20 watts. Output impedance 4, 8, or 16 ohms. Hum and noise—95 db below 20 watts. Uses two 6SN7's, two 5881's, and one 5V4G.

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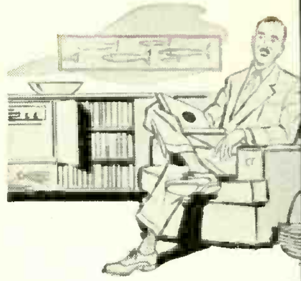

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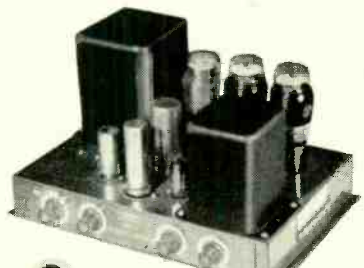

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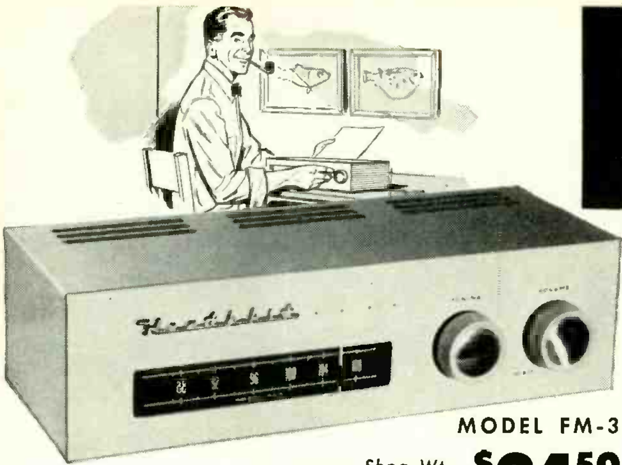

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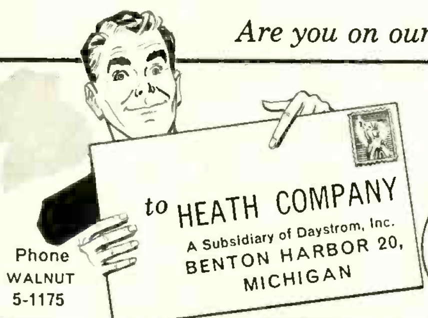

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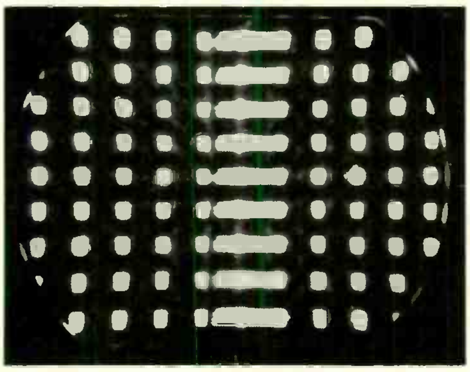
COLOR TV Test Equipment



Pattern for convergence adjustment.

A survey of instruments necessary for color TV servicing

By MATTHEW MANDL*

QUESTIONS uppermost in the minds of technicians who intend servicing color television receivers are:

What type of new test equipment is needed?

How useful will my old equipment be?

Can my existing test gear be modified to be more useful in color television servicing?

First let's emphasize that your present equipment will be just as useful on color receivers as it is on black-and-white sets. The v.t.v.m. is still needed for voltage and resistance checks, and your tube checker can probably be brought up to date to test some of the newer color tube types. If your signal generators have been able to take care of alignment of the newer 45.75-mc video i.f. stages, they will do as good a job on color receivers. The oscilloscope can be used for waveform observation in the sweep circuits and other stages of a color receiver which duplicate those in black-and-white. For some special checks of the subcarrier oscillator, however, a good frequency response in the vertical system of the scope will be necessary.

Capacitor checkers, cross-bar generators and various other black-and-white testing devices also find similar applications in color.

Thus, color television servicing does not mean that black-and-white equipment is obsolete—but it does mean that *additional equipment* of a *specialized nature* must be obtained. Such test gear is a virtual necessity, not only to expedite troubleshooting, but for proper adjustment of the various circuits handling the color signals.

Circuit adjustments

An important aspect of color television servicing involves color circuit adjustments. These procedures require some equipment not used in black-and-white alignment and troubleshooting—color bar generators, white dot generators, etc.

A critical adjustment procedure is *convergence*, the process of adjusting the color receiver so the three beams of the picture tube cross over at the internal aperture mask. This crossover or convergence is necessary so each beam strikes the color phosphor dot which produces the right color. Incorrect colors will result, for instance, if the blue beam strikes the red phosphor or the green beam the blue phosphor dots.

Convergence at the center of the screen is not too difficult, but at the screen edges it becomes involved because of the increased distance which the beams travel. Initially, the center of the screen must be adjusted for good convergence (static or d.c. convergence) after which the magnetic fields of the convergence yoke must be adjusted so the properly shaped modified beam scans the screen. The modification consists of using a parabolic waveform shaped from the horizontal and vertical sweep signals.

A typical convergence circuit is shown in Fig. 1 and is used in the 21-inch RCA chassis CTC4 receiver. Note the number of controls. They indicate only the green beam convergence adjustments. Since three times as many are necessary for all three colors, obviously adjustment can become complex when the system is considerably off true convergence.

A white dot generator is very useful for convergence adjustments. It produces a series of white dots or squares against a black background when convergence is correct. When the beam is misconverged, each white dot breaks up into *three* dots of different colors. It is for this reason that some of the black dot generators used for black-and-white linearity adjustments are not useful for convergence adjustments; a black dot represents the absence of light (beam cutoff) and could not reproduce the identifying color dots indicating misconvergence.

A center vertical segment of the screen is shown in Fig. 2-a. The center of the screen is converged because a white square is present, indicating that each beam in the picture tube is striking its respective phosphor. At the top and bottom there is a lack of convergence, and the white square is broken into three squares of individual colors.

Fig. 2-b shows a horizontal segment not converged and a vertical converged section. Note that convergence dis-

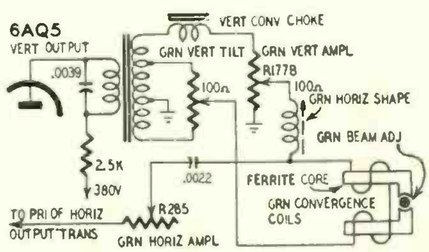
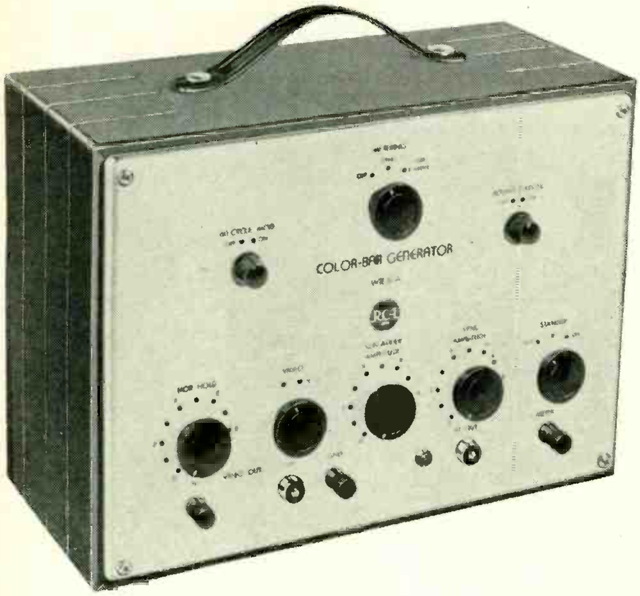


Fig. 1—Vertical and horizontal convergence adjustments for the green beam.

*Author: *Mandl's Television Servicing*



RCA WR-61A color bar generator.

Hickok 655XC color bar generator.

placement of the squares increases at the edges. Center-screen convergence is made by adjusting the beam positioning in the newer receivers having convergence yokes. Dynamic convergence for screen edges is adjusted with the tilt, amplitude and shaping controls shown in Fig. 1.

White dot generators should be able to produce a fairly large dot or square. Small dots are not too clearly visible and the technician is apt to turn the brightness up too high, disturbing proper convergence settings. The generator should be stable so that the dots can be locked in for a stationary pattern. Adjustment of dot size and number is a desirable feature, though not necessary if initial size is adequate. From 10 to 12 dots should be visible horizontally, about 8 to 10 vertically. When the receiver needs only slight retouching for convergence, it can be done by observing a televised scene; when extensive convergence is necessary, the white dot generator is indispensable. Most white dot generators duplicate the function of the cross-bar generator and have available a switch for selecting horizontal or vertical bars or both for linearity adjustments of black-and-white or color receivers.

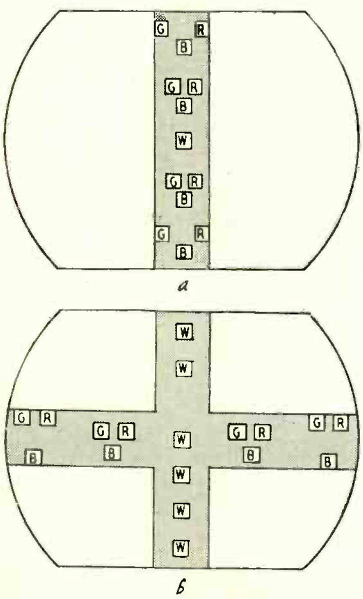


Fig. 2—Segments of screen showing lack of vertical and horizontal convergence.

Another very important service instrument for color television is the color bar generator which permits checking the color a.f.c. system, the matrix and other circuits shown in Fig. 3. True color reproduction depends on the phase of the incoming 3.58-mc burst with respect to the 3.58-mc oscillator in the receiver. Adjustment of gain in the color signal amplifier stages and matrix are also important for true color rendition.

The color bar generator produces a series of differently colored vertical bars conforming to the signals found in the receiver. A typical bar sequence is shown in Fig. 4. The sequence, number and color of the bars differ for the various commercially available generators. Hence the service technician must be familiar with the number and color sequence of the particular instrument he uses, for various misadjustments of phase controls, fine tuning, etc., will disturb the color sequence. The color bars produced by color bar generators are not suitable for linearity checks.

Useful features of these generators include r.f. signal outputs of color subcarrier frequency, sound carrier frequency and luminance signals. Of importance also are outputs providing for positive- and negative-polarity video signals. These features help servicing the various bandpass amplifier circuits, video amplifiers, color killer and burst gate stages.

Color bar generators should produce colors which conform to NTSC standards. Thus, they should include colors conforming to the I and Q signals as well as the R − Y and B − Y signals as shown in Fig. 4. Such color reproduction is necessary so that the generator may be used on receivers which demodulate on the I and Q axis or which have R − Y and B − Y demodulators. The color bars should be stable with true color lock-in so that they can be identified by the particular color sequence listed for the generator in the instruction manual. *The particular sequence of colors from left to right*

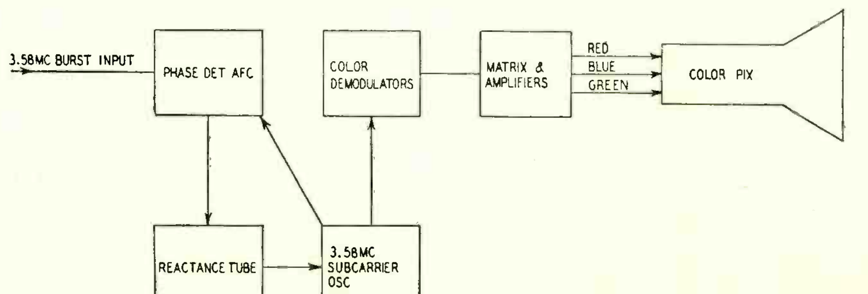


Fig. 3—Circuits that can be adjusted and serviced with a color bar generator.

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isn't important so long as identified NTSC colors are available.

The high-voltage and focus circuit adjustments are few. Focus and second-anode voltages can be read with a v.t.v.m. and high-voltage probe. Voltages up to 25,000 will be encountered.

Commercial units

A variety of color test instruments is available in price ranges from below $100 per unit to well over $200. In general, the more expensive units feature precise crystal control and versatility with respect to the number of output signals available. A number of instruments, in addition to generating color bars or white dots, also duplicate some of the functions found in black-and-white television test equipment—provide r.f. or video signal outputs for alignment and cross bars for linearity checking. Hence, in some instances the technician may desire to obtain the lower-priced equipment if his black-and-white test gear is fairly modern. The higher-priced units will be particularly desirable where black-and-white equipment is outmoded and no longer capable of servicing late-model receivers having i.f. stages with 45.75-mc video and 41.25-mc sound.

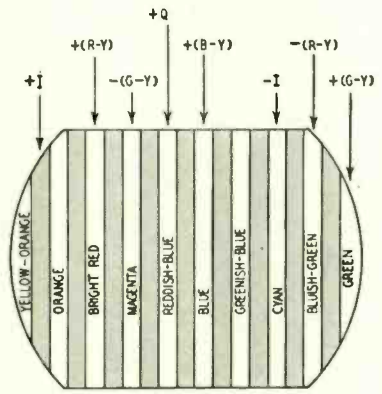


Fig. 4—Typical color bar sequence.

Bar generators

RCA WR-61A. This color bar generator (see photo) produces 10 vertical color bars, including a number which correspond to the NTSC standard R − Y, B − Y, G − Y, I and Q signals as shown in Fig. 4. In addition, the instrument also provides a crystal-controlled picture carrier, color subcarrier and a sound carrier. The stability of the generator is maintained by crystal control. The output signals are those corresponding to channel 3. A separate video output signal is also provided, having either positive or negative polarity.

The radio-frequency output is approximately .01 volt peak to peak across a 300-ohm load. The video output from the HI output terminal is approximately 8 volts peak to peak across 4,700 ohms. Luminance signals are available which show up at the edges of the color bars for checking the registration of the luminance and chrominance signals. A special rectifier circuit is built in the instrument for use with an external v.t.v.m. for measuring and adjusting sync and subcarrier amplitudes.

The picture carrier output is modulated by a color subcarrier and a front-panel switch can be used to eliminate the sound carrier from the output signal for quick identification of sound interference in the bar pattern. The sound carrier signal permits precise tuning of the receiver and checking its sound-rejection and beat-interference characteristics with respect to the color subcarrier and the sound carrier.

Hickok model 655XC. This instrument (see photo) produces a series of eight vertical color bars—green, yellow, red, magenta, white, cyan, blue and black. The white bar is useful as a reference for setting up the colors. It is only when the receiver has proper convergence and correct signal amplitudes of red, blue and green that a white signal can be obtained.

The Hickok unit uses crystal control for the 3.58-mc signal and for the horizontal frame rate.

In addition to the color bar pattern, the generator produces an NTSC standard in-phase I signal and a Q (quadrature phase) signal besides R − Y and B − Y signals.

A 3.58-mc subcarrier of 1 volt peak to peak is provided for alignment and testing the color synchronizing stage. A video output signal is available of 2 volts peak to peak on open-circuit measurement, dropping to 1 volt across a 100-ohm load. The signal can be switched to either positive or negative polarity. An r.f. signal is available, modulated with the color-bar pattern. The r.f. signal can be tuned through channels 4, 5 and 6. A sound carrier output signal is also provided.

Tripplett model 3439. The 3439 (see photo) produces 10 vertical color bars in the sequence, from left to right: yellow-orange, orange, red, blue-red, magenta, blue, green-blue, cyan, blue-green and green. The second, fifth and eighth vertical bars are fairly close to the NTSC standard I, Q, − I signals (3° off). To adjust I and Q circuits, the hue control of the receiver can be varied for the proper phasing of these three signals.

Crystal operation is provided for the signals and the output is set for channel 3. A sound carrier is available, as well

Triplet model 3439 generator.

Kay Electric Chromabar generator.

Win-tronix 150 rainbow generator.

as a video or a modulated r.f. signal. The video signal can be switched to either a positive or negative polarity output. To adjust and observe signal amplitudes, the Triplett unit has a built-in v.t.v.m. with the dial centered above the controls.

Win-Tronix model 150. Designated as a "Rainbow Generator" by the manufacturer, the unit (see photo) provides from one to eight vertical color bars with the main colors produced having the sequence: red, magenta, blue, cyan, green. It has provisions for modulating the r.f. carrier with a 60-cycle luminance signal and the 3.58-mc chroma subcarrier. The chroma subcarrier is phase-modulated with respect to the television receiver frequencies in a linear phase-sweep process. This method scans all the color phases from zero to 360°, a process similar to that used in sweep-frequency generators for TV and FM sideband alignment.

A 300-ohm output connector at the rear of the unit provides the 3.58-mc color signal or the r.f. signal modulated by the color signal. The modulated r.f. signal output is approximately 0.3 volt. Crystal control can be had by inserting a 3.58-mc crystal into the internally wired socket of the unit.

Combination units

While generators are available which produce white dots for convergence adjustments, some combination units on the market contain both the bar and dot generators in one unit. One of these is the **Chromabar** generator (see photo) manufactured by the Kay Electric Co. This unit provides six NTSC colors: green, yellow, red, magenta, blue and cyan, available individually with black-and-white. Other colors, including gray shades or I and Q, are included on special order.

The output amplitude is continuously variable to a maximum of 1.4 volts peak to peak across a 75-ohm load. The phase-angle accuracy is within 3°.

Another unit combining the color bar and white dot generators into a single unit is the **Jackson model 712** color bar generator. This instrument provides a positive or negative video signal and an r.f. signal on channels 3, 4 and 5.

The bar generator produces eight bars: white, yellow, cyan, green, magenta, red, blue and black. A switch permits selecting just the NTSC standard I and Q signals or the R − Y and B − Y signals. A sound carrier signal output is provided in addition to the r.f. and video signals. A switch selects either a luminance- or color-signal output. The video output is adjustable to a maximum of 2 volts peak to peak across a 90-ohm load resistance; the r.f. signal output has a maximum of 0.1 volt across a 300-ohm load.

In addition to the white dots for convergence checking, a white cross-bar signal can also be obtained. Jacks on the rear panel provide a 3.58-mc subcarrier burst signal output and a horizontal sync signal output.

Dot generators

RCA WR-36A. This dot generator (see photo) can be used with a channel selector set from channels 2 through 6. The maximum output voltage is .08. Approximately 10 to 13 vertical bars and 8 to 15 horizontal bars can be obtained. The same number of rectangular dots are available as well as a cross-hatch pattern.

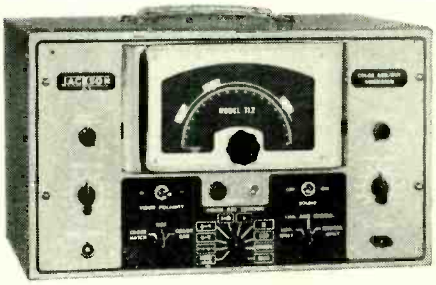
The video signal output is 3.5 volts peak to peak on open circuit. It can be made either positive or negative.

Simpson model 434. This Varidot white dot generator (see photo) produces from 6 to 15 vertical and from 6 to 14 horizontal dots. Controls vary dot width and height and horizontal and vertical retraces are blanked out. The r.f. output is adjustable for channels 2 through 6 and a balanced 300-ohm output is provided. The r.f. output is variable up to .05 volt r.m.s. on open circuit; the video output is adjustable to 3.5 volts peak to peak on open circuit. The internal sync and blanking provided by the generator eliminates the appearance of white smears between dot segments.

Win-Tronix model 160. The model 160 (see photo) white dot generator produces large and small white dots and vertical and horizontal bars for linearity checking. Approximately 10 horizontal and vertical dots are produced in the large-dot position; approximately 15 horizontal and 11 vertical in the small-dot position. The r.f. signal output is adjustable from channels 2 through 6. A jack is provided for external modulation of the r.f. carrier and another jack for increasing dot stability by sync injection from the TV receiver.

Other test equipment

Instruments are available which provide specialized operations in the servicing and adjustment of color television receivers. One of these is the **Simpson Chromatic Probe** (see photo). It contains a crystal rectifier and several resistors, making up a nonlinear network for heterodyning. Thus, the probe can be used to produce the *difference* frequency when the outputs from an



Jackson bar–dot generator.

The RCA WR-36A dot–bar generator.

Simpson 434 white dot generator.

Left—the Win-Tronix model 160 white dot linearity generator.

Right — the Simpson model 406 Chromatic Amplifier.

Below — the Simpson chromatic probe—has crystal rectifier.

AM and an FM generator are fed to it. It is primarily designed to be used with a sweep generator providing two such signals simultaneously, such as the Simpson model 479 or 480. The probe is useful for checking the various frequency points on the response curve of the bandpass amplifier of a color TV receiver. It provides an equivalent detector source following the generators, thus eliminating the necessity for applying the generator signal through a preceding detector stage as is advisable when checking the response curve of video amplifiers.

An additional instrument, also manufactured by Simpson, is the **Chromatic Amplifier model 406**. It raises video signal levels to provide full-screen oscilloscope deflection when an insensitive scope is used.

The Chromatic Amplifier requires no tuning and the front panel merely contains an on–off switch and the input and output terminals. It has a gain of 30 over a 4-mc band, with the output from the amplifier flat within ±0.5 db from 80 kc to 4 mc. It has a high input impedance; the output impedance is approximately 2,200 ohms.

Present equipment

As mentioned, black-and-white equipment can be used in TV servicing. Some can be modified for greater usefulness in servicing color receivers. For the technician about to begin color TV servicing, a high-voltage probe for the v.t.v.m. should constitute his initial purchase toward a future stock of color test equipment. The probe should be capable of extending the useful d.c. voltage range of the instrument above 25,000 (preferably to 30,000).

An oscilloscope should have good vertical sensitivity and wide-band vertical amplifier response. This means that the vertical sweep circuit of the scope should extend to approximately 4 mc to check the 3.58-mc subcarrier oscillator or to observe the signals in the burst amplifier, burst-gate circuits, etc. The less expensive scopes have a vertical frequency response to only 30 kc and are not suitable for test procedures on the subcarrier oscillator. Such scopes can be used for checking the vertical and horizontal sweep systems and similar circuits, in the color receiver which are also present in black-and-white sets. The sensitivity of an existing scope can be increased by using the Simpson Chromatic Amplifier or similar equipment.

Some test instruments can be altered to increase their usefulness for color TV servicing. The manufacturer should be consulted with respect to available data for making changes. Owners of the Hickok model 650 bar generator, for instance, can convert it to produce white dots with a kit available from the maker for under $10. This attachment, not only produces white dots for convergence adjustments, but permits retaining the black dots available for use with black-and-white receivers.

If the present bar generator can't be converted, the purchase of a white dot generator is recommended. With a high-voltage probe, sensitive oscilloscope and white dot generator, a considerable amount of color TV servicing and adjusting can be done. As soon as possible, however, a color bar generator should be acquired.

Use of equipment

The technician should study the operating manual furnished with an instrument so that he is thoroughly familiar with the manner in which it is to be used.

If a color bar generator, for instance, fails to produce a proper sequence of colors, it is not necessarily an indication that it is at fault but rather that the various controls of the receiver require proper adjustment. A single color or virtually all sorts of colors can be obtained by improper use of the bar generator or improper setting of the fine-tuning, phase, hue and other controls on the receiver.

Precautions must also be taken with respect to the dot–bar generator so that brilliancy and contrast controls are properly set for observing dots and adjusting of convergence. While a number of bar and dot generators can be connected directly to the antenna terminals of the receiver, other leads are also provided for coupling to the sweep circuits of the receiver to assure good stability and lock-in. If the technician understands that greater care in adjustments is necessary for proper operation of color test equipment, he will have overcome one of the big hurdles in getting the most from color TV test equipment. END

CHROMA SIGNAL GENERATOR

An inexpensive portable signal generator for color TV servicing

By CHARLES W. RHODES

EITHER a color bar generator or a chroma generator is required to service color receivers. At present most commercial generators are rather expensive and heavy. This generator has been developed to fill the need for an inexpensive portable generator of high stability and accuracy. It can be used without a wide-band (0–5-mc) oscilloscope; the usual service instruments when equipped with a demodulator probe suffice.

In the absence of a color bar pattern from a TV station this instrument will show whether color reception can occur and if the entire chroma section of the receiver is working and properly adjusted. By signal-tracing techniques, a defective circuit may be quickly located. The very critical color a.p.c. (automatic phase control) system may be aligned completely. Lastly, it can provide a color bar pattern for color receivers on display in stores. A defect in the chroma or color a.p.c. circuits does not affect a color receiver tuned to a black-and-white program.

The instrument consists of two oscillators, a video carrier oscillator and a crystal-controlled chroma oscillator. The later amplitude-modulates the video carrier oscillator as the plate of each oscillator (Fig. 1) is returned to B plus through a parallel resonant tuned circuit tuned to 3.5 mc. Link coupling from the carrier oscillator carries the output signal to the color receiver's antenna terminals via a length of 300-ohm line. A small power transformer and selenium rectifier supply power and provide isolation from the a.c. lines. Two crystals are used: one, tuned to exactly 3.563795 mc by its shunt trimmer, will be referred to as the *offset* crystal; the other, tuned to the color subcarrier frequency, 3.579545 mc, is known as the *locked* crystal.

Construction is very simple, there being no critical lead dress. The use of short direct wiring as is customary in all r.f. equipment is desirable. An old TV booster unit makes a very handy starting point as it generally has the transformer, power supply and tube socket. The crystal trimmers should not be accessible except for initial adjustments. The carrier oscillator transformer is tuned to the video carrier frequency of an unused TV channel. Connect the chroma generator to any set tuned to the desired channel and, starting with the minimum value of inductance, adjust for maximum quieting of the snow level on the receiver and then increase inductance a little more. This is not at all critical. The 3.5 mc tuned circuit T1 is tuned for maximum grid-leak bias on the crystal oscillator. This also is a broad adjustment and covers both crystal frequencies.

The crystals used may be surplus or 75-meter amateur units. As they may be pulled in frequency only a few hundred cycles, they must be very close to the specified frequencies. For the locked crystal order either 3580 kc or 3579.5 kc. The other may be either 3564 kc or 3595 kc. I had no trouble with either of the surplus 3580-kc crystals purchased nor with an amateur 3564-kc crystal.

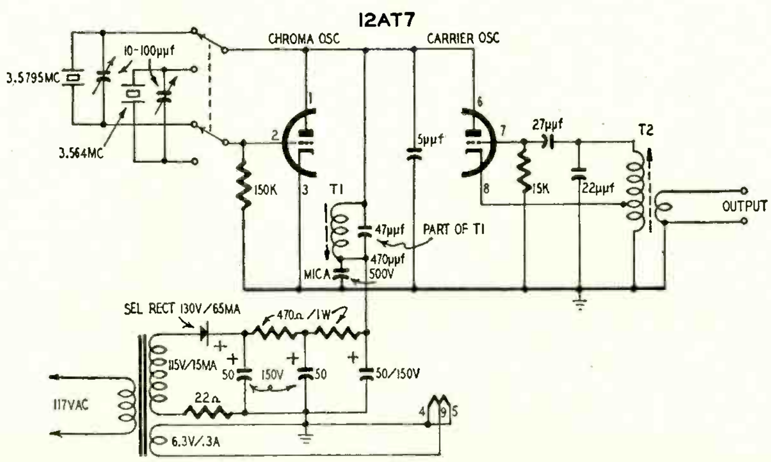


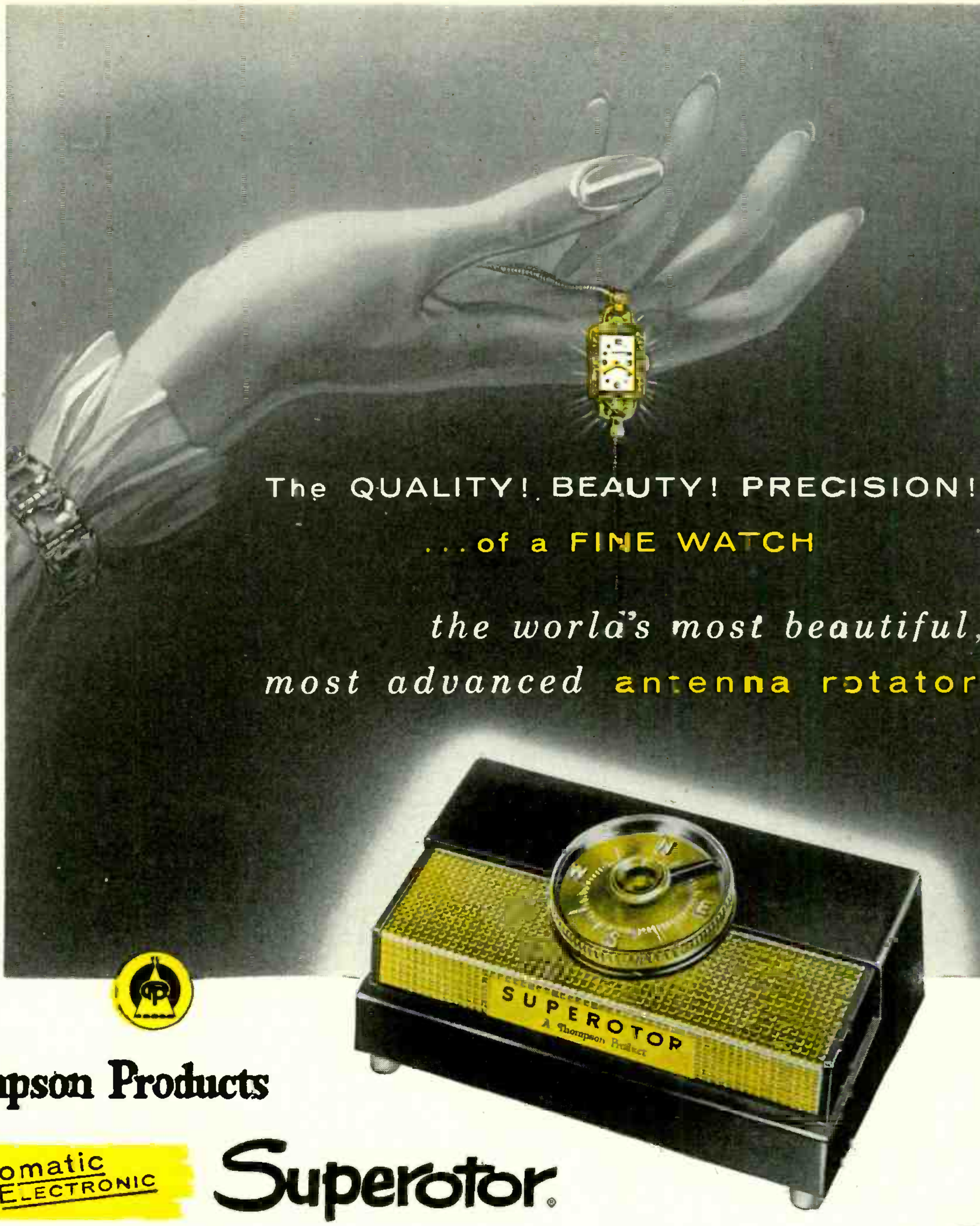
Fig. 1—Schematic diagram of the chroma signal generator—all values are given.

The exact crystal frequencies may now be adjusted by connecting the generator to a properly working color TV set. With the set receiving a program, switch to the generator's channel and turn up the chroma and contrast controls. Switch the offset crystal on and adjust its trimmer until one color band of red, blue, cyan, etc. appear. Momentarily switch off channel and then back —adjust the trimmer for fastest lock-in action. Switch the *locked* crystal on and adjust its trimmer to decrease the number of horizontal color bars until suddenly a locking action occurs, leaving only one hue on the screen. Again, try to lose sync by switching off channel and back, adjusting for fastest lock-in action. (With the *locked* crystal, on some color sets, a very narrow bar will appear at the left edge of the screen and then a wider band of another hue at the right. A third hue will fill about two-thirds of the screen. This is immaterial.)

Fig. 2—Output of the burst amplifier.

While the above procedure sets these crystals fairly accurately, enough so for signal tracing and matrix adjustment, there is an even more accurate method and it should be used before the color a.p.c. is aligned. Tune in either a color program or a station transmitting a color stripe. Short the a.p.c. voltage to chassis and adjust the coil shunting the crystal in the receiver to get the color to lock in at least momentarily. Now, with the a.p.c. still shorted, switch the receiver to the generator. Adjust the *offset* crystal until the colors just slowly float left and right. Adjust the *locked* crystal in the same way. Remove the short on the receiver's a.p.c. This procedure may be done when convenient as the first is generally satisfactory.

The color a.p.c. can lock to this chrome signal generator because at the start of each line the burst amplifier



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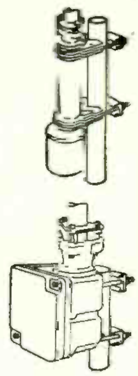

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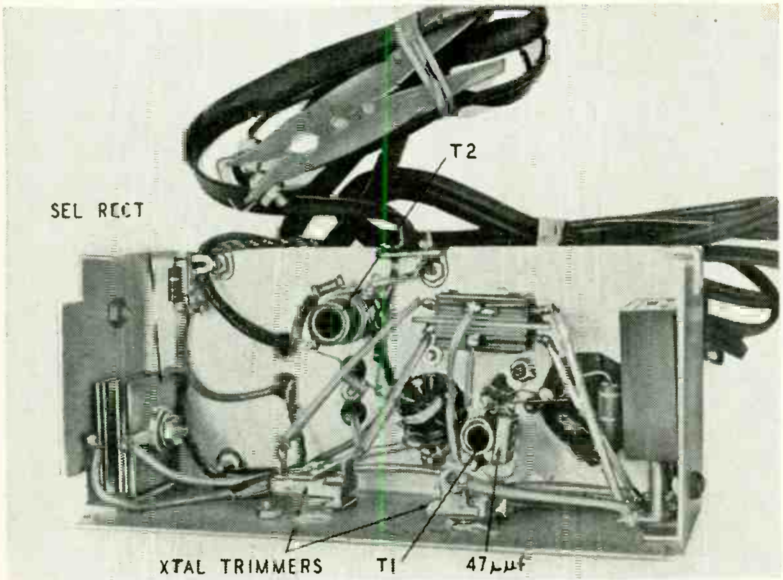
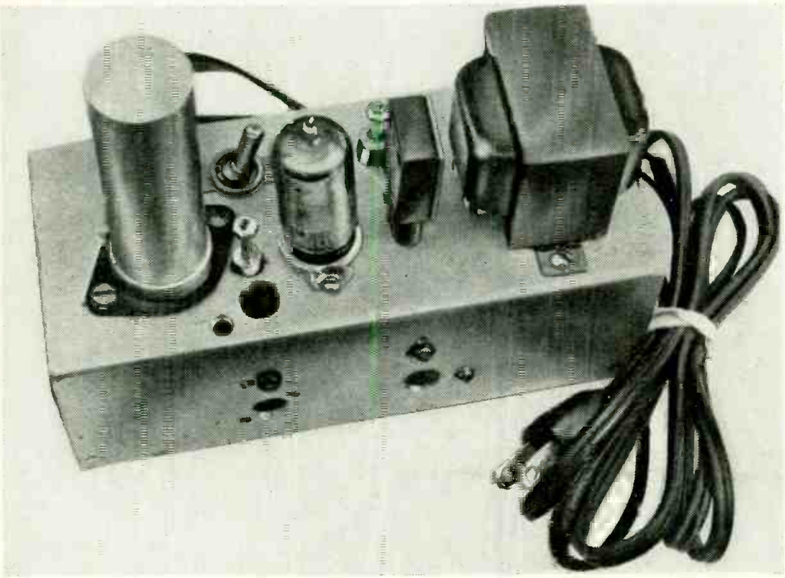
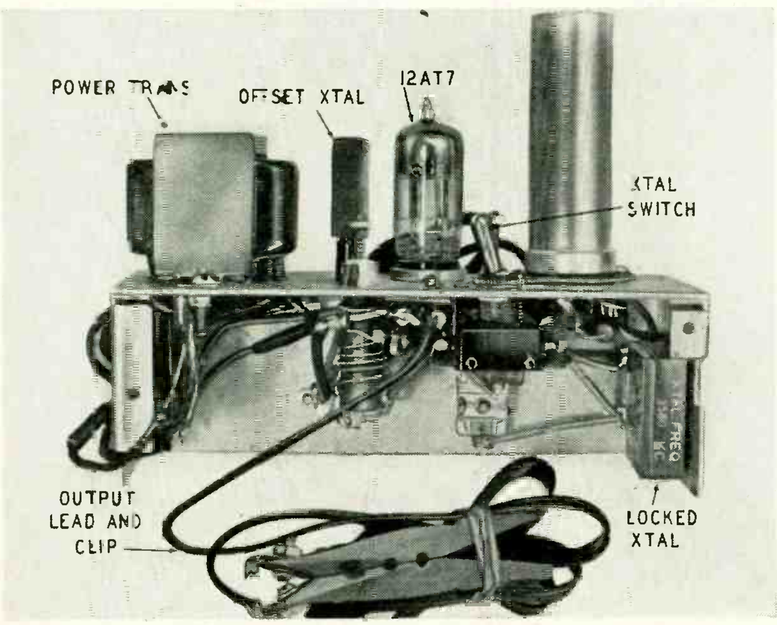


Underchassis view of the generator.



Unit mounted on 6 x 3 x 2-inch chassis.



View shows overall layout of components.

conducts briefly (Fig. 2), feeding the generator's output to the a.p.c. detector. The burst amplifier therefore gates the incoming signal and creates the burst pulse. The bandpass amplifier is cut off during this *same* interval (Fig. 3) and hence delivers no chroma to the demodulators when the burst is sampled. Therefore we find that they have

Fig. 3—Output of bandpass amplifier.

no outputs at that moment. In the demodulators, the chroma signal beats with the 3.58-mc subcarrier. The difference frequency is the a.c. output signal. As the *offset* crystal is 15,750 cycles higher or lower (it matters not which), the demodulators' outputs are sine waves (Fig. 4) at 15,750 cycles. Because during burst interval no chroma reaches the demodulators, a notch in the

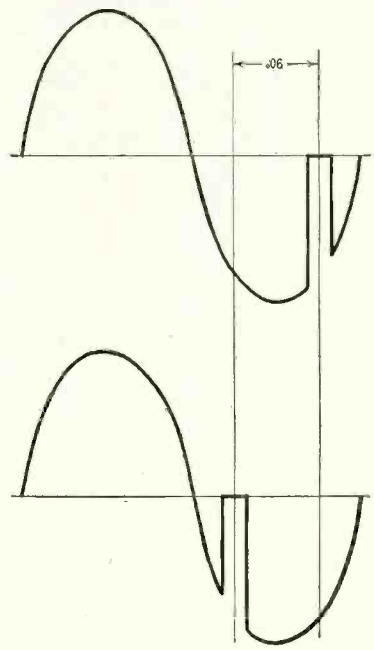


Fig. 4—Output of the two demodulators using the offset crystal.

sine waves will appear denoting burst.

Since the subcarrier fed to the two demodulators is different in phase by 90° in the two circuits, the burst notch will be displaced 90° between the two sine waves.

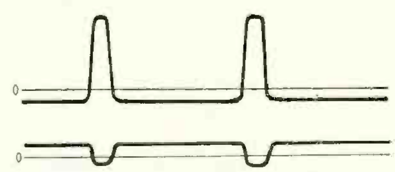
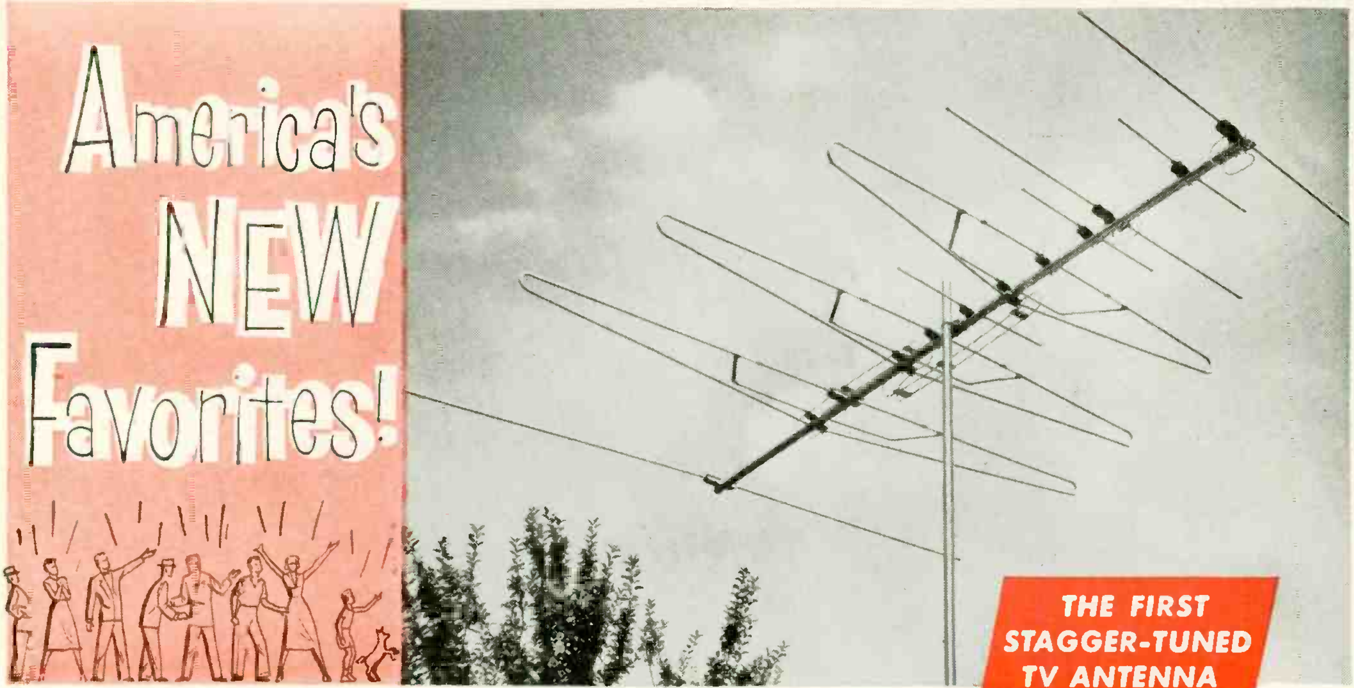


Fig. 5—Output of the two demodulators using the locked crystal.

The *locked* crystal, being of the same frequency as the subcarrier, produces only a d.c. output in the demodulator proportional to the cosine of the phase angle between the chroma and subcarrier. This d.c. voltage changes to that



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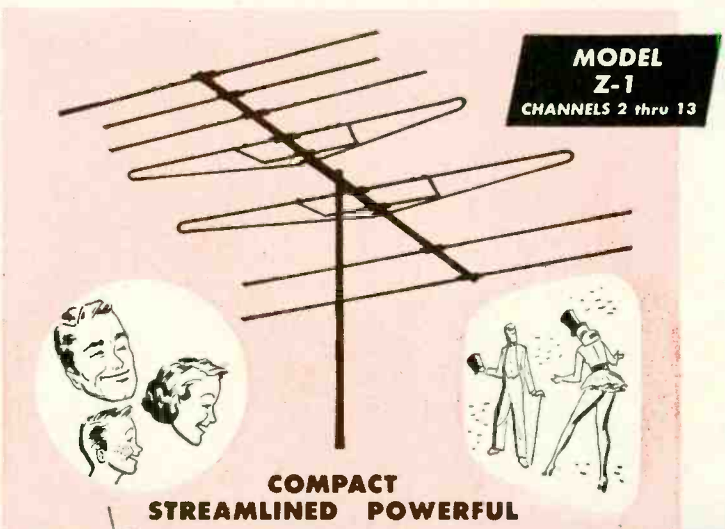

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which would be present without any input signal during burst time. Thus, with an oscilloscope, rectangular pulses (Fig. 5) at 15,750 cycles are observed at the demodulator outputs or on toward the picture tube.

The size and polarity of these pulses depend upon the hue control as it shifts burst phase.

If the demodulators are both dead, either the bandpass amplifier is defective (Fig. 3 won't appear) or the color killer has cut off the bandpass amplifier. The other possibility is that the color subcarrier oscillator is defective. An inoperative oscillator may be caused by a defect in the reactance tube circuits. If the oscillator is inoperative, Fig. 3 will be obtained but Figs. 2, 4 and 5 won't

One defective demodulator would be discovered when a sine wave of Fig. 4 is obtained from only one demodulator. The same applies for the color-difference amplifiers which follow the demodulators.

Fig. 6 is a vectorscope presentation. The output of the R − Y demodulator is connected to the oscilloscope vertical input, the B − Y demodulator to the horizontal input. The horizontal and

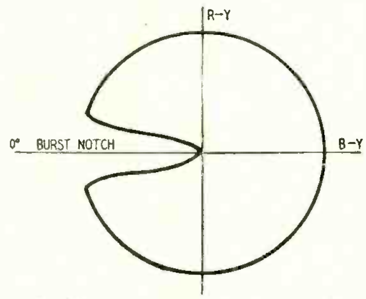


Fig. 6—Pattern of the demodulator output in a color-difference receiver.

vertical gain and positioning controls are adjusted to obtain a well centered circle. (The offset crystal is used.) This will be possible if the demodulators are both operating properly. Overloading may occur if the chroma control is advanced too far. The burst notch lies along the horizontal axis when the hue control is properly set. This notch should rotate about equally in both directions as the hue control is rotated, indicating its range is proper.

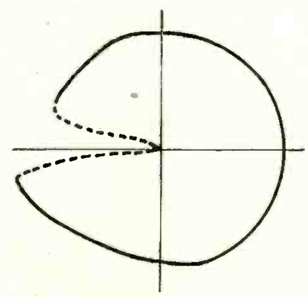


Fig. 7—Pattern shows that the quadrature transformer is out of alignment.

Where the best adjustments possible do not provide a good circle, but an ellipse as in Fig 7, the signals from the subcarrier oscillator are not at 90° as they enter the demodulators and color fidelity is lost. Where the positive and negative outputs of either demodulator are not equal, clipping occurs and the demodulator tube is defective or its operating voltages are not correct. Too high a chroma control setting may cause overload, but this disappears with a reduced setting which still provides vivid colors on the color picture tube.

Fig. 8 shows the same presentation from the I and − Q test points in a CBS-Columbia color receiver which

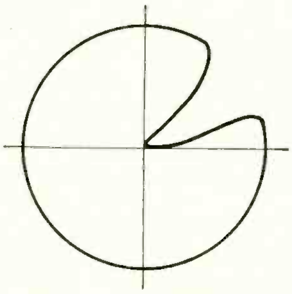


Fig. 8—Pattern of the demodulator output in an I–Q color TV receiver.

uses the I-Q wide-band system. The only difference is in the position of the burst notch. Here it is at about 30° to the − Q axis. When the hue control is properly adjusted on an I-Q receiver, the I gain control is also properly adjusted if the pattern of Fig. 6 appears when the red picture-tube grid is connected to the vertical input and the blue grid to the horizontal input. As there is no Y signal present, the matrix should have as outputs, R − Y and B − Y from I and Q. Adjusting the I gain control for a circle provides accurate adjustment.

Parts for chroma signal generator

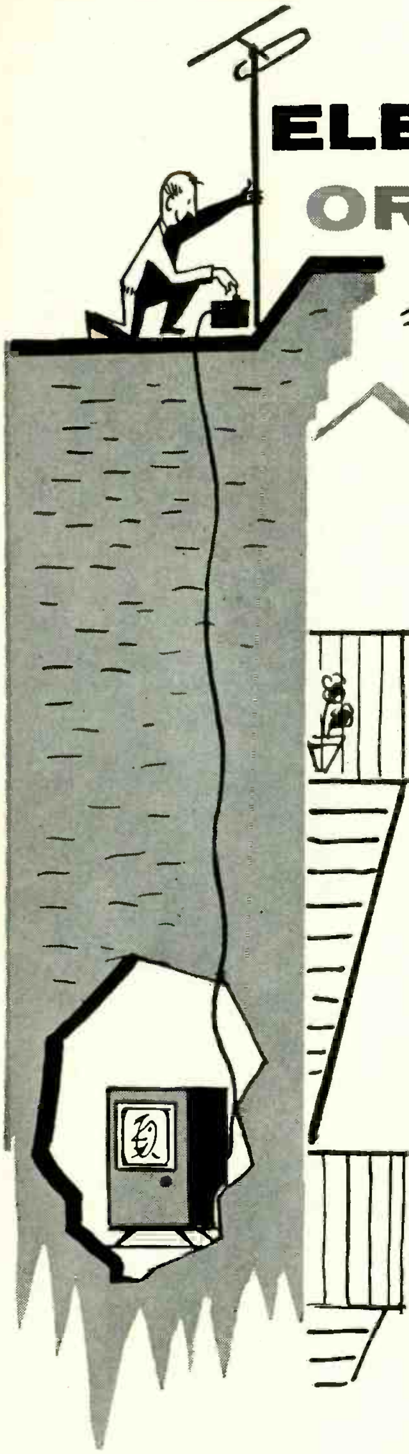
Resistors: 1—22, 1—15,000, 1—150,000 ohms, 1/2 watt; 2—470 ohms, 1 watt.

Capacitors: 1—5; 1—22, 1—27 μμf, NPO ceramic; 1—470 μμf, 500 volts, mica; 1—50-50-50 μf, 150 volts; 2—10-100 μμf, trimmer, NPO ceramic.

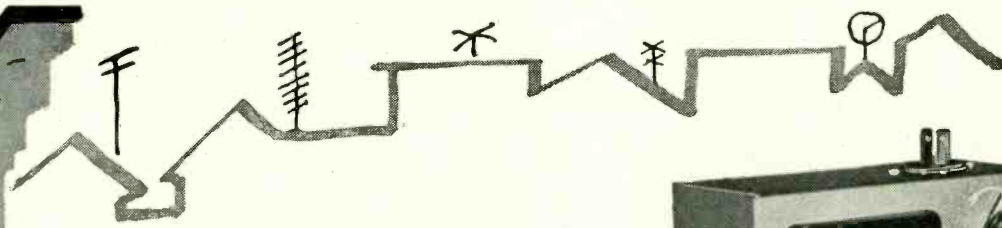
Miscellaneous: 1—T1, 4.5-mc trap (J. W. Miller 4170 or equivalent); 1—T2, 4 1/2 turns of No. 18 wire wound on 1/2-inch form, turns spread over 1/2 inch on form, tap 1 1/2 turns from bottom, link 1 turn around bottom end, powdered-iron core; 1—power transformer, 1:1 turns ratio with 15-ma secondary, 6.3 volts @ 300 ma; 1—12AT7 and socket; 1—d.p.d.t. switch; 1—crystal, 3579.5 kc (see text); 1—crystal, 3564 kc (see text); 1—selenium rectifier, 130 volts @ 65 ma; 2—crystal sockets; 1—aluminum chassis, approximately 6 x 3 x 2 inches; 1—power cord; 1—length of 300-ohm line; 1—terminal strip.

In a color-difference receiver, the equivalent of the I gain control is the R − Y gain control. This may be adjusted or checked by first setting the gains of the horizontal and vertical amplifiers in the scope equal. Feed in, say, 6.3 volts a.c. and adjust for a 45° line or ellipse. Now reconnect the scope as before and adjust the gain control so that the vertical (R − Y) deflection is five-ninths the horizontal (B − Y) deflection.

Once properly aligned, the chroma generator provides a highly stable frequency source to align the color a.p.c. system and a means of checking its performance in accordance with the set manufacturer's instructions. END

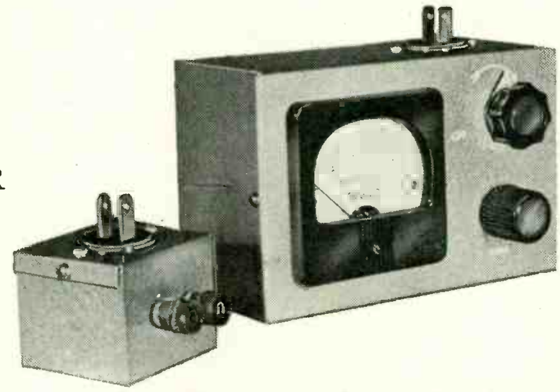


ELECTRONIC COMPASS ORIENTS TV ANTENNA



By RUFUS P. TURNER

A sensitive transistorized meter for placing and orienting antennas



Two units make up the antenna orienter.

THE conventional TV antenna orientation meter consists of two parts: a diode rectifier capacitance-coupled to the video electrode (grid or cathode) of the picture tube right at the set, and a d.c. microammeter which is transported to the roof and is connected to the diode output through a long two-wire line. Many service technicians prefer the compass to a field-strength meter as an indicating instrument for placing and orienting antennas because it operates in conjunction with the receiver to be used with the antenna. Although the antenna compass has been in existence for 6 years, very little has been done to improve it.

The compass described in this article is eight times more sensitive than the conventional type. It has a more rugged indicating meter and loads the TV receiver less. The original compass circuit used a 0–200-μa d.c. meter. My instrument has a 0–1-ma d.c. meter with a single-stage transistor d.c. amplifier for current gain. In this circuit, only 25 microamperes d.c. output from the pickup diode will deflect the milliammeter full scale. A single 1.5-volt size-D flashlight cell powers the amplifier, but this need for d.c. voltage is no inconvenience since the cost of replacing this cell is only 10 cents and (due to the low full-signal drain of 3 ma) over 1,000 hours of life can be expected on a basis of 8 hours of continuous use per day. This represents over 4 months of battery life *at 8 hours a day!* The part of the instrument taken to the roof weighs only 2 pounds.

The pickup section (see diagram) consists of capacitors C1 and C2, a 1N54 diode and resistor R1. These components are mounted in small box but might also be arranged in a probe. The video signal is picked up through clips connected to the receiver ground and to the video pin 2 or 11 of the picture-tube socket. The d.c. output of the pickup section is fed to a two-prong chassis type male plug. The 1N54 diode has been used because of its improved back resistance. A higher resistance R1 may be used without decreasing the rectification efficiency.

A two-wire line, which can be a length of lamp cord or 300-ohm ribbon, is run from the pickup box plug to the corresponding plug in the remote meter box. On each end of this line there is a female receptacle for connection with the male plugs.

The meter box contains the transistor amplifier circuitry, milliammeter and flashlight cell. The amplitude of the incoming direct current, and accordingly the meter swing, is adjusted by sensitivity control, R2. The meter is set initially to zero with potentiometer R3. This operation is the same as zeroing a vacuum-tube voltmeter.

With R2 set to its "zero"-resistance (maximum-sensitivity) position, 2.82 volts peak r.f. input to the diode circuit will provide full-scale deflection of the milliammeter. When R2 is at its "maximum"-resistance (lowest-sensitivity) setting, approximately 100 volts peak r.f. will be required. This covers the whole range of conditions likely to be met in practice. Settings of the sensitivity control have only slight disturbing effect on meter zero.

Since there are no tube heaters to warm up, the instrument is ready to

(*Continued on page* 124)

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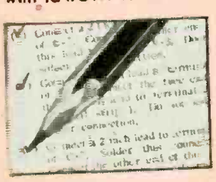

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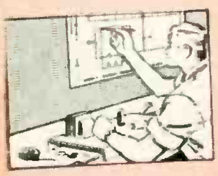

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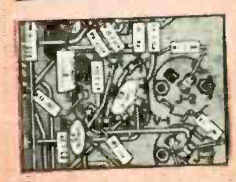

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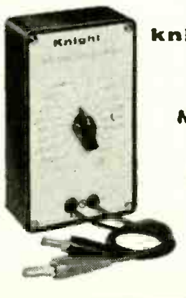

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Model S-234 **$20.95**

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Model S-234. Amplifier Kit. Net.......... **$20.95**

Model S-235. Preamp Kit for above. Net.......... $2.75

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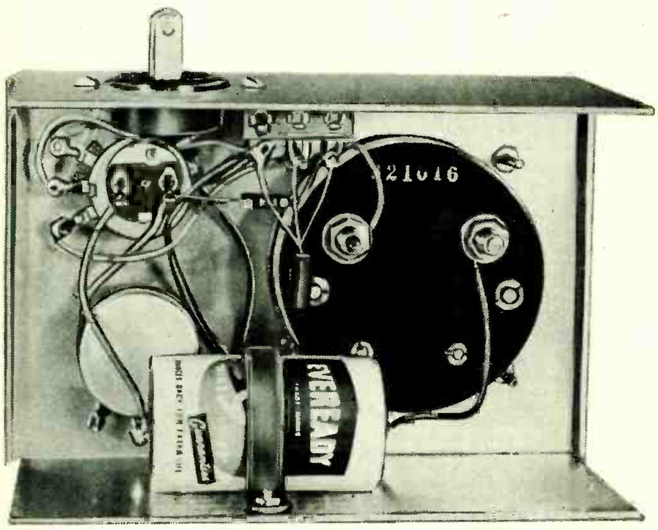
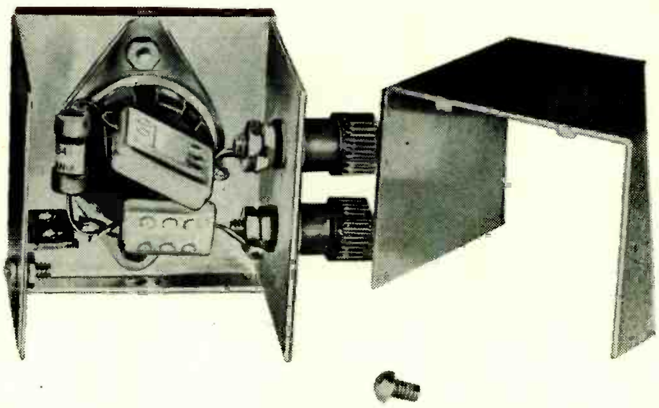


Underchassis view of the meter unit.



Underchassis view of the pickup box.

operate as soon as the on–off switch is closed. This makes the instrument as easy to use as a nonelectronic meter.

Temperature changes which reach the interior of the transistor will cause the no-signal meter current to change. Heat increases the current. The no-signal transistor collector current (initially about 10 microamperes) doubles approximately for each 18°F increase in temperature. This means that the meter must be reset to zero as the ambient temperature grows hotter or colder. However, the drift is not severe in normal field service and occasional resetting to zero is no more of a nuisance than the periodic readjustment of an ohmmeter. Furthermore, should the technician choose not to reset the meter, an initial deflection slightly off zero will not detract from the usefulness of the compass. For these reasons, the circuit has not been complicated nor its power drain increased by including temperature-compensating gimmicks.

The diode pickup circuit (pickup box) is connected to the output of the receiver video channel by connecting the lower clip (see diagram) to receiver ground and the upper clip to the picture-tube grid or cathode, whichever element receives the signal. If a sharp-pointed upper clip is used, the point will puncture the insulation of the video lead, obviating the need to clip to the picture-tube socket. Some of the modern, series-heater TV receivers operate with a hot chassis; that is, the chassis is connected *directly* to one side of the power line. Unless an isolating transformer is used when checking these receivers with any type of instrument used outdoors, the operator must exercise more than ordinary caution to protect himself from dangerous 60-cycle electric shock. *The two instrument boxes are not connected to any part of the circuitry.* The instrument and receiver are switched into operation and the antenna is positioned and rotated for maximum deflection of the meter. When signal pickup is sufficient to slam the pointer, reduce the sensitivity with R2.

Parts for TV compass

1—15,000, 1—33,000 ohms, ½ watt, resistors; 1—1,000-ohm potentiometer, wirewound; 1—250,000-ohm potentiometer with switch; 1—250 μμf, 1—.002 μf, mica capacitors; 1—size-D flashlight cell; 1—0-1-ma d.c. meter (Triplett 327T or equivalent); 2—2-pole male plugs, polarized (Amphenol 61-MPI or equivalent); 2—2-pole female receptacles, polarized (Amphenol 61-MIP-61F or equivalent); 1—CK721 transistor; 1—1N54 germanium diode; 2—knobs; 1—1-lug, 1—3-lug, insulated terminal strips; 2—binding posts; 1—2 x 2 x 1½-inch aluminum box; 1—6 x 4 x 3-inch aluminum box.

Construction

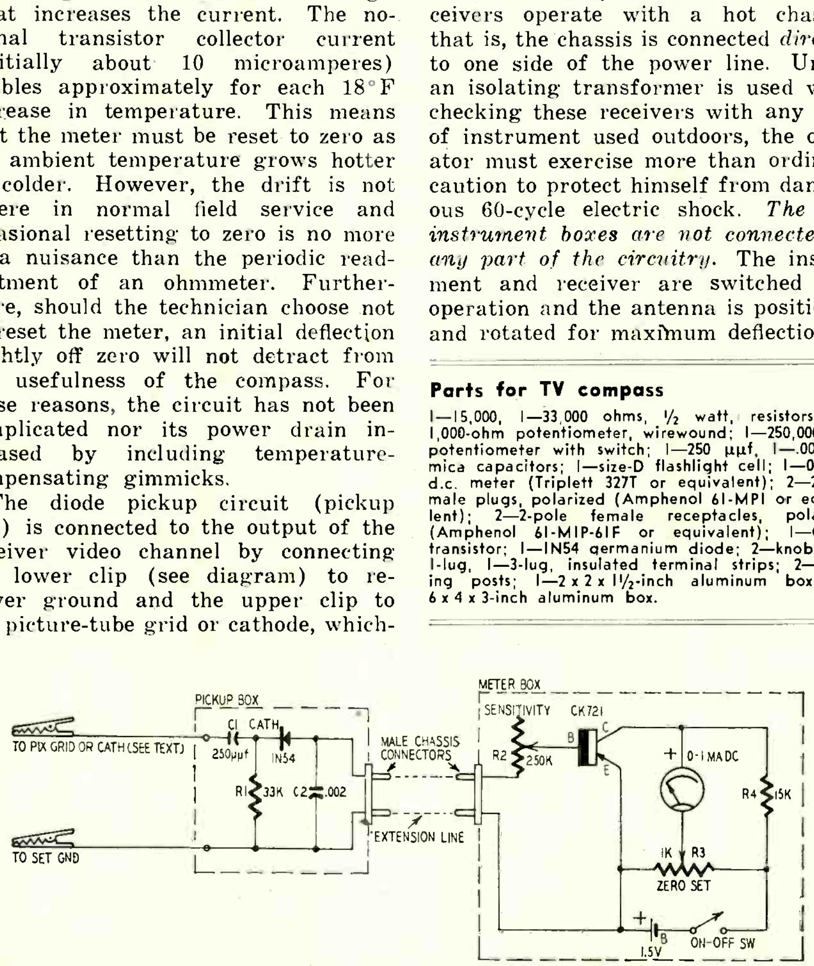
The photos show details of construction. The circuit is not critical and the layout is flexible; other arrangements therefore can be used, if desired. A technician might, for example, prefer to build his instrument in a handle type meter case.

The pickup section is built in an aluminum box 2 x 2 x 1½ inches. Two insulated binding posts (see photos) receive the clip leads from the TV set. A two-prong male plug is mounted in the top of this box for plug-in connection to the outgoing line.

The transistor in the meter box is mounted by soldering its three pigtails (each cut to a length of ¾ inch) to the terminals of a three-lug, insulated terminal strip (see photo). When soldering the transistor and diode leads, hold each lead with pliers to remove the heat. The flashlight cell is held to the bottom of the box with a short strap. Leads are soldered directly to this cell, since replacement is infrequent.

When wiring the instrument, observe carefully the polarities of the diode, transistor, meter and battery. Connect each of these components exactly as shown in the diagram. The two male plugs are polarized; that is, each has one large and one small prong. This prevents plugging in the interconnecting line in the wrong direction.

As much as 150 feet of lamp cord, 300-ohm ribbon or flexible coaxial line have been used successfully with this type of instrument. And there seems no reason why the compass will not operate with longer lines. END



Schematic diagram of the transistorized television antenna compass.

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The Pilot AF-850 AM-FM tuner; Pilot AA-904 audio amplifier; H. H. Scott 710 stroboscopic turntable

By MONITOR

ONCE in a while one runs into a piece of equipment so unobtrusive about its virtues that one is inclined to underrate it. The Pilot AF-850, top tuner in the Pilot line, is an example. Its circuit is not only conventional but rather conservative, with the normal pentode r.f. stage and converter, two i.f. stages, two limiters, Foster-Seeley discriminator and a twin-triode type of reactance automatic frequency control. Its performance is steady, solid and completely uncritical. Casual use might well lead one to dismiss it as unremarkable. In actual fact, only two or three tuners surpass it in any *single* characteristic and I know of none which surpasses it in the net total of virtues and absence of vices.

Sensitivity of the FM section is close to the top category. Pilot's claim of 1.5 μv for 20 db and 5 μv for 40 db quieting appears to be realized. Two or three of the top tuners I have used had somewhat better sensitivity. In my location the AF-850 brought in all but one of the FM stations regularly receivable. This was done with complete limiting with my regular test antenna. The one exception could be received enjoyably with my horn antenna which has higher gain. For local use there is a built-in power-line "antenna." A folded-dipole ribbon-lead antenna is also included in the package.

The AF-850 shines with a unique brightness in ease of tuning and stability. It is remarkably free of drift — by far the best tuner in this respect I have ever used. The a.f.c. is continuously and smoothly variable with a knob on the panel and in its maximum position appears to provide a tuning leeway of ± 150 kc or so. The tuning knob is especially pleasurable to use. The choice of ratio and the flywheel loading provide a smooth control which reminds me of the knob on a fine safe. Selectivity is excellent. Unless the station on the adjacent channel is extremely strong, there is no difficulty bringing in adjacent-channel stations. My family agrees that the AF-850 is the easiest FM tuner for unskilled hands of any we have had.

The sensitivity of 2 μv on the broadcast band is just about tops in tuners and few communications receivers will surpass it. In most locations the built-in ferro-loopstick antenna will prove adequate. Two bandwidths are provided

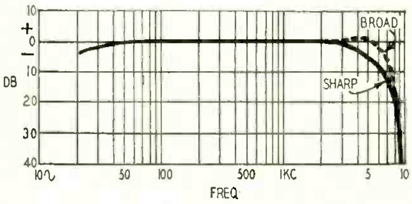


Fig. 1—Diagram shows response of the AM section at 1 mc—40% modulation.

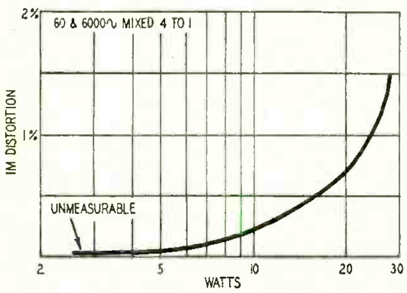


Fig. 2—Pilot AA-904 distortion curve.

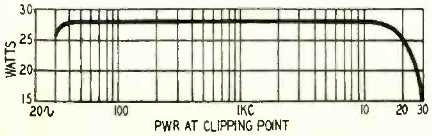


Fig. 3—Pilot AA-904 power curve.

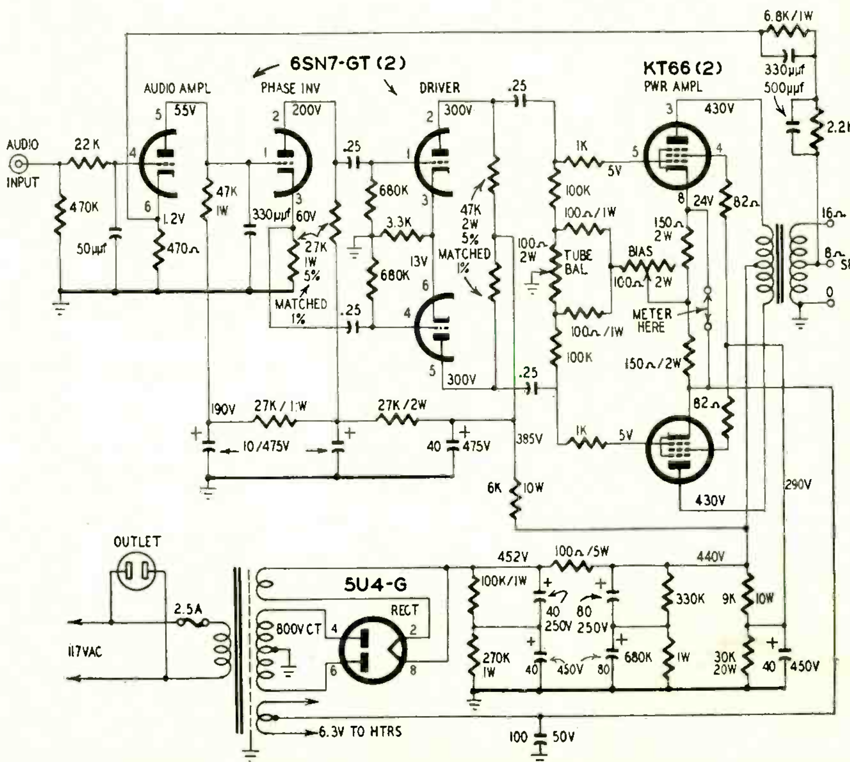


Fig. 4—Schematic of Pilotone AA-904 high-fidelity audio amplifier.

in the two-stage i.f. amplifier. The narrow or sharp bandwidth is about 8 or 9 kc wide at 6 db down, the broad about 15 kc wide. The loss at high frequencies in both positions is largely equalized by a network ahead of the whistle filter which in turn is very sharp and has little skirt effect beyond 10 kc. The response curves I obtained (Fig. 1) in both the sharp and broad positions agree with the manufacturer's curve within 1 or 2 db. The smooth tuning control and the meter make it very easy to tune for best fidelity and least interference.

The AF-850 provides three 500,000-ohm audio inputs: PHONO, TAPE and AUX. These work into a half section of a 12AU7 amplifier and only 150 mv of input is required for full rated output. The 1.5 to 2 volts required to drive most amplifiers to full output is obtainable with very low distortion, though the tuner can provide as much as 10 volts of output on the radio positions. The signal source in use is plainly indicated. The two radio dials are lighted independently and only the one in use is illuminated. The three audio channels have red pilot lights above the dial scales so they are also clearly indicated. The output is from a cathode follower, and hum level is inaudible. The tuner is compact (14½ inches wide, 7½ inches high and 9 inches deep) and has an excellent appearance worthy of its quality and price. For those who like to have a control unit combined with the tuner Pilot offers the AF-860, identical except for the addition of preamplifier, equalizer and tone controls.

Pilot model AA-90 amplifier

Pentode and tetrode operation of power output tubes has been in disrepute among high-fidelity experts for a generation. Even after feedback made it possible to reduce the internal resistance of pentode amplifiers to a point comparable with that of triodes and providing acceptable damping factors, many authorities continue to look askance at this more efficient mode of operation. Lately this prejudice has been suffering considerable erosion but it is still prevalent. For those who cherish it the curves of Figs. 2 and 3, which summarize the performance of the Pilot AA-904 amplifier (see photo), especially the IM distortion curve, will no doubt be a shock. The distortion of the specimen tested was so low that below 7 watts it was necessary to subtract the residual reading of my Heathkit AA-1 audio analyzer to obtain any measure at all. Though I do not claim any great accuracy below that point the curve could be 100% off and still be remarkable. As near as I could measure it the distortion was about .02% at the 5-watt level and less than .01% below 2 watts. The manufacturer avers this distortion curve is representative of production runs.

The other characteristics require no apologies either. About 24 db of feedback is applied in a single loop but this has been so well controlled that nothing short of .05 µf or reactive load will set it off into oscillation. Below that and with no load it is fully and entirely stable. The power curve (Fig. 3) is down about 1 db at 20 and 20,000 cycles, though it slopes more severely beyond. The damping factor is 6, an excellent value for today's high-fidelity speakers which do not require as heavy damping as older models did.

The circuit (Fig. 4) is a conventional Williamson except in the use of pentode connection of the output tubes. Special care, however, is taken to maintain balance in all push-pull stages by using 1% resistors. Also, a simple and convenient means is provided for balancing the output stage and biasing it. Behind an easily removable escutcheon on the chassis there is a terminal board with two screws connected with a wire link. Removing the link opens the two cathodes, and a voltmeter attached to the two terminals can be used to obtain the zero-voltage-difference reading which indicates perfect balance. When the link is replaced, the same voltmeter applied to either terminal and ground will read the bias, which should be 24 volts. There are two phase-correcting networks in series in the feedback loop and two bypass networks within the amplifier to control high-frequency response. The reasons for the low distortion are: higher than usual feedback factor; since pentode operation requires less drive (24 volts instead of about 38), the drivers are not driven so hard; the bias and balance of the output tubes can be adjusted for lowest distortion with a given pair. If there is, between the sound of this pentode version and an Ultra-Linear or triode version of the Williamson, any difference which can be ascribed to the pentode operation, it is beyond the ability of my ears to perceive.

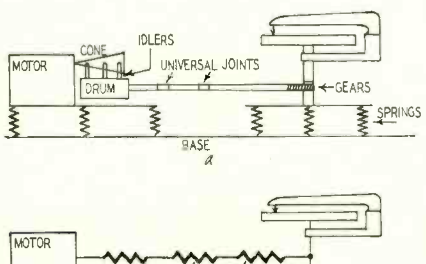
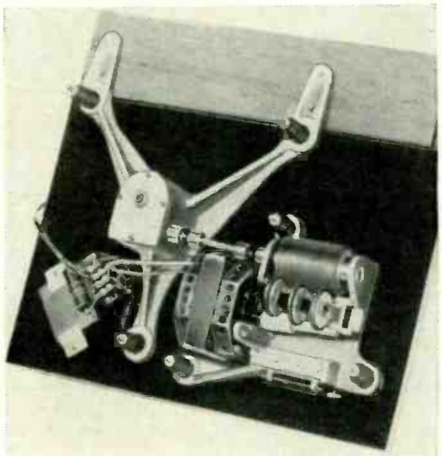


Fig. 5—Diagrams show the Scott turntable layout and equivalent circuit.

H. H. Scott stroboscopic turntable

The H. H. Scott 710 turntable (see photo) was obviously aimed at the closest approximation of the ideal of turntable performance rather than merely to match current standards. Ideals are not approximated for peanuts and at $130 (approximate audiophile net) the Scott will dig a noticeable hole in the best-furnished wallet.

The H. H. Scott type 710 turntable.



Underside of the Scott 710 turntable.

The model AA-904 Pilotone amplifier.

The big villain of turntable performance is rumble. And the better the system otherwise, the greater the price in quality and satisfaction this rude villain exacts. The 710 will not dispose of the rumble problem completely. Unfortunately, there is another turntable involved in every disc recording, that of the cutting lathe, and unfortunately few if any cutting lathes dispose of rumble as thoroughly as does the Scott. Still, with most of today's recordings you will have to own a speaker system really flat to 30 cycles or lower and add considerable loudness control or bass boosting to hear any rumble at all. Even then you'll have to operate at an uncomfortably high volume level.

A second and, to a critical musical ear, equally annoying villain is wow. Scott claims a figure of 0.1% for both wow and flutter combined and again I cannot quarrel. The Scott seems better in this respect than the best tape recorder I have used and yields as steady a pitch, even with piano music, as I have heard.

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MODEL U-98 — fully automatic — incorporates 32 distinct improvements—eliminates all arcing and consequent picture distortion—points directly, positively, instantly to target station—*"just set it and forget it"!* . . . . . . List Price, **$39.95**

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A somewhat related problem is that of synchronizing the speed of the playback turntable with the speed of the recording lathe and thus achieving the identical pitch used by the instruments or orchestra at the time of recording. The Scott deals with this problem as completely as I imagine it can be dealt with. A built-in stroboscope operates at all three standard speeds (33, 45 and 78 r.p.m.) making it possible to see to what degree these standard speeds are attained and maintained.

The stroboscope operates constantly, requires no special lighting or skill or knowledge to interpret, provides clear and positive information. There are adjustments to vary the speed either to correct for the error produced by differences in line voltage or loading of the turntable by the pickup or to change the pitch so that, for example, recordings played with instruments tuned to the Continental pitch will be in tune with ones tuned to the American pitch. The variation possible is $\pm 5\%$ which amounts to just about a whole tone at 33 r.p.m. and even permits transposing to the next lower or higher key.

Each of the three speeds is adjusted individually by a separate knob without affecting the speed of the other two. The adjustment can be made any time without interfering with turntable performance. Thus, it is not only possible to obtain precise synchronization with the three standard speeds but also to make corrections in playback for small errors in the synchronization of cutting lathe with tape recorder and even to permit changing the pitch to suit one's own ear.

I was not aware of any hum problems with the Scott and experienced no difficulty even with such very-low-level cartridges as the Fairchild (without transformer) or the Electro-Sonic, Angel or even the Ferranti.

There are some additional fine points. The turntable is aluminum, so there is no magnetic pull even on cartridges with large and powerful magnets like the Angel. The pickup mounting board, as well as the turntable base, are large enough to accommodate the long transcription type arms and to permit a choice of orientation with the short home type arms.

Choice of operating speeds is positive and simple. There are four pushbuttons, one for each of the three speeds and the fourth for stop. Pushing any of the three starts the turntable revolving at the desired speed. Pushing the stop button stops the turntable and returns the depressed pushbutton to neutral. There is a slip-clutch between turntable and drive so records can be cued or placed and removed without stopping the turntable.

The performance of the Scott is achieved by a radically novel design (Fig. 5-a). The problem so far as rumble is concerned is to isolate the vibration of the motor from the turntable and pickup. In the Scott the system is divided into two entirely independent sections: the motor and speed converter, the turntable and pickup. Each section is floated separately and independently with a combination of steel springs and sponge rubber. Thus, so far as the vibration is concerned, there are two floating mounts in series instead of the usual one. The turntable is gear-driven but the coupling between the gears and the motor is flexible and highly damped instead of solid and fixed. Two rubber or rubberlike universal joints in the drive shaft transmit the torque but tend to absorb the vibration. Furthermore, between this drive shaft and the motor itself idlers with rubber rims also absorb vibration. If we represent the damping elements by resistances, we get the equivalent diagram of Fig. 5-b with five damping elements in the loop.

Another interesting feature is that the pickup mounting board is rigidly mounted to the turntable frame but floats with it on the turntable mount. This is mechanically identical to using a common ground in an audio circuit — places the pickup at the same vibration potential, as it were, as the turntable. It has the incidental benefit of providing isolation of both turntable and pickup from shock transmitted to the base by footsteps, passing trucks or vibration from a speaker, and thus minimizes the thumps, bumps, skipping and jumping due to shock as well as acoustic feedback from the loudspeakers.

The drive system is equally novel. The motor drives a long narrow cone. The drive shaft from the turntable terminates in a drum of the same length as the cone and parallel to it in axis. The three idlers are exactly the same size but are placed between cone and drum so that one engages the cone at its larger diameter, another at its smaller diameter and the third in between. This forms a planetary transmission or, rather, three independent planetary transmissions. Obviously the speed of each idler will be proportional to the diameter of the portion of the cone that it engages. There is a linkage to move each idler a fraction of an inch along its portion of the cone and this movement provides the variation of speed.

At this point the two rubber universal joints perform another service, that of torque damping. The initial starting torque of the motor against the load of turntable puts a twist in the joints; once speed is attained and the turntable acquires momentum the twist is relaxed to a state of normal tension or torsion. However, any sudden increase or decrease in torque will be resisted by the torsion of the rubber and the back torque of the turntable which also loads the universal joints. This tends to dampen irregularities in torque and therefore in speed and — with the heavy flywheel effect of the turntable — accounts for the notable wow characteristics and low flutter of the unit. END

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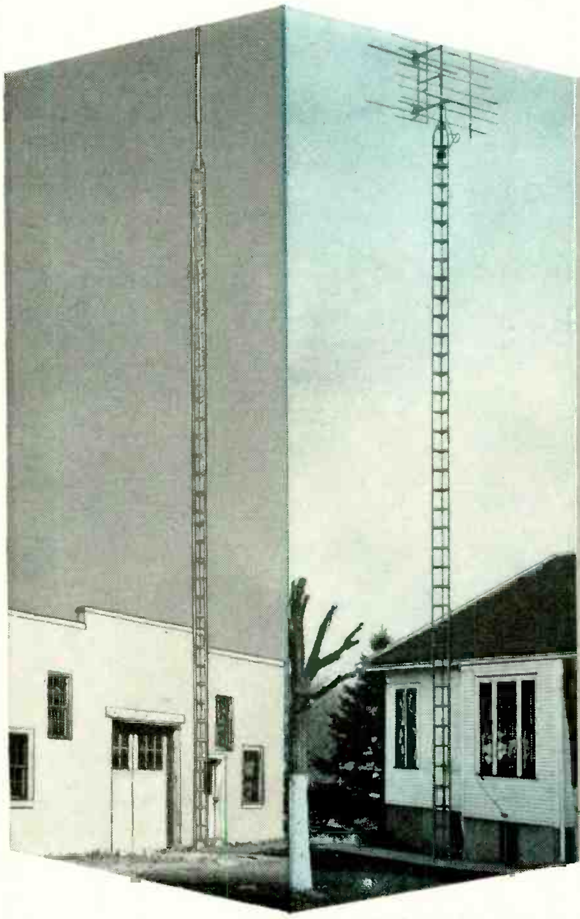

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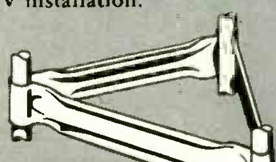

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It is impossible to insert the tube in the wrong socket when using the new Model TC-55. Separate sockets are used, one for each type of tube base. If the tube fits in the socket it can be tested.

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The Model TC-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 TC-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.

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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 TC-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

TUBE TESTER

★ Tests all tubes including 4, 5, 6, 7, Octal, Lock-in, Peanut, Bantam, Hearing Aid, Thyratron Miniatures, Subminiatures, Novals, Sub-minars, Proximity fuse types, etc.

★ Uses the new self-cleaning Lever Action Switches for individual element testing. Because all elements are numbered according to pin-number in the RMA base numbering system, the user can instantly identify which element is under test. Tubes having tapped filaments and tubes with filaments terminating in more than one pin are truly tested with the Model TV-11 as any of the pins may be placed in the neutral position when necessary.

EXTRA SERVICE—The Model TV-11 may be used as an extremely sensitive Condenser Leakage Checker. A relaxation type oscillator incorporated in this model will detect leakages even when the frequency is one per minute.

★ The Model TV-11 does not use any combination type sockets. Instead individual sockets are used for each type of tube. Thus it is impossible to damage a tube by inserting it in the wrong socket.

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

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

★ NOISE TEST: Phono-jack on front panel for plugging in either phones or external amplifier will detect microphonic tubes or noise due to faulty elements and loose internal connections.

The model TV-11 operates on 105-130 Volt 60 Cycles A.C. Comes housed in a beautiful hand-rubbed oak cabinet complete with portable cover.

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ALSO TESTS TRANSISTORS!

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★ **NEWLY DESIGNED FIVE POSITION LEVER SWITCH ASSEMBLY.** Permits application of separate voltages as required for both plate and grid of tube under test, resulting in improved Trans-Conductance circuit.

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A transistor can be safely and adequately tested only under dynamic conditions. The Model TV-12 will test all transistors in that approved manner, and quality is read directly on a special "transistor only" meter scale.

The Model TV-12 will accommodate all transistors including NPN's. PNP's. Photo and Tetrodes, whether made of Germanium or Silicon, either point contact or junction contact types.
Model TV-12 housed in handsome rugged portable cabinet sells for only

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We do not make nor do we recommend use of C.R.T. adapters because a Cathode Ray Tube is a very complex device and to properly test it, you need an instrument designed exclusively to test C. R. Tubes and nothing else. As compared to a makeshift adapter, which sells for about five dollars, our Model TV-40 C.R.T. Tube Tester sells for $15.85. But, if you believe that Television is here to stay, then you must agree that the difference in price is more than justified by the many years of valuable service you will get out of this indispensable instrument.

Incidentally, the Model TV-40 is the ONLY low-priced C.R.T. Tube Tester, which includes a real meter. Neons are fine for gadgets and electro-line testers, but there is no substitute for a meter with an honest-to-goodness emission reading scale.

Superior's New Model TV-40

C. R. T. TUBE TESTER

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.
- Test for open elements.

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

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USE APPROVAL FORM ON NEXT PAGE

Superior's new Model 670-A

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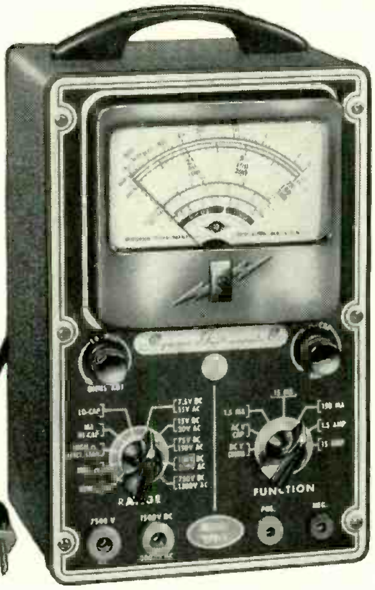

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SPECIFICATIONS:

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D.C. CURRENT: 0 to 1.5/15/150 Ma. 0 to 1.5/15 Amperes

RESISTANCE: 0 to 1,000/100,000 Ohms 0 to 10 Megohms

CAPACITY: .001 to 1 Mfd. 1 to 50 Mfd. (Good-Bad scale for checking quality of electrolytic condensers)

REACTANCE: 50 to 2,500 Ohms, 2,500 Ohms to 2.5 Megohms

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ADDED FEATURE:

Built-in ISOLATION TRANSFORMER reduces possibility of burning out meter through misuse.

The Model 670-A comes housed in a rugged crackle-finished steel cabinet complete with test leads and operating instructions.

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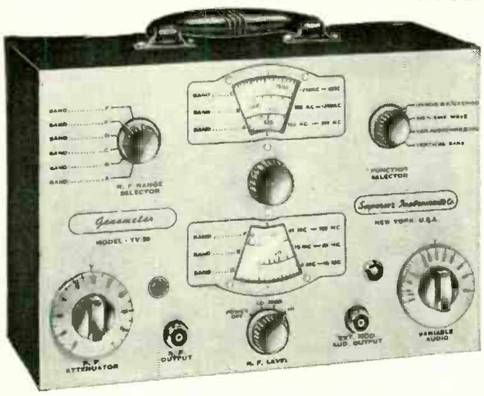

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- ✓ Audio Frequency Generator
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- ✓ Cross Hatch Generator
- ✓ Color Dot Pattern Generator
- ✓ Marker Generator

R. F. SIGNAL GENERATOR: The Model TV-50 Genometer provides complete coverage for A.M. and F.M. alignment. Generates Radio Frequencies from 100 Kilocycles to 60 Megacycles on fundamentals and from 60 Megacycles to 180 Megacycles on powerful harmonics.

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 patrern will consist of non-shifting horizontal and vertical lines interlaced to provide a stable cross-hatch effect.

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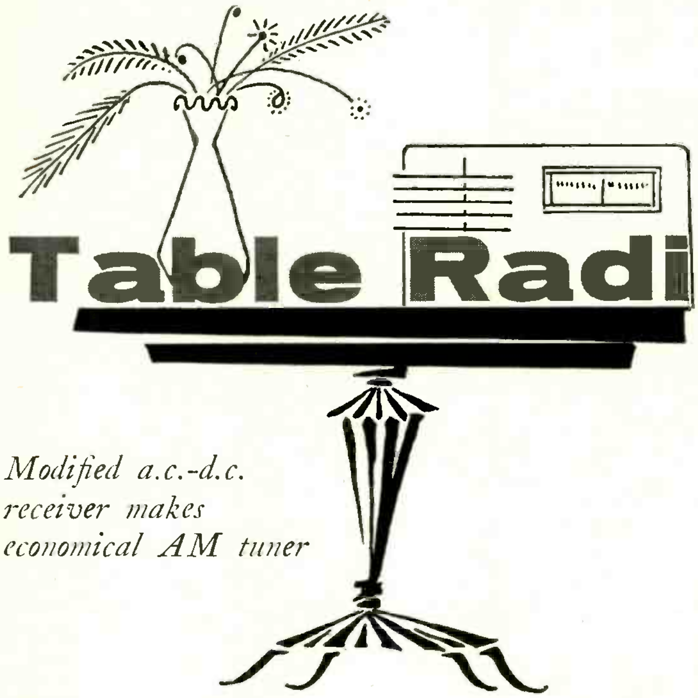

Table Radios into Hi-Fi Tuners

Modified a.c.-d.c. receiver makes economical AM tuner

By JOSEPH MARSHALL

FM radio and LP recordings provide by far the greatest portion of the listening fare on most high-fidelity installations. However, even in metropolitan areas having several FM stations many desired programs are broadcast only on AM stations. Often, therefore, a need arises for an adequate and economical AM tuner either to supplement the FM tuner and record player or to serve as the primary source of program material. The ordinary table-model a.c.–d.c. radio can be converted very simply and economically into a satisfactory tuner. Since almost every household possesses one or more such radios, a conversion offers a means of saving a sizable portion of the investment in a hi-fi installation.

Most a.c.–d.c. radios consist of a converter, i.f., detector–a.v.c.–first audio and beam-power output stages. Most use vacuum-tube rectifiers; some the more compact, selenium rectifiers. In any case Fig. 1 is representative of the audio end of more than 90% of such receivers.

The a.c.–d.c. radio is more suitable for conversion to hi-fi tuners than more elaborate models having an r.f. and additional i.f. stage. The bandpass of the simple receiver, while narrow enough to minimize the most serious interference, is sufficiently wide to pass most of the desired high frequencies. And for primary areas with hi-fi AM stations, it can be widened to provide about as much usable fidelity as AM broadcasting permits.

Even in primary areas so close to the transmitter that the desired signal swamps most or all electrical and radio interference, a bandpass of about 15 kc, which results in an audio response up to 7,500 cycles, is about the limit for enjoyable reception because a wider bandpass increases the noise level to the point where it produces outright annoyance or its amplitude is sufficient to effectively mask frequencies above 7,500 cycles.

On the fringe of the primary area and beyond, with conditions on the broadcast band as they are today, interference-free reception limits the bandwidth to only 10 kc and an audio response which slopes rapidly beyond 5,000 cycles. The table-model radio can easily meet the bandwidth requirements of either situation with very slight modifications and little if any investment in additional parts.

The steps necessary for conversion are: provide a suitable takeoff point for the audio, disable the output stage and speaker, improve the frequency response, reduce the hum level sufficiently to make the additional low-frequency response usable.

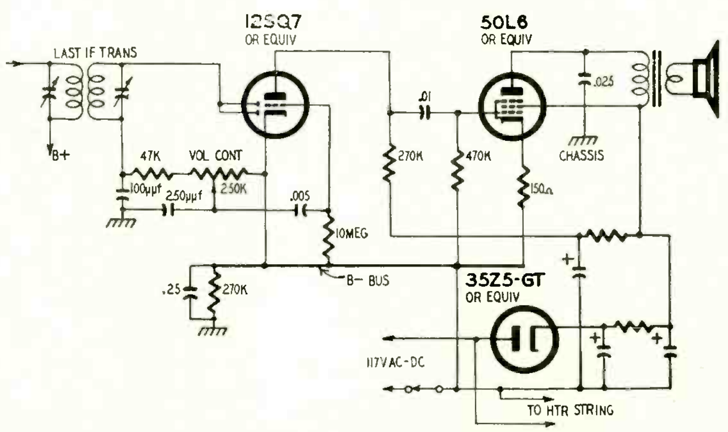

Fig. 1—Audio output stage and power supply of a typical a.c.–d.c. radio.

The hot chassis problem

Providing the audio takeoff point and connecting the tuner to the amplifier are not as simple as might appear at first thought. The trouble is that the audio amplifier will certainly have a transformer type power supply and the chassis will be the common ground for both the audio frequencies and the operating voltages. In the transformerless a.c.–d.c. radio the chassis serves as a common ground for r.f. and a.f. but the B-minus point is isolated from the chassis. Moreover, in the transformer type supply the chassis and B minus are isolated from the power line. In the a.c.–d.c. radio B minus is connected directly to one side of the power line and the chassis is also in the power-line circuit through a capacitor and high-value series resistor. Therefore, the chassis and common ground points of radio and amplifier are at different potentials with respect to the power line, operating voltages on the tubes and the desired audio frequencies. So that, in the interests of safety for equipment and persons, as well as in the interest of not disturbing the operating parameters of either radio or amplifier, it is necessary to isolate the chassis and B-minus points.

We can get the necessary isolation and still minimize hum pickup by using

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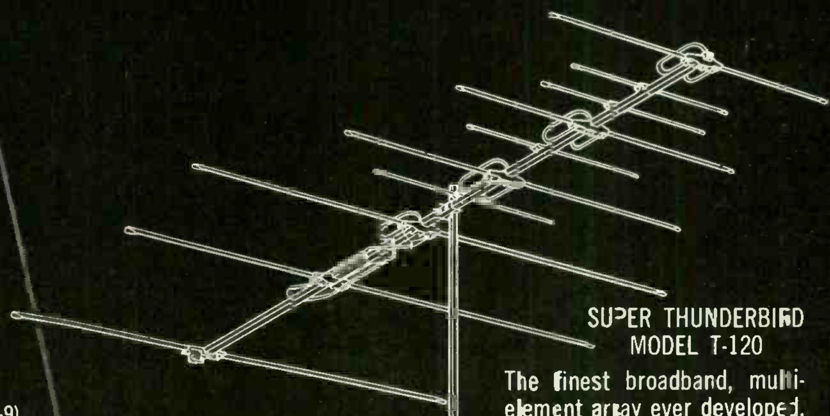

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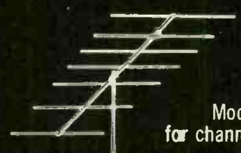
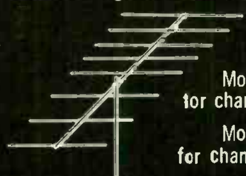


Model Y7X1 (7-8-9) for channels 7, 8, and 9.



Model Y8X1 (10-11) for channels 10 and 11.

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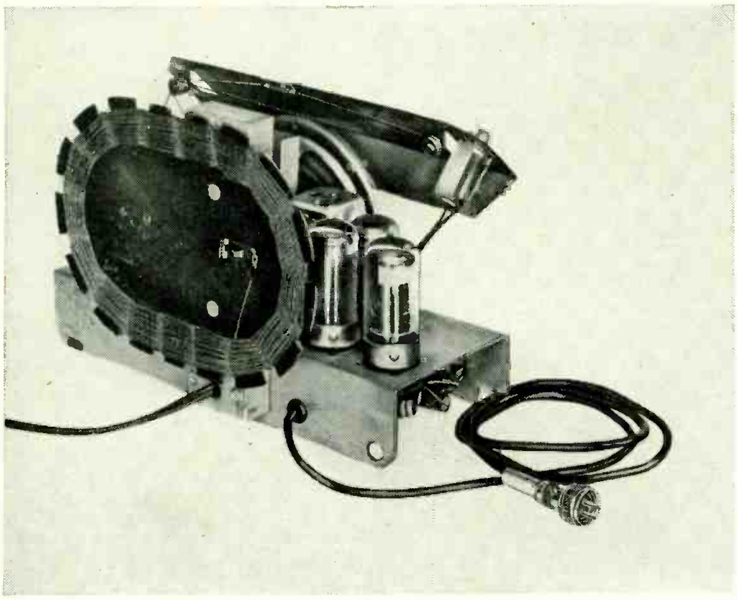


Typical a.c.–d.c. receiver modified for feeding a high-fidelity audio amplifier.

an insulated, shielded two-conductor microphone cable instead of the usual one-conductor shielded cable. The shield is grounded *only* to the chassis of the amplifier, the two inner conductors picking up the audio through blocking capacitors as indicated in Fig. 2. In this way the two units are isolated so far as d.c. operating and line voltages are concerned, and still provide adequate shielding of the connecting cable to minimize hum pickup. We also protect ourselves against shocks and the equipment against possible damage. To preserve isolation and consequent safety, the two chassis must not be permitted to touch each other or be connected together.

Although the chassis of the radio could be removed from its cabinet and placed in the same cabinet as the audio amplifier, it is simpler and more convenient, as well as safer, to keep the radio in its cabinet and connect it to the amplifier through a cable. If the cable length is held down to 5 feet or less there will be no significant loss of the high audio frequencies. Cable lengths as great as 10 feet will not be too serious and the high-frequency losses can be compensated for by some treble boosting in the amplifier. A location more remote than this, however, would require a cathode follower output on the tuner and, unfortunately, it is not easy to provide a cathode follower in an a.c.–d.c. radio because of the lack of suitable tubes with high-voltage filaments—although it might be possible to modify the output stage to a cathode follower.

Receiver modifications

It is not possible to remove the output tube from an a.c.–d.c. radio because the filament chain would be broken. However, it can be disabled as far as the audio and d.c. voltages are concerned and still remain part of the filament chain. This is done simply by disconnecting the following leads at the socket terminal: the lead from output transformer to the plate; the lead from the screen to B plus; the grid resistor; the cathode resistor. All these changes are indicated in Fig. 3. The speaker should also be disconnected from the secondary of the output transformer. The output tube will now serve simply as a ballast tube in the filament chain. It will draw no plate current and will not affect the audio signal.

The low-frequency response of a.c.–d.c. radios is very poor below 100 cycles and must be improved for hi-fi reception. This is very easily done by changing the coupling capacitor between the first audio stage and the output tube from its present value of about .01 to 0.1 μf. The same value can be used as the blocking capacitor at the ground end of the connecting cable. It is highly probable that the first audio amplifier will use grid-leak bias—as indicated by a grid resistor of 5 to 10 megohms for the triode section of the 12SQ7 or equivalent tube. In this case, no change in the coupling capacitor of that stage is necessary since the .005-μf capacitor will, in conjunction with the very high grid resistance, have a time constant low enough to pass the desired low frequencies.

Reducing hum level

Increasing the bass response, however, will almost certainly raise the 60-cycle hum level to an objectionable stage. Fortunately, there is a simple means of reducing the hum at no additional cost. The primary of the output transformer, now no longer being used, can be employed as a choke. If the receiver already uses one choke in the filter, the transformer can be inserted in series with the present choke to produce a two-stage filter. Some, if not most, receivers use a resistor instead of a choke. In that case the transformer primary can be used to replace the resistor. In either case, the addition of a choke will usually reduce the hum level to a point low enough to be tolerable. If further filtering is necessary, additional filter capacitance can easily be added.

If the receiver is used in a primary signal strength area, it may be desirable to widen the bandwidth of the i.f. amplifier. This is easily done by detuning the secondaries of the i.f. transformers slightly. For the most symmetrical response curve, an oscilloscope and sweep generator should be used. However, a v.t.v.m. connected across the a.v.c. line will serve as a good enough indicator and careful detuning to provide as nearly uniform deflection on both sides and as flat a

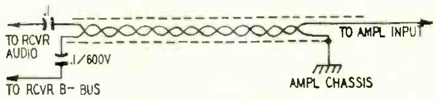


Fig. 2—Radio–amplifier connection.

top as possible can produce excellent results. A bandpass of 15 kc is easy to obtain even without a scope but a wider one with a suitable flat top requires the use of a scope.

By these very simple changes and modifications, it is possible to produce an AM tuner good enough for the very great majority of hi-fi installations at little or no cost beyond that of an hour or so of labor. END

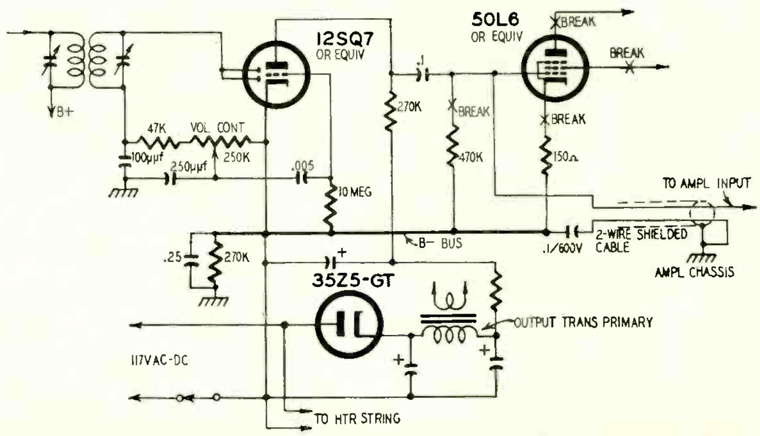


Fig. 3—Modified output circuit for connection to a hi-fi amplifier.

OUR ABBREVIATIONS OF ELECTRONIC TERMS

As some of our readers have noted, RADIO-ELECTRONICS attempts to maintain a consistent style in its abbreviations.

Many of our readers have not been with us long enough to profit by our consistency. Others have requested a list of abbreviations to help them in their own writing. Therefore we are printing this list of abbreviations in the hope that they may be useful.

The list below represents a revision of abbreviations used in this magazine. Many are always spelled out in text but abbreviated in our art work. Terms which appear only in art work—as well as those capitalized in text—appear in capitals. Other abbreviations used in drawings only are omitted since they are practically self-explanatory. Terms like *ft*, *lb*, etc., which are not electronic, are generally omitted. Note that in those (and other) abbreviations the period is used only where the abbreviation might be confused for another word: *ft*, for example, but *in.* for inch. Abbreviations in lower case are so printed in text; are capitalized in artwork.

ELECTRONIC TERM	ABBREVIATION
adjacent	ADJ
alternating current	ac
American wire gauge	AWG
ampere(s)	amp
amplifier	AMPL
amplitude modulation	AM
antenna	ANT
attenuator	ATTEN
audio frequency	af
audio-frequency choke	af choke
audio-frequency transformer	AFT
automatic chroma control	ACC
automatic frequency control	afc
automatic gain control	agc
automatic phase control	apc
automatic volume control	avc
autotransformer	AUTOTRANS
Barkhausen oscillation	BO
base (of transistors)	b or base
battery	BATT
beat frequency oscillator	bfo
blocking tube oscillator	BTO
broadcast interference	BCI
calibrate	CALIB
capacitor (capacitance)	C, CAP
cathode	CATH (K on tube diagrams)
cathode follower	CATH FOLL
cathode-ray (tube, etc.)	C-R
cathode-ray oscilloscope	CRO
channel	CHAN
charge	CHG
choke	CH (or CHOKE)
circuit	CKT
circuit breaker	CKT BRKR
coaxial	coax
coil	L
collector	c (of transistors)
common	COM
conductor	COND
connection	CONN
continuous wave	CW
control	CONT
convergence	CONV
converter	CONVTR
counter electromotive force	counter emf
crystal	xtal
current	I
decibel(s)	db
deflection	DEFL
demodulator	DEMOD
detector	DET
dielectric	DIELEC
direct current	dc
direct current restorer	DC REST
direction finder	df
discharge	DISCH
discriminator	DISCRIM
distance	dx
double cotton covered (wire)	dcc
double pole double throw	dpdt
double pole single throw	dpst
double silk covered (wire)	dsc
dynamic	DYN
effective radiated power	ERP
electric	ELEC
electrode	ELECT
electromotive force	emf
emitter (transistor)	e
enameled (wire)	ENAM
equivalent	EQUIV
erase head	ERASE HD
external or extension	EXT
farad(s)	F (f in combination)
filament	FIL (F in tube diagrams)
follower (ing)	FOLL
frequency	f, FREQ
frequency modulation	FM
generator	GEN
grid	G (in tube diagrams)
grid dip oscillator	GDO
ground	GND
ground controlled approach	GCA
head	HD
heater	HTR (H)
henry	h
high frequency	hf
horizontal	HORIZ
impedance	Z
inches per second	ips
inductor	L
input	IN
instrument landing system	ILS
intermediate frequency	if
intermodulation	IM
inverter	INV
kilocycle	kc
kilowatt	kw
limiter	LIM
linearity	LIN
low frequency	lf
maximum	max
megacycle(s)	mc
megohm	meg
meter	M
micro- (one-millionth)	u
microfarads	uf
microhenry (ies)	uh
micromicrofarad(s)	uuf
microphone	mike
microseconds	usec
milliampere(s)	ma
millihenry(ies)	mh
minimum	MIN
modulation (modulator)	MOD
multiplier	MULT
multivibrator	MVB
narrow-band FM	NBFM
negative	NEG
negative-positive-negative (transistors)	n-p-n
neon	NE
network	NET
oscillator	OSC
output	OUT
peak-to-peak	PP
permanent	PERM
permanent magnet (speaker)	PM
phase modulation	PM
picture (TV)	pix
pilot lamp	PL
plan position indicator (radar)	PPI
plate	P
positive	POS
positive-negative-positive (transistors)	p-n-p
potential	E
potentiometer	POT
preamplifier	preamp
primary	PRI
public address	PA
pulse repetition frequency	prf
pulses per second	pps
reactance–resistance ratio	Q
regeneration	regen
quadrature	QUAD
radio frequency	rf
radio-frequency choke	RFC
radio-frequency transformer	RFT
reactance	X
recorder	RCDR
recording	RCDG
rectifier	RECT
regulator	REG
relay	Ry
resistance (resistor)	R
root mean square	rms
screen grid	SG
secondary	SEC
selenium (rectifier)	SEL (RECT)
separator	SEP
shortwave	SW
signal	SIG
single cotton covered (wire)	scc
single pole double throw	spdt
single pole single throw	spst
single silk covered (wire)	ssc
speaker	SPKR
standing wave ratio	SWR
switch	S
synchronization	sync
tuned plate tuned grid	tptg
telegraph	TELEG
telephone	phone(s)
television interference	TVI
terminal	TERM
thousand	K
transformer	TRANS
transistor	often V
trimmer	T
tube	V
tuned radio frequency	trf
ultra high frequency	uhf
vacuum-tube voltmeter	vtvm
variable	VAR
variable frequency oscillator	VFO
vertical	VERT
very high frequency	vhf
vibrator	VIB
voice coil	VC
voltage	E (sometimes V in transistor diagrams)
volt(s)	v
volt-ampere	va
volt-ohmmeter	vom
voltage standing wave ratio	vswr
volts ac, dc	vac, vdc
volume	VOL
volume unit(s)	VU
watt(s)	w

—END—

MAKING PHOTOETCHED CIRCUITS IN YOUR WORKSHOP

By RICHARD H. DORF*

Part II—Sensitizing the laminate; exposing the panel; developing the image; etching

THE foil-clad laminate on which the circuits are etched consists of a base material of phenolic or some other substance. For most purposes the cheapest grade of phenolic (XP) is satisfactory, and it comes in several thicknesses beginning at about 1/64 inch. There are other base materials for critical applications but, unless it is absolutely necessary, steer clear of the glass-fiber-base substances. They ruin drills and saws. The base material is usually covered with copper foil .00135 inch thick. It is bonded to the base with a very effective adhesive and will generally "lift" only if excessive heat is applied. Use a piece of this laminate somewhat larger than the final circuit for ideal results — the photo resist coating may tend to form a bead at the lower edge during the drip-dry time. Laminate is available with copper on either one or both sides; choose the proper type, trying to stick to one-side panels where feasible.

The laminate must be thoroughly cleaned before use. Do this with an abrasive type kitchen cleanser such as Kirkman's. The copper must be absolutely clean and of uniform light color. Once clean, *do not touch it with the fingers*. Run warm water over it for at least 2 minutes to be sure the last trace of cleanser is removed and finish with hot water alone for faster drying. Do not dry—let the water evaporate.

Equipment and setup for exposing the sensitized laminate.

The next material required is Kodak Photo Resist, obtainable in quart bottles. Pour a little into a glass or enameled tray. Dunk the panel into the resist face up and give it a moment to spread uniformly over the copper. Then remove the panel from the tray and hang it up to drip dry.

For best results:

1. Be absolutely certain that all materials which come in contact with the Kodak Photo Resist are completely dry. The slightest bit of water causes the resist to solidify, making it useless.

2. Do not touch any part of the copper with the hands or with anything else (except the negative) between the initial cleaning and the time the laminate goes into the etching acid.

3. If the panel is larger than the final piece, drill a small hole near the center of one of the long edges and insert a wire a few inches long as a handle. This keeps fingers out of the liquids.

4. When drying the panel, hang it so an edge is parallel to the floor. If hung by a corner — normal with films — a diagonal streak of resist may cause the coating to be heavier along the streak and give imperfect results.

5. While a darkened room is not necessary, try to keep Kodak Photo Resist, Photo Resist Dye and Photo Resist Developer away from too much light, as light reduces the potency.

6. The photo resist is not cheap. Let the initial drops from the hanging panel drip into a tray, then pour it back into the bottle. Screw the cap on tight.

7. Be sure the resist is thoroughly dry before exposing the panel. On one-sided laminate a good test is to stroke the noncopper side with a finger. No heat is needed, just a hanging time of 15 to 30 minutes in ordinary climates.

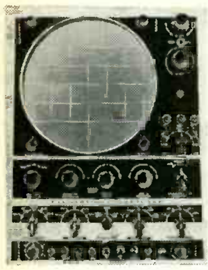
You are ready now to start the actual making of a printed circuit, using the

(*Continued on page* 142)

*Electronics consultant, New York.

precise EXTRA! EXCLUSIVE..

who murdered the serviceman?



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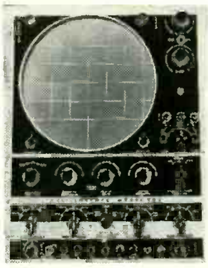
300W $199.50



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THE FAMOUS MODEL #111
111K $69.95
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LOWEST PRICED WIRED 4½" VTVM
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RF—AF—BAR GENERATOR with pre-assembled* head
630K $33.95
630KA* $38.95
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Prices slightly higher in the West. Prices and specifications subject to change without notice.

OR at least the serviceman's confidence in tube testers. LOOK at the FACTS —A serviceman trusts his VTVM (like the Precise 9071 or 909); his signal generator (like the Precise 610 or 630 or 635); his oscilloscopes (like the famous 300 or 308 or 315).

BUT . . . HE DOES NOT TRUST HIS TUBE TESTER (UNLESS IT'S A PRECISE 111).

For the serviceman's sake, WHY?

Precise engineers recognize him as a logical, intelligent fellow. They knew he had good reasons and they looked into the matter with him in mind. Our electronic sleuths found that some manufacturers used an Em (emission) test, some a Gm (mutual transconductance), some a so-called combination, and some a sort of OUIJA board. Some manufactured tube testers that were fast—some slow—some tied almost all the elements together. In some you could cut off pins and the tube merrily read "good." Some didn't even connect all the pins. NO wonder our serviceman's confidence was being murdered!

What then has Precise done to prevent this mayhem. We went directly to the tube manufacturers before offering the serviceman a tube tester. We found out how the tube manufacturer gets the kind of check a serviceman wants . . . a 100% test! We wanted to offer a tube tester that simulates operating conditions in a set. WE HAVE DONE THIS. We added a lot of other requirements . . . A SHORT CHECK, GAS CHECK, Gm, Em, LIFE, FILAMENT CURRENT for 600 mil tubes, BIAS, NOISE and other checks.

RESULT, a tube tester with built in confidence . . . you can even see the tube characteristic curve on an oscilloscope. What's more you can operate this tube tester as simply as the ordinary testers. The Precise 111 has about the same number of controls . . . Remember! it uses rotary switches instead of lever type, because the rotary gives over twice the protection against becoming obsolete. Furthermore, several tests are listed for each tube (an Em and a Gm) with the 100% test starred.

NOW YOU CAN TEST YOUR TUBES *COMPLETELY*. FOR PROOF OF WHAT WE OFFER SEE THE RESULTS OF AN INDEPENDENT SURVEY.

THE FINEST VOLT, REG, 7" VTVM KIT
9071K $35.95
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LOW PRICED RF SIGNAL GENERATOR "BEST BUY" IN GEN. FIELD
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UNIV. AF, SINE, SQ, & PULSE GEN.
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precise THE FINEST KIT AND WIRED TEST EQUIPMENT

WRITE FOR CATALOG RE 1-6

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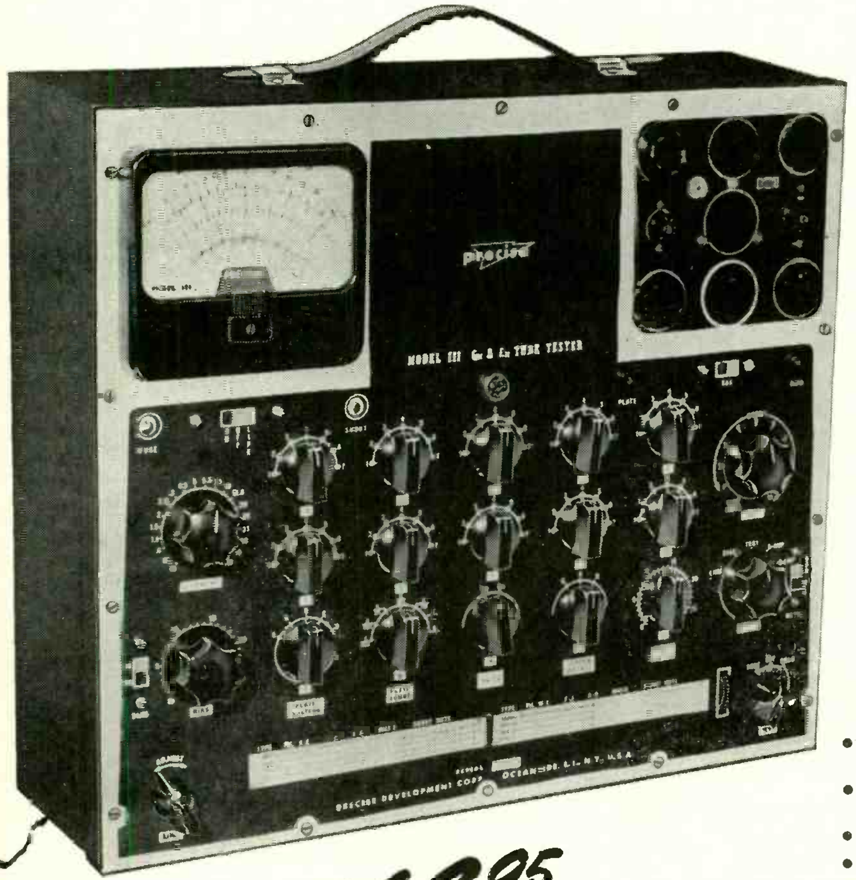
..INDEPENDENT SCIENTIFIC SURVEY

PRECISE MODEL #111 PROVED "BEST COMMERCIAL TUBE TESTER AT ANY PRICE" IN INDEPENDENT SURVEY



precise

Model #111

MUTUAL CONDUCTANCE AND EMISSION

TUBE TESTER

An independent scientific survey conducted by an impartial testing laboratory confirms what purchasers already know: "The most advanced, the most complete tube tester and the best priced is made by PRECISE DEVELOPMENT CORP., Oceanside, N. Y."

111K (kit form)
NOW ONLY $69.95

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Prices slightly higher in the West. Prices and specifications subject to change without notice.

NOW YOU CAN CHECK TUBES THE MANUFACTURER'S WAY

- Checks both emission and mutual conductance
- Checks all tubes including hearing aid, miniatures
- Six different plate voltages
- Different grid signals
- Simplified Short check
- Gas check
- New type switches
- Deeply etched aluminum panel
- Three different screen voltages
- Latest roll chart
- Measures filament current
- Measures grid bias

CHECK THESE ADDITIONAL 'specs' . . . TALK TO YOUR JOBBER AND TO ANYONE WHO HAS THIS OUTSTANDING TUBE TESTER...

The Model 111 is the only single commercial tube tester that checks all tubes for both EMISSION and MUTUAL CONDUCTANCE separately. Filament current is measured directly on large meter when checking a VOLTAGE SAPPER tube. NEW, MODERN DESIGNED ROTARY SWITCHES allow you to check each tube element individually NEW TYPE Single Rotary switch for complete short checks. The 111 makes all BIAS, FILAMENT VOLTAGE, GAS, LIFE checks visually on large meter . . . 5 individually calibrated ranges and scales for mutual conductance tests. NEWLY DESIGNED "NO BACKLASH" ROLL CHART lists all tubes including the new type 600 mil series tubes. Provisions are made for testing many color tubes. All CRT's can be checked with accessory adaptor, Model PTA.

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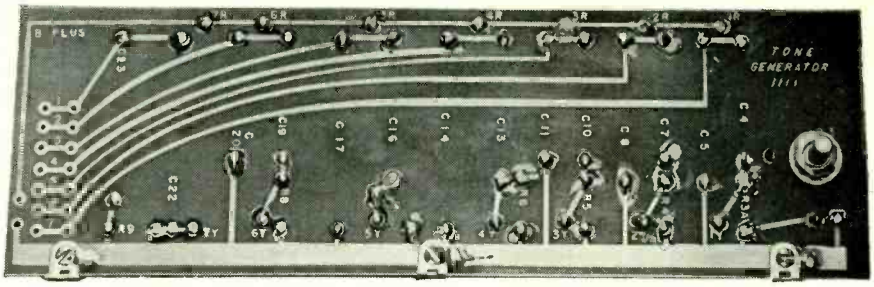
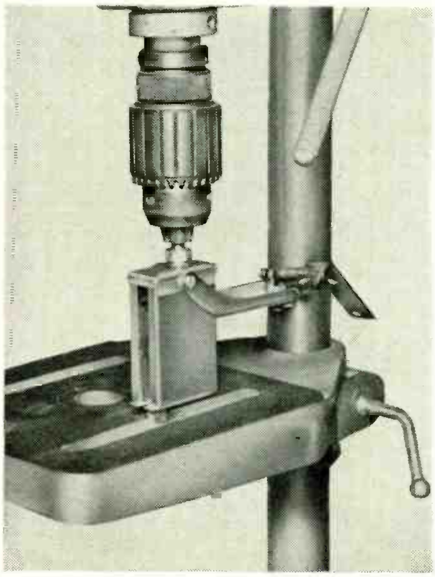


The completed printed circut. Globules of solder are at the connection points.

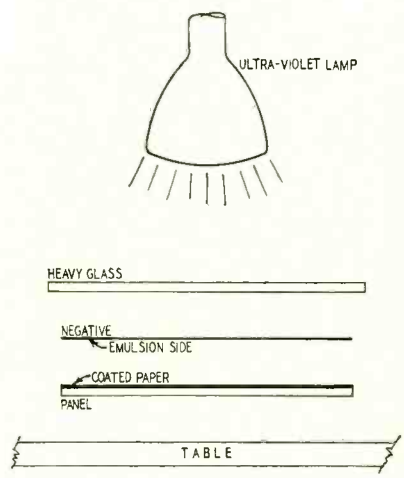
panel which has just been coated. You may coat as many panels as you like at a time. Wrap any you are not going to use immediately in paper and store away from light; they will keep indefinitely and will be ready for use at any time.

You will need a table with a flat top, a piece of heavy glass and an exposure lamp. A mercury-vapor ultra-violet lamp especially made for photographic purposes by Hanovia is ideal. This lamp fits into an ordinary lamp socket which you can hang on the end of a cord above the table. When the switch is turned on, the lamp will light; after a few seconds it will momentarily reduce its light output, then immediately go back to full brilliance and remain on until the switch is opened. After it is turned off, however, the lamp will not go on again for several minutes. So if you are in a hurry, do not turn on the lamp until you are actually ready to start using it. It gives off light in plenty but no heat is transmitted to the negative, which would tend to curl and even melt with an ordinary photoflood. These lamps can be obtained from Hanovia distributors—if you have none locally, any store handling health lamps will be in a position to give you information as to where one can be ordered.



Roto drill saw for cutting laminate.

The diagram shows how to set up the materials. Be sure that the emulsion (dull) side of the film is down against the panel, a point you can check by seeing that the pattern reads right rather than in mirror fashion as viewed through the glass. There must be good contact at all points. If the panel is somewhat warped, use a piece of glass a good deal larger than the negative and panel and weight it down at the edges with good heavy weights and leave it there till it straightens out.



Showing how the equipment is assembled to expose the sensitized laminate.

Exposure time depends on such factors as distance from lamp to panel, line voltage and others. However, I have a standard which should be universally applicable. With the lamp at a distance of 12 inches from the table, the time is 6 minutes. A couple of test exposures on short strips cut from larger panels will make this clear. Try to place the materials directly under the lamp for most even exposure. If the panel is more than about 8 inches square, the lamp might be raised somewhat and exposure time lengthened. Once set for a given set of circumstances, all exposures can be made the same in the future. A person who has had some experience in developing his own negatives and making prints will find all the procedures strictly matters of routine.

Developing the image

When the exposure is finished, turn off the light and remove the panel. Place it immediately in a tray of Kodak

Exclusive!

The First MULTI-CHANNEL YAGI...PRE-TUNED TO CHANNELS OF YOUR CHOICE

New! **WINEGARD**

Combo

. . . Gives You *More Gain* on Channels in Your Area

. . . Because it's *Peaked* to Channels in Your Area

There has never been an antenna like the COMBO—the first MULTI-CHANNEL TV ANTENNA that is actually PRE-TUNED TO YOUR AREA. The Combo is factory peaked in 16 different channel combinations—one of which will give you the ultimate in performance on the specific channels you want.

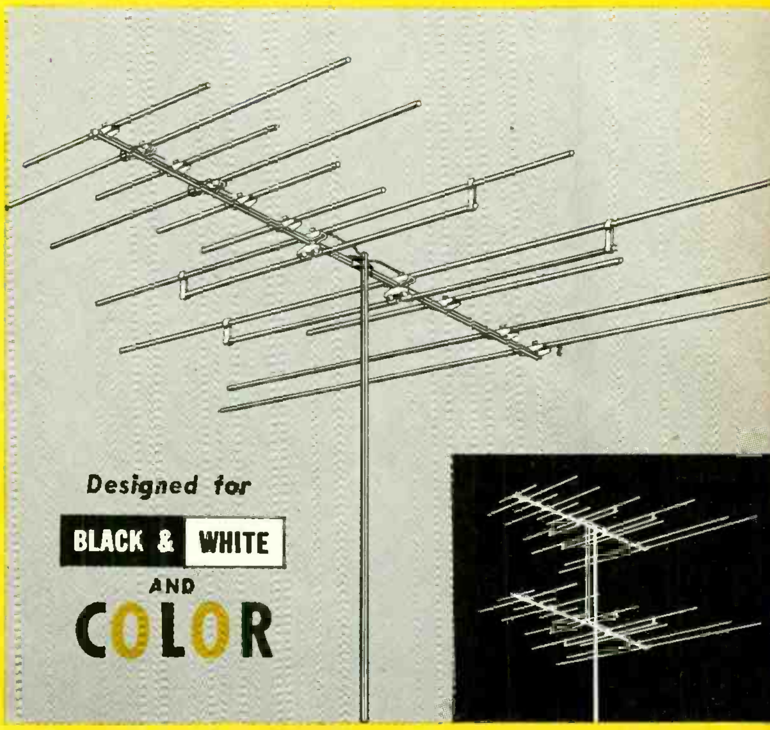
This is the first logical, practical TV antenna development in years. The Winegard COMBO is guaranteed to give better performance on all channels in your area, regardless of size or number of bays of the antenna you are now using.

Another original by WINEGARD!

Available in 16 Factory Pre-Tuned Combinations

Custom-Combo Model No.	Channels Peaked for											
TC3-A	2	3	4	5	6	7	8	9	10	11	12	13
TC3-B	2	3	4	5	6	7	8	9	10			
TC3-C	2	3	4	5	6		8	9	10			
TC3-D	2	3	4	5	6				10	11	12	13
TC3-E	2	3	4			7	8	9	10	11	12	13
TC3-F	2	3	4			7	8	9	10			
TC3-G	2	3	4				8	9	10	11		
TC3-H	2	3	4						10	11	12	13
TC3-I		3	4	5	6	7	8	9	10	11	12	13
TC3-J		3	4	5	6	7	8	9	10			
TC3-K		3	4	5	6		8	9	10	11		
TC3-L		3	4	5	6				10	11	12	13
TC3-M			4	5	6	7	8	9	10	11	12	13
TC3-N			4	5	6	7	8	9	10			
TC3-O			4	5	6		8	9	10	11		
TC3-P			4	5	6				10	11	12	13

*Patent No. 2700105



Single bay Combo — $29.95   Double bay Combo — $59.95

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1. Pre-Peaked to Your Channels
2. Electro-Lens* Director System
3. Completely Pre-Assembled
4. Automatic Twin-Lock Hardware
5. All Aluminum and Stainless Steel Construction

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Please RUSH ☐ COMBO Bulletin No. WL11135
☐ Address of nearest distributor

NAME OF FIRM

ADDRESS

CITY ZONE STATE

SIGNATURE

Photo Resist Developer. The tray must be glass or enamel without any defects. Be sure to keep all water well out of the way since it will harm the developer. Agitate the tray constantly. Development time is at least 2½ minutes, but overdevelopment for a couple of minutes or more causes no harm and is a safety factor.

The developed image will not be visible. Developing simply dissolves away the resist which was not hardened by light; however, the resist is so transparent that this cannot be seen.

It is not necessary to see the developed pattern to etch it. It is a safety factor, however, a check to see that everything is as it should be. There are two ways to make the pattern visible.

The first and a good way is to use Kodak Photo Resist Dye. Pour some in a tray. Take the panel from the developer and immerse it in the dye for 30 to 60 seconds *without wetting it with water*. Then wash the panel under a light stream of warm water. After this washing the areas to which resist has stuck will be dense black and the areas to be etched will be clear copper. Wash the panel thoroughly (but don't rub it) to see that no dye sticks to undesired areas since the dye acts as a resist during etching. The wiring pattern will be clearly shown in black and can be checked. If any lines are imperfect they can be touched up by applying resist with a brush *after the panel is dry*, followed by an exposure to the light. If there is black where there should be none, it can be scraped away.

The second method does without the dye. Simply wash the panel after it comes out of the developer with warm water—around 120°F—for at least 1 minute until the pattern is visible. There will not be a great deal of visual contrast, but enough to see. This method has at least the advantage that the dye, which is rather messy and hard to clean, is absent.

Etching

The final major step is the actual etching. The material used may be either ferric chloride or chromic acid. Ferric chloride is hard to get in any but liquid form and the liquid may present some difficulties in storage and handling — it cannot be mailed. Chromic acid can be had in chip form; it is mixed with water before use.

The tray in which the etching is done must be glass or enamel. If enamel, it must be unchipped since the acid will eat away the metal base of the tray where it is vulnerable. The acid should not get on clothes or face; if it does get on the skin it is not harmful if washed off immediately. It is not removable from clothes.

Immerse the panel in the acid and agitate the panel throughout the process. It is the mixture of air with the acid that does the etching so it is a good idea to immerse the piece, remove it and let it drip for a second or two, then immerse it again and keep up this

SELLING OUT!

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Prices Reduced Up to 80%

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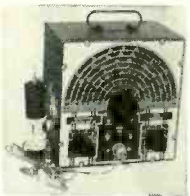
This is the opportunity of a lifetime!

Below mentioned units are not kits, but all factory wired and brand new. Some models have been discontinued by the manufacturer, but every one is factory sealed and carries a one year factory guarantee. Satisfaction or money refunded within 10 days.



Model 999 Combination F.M., A.M. and Television

SIGNAL GENERATOR

A.C. operated, generates R.F. frequencies from 150 kc. to 50 mc. Positive action attenuator provides effective output control at all times. R.F. is obtainable separately or modulated by the Audio Frequency. Complete with test leads, instructions. Reg. $39.50; **now only** **$19.50**

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Model TC-10 Quality Multitester

AC and DC Voltage Ranges: 0-5/15/150/-1500/3000 Volts. DC Current Ranges: 0-5/50 ma. 0-1.5 Amps. Resistance Ranges: 0-100 ohms. 0-100 K. Complete with batteries, instructions: Size: 6"x3½"x2"

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Combination Test Speaker and Signal Tracer

plus speaker substitution
plus resistor tester plus field substitutor
plus condenser tester plus voice coil substitution
plus output indicator

Complete with full instructions

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Famous-Make

OHMMETER

Has a double range of 0-10 and 0-1000 ohms for accurate measurement of low resistance. Widely used for production testing, armature and field resistances of small motors relay and coil testing transformer winding tests, etc.

Complete with test leads, instructions, leather case.

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Multimeter

1% WIRE WOUND PRECISION RESISTORS

D.C. Volt Ranges: 0-150-300 D.C. Ma: 0-60-120-300-600. AC Volt Ranges: 0-150-300. Ohm Ranges: 0-1000/100,000. Complete with instructions.

Reg. $24.50 **now only** **$9.95**

SUPERIOR

Model PB-100

Volt-Ohm-Milliammeter

Measures DC Voltages to 2500 Volts, AC Voltages to 1000 Volts, Resistance to 1 Megohm, Output Volts to 1000 Volts, DC Current to 2.5 Amperes, Decibels to plus 55 D.B. Push Button Operation. Complete with instructions and test leads.

Reg. $28.40 **now only** **$15.00**

		Dealers Net Price	Selling-Out Price
SUPERIOR	Model 660-A Signal Generator	$ 42.50	$ 29.50
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GENERAL ELECTRONICS	" 200, AM-FM & Television Signal Generator, AC operated	39.50	24.50
REINER ELECTRONICS	" 333, DC Volt-Ohm-Milliammeter	26.95	9.95
RADIO CITY PRODUCTS	" 668 Electronic Multitester	74.50	39.50
"	" 665 AC-DC Volt-Ohm Capacity, VTVM	95.40	49.50
SHALLCROSS	" 630 Wheatstone Resistance Bridge	145.00	75.00
ELECTRONIC MEASUREMENTS CORPORATION	" 102, Voltmeter	14.90	11.90
"	" 103 "	18.75	15.00
"	" 104 "	26.95	21.50
"	" 106 Vacuum Tube Voltmeter	35.90	28.75
"	" 107 " " "	48.90	39.00
"	" 205-P Tube Tester	47.50	37.50
"	" 206-P Mutual Conductance Tube Tester	83.50	67.50
"	" 600 Oscilloscope	99.50	79.50
GRUEN	2½" DC, D'Arsonval Type, 1 Milliammeter, Meter	9.95	2.95
WESTON	Model 507, F.S. 1, 2 Milliam. Meter	12.95	3.95
TRIPLETT	331-JP 30 Amperes, Meter	12.95	4.95
MARION	3" D'Arsonval Type, 1 Milliam. with calibrated Volt-Ohm Current Scale, Meter	12.95	3.95
ACRO	Radio & Phonograph Chassis Cradles	6.95	2.95
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"	Extension line cords, 12 foot with plug	.95 each	.40
"	Electrical Iron Cords, 6 foot with plug and on and off switch	1.25 each	.45
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CAPITOL	Infra-red heat, automatic broiler	Reduced to	9.95 each

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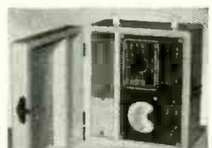
Meets U.S. Army requirements for accuracy and durability. Measures AC Voltages: 0-7.5/15/150/-750. D.C. Voltages: 0 to 2.5/15/150/750. D.C. Current: 0 to 7.5/75 ma. Resistance: 0 to 5,000/500,-000 Ohms. Complete with leather case, instructions.

Reg. $29.25 **now only** **$14.50**



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5,000 ohms per Volt,

Volt-Ohm-Milliammeter

D.C. Voltages to 1500 Volts. A.C. Voltages to 1500 Volts. Resistance to 2 Megohms, Output Volts to 1500 Volts, D.C. Current to 150 Ma., Decibels to plus 58 D.B. Complete with instructions and test leads.

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TUBE AND SET TESTER

Test all tubes up to date, incl. 4, 5, 6, 7L, octals, loctals, television, magic eye, thyrators single ended floating filament, mercury vapor, new miniatures, etc. Multimeter Specifications: AC and DC Voltage Ranges: 0-1-100-1000-5000. DC Current Ranges: 0-10-100-1 Amp. Low Res. Range: 0-10,000 Ohms. Medium Re. Range: 0-100,000 Ohms High Res. Range: 0-1 megohm. Complete with test leads and instructions. Reg. $49.50 **now only** **$29.50** routine. The time will vary from about 20 to 40 minutes; it is finished when all metal is removed from the blank areas.

Wash the acid off the piece when it is etched, then remove the dye if it has been used. The solvent for the dye is the developer which may also be used for any other cleanup of the dye, though sparingly for it is not cheap. Clean the piece of resist even if no dye was used. Kitchen cleanser can be used to save money in either case.

Using the product

You now have a printed circuit equal in quality to any you can buy. You are not finished, however. You must drill the necessary holes. If the piece is ⅛ inch or more thick you can simply put it on the drill press or use a hand drill in the normal way. The rear may chip somewhat as the drill goes through, but that is not serious if you do not care about appearance. For professional results, however, always back the piece with wood. If you have the usual set of fractional drills, a 1/16-inch diameter hole is adequate for all the connection points. If you have drawn the concentric holes as instructed, the drill will center itself automatically.

Be very careful in drilling larger holes. Normal sizes, even as much as ⅜ inch for mounting potentiometers and the like, may be drilled. But note the tendency of phenolic to chip and work up to the final size by using a series of smaller drills. For holes to accommodate tube sockets, for example, use a fly cutter or hole saw. Do *not* try to use ordinary chassis punches. Phenolic can usually be punched, but not that way. To trim the piece to size, use a hacksaw with the finest teeth. A good device for this purpose if you have a drill press is a gadet like the Roto drill saw (see photo). This can be used with a drill press by adding a couple of pieces of metal in the form of a Y to keep it from rotating. The spring shown in the photo holds the pieces firmly enough to prevent rotation but slides up the post when desired.

Bare-copper printed circuits are rarely used in industry because a plated copper takes dip-soldering better, especially if the plating is solder. For hand-soldered pieces, the bare copper presents no problem at all. If you don't use it immediately, clean it before use with an abrasive kitchen powder. Use an Ungar or similar iron with a 20-watt chisel or pyramid tip. Get the foil just hot enough to make the solder flow and don't be afraid to touch the solder to the iron, despite normal practice. Too much heat will lift the foil, but normal care prevents that. The appearance of the panel (see Part I) after soldering is shown in one of the photos. The little blobs of solder at each connection point make a perfect job.

Non-circuitry uses

Etched circuits are useful for many purposes other than simple wiring — as commutators, switches, etc. One rather


EXTRA!

unusual use — distinctive nameplates, dials, and meter scales — gives intriguing and delightful effects.

There are several possible methods of making nameplates. For each it is necessary to make the master with the appropriate printing, writing or typing. A printer will furnish a "reproduction proof" of anything you like at very small cost, but you can save money and time by cutting out letters or whole words and phrases from magazines, using your letterhead for your name.

To make an etched nameplate simply go through the steps outlined exactly as if the master copy were a circuit drawing. This will give copper lettering on the phenolic background. However, you can have jet-black lettering on any material you like as long as it is not very porous—phenolic, any metal, chassis, rack panels and so on. To make these, carry through the process as far as development in the Photo Resist Developer exactly as though you were working on normal laminate. Then dip the piece in Photo Resist Dye, rinse with water and stop. You can use a reverse system to obtain bright metal letters on a black background simply by using a positive film (black lettering on a clear background) instead of the usual negative.

Using laminate to etch nameplates gives beautiful results—provided there are no very thin lines to reproduce. Thin lines tend to be damaged because the solution works on the unprotected edges of the letters as they are formed by etching away the background material. Thin lines are too easily obliterated in this way.

In any nameplate process, finish off the job by giving it a coating of Krylon or similar clear plastic spray to protect the dye from abrasion or to keep the copper gleaming.

Some of the materials mentioned in this article may not be easily obtainable everywhere or may be obtainable only in larger quantities than occasional experimental use warrants. A list of companies selling kits and materials in small quantities is given on page 36 of the September, 1955, issue. END

"These callbacks are a nuisance."

Technicians News

FRSAP TALKS OF UNITY

The question of unity was one of the most important discussed at the October meeting of the Federation of Radio Servicemen's Associations of Pennsylvania. After going into the matter in detail, it was resolved that the delegates take the question of joining NATESA back to their chapters or groups for discussion and approval or otherwise.

The system of self-licensing as advocated at previous meetings was another important matter taken up. The plan as proposed would be set up on a local level, but through the state federation. This was also referred back to the delegates to present to their locals for discussion.

Newsletter, plaque and lecture committees were appointed by president Bert Bregenzer, and reports on group insurance were considered.

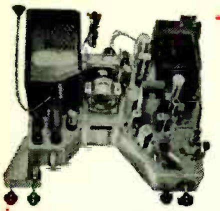
CINCINNATI LICENSING

A system of self-licensing is expected to take effect shortly in Cincinnati. It is sponsored by the Association of Television Service Companies and is limited to members of the association. Among the qualifications necessary for the association's license are: possession of adequate test equipment, service data and replacement parts; at least one qualified television technician; a business telephone; regular operation during standard business hours; adequate insurance on customers' property and a 90-day guarantee on parts furnished and work done.

A qualified ***technician***, under the association rules, must have 8,000 hours of practical experience in TV servicing (about 4 years) and pass oral or written examinations. Alternatively, he may have 4,000 hours' experience plus credentials from an accredited service school, and pass the same examinations. A television ***serviceman*** will be certified if he has 2,000 hours of service and is otherwise qualified; an ***apprentice***, if he has school training and 3 months' experience; a ***trainee***, if he fails to qualify for apprentice. A licensing fee of $15 per shop and $2.50 per man will be levied.

NEW STATE ASSOCIATION

A temporary board of 11 members was elected and a provisional constitution for a California state group ratified at a meeting held in October under the auspices of the Television Service Betterment Committee of California.



Build your own

SUPER DE LUXE 31-TUBE #630 TV CHASSIS

#630 SUPER DELUXE 31-TUBE TV KIT

OPERATES 16" to 21" PICTURE TUBES • Engineered in strict adherence to the genuine **RCA #630** plus added features • **FULL 4MC BANDWIDTH** • **CASCODE TUNER** • **COSINE DEFLECTION YOKE** • **LARGER POWER TRANSFORMER** • **KEYED AGC** • **12" SPEAKER** • **CONDENSERS** and **RESISTORS** at rated capacities and tolerances. You receive a **COMPLETE SET of PARTS** and **TUBES**, everything needed is included (less CRT & wire). All I.F. Coils and Transformers are factory pre-aligned and tuned. You will enjoy building it with **"LIFE-SIZE** easy to follow step-by-step **ASSEMBLING INSTRUCTIONS"** included with each **KIT.**

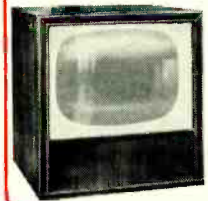
***Slashed to* $99.99** Less CRT

Similar KIT for 24" or 27" CRT slashed to $110.39

CUSTOM-BUILT CABINETS FROM FACTORY TO YOU

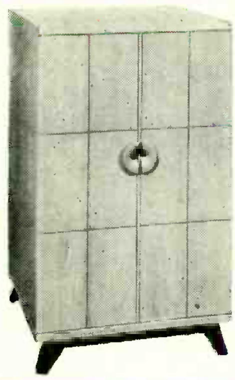
3 LEADING 1956 STYLES in genuine Mahogany or walnut (blond 10% extra • Ready drilled for any #630 TV chassis and cutout for any 16", 17", 19", 20" or 21" picture tube at no extras in price • Also supplied with undrilled knob panel for any other TV set • EVERYTHING NECESSARY for an easy perfect chassis and CRT assembly is included • Each cabinet is delivered complete as pictured with mask, safety glass, mounting brackets, backboard, back-cup, hardware and assembling instructions • Each cabinet is shipped in an air cushioned carton from **FACTORY to YOU!**

GEM $35.91



GEM also available for 24" or 27" picture tube **$59.54**

WESTCHESTER $88.70



MANHATTAN $53.43

MAN-HATTAN also available for 24" or 27" picture tube **$79.22**

#630 SUPER DE LUXE TV CHASSIS

LICENSED UNDER RCA PATENTS

COMPLETE READY TO PLUG IN AND PLAY

Similar in features to the 16" to 21" TV KIT above.

***Slashed to* $142.27** (less CRT)

DUMONT OR THOMAS PICTURE TUBES

BRAND NEW in Factory Sealed Cartons — With a Full Year Guarantee

17" #17BP4A **$22.66** | **21"** #21EP4B Aluminized **$32.21** | **24"** 90° #24CP4A Aluminized **$48.99** | **27"** 90° #27EP4A Aluminized **$74.31**

#630 BY TECHMASTER

COMPLETE LINE AT SPECIAL PRICES

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STANDARD CASCODE TUNER

For better all around performance
Complete with tubes and Brooks **CASCODE MANUAL** with step-by-step instructions and all extra parts needed. **$15.97**

PULSE KEYED AGC KIT

Finest, most accurate and the easiest Kit to install in any make TV RECEIVER including the No. 630. Improves performance and insures a steady picture on all channels.

COMPLETE SET OF PARTS **$2.99**
Including 6AU6 tube & Instructions

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This is the most terrific new sensation in Flyback Transformers. It is similar to the popular No. X-053 and goes up as high as 16KV. With it you receive easy-to-follow instructions and schematic diagrams that apply to improve practically all makes of TV Receivers **$4.86**

COSINE DEFLECTION YOKE

The latest achievement in the 70° type, with complete wired network. Will add new life to any TV Set, in brilliance, clarity and sweep. This is the same type we supply with our Kits, with it you receive easy-to-follow instructions and diagrams **$4.92**

18KV FLYBACK TRANSF.

This new Flyback Transformer now makes 90° conversions easy on any make TV Set. Customers report excellence on 24" and 27" TV Sets built or converted with this Transformer. Instructions and schematic diagrams included **$5.24**

COSINE DEFLECTION YOKE

NEW 90° TYPE, with complete wired network. It solves all problems formerly sought for, in 90° Yokes, for undistorted clear pictures and ease of overall sweep. Instructions and schematic diagrams included for building, replacing and converting **$5.98**

MICA & CERAMIC CONDENSERS

Values up to 85c each

5, 10, 51, 56, 82, 100, 120, 150, 220, 270, 330, 390, 470, 510, 680, 1000, 1200, 1500, 3900, 6800 MMF .... Your choice **5c each**

21" TV CONVERSION KIT

Positively the HOTTEST item in CONVERSIONS. Customers tell us they even use it to bring a 21" Set up-to-date for greater power, brilliancy and clarity.

Convert **ANY MAKE TV RECEIVER** including #630 to operate the **21"** or **ANY 70° PICTURE TUBE**

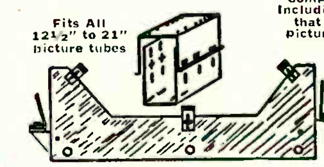
COMPLETE SET OF ESSENTIAL PARTS includes matched set of Todd 70° **COSINE DEFLECTION YOKE and TODD HV FLYBACK TRANSFORMER**

List Price $33.50

Your price... $13.97 Incl. **CONVERSION MANUAL** with Step-by-Step Instructions & Diagrams.

Similar Kit for 24", 27" or any 90° CRT **$15.98**

UNIVERSAL Picture Tube MOUNTING BRACKETS



$4.97

#630 TV BASIC PARKS KIT

PUNCHED & DRILLED CHASSIS PAN
BRACKET & SHIELD KIT (18 items)
VIDEO & I.F. KIT (19 items)
POWER TRANSFORMER #201T6
VERTICAL OUTPUT TRANSFORMER
VERTICAL BLOCKING TRANSFORMER
FLYBACK TRANSFORMER #211T5
FOCUS COIL, 470 ohms #202D2
COSINE DEFLECTION YOKE 70°

All for Only **$29.97** Including Instructions

#630 Parts in COMPLETE SETS

TV WIRE & SOLDER KIT, for any Set..........	$ .98
630-KIT, screws, nuts, rivets, washers, etc..........	1.69
VIDEO AND I.F. KIT, 19 items..........	4.99
VARIABLE CONTROL KIT, 9 controls..........	3.97
CARBON RESISTOR KIT, 107 resistors..........	4.98
WIREWOUND RESISTOR KIT, 4 resistors..........	1.76
ELECTROLYTIC CONDENSER KIT, 6 cond..........	4.96
TUBULAR CONDENSER KIT, 38 condensers....	3.63

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65 ma. . . .	$.46	250 ma. . .	$1.08
75 ma. . . .	.49	300 ma. . .	1.19
100 ma. . . .	.62	350 ma. . .	1.26
150 ma. . . .	.74	450 ma. . .	1.42

PM SPEAKERS (ALNICO #5)

Brand New Factory Guaranteed Stock
1 oz. mag. on 3" to 6", heavier mag. on 8" & 12"

3"	$ .98	6"	$1.58
4"	1.17	8"	2.64
5"	1.29	12"	4.67

TUBULAR CONDENSERS—85°C

TOP QUALITY—Equally as good for TV or Radio Work. Example of value we offer . . . .047—600v lists at 36c

.005—400v	4c	.047—600v	9c
.01 —400v	5c	.1 —600v	12c
.02 —400v	5c	.25 —600v	14c
.047—400v	7c	.001—1000v ...	11c
.1 —400v	9c	.01 —1000v ...	14c
.25 —400v	12c	.035—1000v ...	16c
.005—600v	7c	.05 —1000v ...	18c
.01 —600x	8c	.1 —1000v ...	22c
.02 —600v	8c	.5 —400v	28c

CARBON RESISTORS

Regular factory stock in. Stackpole, I.R.C. Speer. Order any ohmage from 2.2 ohms to 10 meg in the desired tolerance. Deduct 10% on lots of 100 or over.

½ WATT,	5%....5c	10%....4c	20%....3c
1 WATT,	5%....6c	10%....5c	20%....4c
2 WATT,	5%....9c	10%....7c	20%....5c

ELECTROLYTIC CONDENSERS—85°C

40/10/80 mfd—450/450/150v	$1.37
40/40/10 mfd—450/450/450v	1.49
80/50 mfd—450/50v	1.49
40/10/10 mfd—450/450/350v	1.37
20/80 mfd—450/350v	1.49
250/1000 mfd—10/6v	.98

20 mfd—150v ...	27c	8 mfd—450v.....	26c
20/30 mfd—150v.	38c	20 mfd—450v....	42c
50/30 mfd—150v.	39c	30 mfd—450v....	49c

Brooks LIFE-SIZE TV INSTRUCTIONS for building any #630 TV Receiver from the original 10" to the latest 27" **$1.25** postpaid

90° TV CONVERSION MANUAL, how to convert any TV SET to 24", 27", etc. **50¢** postpaid

HINTS FOR BETTER PERFORMANCE on your #630 TV receiver.......... **50¢** postpaid

70° TV CONVERSION MANUAL, how to convert any TV SET to 17", 21", etc. **50¢** postpaid

Brooks CASCODE MANUAL, how to install Cascode Tuner in any make TV Set. .... **25¢** postpaid

A.G.C. STEP-BY-STEP INSTRUCTIONS, how to add A.G.C. to any make TV Receiver .... **25¢** postpaid

BROOKS RADIO & TV CORP., 84 Vesey St., Dept. A, New York 7, N.Y.

TELEPHONE COrtland 7-2359

The meeting was held in San Jose, with the Radio Television Association of Santa Clara Valley (RTASCV) as hosts. It was the third organizational session under the sponsorship of the committee; the first session was held last May.

Chairman Thomas Lawson of the TSBCC, acting chairman of the new group, stated they hoped to file articles of incorporation before the end of 1955 and to be ready for election of full-term officers and all other association activities before May.

A NEW PAPER

We have just received Vol. I, No. 1, of *RTA*, official publication of the Radio Television Association of Santa Clara Valley (Calif.). The new magazine is an attractive 6 x 9-inch, 16-page publication. Unlike many technician's journals, it is thoroughly advertising-conscious and presents itself as "a direct approach to the Valley's top dealer–service organization group . . . a highly flexible medium that will bring big returns to our advertisers." Direct results are three full-page ads (including the front cover) and several smaller ones.

Most interesting of the editorial features are an account of cooperation with station KNTV; a report on the state unity meeting; the RTASCV Standards of Practice, which includes a 16-item code of ethics, an editorial by the president of the association, H. Lawrence Schmidt.

OHIO STATE GROUP

A state TV service association for Ohio was formed at a November meeting in Columbus. It will be known as TESA (Television Electronic Service Association) of Ohio, and will be affiliated with the National Alliance of Television Electronics & Service Associations (NATESA).

Richard E. Miller, Sr. of Cincinnati was elected president; Marvin A. Miller of Springfield, Vern V. LaPlante of Toledo and Harry L. Hakes of Hillsboro, vice presidents; John T. Graham of Columbus, secretary-treasurer. The organization is expected to represent about 16 local groups.

L. I. HAS DISTRIBUTORS

The Long Island Guild informs us that they were in error in the statement that there is no bona fide Sylvania distributor in their territory. This statement was made in a letter to Sylvania, an abridgment of which was published in our December, 1955, issue on page 115.

The guild apologizes to Long Island Electric and Melville Radio, two distributors who have been cooperating with the guild program. The fact that they were Sylvania distributors was accidentally overlooked at the time the letter was written, the guild report stated. END

new Records

MONITOR

Note: Records below are 12-inch LP and play back with RIAA curve unless otherwise indicated.

Spotlight on Percussion
Arnold Goldberg and Kenny Clark
Vox DL-180

This Vox entry in the percussion sweepstakes has one fault: the voice narration is too loud for the level at which the record must be played. This is the more unfortunate because this excellent recording possesses many subtle nuances with high test value in weeding out merely fine from superb high-fidelity systems.

Extremely clean and well defined, it has a truly fine transient response. The drums are not particularly bigger or deeper, but the delicate qualities of the instruments are defined with great clarity and faithfulness. The rapid rolls of traps, drums, temple blocks, castanets and *guiro* (gourd with scraper) are highly exceptional test material for transient response; the individual staccato pulses are distinct even in the most rapid bursts. Any tendency to blur them indicates poor transient response, an unstable amplifier or speaker hangover.

The record will sound pretty good on just about any system worthy of the high-fidelity label; but there are several sure-fire measures of genuine response below 30 cycles and very severe tests of rumble, hum and overall noise figure. In the marimba passage an underlying rumble consists apparently of beat notes, striking transients, possibly a touch of mike blast and very likely a touch of tape-recorder flutter. On a system responding below 30 cycles this produces a sound as of a heavy and near diesel train. To some degree the same effect is found in the vibraphone passage. In other portions, where the gain was boosted in cutting the master, the tape-recorder flutter is plainly audible—provided the playback system has an extremely low noise figure. Finally, a faint groove-echo (or possibly tape print-through) in several spots ahead of the voice (perhaps 50 or 55 db down) will be audible only on systems with superb noise figures.

Xylophone and castanet transients are very well defined but if the system goes far enough down one can hear a touch of mike blast produced by the violent attacks. The curious "spit" of the whip (actually a mouse-traplike arrangement of two wooden blocks) is excellently reproduced. The very fine definition of the multi-track recording of *Anchors Aweigh* and the other selections by Goldberg and Clark provides exceptional material for testing playback definition. The accompanying booklet (by R. D. Darrell, Ward Botsford and Rudolph Van Gelder) does a fine job of covering the various musical and sound aspects. Teachers of music, as well as audiophiles, will find this a most useful recording.

Easy Listening Vol. 3
Red Daugherty Sextette
Audiophile AP-27 (AES)

Set your equalizer for AES bass and a flat or —6-db treble (the EUR curve isn't bad either), raise the volume so the piano is about as loud as it would be in your room and you can measure how far short your hi-fi system is of the best possible by measuring how far short of actually being there the effect is.

Assuming that your system is capable of producing a true "being-there" effect you can demonstrate that response above 10 kc is essential for realism by playing this with and without a 10-kc cutoff. A good part of the illusion is produced by the remarkably clean and sharp traps which require a very fine transient re-

(Continued on page 154)

LEARN MORE! EARN MORE!
WITH H. G. CISIN'S TV SERVICE BOOKS

Facts About "SHOOT TV & RADIO TROUBLE FAST"

This newest Cisin book was written in response to the demands of thousands of radio-television servicemen. Mr. Cisin, inventor of the AC-DC radio circuit, has adapted his famous streamlined trouble shooting method to servicing of AC-DC radios, in the only book which combines both TV and radio trouble tracing. SHOOT TV & RADIO TROUBLE FAST also contains a section on PRINTED CIRCUIT SERVICING, of vital interest to all servicemen.

FACTS ABOUT THE AUTHOR

H. G. Cisin, technical author and publisher, is also well-known as a radio and television inventor, electronic consulting engineer and educator.

Holder of six U.S. patents, perhaps the most famous of his inventions is the basic AC-DC circuit which makes present-day small radios possible. Among the concerns he has licensed under his patents are: RCA, AT&T, W.E. Co., Bell Telephone Co., and many others. He is also the inventor of the 3-way portable radio and of other important television and radio devices. He is the author of many technical books and also of hundreds of radio & TV technical articles.

Mr. Cisin learned practical television servicing the hard way by actually working at a test bench on hundreds of faulty TV sets. He has trained thousands of technicians, many now owning their own prosperous TV service concerns, or holding highly paid TV positions. A graduate of Cornell University, he has concentrated on teaching television and radio to men with little formal education. His years of study, practice and experience are embodied in his radio and television service books.

WHAT TV SERVICEMEN & TECHNICIANS SAY ABOUT CISIN BOOKS

Send another copy. Have one, but am afraid I might mislay it. Can't afford to be without it.
Edward Danek, Chicago, Illinois

As TV instructor, writer and technician, I can fully appreciate this fine book.
Nicholas B. Cook, Paterson, N. J.

Enormously pleased with results obtained by using your book. Hasn't failed me yet.
Joseph B. Seiler, Chicago, Illinois

Your book has taken the mystery out of TV servicing. Better than any book on the subject I have ever seen, but still the lowest priced.
John B. Kielsen (Jack's Radio Hospital), Chicago, Illinois

Your book has helped me tremendously. Hold a top bench job with one of the largest servicing organizations here.
A. J. Thornton, Kalamazoo, Michigan

Please send me another book. Lent my copy to a friend, also a TV serviceman, and can not get it back. We both think it's great.
E. L. Coleman, Youngstown, Ohio

Unable to see how you can give so much for so little. Paid three times as much for other TV service books which didn't contain 1 percent of the information in your book.
Frank Stuprich, Detroit, Michigan

Clear, concise handling of a complicated subject in a way the average serviceman can easily grasp it.
Thomas E. Denton, East Orange, N. J.

Hundreds of similar letters in our files.

SHOOT TV & RADIO TROUBLE *FAST*

NEW! A complete section on Rapid Trouble Shooting of AC-DC radio sets combined with new edition of Rapid TV Trouble Shooting Method. Enables you to locate radio & TV faults in record-breaking time, regardless of make or model.

Quickest Radio & TV Trouble Shooter—No. T2 .... $1.50

TV CONSULTANT

NEW, easy to use way to solve toughest TV troubles. UHF and COLOR TV sections included. Modern alignment methods clearly shown, tell exactly WHAT to do and HOW to do it. Practical pointers on the use of all TV TEST INSTRUMENTS. Over 300 pix, raster and sound symptoms. Detailed directions tell where and how to find faulty parts. Over 135 RAPID CHECKS, many using pix tube as trouble locator. 125 illstr. of scope wave forms, diagrams, station patterns, show various defects. NO THEORY—NO MATH—NO FORMULAS—just practical service info covering all types of TV sets.

TV Serviceman's Silent Partner
No. L1 .... Only $2

RCA TV MODELS
1947 to 1955 TUBE LOCATION GUIDES

Most complete compilation of RCA Trouble Indicating Tube Location Guides ever produced. Contains hundreds of RCA models from earliest 1947 sets to latest 1955 models including Color TV.

Each guide shows positions of all tubes and also by a copyrighted method indicates effect of each tube on operation of TV set. Scraps old-style fine-print function names such as AGC Gate, Sync Clip, Vert. Mult., etc. Instead tells plainly what each tube actually does. Tubes affecting picture are marked "P," sound "S," contrast "C," horizontal sweep "H," etc.

Fits Every Tube Caddy—No. A1 ... $1

TV TUBE LOCATOR

TROUBLE INDICATING TUBE LOCATION GUIDES over 3000 most popular models. Admiral to Zenith. Shows PIX tubes used in many models. Covers products of over 110 different TV manufacturers. Over 135 common TV troubles are listed with explicit directions for locating defective tubes which cause each fault.

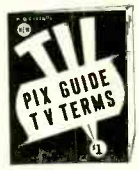
Speed Servicing—No. K1 .... $1

TV DOCTOR

How to Diagnose and Remedy TV Troubles; Useful Info About TV Sets; Easy Trouble Checks; UHF Servicing; Antenna Know-How; Servicing Hints; Color TV; Troubles Due to Defective Tubes; How to Read Schematic Diagrams. Practical hints for prospective TV servicemen.

Beginner's Best Buy—No. D5 ...... $1

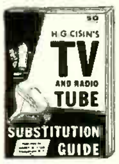
NEW! TROUBLE SHOOTING PIX GUIDE incl. TV TERMS EXPLAINED



Sect. 1 is a fully illustrated Guide to oft-recurring picture faults. Causes and cures explained. Copyrighted illustrated CHART tells where troubles start in typical TV sets. Illustrations show resulting faulty TV pictures.
Sect. 2 explains hundreds of TV terms in non-technical language.

Pix Show Faults—No. G1 .... $1

NEW! TV & RADIO TUBE SUBSTITUTION GUIDE



Contains tube replacements for TV sets, radios and other electronic devices. All fit same socket and NEED NO CHANGES IN WIRING. Also contains complete data on

TV PICTURE TUBE

replacements, many directly, others with only slight changes.

Substitute with Certainty
No. S1 .... Only 50c

TV TROUBLE TRACER

Each vol. has different TROUBLE INDICATING TUBE LOCATION GUIDES of hundreds of popular TV models. Each has over 70 illustr. & Guides. 40 most common pix troubles illustrated.

Vol. 1 (No. TT1) older models;
Vol. 2 (No. TT2) 1952-1953 sets;
Vol. 3 (No. TT3) 1953-1954 sets;
Vol. 4 (No. TT4) 1954-1955 models.

Find It & Fix It .... Each Vol. 50c

ABC OF COLOR TV

Takes mystery out of Color TV. Explains this fascinating new TV development in simple down-to-earth manner. Translates technical descriptions of research scientists into plain language. Covers basic color principles, color signal, transmission, color TV reception, plus practical pointers on color pix tubes, tests, etc.

Color TV Simplified—No. R1 .... $1

RAPID TV TROUBLE SHOOTING METHOD

This unique servicing method has helped thousands to become expert TV diagnosticians. Pix, raster & sound troubles are listed and given code numbers. When these are combined they tell exactly where trouble exists. Then step-by-step directions enable you to find faulty part.

Easy To Use—No. T1 .... $1

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with every purchase of $5 or over

FREE: TV & RADIO TUBE SUBSTITUTION GUIDE
plus TV TROUBLE TRACER, Vol. 4
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☐ TT2—50c ☐ TT3—50c ☐ TT4—50c
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sponse above 10 kc to be reproduced sharply and cleanly.

Aside from the notable high-highs there is a very nicely damped drum, a gutty double bass and easy-listening music (*Tailgate Ramble, I Never Knew, Some of These Days, Sheik of Araby, Ain't She Sweet,* etc.). I consider *Tailgate Ramble* one of the very finest showoff pieces available. To demonstrate good hi-fi or simply to enjoy some fine jazz, well-played and wonderfully recorded, this is required listening in my book.

Traditional Jazz Vol. 4
Doc Evans and Band
Audiophile AP-29 (78-r.p.m. microgroove, AES bass, flat treble)

E. D. Nunn considers this the finest disc he has produced. Its high quality is less obvious and it doesn't have the peculiarly special demonstration value of AP-27, but it presents the jazz of the 'Twenties (*That's a Plenty, London Blues, Eccentric Blues* and *Bye and Bye*) with such faithfulness—both the music and original styles—and so complete an illusion of presence that it is enough to make anyone who lived the jazz age cry into his near-beer with nostalgia. Extremely fine tuba and drums.

Cornet Artistry
Doc Evans and Band
Audiophile AP-31 (AES)

More very fine and very real, mostly Chicago style, jazz featuring the silver-smooth, plaintive Doc Evans cornet in *Limehouse Blues, Don't Worry About Me, Melancholy Baby, Memories of You, Just a Gigolo, Old-Fashioned Love* and *Stars Fell on Alabama*, but offering also some fine drums and double bass, very fine woodblocks, sharp percussive traps and handclapping. Very good test material for pickups and needle condition. If with AES equalization the cornet sounds at all strident, chances are the pickup has a peak or the needle is poor. With flat pickup and a good needle there should be little or no unnatural stridency even with flat treble.

Sounds of the Boudoir ERA El 50001

Cook's *Burlesque* proved that when it comes to striptease the ear is no substitute for the eye, and this clinches the proof. It tries to bring a "Hollywood model's boudoir" to the living room and is supposed to "tell in sound how a lovely actress wakes up in the morning and a red-headed model goes to sleep at night." Eliminate the narrator's leering, smirking voice and the sounds might as well be ascribed to a greasemonkey washing, polishing and cleaning a car. The only thing the recording will test is the listener's gullibility, suggestibility and imagination.

HAYDN: _Missa Solemnis_ (Lord Nelson Mass)
Vienna Academic Choir and Vienna State Opera Orchestra conducted by Mario Rossi Vanguard VRS-470

SPELLMAN: _The Vigil of Venus_
Vienna Academic Choir and Vienna State Opera Orchestra conducted by Zoltan Fekete MGM E-3085

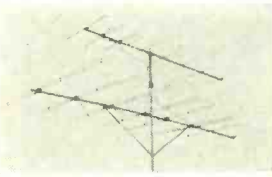
Clearly among the busiest in the world, these two musical groups appear not only on these labels but several others and do a fine job for all of them. The combination of voices and orchestra can provide a spectacular demonstration of hi-fi and either of these records will do the job. The Haydn mass is especially notable for its unique scoring for strings, kettle drums and trumpets and is far more satisfying as music. If one forgets it is a mass, the general effect is rather like that of Beethoven's *Ninth* but much easier to take. The recording is very fine.

Spellman is an obscure American composer circa in the Twenties and Thirties and this is one of his most ambitious works. There is nothing remarkable about either the music or the hi-fi qualities, but the overall effect, played fairly loud, can be very imposing. END

Names and addresses of manufacturers of any items mentioned in this column may be obtained by writing Monitor, RADIO-ELECTRONICS, *25 West Broadway, New York 7, N.Y.*

new Devices

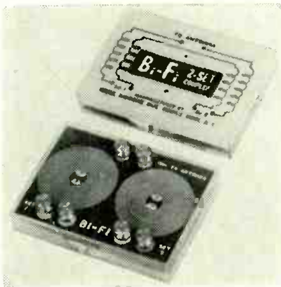
ANTENNA, *K.O.* Front-to-back ratios from 20:1 to 50:1 relative voltage on low band; to 13:1 on high. High gain characteristics from 7 to 9 db on low band, 8.5 to 10.5 db on high.



(Figures for single bay.) K.O. is driven end-fire array of two individual antennas.

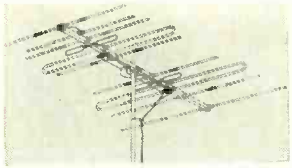
Model 1026 (6 driven elements covers channels 2–6; *model 1073* (2 driven elements) channels 7–13; broadband *model 1023* entire v.h.f. band.—**Channel Master Corp.**, Ellenville, N. Y.

2-SET COUPLER, *Bi-Fi 2-Set Antenna Coupler*, for connecting two TV or FM sets to a



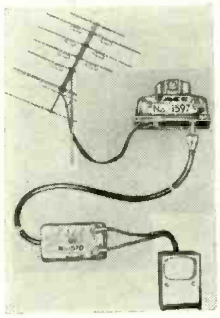
common antenna. Provides high audio and video signal transfer. Improves matching, reduces ghost and interset interference. Bifilar printed circuit construction. Polystyrene case eliminates losses due to impedance changes. Mounts in any convenient location between sets or near or behind one set.—**Federal Electronics Sales**, Federal Electronics Bldg., Rockville Centre, N. Y.

V.H.F. ANTENNA, *Finco* Twin-Driven *model B-8 Geomatic*. Very high front-to-back ratio eliminates venetian blinds, back ghosts, etc. No sacrifice of gain on low or high bands. Multiple



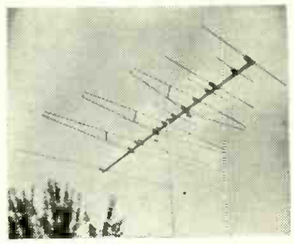
reflectors and directors, including combination and collinear elements, produce sharp directivity normally found only in Yagis cut for single channel.—**Finney Co.**, 4612 St. Clair Ave., Cleveland 3, Ohio.

COAXIAL TV COUPLER *Taco models 1597* and *1570* permit use of 72-ohm coaxial cable as TV lead-in to reduce man-made static and running antenna lead without regard to proximity to metal gutters, etc. *Model 1597* matches antenna to 72



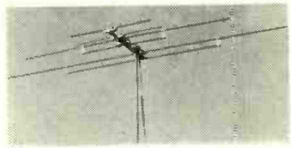
ohms and *1570* matches 72-ohm lead to 300-ohm receiver terminals.—**Technical Appliance Corp.**, Sherburne, N. Y.

TV ANTENNA, *Zephyr Royal*, stagger-tuned to 6 pre-determined frequencies—channels 2, 4, 6, 7, 10, 13—giving flat re-



sponse over v.h.f. band. Optimum phasing for maximum forward gain.—**Trio Mfg. Co.**, Griggsville, Ill.

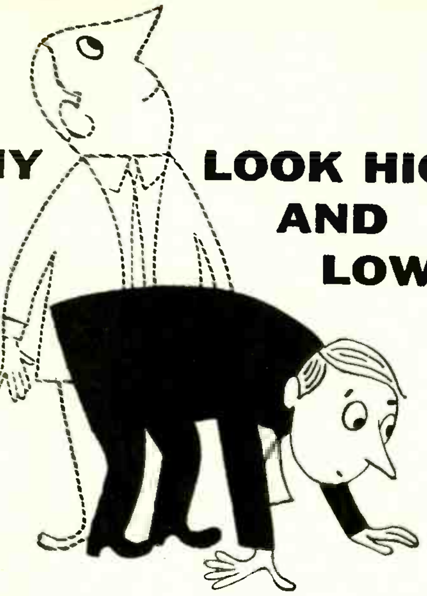
TV ANTENNA, *Color-Beam*, unfolds like an umbrella. Elements snap and lock into place



automatically. Support mast and one end of lead-in wire attached to antenna. Other end of wire has clip for fastening screws on back of set.—**Winegard Co.**, Burlington, Iowa.

20-WATT AMPLIFIER, *model*

WHY LOOK HIGH AND LOW



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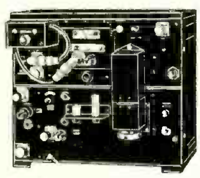

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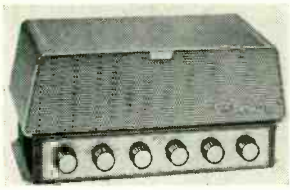
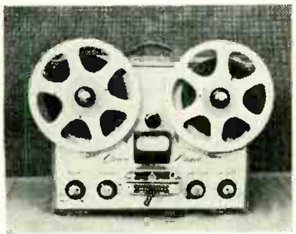
HIGH-FIDELITY AMPLIFIERS self cabineted *G* series, *2122-C*, *2199-B*, and *2200-C*. Satin-finish gold cover houses entire deck area. Amplifiers



available with chassis deck exposed. Entire front face of perforated metal grill; back open for maximum ventilation. —**Bell Sound Systems**, 555 Marion Rd., Columbus 7, Ohio.

TAPE RECORDERS, *Crown Imperial*, *Broadcaster* and *Deluxe*. Flat response ±2 db, 20–18,000 cycles at 7½ i.p.s.; at



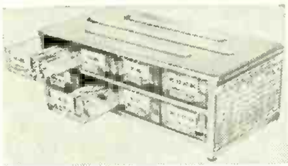
3¾ i.p.s., +3 db, 20–8,000 cycles. Uses 10½-inch reels.—**International Radio & Electronics Corp.**, S. 17 St. & Mishawaka Rd., Elkhart, Ind.

TUBELESS HI-FI AM TUNER, *model 595 high-fidelity AM tuner*, has crystal detector with negative mutual coupled bandpass circuit. Audio output from .07 to 0.7 volt on broad-

cast stations within 20–25 miles. Connects to TV antenna and plays through audio circuit of TV set or uses a good antenna and high-quality audio system. 4 x 7 x 3½ inches.—**J. W. Miller Co.**, 5917 South Main St., Los Angeles 3, Calif.

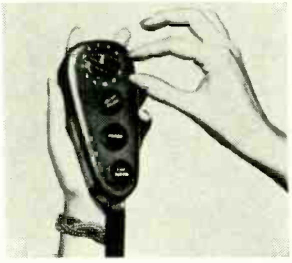
CONVERSION KIT for converting all RCA sets from 21-inch metal picture tubes to 21-inch glass picture tubes.—**Colman Tool & Machine Co.**, Amarillo, Tex.

PISTON CAPACITOR KIT, *PK85*, 85 quartz and glass precision piston capacitors, 10 basic types, for experimental



purposes. Compact metal cabinet, with double row of compartment drawers, holds capacitors.—**JFD Mfg. Co., Inc.**, 6101 16 Ave., Brooklyn 4, N. Y.

TV REMOTE CONTROL UNIT, *Magic Brain:* control knobs for fine tuning, picture control, on-off and volume; a dial for all v.h.f. channels. Installable in most RCA Victor TV sets without u.h.f. tuners manufactured since 1951. 5½ x 2¼ x 2 inches. Connected to receiver by 30-foot flat cord with pro-



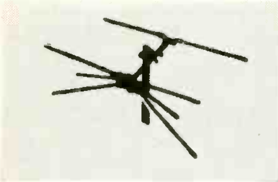
tective cover. Subchassis and motor inside receiver. Changeover from local to remote control by turning tuning knob on receiver fully clockwise.—**RCA Victor Television Div.**, Camden, N. J.

C-R TESTER, *model 400*, replaces B & K *model 350*. 4½-inch plastic meter. Checks and corrects most TV picture-tube troubles without removing tube from set. Locates and repairs inter-element shorts and open circuits, stops leakage, reactivates picture-tube cathode and restores emission. Life test

checks gas content, predicts probable useful life expectancy. *Model 200* with 3-inch meter performs many functions of former *model 350*.—**B & K Mfg. Co.**, 3726 N. Southport Ave., Chicago 13, Ill.

V.O.M. *Volometer model 102*. 3½-inch 800 μa D'Arsonval type meter, accurate to within 2%. Combines 5 a.c. voltage ranges: 0–3,000; 5 d.c., 0–3000; 3 current ranges a.c., 0 to 600 ma; 4 current ranges d.c., 0 to 130 maximum, 0 to 1.2 amps; 2 resistance ranges, 0 to 1,000 ohms, 0 to 1 megohm. — **Electronic**

(*Continued on page* 163)



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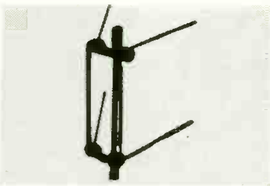

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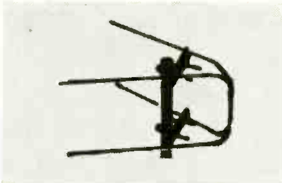

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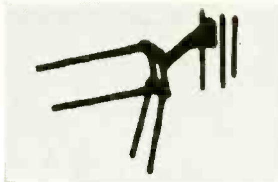

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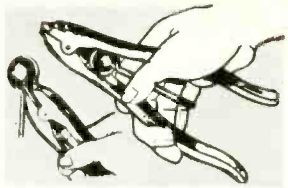

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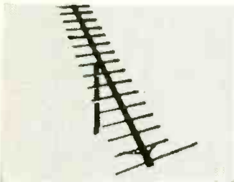

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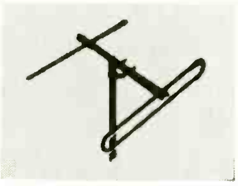

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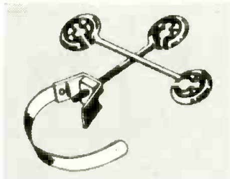

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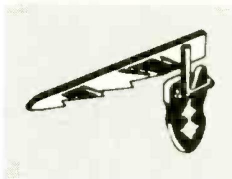

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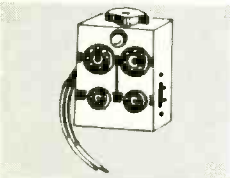

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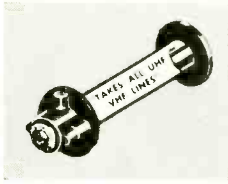

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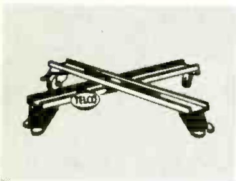

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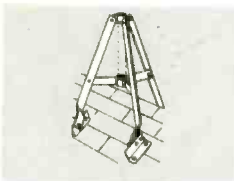

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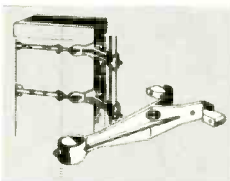

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Cast alum. pair for 1¼" masts.
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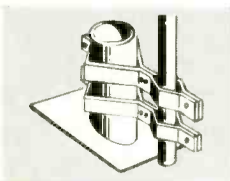

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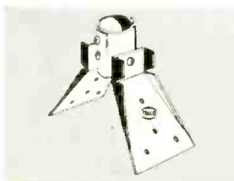

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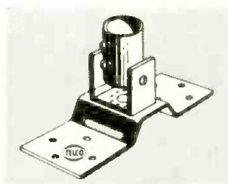

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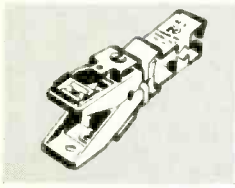

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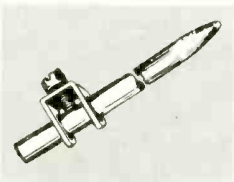

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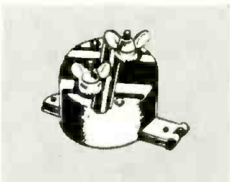

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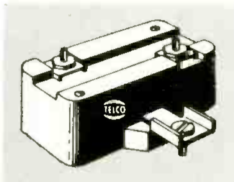

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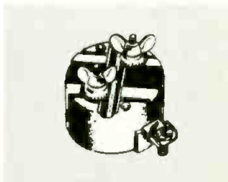

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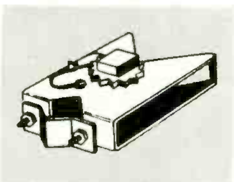

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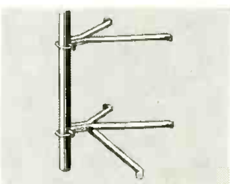

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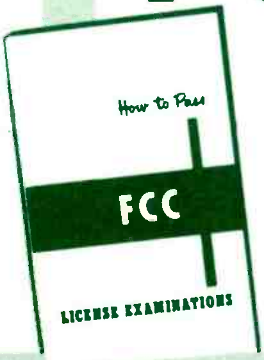

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5"x7"	$2.35	$2.10
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4x6	450 Ohm	98c	10"	1700 Ohm	$1.49
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Stock No. R-GDK10 ....$3.45

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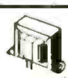

TV REPLACEMENT CHOKE—2.5 henry at 150 MA. 60 ohms DC Res. Size 2¼" x 3¼" x 2". Mtg. Ctrs. 2¾" apart. Stock No. R-25H6.
59c ea.—3 for $1.59

250 MA SWINGING CHOKE—Rated at 4.5 henrys at 250 MA to 8.5 henrys at 50 MA. DC res. 150 ohms. Open frame mounting—2" H. x 2" W. Mtg. Ctrs. 3-5/15" apart. Stock No. R-SWK45
69c ea.—3 for $1.95

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An outstanding power transformer value. 350-0-350 volts at 250 MA. 5 Volts at 6 Amps. 6.3 Volts at 6 Amps. and 6.3 Volts at 1.2 Amps. Size 4⅝" x 3¾" x 4⅝" Mtg. Ctrs. 3" x 3¾". Shpg. wt. 11 lbs.

Stock No. R-TVP15 ....$4.95

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6.3 V @ 1 Amp. Worth $2.95 JAN SPECS — **$1.19 Ea.** 3 for $2.95

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6J6's—6 for $3.00 6SN7—5 for $3.00

Send for Bargain Tube Sheet No. 114—Thousand of Fabulous Tube Values!

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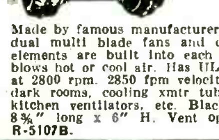

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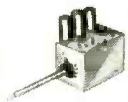
LATEST SARKES TARZIAN CASCODE VHF TUNER



Another exceptional tuner value from Concord. Latest 3 tube Sarkes Tarzian Cascode tuners for less than manufacturer's cost! Covers all 13 VHF channels with unusually high sensitivity and low co-channel interference. Designed to last a lifetime and give terrific fringe area reception. Ideal low cost replacement unit. Guaranteed Brand New and in excellent operating condition. Available for either 21 or 41 megacycle use. Please specify.

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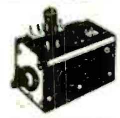
Stock No. R-STD-3 ....$8.95 ea.

KIT OF USED SARKES TARZIAN TUNERS

IDEAL FOR EXPERIMENTING OR REPLACEMENT PARTS. LESS TUBES. **3 for $1.98**

WESTINGHOUSE UHF TUNERS



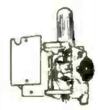
CONVERT TO UHF For Only **$1.95**

Worth $24.95

It's Fabulous!! The opportunity of a lifetime. Now you can convert to UHF for only $1.95. Sensational Westinghouse UHF Tuners are designed to operate in conjunction with your present VHF tuner to give you complete ALL-CHANNEL coverage. Tunes 450 to 870 Mc. Output 43 Mc. Regular 300 ohm input. The ideal basic element for building tuner, converter, booster or for experimenting on UHF. Convenient size for installation in TV chassis. (5 x 2½ x 5"). Complete with 6AF4 and crystal easy-to-follow schematic. Shpg. wt. 2 lbs. Stock No. 99-G-V11390

WESTINGHOUSE UHF RECEPTOR

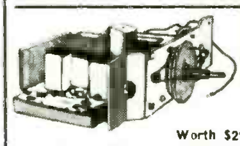
Complete with 6AF4 Tube, Crystal Diode, Schematic and Instructions



What more can we say! You get this highly miniatured UHF receptor complete with tube, germanium diode, resistors, condensers, coils, variable condenser, plug and socket, all for LESS THAN THE PRICE OF THE TUBE ALONE!! In addition we throw in a schematic diagram and installation instructions. Quantities are limited, so buy now and save!!

Stock No. WTC-2 Whatta Buy! — All for only **$1.25 ea.**

FAMOUS CROSLEY UHF TUNERS



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- ★ One Coaxial, 3-Way VTVM Probe for all functions except High Frequency Probe RF-12.
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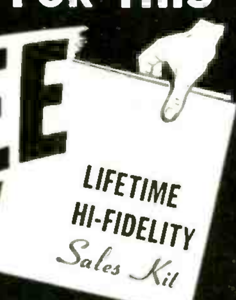

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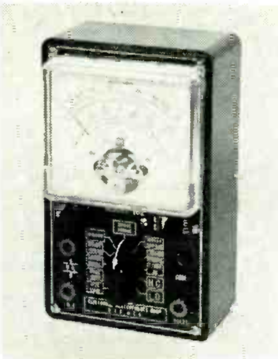
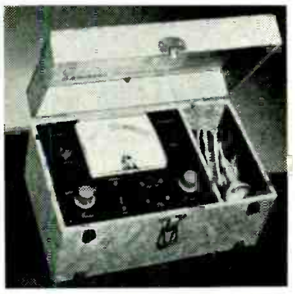


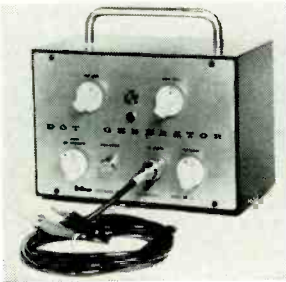
Measurements Corp., 280 Lafayette St., New York 12, N. Y.

C-R TUBE CHECKER KIT, *CC-1*, tests for shorts, leakage and emission. Shadowgraph test (spot of light on screen) indicates whether all electromagnetic deflection picture tubes are capable of functioning; indicates condition on good–bad scale. Supplies all operating



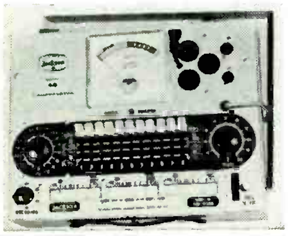
voltages to tube under test. Protective spring-loaded test switches. **Heath Co.**, a subsidiary of Daystrom, Inc., Benton Harbor 20, Mich.

WHITE DOT GENERATOR, *model CD*, in kit form. Preriveted sockets and terminals. Generator output can be fed directly to antenna terminals of color receiver. Weighs 6½



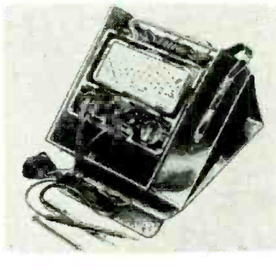
pounds, measures 5 x 9 x 6 inches. — **Hoffman Electronics Corp.**, 3671 S. Hill St., Los Angeles 7, Calif.

TUBE TESTER, *model 49*, features number of plug-in accessories, using basic meter and



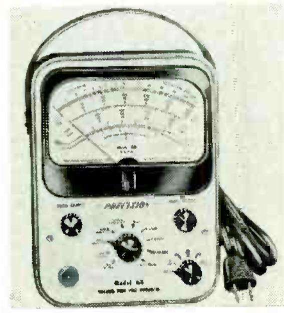
power supply for additional tube and components tests. Includes high-resistance shorts tester measuring interelement leakage to 2 megohms, heater current tester, selenium rectifier checker. Lever-action switches. 4½-inch meter indicates tube condition on a colored good-bad scale which is also marked in percent of normal quality.—**Jackson Electrical Instrument Co.**, 16-18 S. Patterson Blvd., Dayton 2, O.

V.T.V.M., *Phaostron 777*, self-contained, with 42 ranges, illuminated 4⅞-inch scale color-coded green for ohms, black for a.c. and d.c., red for peak-to-peak volts; 2 zero-center scales for FM alignment; double-



shielded 200-μa movement; separate range and function switches; unbreakable nonmagnetic metal case. Accuracy: 3% d.c., 5% a.c. Accessories include high-frequency coaxial cable, d.c. probe and leather carrying case.—**Phaostron Co.**, 151 Pasadena Ave., South Pasadena, Calif.

V.T.V.M., *model 68* (illustrated), a.c.-operated, wide-range, general-purpose electronic test set. 5¼-inch wide-angle meter, ±2% accuracy. 1% multipliers and shunts, wire and deposited film types. Has 5 plus and 5 minus d.c. voltage ranges: 3, 12, 60,



300, 1,200 at 13⅓ megohms constant input resistance; 5 resistance ranges to 1,000 megohms; 5 peak-to-peak voltage ranges: 8, 32, 160, 800, 3,200; 5 stabilized zero-center reference ranges for FM discriminator balancing.

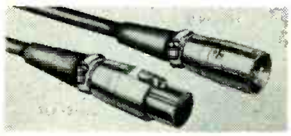
Model 78, battery-operated wide-range general-purpose electronic test set. Uses same meter as *model 68*. Contains one No. 477 (67.5 volts), 2 No. 950 (1.5 volts) batteries. 6 zero-center d.c. voltage ranges at 13⅓ megohms constant input resistance: ±1.5, ±6, ±30, ±150, ±600, ±1,500; 5 resistance ranges to 1,000 megohms; 5 high-impedance r.m.s. a.c. voltage ranges at 8 megohms input resistance and 67 $\mu\mu$f input capacitance: 3, 12, 60, 300, 1,200. — **Precision Apparatus**

Co., Inc., 70-31 84th St., Glendale 27, N. Y.

FIBERGLAS DROP CLOTH protects floors and rugs against hot solder, scratches, etc. 37 x 48 inches, fire resistant. Used as rainproof chassis cover.

Folds compactly into a tube caddy. — **CBS-Hytron**, Div. of Columbia Broadcasting System Inc., Danvers, Mass.

AUDIO CORD CONNECTORS, *XLR*, shockproofed for quiet connection by use of insulating material of resilient synthetic rubber (polychloroprene). Positive cable clamp for even grip on cable through a rubber bushing. Two insert arrangements available—one with three 15-ampere contacts for No. 14

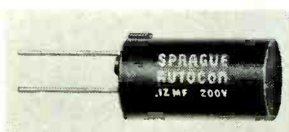


wire, other with four 10-ampere contacts for No. 16 wire. Solder pots pretinned; standard finish satin nickel. Panel style rectangular flange receptacle provides closer mounting for crowded installations.—**Cannon Electric Co.**, 3209 Humboldt St., Los Angeles 31, Calif.

OUTPUT TRANSFORMER, *Dynaco A-430*, high-fidelity audio output unit matching 6550 or 6CA7/EL34 tubes in circuits delivering 50 to 100 watts, for converting Williamson-type amplifiers to 50 watts output. Response ±1 db from 6 to 60,000

cycles. Undistorted power output rating, 50 watts from 20–20,000 cycles; 100 watts from 30–15,000 cycles. Phase characteristics permit substantial feedback without amplifier instability.—**Dyna Co.**, 5142 Master St., Philadelphia 31, Pa.

SINGLE-ENDED CAPACITORS, *Sprague type SE Autocon* molded-paper replacements for single-ended types in printed circuits. Tiny standoff feet eliminate dust and moisture

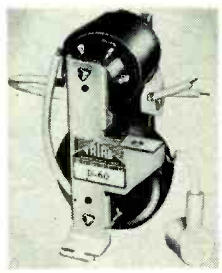


traps under capacitors and prevent printed wiring shorts. Leads 1-inch long. Type HCX solid dialectric for high insulation resistance, low power factor and flat temperature-capacitance curve. Plastic shell excludes moisture. 47 types with values from .001 to 0.47 μf at 200, 400 and 600 volts.—**Sprague Products Co.**, 81 Marshall St., North Adams, Mass.

ANTI-STATIC SPRAY, *No-Fog NF-102*, a colorless, odorless liquid sprayed on tube or mask and wiped with clean dry cloth. Leaves microscopic film

as insulation against static. Good for cleaning phonograph records, plastic products, etc. —**Tele-Matic Industries Inc.**, 16 Howard Ave., Brooklyn 21, N. Y.

FLYBACK TRANSFORMERS, five *Triad* types, correct replacements for use in RCA, Traveler and Zenith TV receivers. Electrically and mechanically interchangeable with original



equipment. Complete line of TV replacement transformers listed in catalog TV-155.—**Triad Transformer Corp.**, 4055 Redwood Ave., Venice, Calif., or Triad distributors.

4-SPEED RECORD PLAYER, *Quartet*, plays new 16 r.p.m. Talking Book records and all other speeds automatically. Accessory to all Hoffman 21- and 24-inch table or console models with Super Mark 10 or Mark 5 chassis. Can be plugged into radio, amplifier and TV receivers equipped with phono input jack. Dual sapphire needles, ceramic long-life car-

tridge, automatic shutoff after last record. Featherweight tone arm. *Model W120* walnut base; *model M120* mahogany; *model B120* blond. — **Hoffman Radio Div., Hoffman Electronics Corp.**, 3761 S. Hill St., Los Angeles 7, Calif. END

All specifications given on these pages are from manufacturers' data.

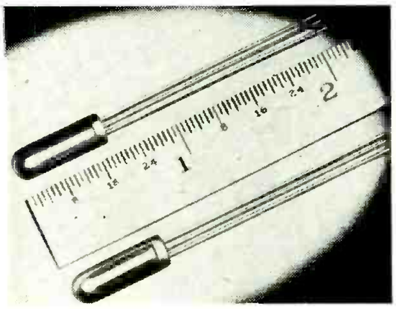
new Tubes & Transistors

3CE5 and 6CE5

High-mutual-conductance sharp-cutoff pentodes, the 3CE5 and 6CE5, have been announced by CBS-Hytron. They are designed for use in v.h.f. tuners and as i.f. amplifiers and feature a very sharp cutoff characteristic. Electrically and mechanically the tubes resemble types 3CB6 and 6CB6.

2-OC72 transistor

Announced by Amperex, the 2-OC72 (see photo) is a matched-pair high-current low-voltage power type designed for such applications as portable



phonographs and radios and similar portable equipment. The p-n-p push-pull units can deliver 200 mw from a 6-volt battery supply.

6810 phototube

This head-on type multiplier phototube is intended for use in scintillation counters and other applications involving low-level, large-area light sources. Announced by RCA, the 6810 features fast response, high current gain, relative freedom from after-pulses and small spread in electron transit time. Since the tube can deliver pulse currents of up to 0.5 ampere with good linearity, there is generally no need for associated wide-band amplifiers.

The 6810 has high sensitivity to blue-rich light and negligible sensitivity to red radiation. Design features include 14 electrostatically focused multiplying (dynode) stages and a focusing electrode with external connection for shaping the field which directs photoelectrons from the cathode onto the first dynode.

Silicon rectifier

Development of a silicon power rectifier capable of operating at ambient temperatures up to 200°C was an-announced by Hoffman Electronics. The

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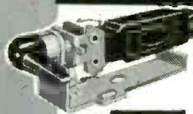
HIGH-FIDELITY TURNOVER CARTRIDGE



- 40-14000 CYCLE
- NEVER BEFORE AT SUCH A PRICE!

Lafayette brings you one of the finest high-fidelity turnover cartridges, AT AN UNBELIEVABLE PRICE! Frequency response from 40-14000 cycles +2 db. Has 2 sapphire styli to play all speeds. Needle pressure only 5 grams on LP cond 12-15 grams on 78. Output is .5 volts. Complete with turnover mechanism and knob, fits Webster, Garrad, VM, Collaro and tone arms of leading manufacturers of record changers and players.

2.75 Reg. Price ~~8.50~~

PK-79 .... Singly, Each 2.75
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CRYSTAL MICROPHONE

COMPARE IT WITH ANY MIKE AT 2 to 3 TIMES THE PRICE

A quality crystal Microphone for PA systems, house recorders, etc. Frequency response 30 to 10,000 cycles. Output level —52 db. Provides ample output for use with low gain amplifiers. Complete with 5 ft. of shielded cable. Shpg. wt., 3½" lbs.

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SLIM HIGH OUTPUT DYNAMIC MICROPHONE

NEW!

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A pencil-slim design, high output PA Dynamic Microphone of exceptional quality, at a price that is ⅓ of the price of any comparable microphone on the market today. Very smooth response, 50-11,000 cycles. Omnidirectional, tiltable head. Switch on side gives choice of either high impedance (50,000 ohms) or low impedance (250 ohms). Instantly removable bracket permits use either on stand or as hand mike. Features exceptional mechanical strength. Cast case with satin chrome finish, ⅝"-27 thread, Acoustically-treated grille head, 8" long; 1¼" barrel diameter. Shipping weight 2 lbs.

PA-29 .... In lots of 3, Each $9.25
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FOR RECORDING TELEPHONE CONVERSATIONS

Induction telephone pickup. Telephone conversations can now be picked up with no tapping of wires or special telephone circuits. Simply place the phone base, either cradle or upright type, on the pick-up platform and connect the leads to the high impedance input of any medium gain audio amplifier, or directly to any tape disc or wire recorder.

MS-16 .... 2.95

A NEW LIGHT WEIGHT DYNAMIC EARPHONE

Fits right into the ear. Ideal for use with radio sets, for private listening. DC resistance 2000 ohm impedance 5000 ohm with 3 ft of Plastic Cord.

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TRANSISTOR 455 KC I.F.

Specially designed for transistor circuits, only ½" square by ¾" high.

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Single, Each ...... 89¢

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P-N-P 99¢

TRANSISTOR LOOP ANTENNA

Fixed inductance tapped to match 800 ohm input. Covers 540-1650 kc with 365 mmf variable cond. size 9/16 x 4⅛".

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TRANSISTOR TYPE 2N107

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TRANSISTOR OSCILLATOR COIL

Supplies local OSC. energy to mixer stage. IF 455 KC. Use with 365 mmf cond. ⅝" x 1⅛" high.

MS-165 .... Net 49¢

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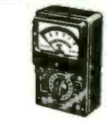
RAYTHEON TRANSISTOR CK-760 (2N112)

HIGH SENSITIVITY AC-DC MULTITESTER



20,000 OHMS PER VOLT DC and 10,000 OHMS PER VOLT AC

The New Lafayette High Sensitivity Multitester is a complete instrument (not a kit) packed with every desirable feature found in instruments costing twice as much. One of the most sensitive multitesters ever offered: **20,000 ohms per volt DC** and **10,000 ohms per volt AC**; having a highly sensitive 35 microamp meter. Check these full scale readings. **DC Volts:** 0-6; 0-12; 0-60; 0-300; 0-1200; 0-6000 volts at 20,000 ohms per volt. **AC Volts:** 0-6; 0-12; 0-60; 0-300; 0-1200 at 10,000 ohms per volt. DC current ranges: 60 microamp, 0-6; 0-60; 0-600 milliamps. **Resistance ranges:** 0-4; 0-40; 0-400K; 4 meg. ohms. **Decibel:** —20 to +17 db (0 = .774 volt). **Capacity:** 250 mmf-10 MF. **Inductance:** 20-1000 millihenry. Extreme versatility and accuracy; 1% precision resistors. ¾" meter; plastic front with metal bottom for ruggedness. Size: 5¾" x 3¾" x 2⅝"; complete with batteries and test leads. Shipping weight 4 lbs.

RW-30A .... In lots of 3, Each $19.25
Singly, Each $19.95

IMPORTED BINOCULARS

All have coated lenses — clamped in prisms — light weight all metal bodies. Complete with case and straps.

FULLY GUARANTEED FOR 6 MOS. AGAINST MECHANICAL AND OPTICAL DEFECTS.

ADD 10% FED. TAX TO PRICES

F-182 —	6x,15	I.F.	...NET 10.75
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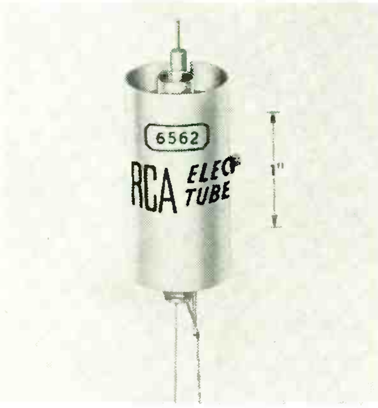
F-164 —	7x.50	C.F.	...NET 24.95
F-117 —	10x,35	C.F.	...NET 23.95
F-104 —	12x.50	I.F.	...NET 27.95
F-118 —	16x.50	C.F.	...NET 31.50
F-185 —	20x.50	C.F.	...NET 37.50

rectifier (see photo), designated NS-P1, is housed in a rugged, vibration-proof case measuring approximately 1⅛ inches in diameter and 1¼ inches in height.

The maximum reverse working voltage is 60 and the forward current density at 1 volt is in excess of 600 amperes per square inch of junction area.

6562 pencil type oscillator

This triode is a fixed-tuned u.h.f. oscillator having pencil type construction (see photo) and is intended for transmitting service in radiosonde applications. The 6562, produced by RCA, has two resonators: one is fixed-tuned and connected between grid and cathode; the other, connected between grid and plate, is loop-coupled to a coaxial r.f. output terminal and can be tuned to 1,680 mc. The useful power output of the tube is approximately 600 milliwatts.



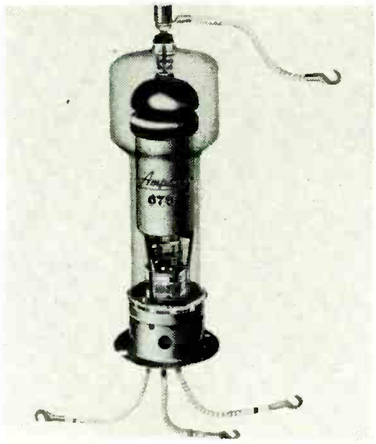
6806 beam power tube

Another RCA announcement concerns the high-power 6806, designed for operation as a grid-driven power amplifier at frequencies up to 1,000 mc. It has a maximum plate-dissipation rating of 35 kw.

In color or black-and-white television service the 6806 can deliver a synchronizing-level power output of 30 kw at 550 mc or 25 kw at 750 mc. As a CW amplifier in class-C telegraphy service the 6806 is capable of giving a useful power output of 25 kw at 400 mc.

6786 rectifier

A new mercury-vapor grid-controlled rectifier, the 6786 (see photo), has been announced by Amperex. The tube has a peak inverse voltage rating of 15 kv and an average plate current of 10 amperes. For intermittent operation, a

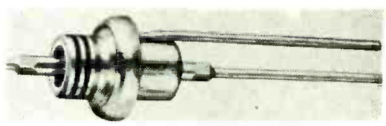


maximum plate current of 15 amperes may be used.

The 6786 is designed for high-current power supplies in radio transmitters and industrial r.f. generators. Under normal ambient temperature conditions, no forced-air cooling is necessary.

HA5001, 2, 3 transistors

The Semiconductor Division of Hughes Aircraft has announced three new n-p-n fused-junction germanium transistors, the HA5001, HA5002, HA5003. These are medium-power units having high gain and low noise figures. They show a negligible alpha-crowding effect at high currents, making them especially suitable for high-current medium-power amplifiers. All three types have a maximum collector current of 100 ma and a collector dis-

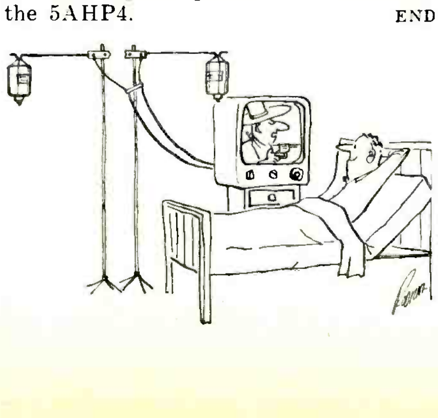


sipation of 500 mw. With suitable heat sinks these ratings can be increased.

For the HA5001, HA5002 and HA5003, respectively, maximum current amplification (alpha) is 1.0, 0.965 and 0.99; maximum collector-to-base voltage is 30, 15 and 20; collector cutoff current is 5, 12 and 10μa.

5AHP4 picture tube

A universal picture tube, the 5AHP4, has been announced by La Salle Tube Co., Chicago. It does not require a focus device or ion-trap magnet. To observe set performance it is necessary only to connect the high-voltage lead and the regular picture-tube socket to the 5AHP4. END



Patents

COLOR KINESCOPE

Patent No. 2,711,493

Ernest O. Lawrence, Berkeley, Calif. (Assigned to Chromatic Television Labs., Inc., San Francisco, Calif.)

This patent is awarded to a researcher who has done much previous work on color kinescopes (see RADIO-ELECTRONICS, June, 1955, page 110).

As shown in Fig. 1, the new tube differs in several respects from conventional tubes. The green gun is centrally located and its beam passes straight through the tube. The red gun is above. Its beam is deflected by plates D1. The beam from the lower blue gun is deflected by plates D2 as shown. These blue, green and red beams (marked B, G and R) are focused by coil F so that they arrive at the target together.

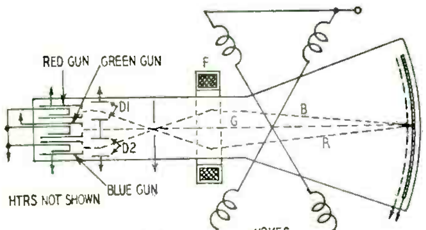


Fig. 1

Fig. 2 is a magnified diagram which shows how the beam *angle of incidence* controls color. Just in front of the target is a wire grid with individual wires W. These are biased negatively with respect to the target. Each wire corresponds to a group of three color phosphors which are deposited on the target in *thin horizontal strips*. They appear as R (red), G (green) and B (blue). For example, the green phosphor strip is always deposited midway between any two wires. Of course, each negative wire repels electrons near it.

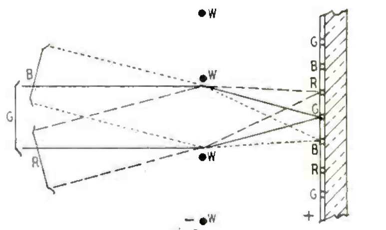


Fig. 2

The beam from the blue (B) gun arrives at a downward angle. It is shown by dotted lines. Note how repulsion by the negative wire grid focuses this beam accurately on the blue (B) phosphor. The red (R) beam (dashed lines directed upward) is focused on the red phosphor. The green (G) beam (continuous lines) arrives head on and is focused midway between the wires.

3-GUN KINESCOPE

Patent No. 2,719,241

(Assigned to Westinghouse Electric Corp., John W. Coltman, Pittsburgh, Pa.)

This new invention, it is claimed, simplifies the construction of a 3-color kinescope tube, while permitting better color registration.

Fig. 1 shows the general layout of the new tube. It has two screens: S1 a photoelectric and S2 a picture screen. They are shown in greater detail in Fig. 2. High-velocity electrons from the gun penetrate the aluminum backing of S1 and strike a phosphor layer which emits light. The light passes through a transparent medium and a thin layer of tin oxide, a semiconductor. It excites the photoemissive surface. The latter emits electrons. Note that strips of conducting material lie between the emissive surface and the tin oxide. Naturally light cannot pass through the conducting strips, therefore electrons are emitted only at the gaps between strips.

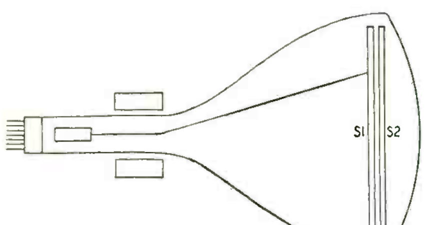


Fig. 1

Now for S2. This includes phosphor layers as shown in Fig. 2. R, G, B denote red, green and blue. Note that a green layer occurs between each of the other colors. Also, the green layers are opposite to and parallel with each gap in S1.

Electrons coming from the *gap* between strips of S1 normally fall on each *green phosphor* in S2, since the green phosphor strips are in front of the gaps. Normally, therefore, only green would be visible on the picture screen.

A high voltage is connected between S1 and S2 as shown. It biases S2 positive so that electrons coming from the photoelectric screen are

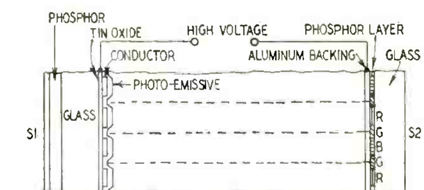


Fig. 2-a

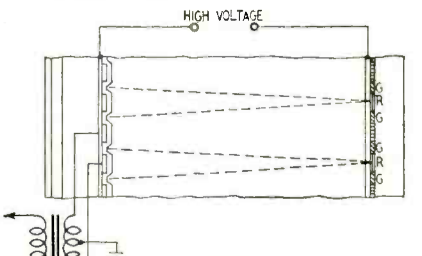


Fig. 2-b

attracted and accelerated towards S2. In addition, a.c. is applied to the conducting strips of S1. See Fig. 3, where alternate strips are shown tied together and connected to the color signal. Thus during one half-cycle of this signal, the even numbered strips will be more positive than the odd. This polarity is reversed during the next half-cycle.

Fig. 2-a shows that when the color signal voltage is zero, electrons move in straight lines from S1 to S2 and strike the green phosphors. When the odd-numbered strips are more *negative* than the even-numbered, the electrons are deflected as shown in Fig. 2-b. Then each beam falls on the red phosphors. One-half cycle later

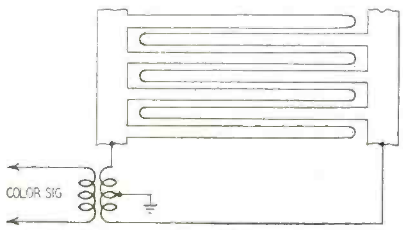


Fig. 3

the beams will be deflected in the opposite directions and they will scan only the blue phosphors.

Fig. 4 shows the shape of the color signal applied to alternate conducting strips of S1.

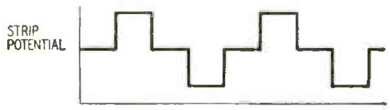


Fig. 4

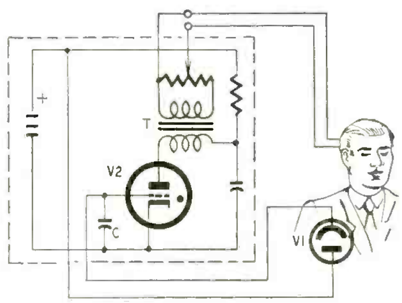
It is a complicated square wave. When its voltage is zero, green is scanned so this color appears more often than either of the others. For that reason the green phosphors must be narrower than the others.

AIDING THE BLIND

Patent No. 2,721,316

Joseph D. Shaw, Cincinnati, Ohio

Though the vision area of a brain is undamaged, the eyes and optic nerves may be unable to transmit the necessary impulses to the brain. This device generates and sends a signal to the brain so that the *sensation* of light occurs. According to this inventor, it is possible to place plastic sockets within the skull to contact the sensitive brain areas for the purpose described.



The diagram shows a phototube V1 whose output charges C. When this capacitor is charged to a predetermined level, it fires the gas thyratron V2 which transmits the brain pulse (via transformer T). When this occurs, the blind person receives the sensation of light.

With such an arrangement, a person can see whether an object in front of his photocell is light or dark and can judge its brilliance. In a more complicated form of the invention several cells are used with a corresponding number of terminals at the brain. Then the person can scan several areas at once and perhaps perceive a rough outline of the object.

For finer detail, of course, the sensitivity of the system will have to be improved. However, even in its present form it represents a significant aid to the blind. END

radio-electronic Circuits

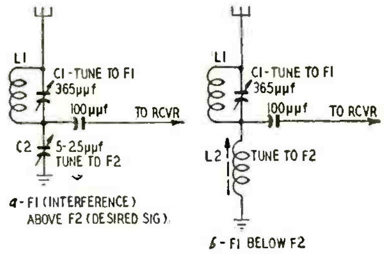
MULTIPLE WAVETRAP

The usual wavetrap with a single resonant circuit is not very effective in eliminating interference whose frequency is close to that of the desired signal. Its response curve is so broad that it attenuates the desired signal too much. Here is a multiresonant wavetrap that overcomes this disadvantage. I live close to the transmitting towers of a broadcast station and use the trap to prevent interference to another station a few channels away.

A tuned circuit is reactive at all frequencies off resonance. A parallel-tuned (antiresonant) circuit appears as an inductive reactance at all frequencies *below* resonance and as a capacitive reactance above resonance. The reactive effects are just the opposite for a series-tuned circuit.

The trap shown at *a* in the illustration is used to receive a signal whose frequency is *lower* than that of the interference. The parallel-tuned network (L1–C1) is tuned to the interference frequency (F1). This network appears as an inductance at frequencies lower than F1 so C2 can be used to tune this inductive reactance to F2, the frequency of the desired signal. The signal voltage developed across C2 is fed to the antenna post on the receiver.

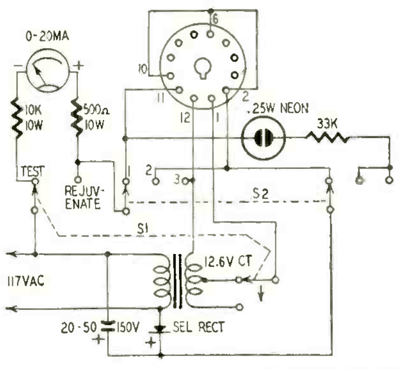
If the signal is above the interference frequency, L1–C1 appears as a capacitor to the signal frequency when tuned to F1. In this case, C2 can be replaced by a variable inductor (L2) and the combination tuned to F2 as at *b* in the illustration.



L1 is approximately 110 turns of No. 28 enameled wire closewound in a single layer on a 1½-inch diameter form. L2 is a variable inductor whose value is determined experimentally. You can try various horizontal linearity and width coils and ferrite-core broadcast and shortwave coils to find one that will peak the desired signal at about the center of its range.—*L. David Oliphant*

IMPROVED CRT TESTER

Mr. Cavaseno's cathode-ray tube tester and rejuvenator (August, 1955) is a handy and useful instrument. The diagram shows how I have increased its versatility by modifying the circuit to provide a test for shorts. The 10-ohm potentiometer in the original was eliminated by using a 12.6-volt center-tapped transformer and making S1 a double-pole switch connected as shown. The auxiliary power supply feature was left out because it was not needed here.



A ¼-watt neon lamp, a 33,000-ohm resistor and a double-pole 3-position switch (S2) provide the short test. Position 1 of S2 is used for testing emission and rejuvenating. Position 2 checks for shorts between cathode and control grid and position 3 shows shorts between heater and cathode. The neon lamp glows in positions 2 and 3 when the resistance between the shorted elements is from zero to over 2 megohms.
—*W. G. Eslick*

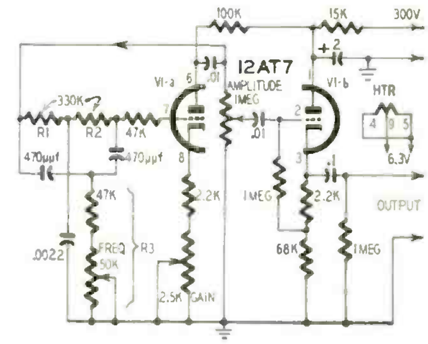
NEW R-C OSCILLATOR

Twin-T (also called parallel-T) networks provide almost infinite rejection of one particular frequency. They are commonly used as notch or rejection filters and as tuned peaking circuits when connected in the negative-feedback loop around an amplifier. In the latter application, feedback is minimum at the resonant frequency and amplifier gain is maximum. Noticing that a badly unbalanced network may cause oscillations when connected in a feedback loop, M. J. Tucker developed a new type of R-C oscillator producing good waveform and requiring only a single-stage low-gain amplifier.

The oscillator is described in detail in *Electronic Engineering* (London, England). The oscillator proper consists of the twin-T network and V1-a.

V1-b is the cathode-follower output stage. Output is controlled by the 1-megohm potentiometer in the grid circuit.

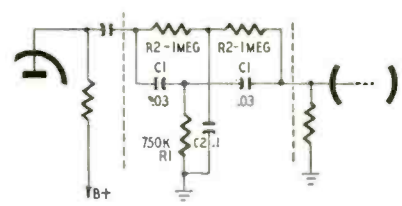
The waveform is purest when the



amplifier gain—controlled by the 2,500-ohm potentiometer—is just sufficient to sustain oscillations. The frequency can be varied over a limited range by varying either R1 or R3 alone and readjusting the gain. When R3 is 68,000 ohms, the frequency range is approximately 1,500 to 800 cycles as R1 is increased from 100,000 to 700,000 ohms. Decreasing R1 below 100,000 ohms places an excessive shunt load on V1-a and oscillations cannot be maintained. When R3 is varied between 20,000 and 150,000 ohms, the frequency range is approximately 1,400 to 800 cycles. The 47,000-ohm grid resistor prevents parasitic oscillations.

RUMBLE FILTER FOR 45's

The popular little 45-r.p.m. record changers often produce an annoying rumble when connected to a wide-range audio system. A simple rumble filter will often prevent having to turn down the bass control. L-C filters that completely eliminate the rumble frequency are difficult to design and even harder to get working satisfactorily. They also have a tendency to pick up hum



and introduce it into the audio system.

The filter shown between the dashed lines in the diagram will reduce rumble to a tolerable level and does not readily pick up hum. It is inexpensive and easy to construct. Although designed especially for RCA 45-r.p.m. changers, it can be used with any type. In these cases, it may be necessary to experiment with capacitor values to obtain maximum attenuation.

Connect the filter between the preamplifier and amplifier input terminals or between first and second stages of the main amplifier. Insertion loss is low and extra amplification is not needed. *—R. D. Sandison*

(The design of a parallel-T network

like that in the rumble filter requires that R2 equal 2R1 and C2 equal 2C1. These relationships were not followed closely in this circuit so we assume that the constants were altered to provide optimum performance in this application. The formula for the null frequency of a parallel-T in cycles is 159,000/R2 × C1 or 159,000/R1 × C2; where capacitance is in microfarads and resistance in ohms.—*Editor*)

A.F. OUTPUT METERS

Audio fans often need an output meter when an amplifier or receiver is used for feeding a disc or tape recorder. Judging from the letters we have received, many have tried to use standard VU and db meters without much success because they have connected them across voice coil circuits instead of the 500- or 600-ohm circuits for which they are usually designed and calibrated.

The diagrams in Figs. 1 and 2 show simple output meters that can be added to existing equipment. Fig. 1 uses a d.c. milliammeter which may have a full-scale range up to 10 ma, a half-wave instrument rectifier and a pair

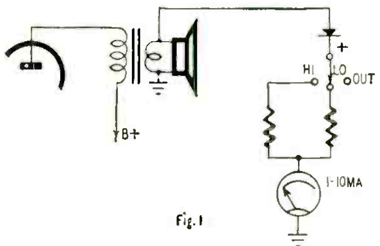


Fig. 1

of calibrating resistors. The values of the resistors are determined experimentally for high and low amplifier outputs.

The circuit in Fig. 2—reprinted from *The Radio Constructor* (London, England)—shows a vacuum-tube diode in

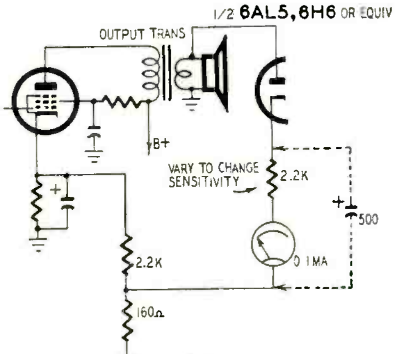


Fig. 2

place of the instrument rectifier. Contact bias in the diode is bucked out by returning the diode cathode to a voltage divider across the cathode of the output stage. The meter can be zeroed by replacing the 160- and 2,200-ohm resistors with a wirewound potentiometer of about 2,500 ohms. A capacitor of several hundred microfarads can be connected as shown by dashed lines to damp the meter movement. END

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Question Box

CONVERTING 6-VOLT RADIOS FOR 12-VOLT MOBILE OPERATION

Please print details for converting 6-volt auto radios and 2-way mobile equipment to operate from 12-volt batteries.—E. E. P., Pittsburgh, Pa.

Most manufacturers of two-way radio equipment will now convert the units for 12-volt operation at a nominal charge. This is the most practical method. If the equipment is to be transferred back and forth between vehicles with 6- and 12-volt ignition systems, you can use one of the new converters that deliver 6 volts d.c. output with 12 volts input. One of these is the Carter *Change-A-Volt* dynamotor and the other is a synchronous vibrator and transformer arrangement made by Motorola.

Of course, you can also replace the tubes with 12-volt equivalents or wire their heaters in series-parallel for 12-volt operation and replace the B supply with a 12-volt type.

The most practical method of converting auto receivers is to replace the tubes, vibrator and vibrator transformer with equivalent 12-volt types. Suitable transformers with a wide range of voltages and currents are made by such manufacturers as Halldorson, Merit, Stancor and Thordarson. Cornell-Dubilier, James, Mallory, Radiart and others make 12-volt vibrators.

If you don't want to replace the tubes with 12-volt types, you can rewire the heater circuits in series-parallel strings as shown in the diagrams. Figs. 1, 2 and 3 show possible revisions in the

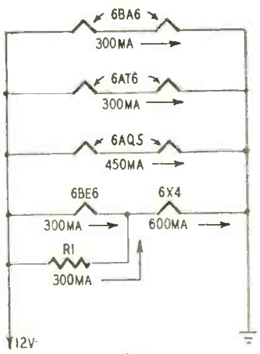

Fig. 1

heater circuit of a typical 8-tube auto radio. Wherever possible, divide the tubes into series strings that draw the same current. In Fig. 1, the 6AQ5's with their 450-ma heaters are in one string, the 6BA6's with 300-ma heaters in another and so on. The 6X4 with its 600-ma heater is connected in a series string with a 300-ma 6BE6 so a shunt resistor (R1) is added to carry the excess current (300 ma) around the 6BE6.

Fig. 2 shows an arrangement that eliminates the shunt resistor. Here, two 300-ma tubes are paralleled and connected in series with the 6X4 across

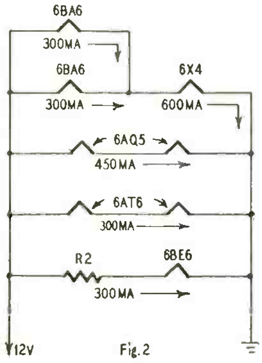

Fig. 2

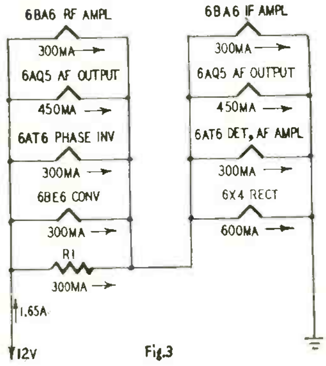

Fig. 3

the 12-volt circuit. Resistor R2 provides a 6-volt drop in series with the 6AV6.

Fig. 3 is a third arrangement in which the tubes are divided into two parallel strings that are then connected in series. The sum of the heater currents must be equal in each branch so shunt resistor R1 is added to one side to balance the excess current drawn by the 6X4.

Fig. 4 is a possible heater circuit in a typical 5-tube auto radio. Both series and shunt resistors are needed here. R1 bypasses excess current drawn by the 6AS5 and R2 drops the voltage to 6.3 for the 6AV6.

A shunt resistor (R1 in the diagrams) is always used across the heater of a tube (A) whose current rating I_A is less than the maximum flowing in a series circuit. This maximum current (I_B) is drawn by tube B. The resistance of R1 in ohms is found from the formula $E_A/(I_B - I_A)$ where E_A and I_A are heater voltage and cur-

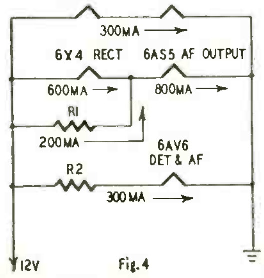

Fig. 4

rent (in amps), respectively, of tube A and I_B is the heater current of tube B in amps.

For example, if a 300-ma heater is in series with one drawing 600 ma as in the case of the 6BE6 and 6X4 in Fig. 1, the resistance of R1 is 6.3/0.6 − 0.3 or 21 ohms and the wattage dissipated is $E_A(I_B - I_A)$ or 6.3 × 0.3. In practice, a 20-ohm 5-watt resistor can be used.

Voltage-dropping resistors R2 are determined by the formula $(E_{supply} - E_{tube})/I_{tube}$. In Figs. 2 and 4, R2 is (12.6 − 6.3)/0.3 or 21 ohms. The wattage is computed in the same way as R1.

POWER SUPPLY CIRCUIT

Please print the circuit of a power supply using a transformer with a 220-volt 50-ma secondary. I want to use full-wave rectification to simplify filtering.—H. L., Chicago, Ill.

The diagram in Fig. 1 shows a full-wave bridge type selenium rectifier. You can purchase a composite bridge

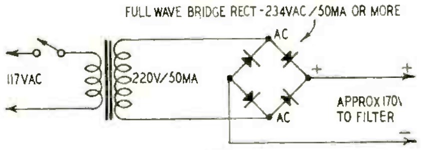

Fig. 1

or you can make up one with 130-volt 50-ma selenium rectifiers. It is desirable to use two such rectifiers in series (plus terminal of one to the minus terminal of the other) in each arm of the bridge to increase the safety factor. This circuit will deliver approximately 170 volts to the filter. The output

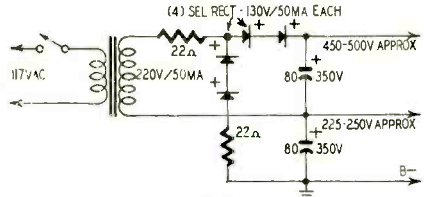

Fig. 2

voltage will then rise to around 240, depending on the value of the input filter capacitor and the load current.

Fig. 2 is a full-wave voltage-doubler type supply delivering maximum voltages of around 250 and 500 at two output terminals. END

Radio Thirty-Five Years Ago

In Gernsback Publications

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Wireless Association of America	1908
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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 January, 1922 Science and Invention (formerly Electrical Experimenter)

Shall I Take Up Engineering?, by H. Winfield Secor

Ultra High Speed Atoms—and Their Effects, by Rogers D. Rusk, M. A.

Radio Central, by Arthur H. Lynch

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Technotes

G-E 825

Excessive brightness on the left-hand side of the screen in this model has been traced to a defective 5V4 damper tube. Replacement will clear up the trouble. —*John Flint*

GAROD TELE-ZOOM

A defect in the Tele-Zoom circuit has been found to be caused by dirty switch contacts. Clean the contacts with carbon tetrachloride. To eliminate possible future trouble, also clean the relay in the receiver.—*Lyle Briggs*

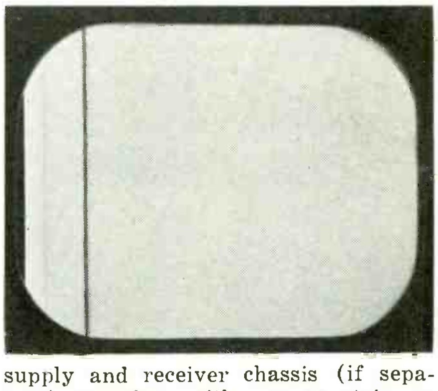
PIE CRUST

On a Motorola 71M I found that pie-crust oscillation covering the entire screen was due to the picture-tube mount touching the shield cover of the high-voltage power supply. Cardboard insulation cleared the trouble.—*Monty Britt*

BLACK VERTICAL LINES

These appear on the left side of the raster and are usually due to Barkhausen oscillation (see photo) in the horizontal output tube.

Remedy: Replace horizontal output tube. Check adjustment of horizontal drive and linearity controls. Bond power



supply and receiver chassis (if separate) together with copper strip or plate. Dress antenna lead-in away from power supply. Install and adjust small permanent magnet on horizontal output tube. Install coaxial transmission line (RG/59/U in strong signal areas, lower-loss RG/11/U in fringe areas). Ground coax shield to antenna connector shield.—*B. J. de Lentore*

TVI ON AM RECEIVERS

This appears in the form of heterodyning, "birdies" hash, buzz or squeals.

Possible causes: Defective damping tube. Defective horizontal output tube. Incorrect adjustment of horizontal linearity control. Improper shielding of high-voltage power supply. Antenna lead-in unshielded or too close to deflection yoke or high-voltage leads. Unshielded yoke or improper dressing of yoke leads. Direct radiation from grid or anode of picture tube (this is especially prevalent in late-model large-screen sets and in metal-cone picture tubes). Radiation through a.c. power line. *Remedies:* Replace damper tube (in some early sets the 6W4 damper used a separate heater transformer which had no electrostatic shield. Check this possibility). Replace parasitic or oscillating horizontal output tube. Adjust set for good horizontal linearity with test pattern or bar-dot generator. Reduce horizontal drive if possible without affecting size or quality of picture. Shield the high-voltage power supply with copper screen; ground screen to receiver chassis. Re-dress lead-in away from deflection yoke leads and high-voltage circuits. Shield yoke leads with tinfoil and ground. Re-dress high-voltage leads. Install high-pass filter in TV antenna leads (as close as possible to tuner) to prevent radiation through antenna. Bypass each side of the a.c. line to ground with a .02 μf capacitor (or in some cases, .05 μf).—*John B. Ledbetter*

WHITE VERTICAL LINE

Trouble is a line that may change or shift when horizontal hold is adjusted. (Same trouble may appear as "veneer" effect on side of screen.)

Possible Cause: Misadjustment of horizontal a.f.c. transformer.

Remedy: Readjust transformer; see that horizontal hold control covers its normal range. If circuit is unstable, check or replace horizontal a.f.c. control tube and realign transformer if necessary. If trouble remains, check horizontal discriminator transformer or coupling capacitor in this circuit. This trouble can also be due to sync generator misadjustment or a defect at the TV station. Check on two or more stations.—*L. B. Johnson*

SLOW "AIRPLANE TYPE" FLICKER

This is so called because it resembles the effect produced by an airplane flying overhead. It may be due to fluctuating line voltage, faulty receiver installation or a defective tube.

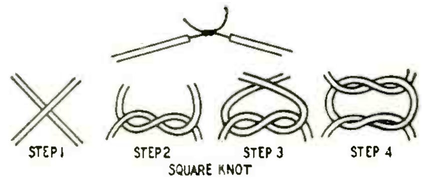
To check, measure the line voltage with an undamped 0-150-volt a.c. voltmeter. If variations are excessive, call the service department of local electric utility company for proper action. (In rural or remote areas, a suitable constant-voltage transformer at the set may be necessary.) Check the installation, and correct obvious faults (loose or swaying lead-in, antenna, etc.). Replace defective video i.f. tube. Low line voltage will also result in poor definition in some receivers due to video stages operating at improper bias and plate voltages. Remedies are same as above.—*Johti Lehte*

END

try This one

SPLICING STRANDED WIRE

When splicing two stranded wires, some technicians simply wrap the severed ends around each other before taping. A slight tug on such a splice pulls it apart, often causing blown fuses and service callbacks.



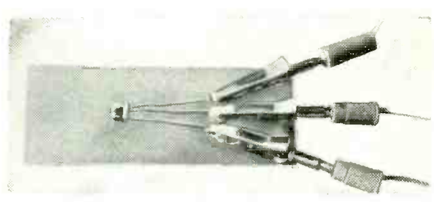
A better method is first to tie the bared ends with a tight square knot (see drawing) and then wrap the ends around each other before taping. This splice will resist all efforts to pull it apart—even to the breaking point of the wire.—*Harry J. Miller*

IMPROVING CAPACITOR BRIDGES

My capacitor bridge, like many instruments of this type, uses an electron-ray indicator tube as a null or balance indicator. The shadow is not sharp enough and the tube is not sufficiently sensitive to permit matching capacitors as closely as required in some applications. I find that capacitors can be matched much more accurately by connecting a v.t.v.m. between the grid and cathode of the indicator and using the voltage swing to indicate balance.—*George R. Anglado*

TRANSISTOR SOCKET

Many experimenters use clip leads in wiring temporary and experimental hookups. If the circuit contains a transistor, there are some difficulties.



If the leads are clipped to the soldering leads of the transistor, the mechanical strain is far too great. If a standard transistor socket is mounted on a little terminal board, it will soon have to be discarded because it is not built for frequent changing of the transistor. I use the gadget shown in the photograph.

Three crocodile clips designed to fit banana plugs are screwed to a piece of plastic sheet as shown. Contact is perfect because the transistor leads are held firmly by the jaws of the clips. Little differences in the lead lengths and spacings of different transistors are irrelevant for this socket. For example, you may exchange a 2N36 with a 0C71 in a few seconds.—*Joseph Braunbeck*

HANDY TEST ADAPTER

Here is an easy way to measure voltages at the tube sockets from the top of the chassis. Run a length of bare copper wire through a piece of spaghetti tubing and twist a loop in one end to fit pins on miniature sockets

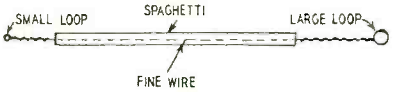


Fig. 1

and a loop on the other end to fit pins on octal or other tube types. See Fig. 1. Remove the tube from the socket. Scratch the pins with a knife to remove film and corrosion, place the loop over the correct pin and then follow it

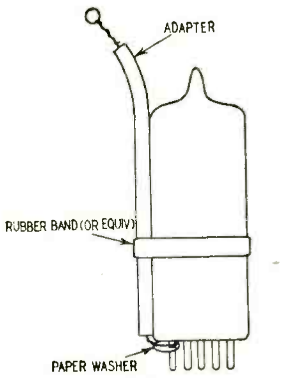


Fig. 2

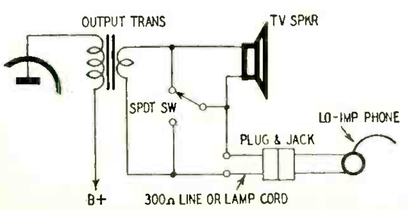
with a paper washer (see Fig. 2) to hold the loop in place and insulate it from accidental contact with the chassis.

A miniature test clip or a test prod measures the voltage at the other end of the adapter. A rubber band clamps the adapter to the tube and prevents it from shorting to the chassis.—*Arthur Trauffer*

LOW-Z PHONES FOR TV

There is a demand for extension phones for TV viewers who do not wish to disturb others. A simple and inexpensive installation is shown in the diagram. Using a low-impedance phone for this purpose eliminates the need for blocking capacitors and underchassis wiring.

The headphone is connected in series with the TV speaker voice coil and a s.p.d.t. switch is used to short out the one not being used. The switch is preferably mounted out of sight on the back



of the cabinet but located so it can be reached easily.

Connection from the TV set to the phone jack may be with lamp cord or 300-ohm lead-in (which can be run under the rug to the viewing location).

Good low-impedance phones of 8 to 15 ohms can be bought for less than $2. We have used receivers from old apartment-house installations in several cases and even sound-powered toy telephone sets.—*Paul Falk*

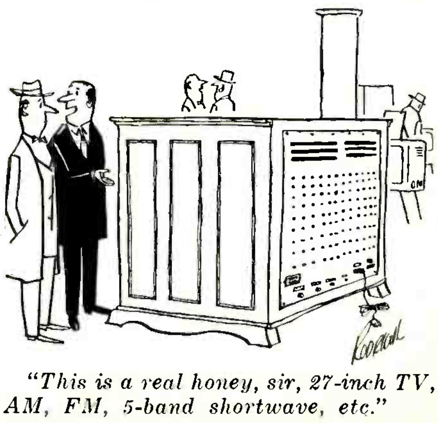
(The C. F. Cannon Co. supplies headsets with 11 ohms d.c. resistance at the same price as its equivalent 1,000-ohm single and 2,000-ohm double units.—*Editor*)

RECTIFIER TESTS

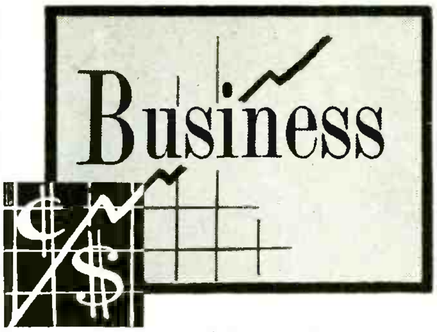
Like the tubes they replace, selenium rectifiers gradually grow weak. In TV sets a common symptom of a weak selenium rectifier is insufficient width (sometimes also height). Portable or a.c.-d.c. radios with weak rectifiers often cut off when an appliance such as a refrigerator or an oil burner goes on.

Selenium rectifiers can be checked by ohmmeters and selenium rectifier testers, but there is no check as positive as direct substitution. The rectifier need not be removed or unsoldered to check it. All that is needed is to parallel an equal-size (or larger) unit across its terminals, observing polarity, of course. If it is inconvenient (as in some TV sets) to get across both terminals, the first and last heat dissipating plates will do equally well. A pair of test leads with color-coded alligator clips on one end and corresponding color-coded test prods on the other makes a handy and useful test unit. A good selenium rectifier is inserted in the clips. If the original unit is O.K., little or no improvement will be noticed. In TV sets with two selenium rectifiers replace both units if improvement is noted as each is bridged. When checking portable radios, reduce the line voltage with a Variac or similar control until the set cuts off. When a defective rectifier is shunted with the test unit, the set will come to life, then go off again when the test unit is removed.

With selenium rectifiers that are shorted or have developed a high reverse current, the nose will be the best test. The sickening odor of spoiled eggs common to this type of failures is easily detected.—*Charles Garrett* END



"This is a real honey, sir, 27-inch TV, AM, FM, 5-band shortwave, etc."



Merchandising and Promotion

CBS-Hytron, Danvers, Mass., is sponsoring 15 minutes of the Garry Moore TV show on alternate Friday mornings over CBS. The program is aimed at

selling the woman of the house because of a recent survey which showed that it is the woman who usually requests TV service and is at home when the service technician calls.

Raytheon Manufacturing Co., Waltham, Mass., produced a 20-minute motion picture "Safe Passage," which shows why ship collisions occur in spite of radar equipment. Invariably it is because of improper use of equipment or human failure.

Brach Manufacturing Co., Newark, N. J., a division of General Bronze Corp., launched the biggest promotional campaign in its history on its *Magne-Tenna* indoor TV antenna.

Oxford Electric Corp., Chicago, de-

veloped a new line of colorful display packages for its replacement speakers.

Atlas Sound Corp., Brooklyn, N. Y., designed a promotion package for deal-

ers handling its PA loudspeakers, microphone stands and accessories. It includes mailing pieces and a satin banner for window or wall display.

United Catalog Publishers, New York, issued its distributors a four-color counter and window display with shipments of the 1956 edition of its *Radio-Electronic Master*.

Supreme Publications, Highland Park,

Ill., designed a new display stand for its manuals.

Altec Lansing, Beverly Hills, Calif., is offering high-fidelity establishments a new store display for its products.

Jensen Industries, Forest Park, Ill., needle manufacturer, now features a

chrome-plated wire frame display for distributors and dealers of its needles and accessories.

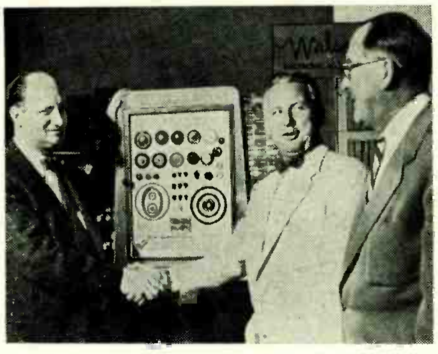
Pentron Corp., Chicago, is marketing its new prerecorded tapes in a counter merchandiser supplied free with each order of 12 or more *Moods in Music* tapes.

Almo Radio Co., Philadelphia, is sponsoring its Third Annual Industrial Show at the Penn Sherwood Hotel, Philadelphia, Jan. 25–26. Over 90 manufacturers are expected to participate.

Talley Electronic Development Co., Cincinnati, Ohio, is displaying its new *Genaprobe* variable-frequency audio

generator and voltage indicators in a counter display which holds 12 of the packaged units.

Walsco Electronic Sales Co., Los Angeles, Calif., recently installed its 1,000th *Phono Drive* display counter unit in the newest branch of Peninsula



Radio & Supply Co., San Jose, Calif. Photo shows William Bundie (left), owner of Peninsula, being congratulated by Walsco representatives Ken E. Ross (center) and Charles N. Meyer.

Production and Sales

RETMA reported the production of more than 5,760,506 TV sets and 10,027,362 radios for the first nine months of 1955 compared with 4,733,315 TV sets and 7,042,442 radios turned out during the same period during 1954. The asssociation also reported the retail sale of 5,149,977 TV sets and 3,942,676 radios—exclusive of automobile sets—for the first nine months of 1955. During 1954, 4,645,063 TV sets and 4,032,704 radios were sold.

RETMA reported manufacturers' sales of 347,668,000 receiving tubes and 7,680,781 TV picture tubes for the first nine months of 1955. This compares with 266,050,000 receiving tubes and 6,476,566 picture tubes for the 1954 period.

New Plants and Expansion

Sylvania Electric Products is building a new multimillion dollar plant at Altoona, Pa., for the production of receiving tubes.

CBS-Hytron, Danvers, Mass., is planning a complete new 55,000-square-foot tube and transistor warehouse in Chicago to service its midwestern distributors and dealers better.

Raytheon Manufacturing Co., Waltham, Mass., leased plant space in Maynard, Mass., which will be devoted to the development and engineering of radar equipment for its Missile and Radar Division.

Allen B. Du Mont Labs., Clifton, N. J., has begun operations in its new West Coast headquarters in Los Angeles.

Krylon, Inc., is now located in its new plant in Norristown, Pa.

Westinghouse Electric established a new department in Baltimore for the manufacture of a line of industrial electronic products. Robert C. Cheek, assistant manager of the Baltimore Electronics Division, was named manager of the new department.

James Vibrapower Co. is now located in its new manufacturing facilities in

Chicago, adjacent to its former quarters.

Allied Radio Corp., Chicago, opened its third high-fidelity studio in the Chicago area.

Mergers

Van Norman Co., Springfield, Mass. machine tool manufacturer, acquired Insuline Corp. of America, Manchester, N. H., which it will operate as a subsidiary. There will be no change in personnel. Samuel J. Spector continues as Insuline president and chief executive officer; Bernard L. Cahn, vice president for sales; and Myles Spector, vice president for manufacturing.

Clevite Corp., Cleveland, acquired full ownership of Transistor Products, Inc., Waltham, Mass., in which it formerly held a majority interest. The company's name has been changed to **Clevite Transistor Products** and will operate as a division of the parent company.

New York Transformer Co., Alpha, N. J., acquired Tartak Electronics, Burbank, Calif., as a West Coast subsidiary which will now be known as **NYT Electronics.**

Business Briefs

. . . **Ohmite Manufacturing Co.**, Skokie, Ill., will now manufacture *Amrecon* relays previously made by its subsidiary, American Relay & Controls, Inc. Formerly available for manufacturers only, they will now be sold to distributors as well.

. . . **The 1956 Los Angeles High-Fidelity Music Show** will be held Feb. 8–11 in the Alexandria Hotel in Los Angeles.

. . . **RETMA** issued a new booklet outlining its services and activities.

. . . **Electronic Instrument Co.**, Brooklyn, N. Y., manufacturer of *Eico* kits, recently celebrated its 10th anniversary.

. . . **Cornell-Dubilier Electric Co.**, South Plainfield N. J. has modernized and expanded its *Powercon* line of vibrator-powered converters to include the marine, aircraft, business office, ham, appliance, mobile and industrial fields.

. . . **Magnavox**, Ft. Wayne, Ind., held the second of its color TV training program courses in New York City recently.

. . . **JFD Manufacturing Co.**, Brooklyn, N. Y., recently made a shipment of three trailer loads of TV receiving antennas to the U. S. Government which it states is the first shipment of its type in the industry to be made. END

Calendar of Events

1956 Electronic Parts Distributors Show management announced registration for the show—a closed exhibition for distributors, representatives and manufacturers' personnel—would be made by mail only before the show opened.

Polytechnic Institute of Brooklyn international symposium on nonlinear circuit analysis April 25–27.

1956 High-Fidelity Show in Chicago Nov. 2–5.

NEDA and Radio Parts and Electronic Equipment Shows, Inc. are planning a series of five regional distributor seminars to be held in key cities throughout the U. S. during 1956.

Les A. Thayer

Les A. Thayer, sales manager of the Merchandise Division of Belden Manufacturing Co., Chicago, celebrated his 25th anniversary with the company. He will be presented with a commemorative gold watch and will be admitted to the Belden 25-year Club at its next meeting in February.

Howard T. Souther (upper right of photo), manager of the Reproducing Components Division of Electro-Voice, Inc., Buchanan, Mich., was named marketing director in a realignment of Sales Division executives. **Webster F. Soules**, (upper left), manager of the Distributor Sales Division, was named administrative assistant. **George Riley** (lower right), former assistant manager of the Distributor Sales Division, was appointed manager of the Distributor Sales Division and **Cullen H. Macpherson** (lower left), assistant manager of the Reproducing Components Division, was promoted to manager of high-fidelity products.

Ray R. Simpson, founder of Simpson Electric Co., Chicago, was honored at the company's recent sales conference at Lac du Flambeau for his 50 years in

W. E. Carroll (left) presents portrait to Ray R. Simpson (right).

the electrical instruments industry. Simpson was presented with an oil portrait of himself, a gift from the company and its sales representatives, by Wallace E. Carroll, president of the company.

Raymond E. Carlson, vice president in charge of sales and a director of Tung-Sol Electric, Newark, N. J., relinquished his sales responsibilities but


Raymond E. Carlson George W. Keown

remains with the company as vice president and a member of the board. **George W. Keown**, general sales manager of the company, was elected a vice president and assumes the sales responsibilities.

Sam Schlussel

Sam Schlussel, chief field and sales engineer of Channel Master Corp., Ellenville, N. Y., was appointed to the new post of sales manager, antennas and accessories.

John J. Kaul

John J. Kaul was named sales manager of Terado Co., St. Paul, Minn. Since joining the firm in 1949 he has worked with new product promotion and distribution through jobber and dealer outlets.

Robert G. Dailey

Robert G. Dailey was appointed vice president of Vokar Corp., Dexter, Mich. He was formerly general sales manager and will continue to direct all sales activities.

Obituaries

Otto Paschkes, founder and president of Astron Manufacturing Corp., East Newark, N. J., recently at his home in Scarsdale, N. Y., after a long illness.

Irving Golin, president and founder of University Loudspeakers, Inc., White Plains, N. Y., in a New York hospital at the age of 46.

Charles C. Leininger, Jr., advertising manager of National Carbon Co., at his home in New Canaan, Conn.

John B. Merrill, vice president, operations, of Sylvania Electric Products' Tungsten and Chemical, Atomic Energy, Electronics, and Parts Divisions and his wife in the United Air Lines plane

crash near Laramie, Wyo., early last fall.

Alfred H. Corwin, pioneer designer and manufacturer of radio parts and equipment, at his dairy farm near Long Valley, N. J., after a long illness. He was formerly president of Radio Distributing Co., Newark, and Garod Corp., Nutley, N. J.

Personnel Notes

. . . **Dr. Elmer W. Engstrom**, executive vice president, research and engineering, of RCA, was elevated to the new post of senior executive vice president in a realignment of top level positions at RCA. **Ewen C. Anderson** was named executive vice president, public relations; **Charles M. Odorizzi**, executive vice president, sales and services, and **W. W. Watts**, executive vice presdent electronic components. **Robert A. Seidel** continues as executive vice president, consumer products. **Dr. Douglas H. Ewing** was elected vice president, RCA Laboratories; **Charles P. Baxter**, vice president and general manager, RCA Victor Television Division; **James M. Toney**, vice president and general manager, RCA Victor Radio and Victrola Division.

. . . **Frederick D. Ogilby**, vice president of the Philco Television Division, was appointed vice president, marketing, and **James M. Skinner, Jr.**, also a former vice president of the Television Division, was named vice president and general manager of the Television Division. Philco also established a new Automotive Division for the manufacture and sale of radios and other products headed by **William H. Chaffee**, former vice president and general manager of the Radio Division. **Henry E. Bowes**, advertising and promotion manager of the Television Division, was made general manager of the Home Radio Division.

. . . **A. C. Elles**, industrial and contract sales manager of I.D.E.A., Inc., Indianapolis, was appointed general sales manager of the company. He will coordinate sales activities of three divisions—Regency, Monitoradio and Electronic Equipment.

. . . **J. Homer (Robby) Robinson**, veteran sales and merchandising executive, was appointed advertising and sales manager of the Brach Manufacturing Division of General Bronze Co., Newark, N. J., manufacturer of TV antennas.

. . . **Arthur V. Loughren**, vice president in charge of research for Hazeltine Corp., was elected president of the IRE for 1956. **Frank J. Bingley**, Philco Corp., was named to receive the Institute of Radio Engineers' Vladimar K. Zworykin Television Prize Award for 1956.

. . . **Seymour D. Gurian**, assistant sales manager in charge of the New York office of Radio Receptor Co., Brooklyn, N. Y., and senior engineer of the Engineering Department's components and standards section, was named sales manager of the Engineering Products Division. END

technical Literature

TV AND BROADCAST MIKES

Catalog No. 120 contains detailed application information, features and specifications on professional microphones for telecasting and broadcasting. It shows how they work and includes polar patterns, frequency response curves and wiring diagrams. Information on the relation of the particular microphone to the overall station operation is included. Accessories are also illustrated and described.

Electro-Voice, Inc., Buchanan, Mich.

> 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.

OSCILLOGRAPHIC RECORDING

A 16-page catalog describes the *150 Series* of oscillographic recording systems. Included are 11 plug-in preamplifiers and 1-, 2-, 4-, 6- and 8-channel models. Performance data for these interchangeable front ends, as well as frequency response characteristics of galvanometer with driver amplifier, are also provided. Technical details are given on the *model 150-1900* master oscillator power amplifier and model 150-300/700 wide-band driver amplifier and power supply. A price list covers basic assemblies, complete systems, preamplifiers, amplifiers, recorders, cabinets, cases and accessories.

Sanborn Co., Industrial Div., 195 Massachusetts Ave., Cambridge 39, Mass.

SINGLE SIDEBAND

A 24-page bulletin, *Single Sideband, No. 9*, gives ratings for Eimac tubes and discusses other technical topics in this field.

Technical Services Dept., Eitel-McCullough, Inc., San Bruno, Calif.

TEST EQUIPMENT

Catalog R36A illustrates and describes instruments for servicing TV, radio and other communications equipment as well as industrial electronic and electrical equipment. It also describes the Weston simplified method of visual alignment for TV receivers.

Weston Electrical Instrument Corp., 614 Frelinghuysen Ave., Newark 5, N. J.

POWER AND GAS TUBES

RCA's 24-page booklet *Power and Gas Tubes, Form No. PG-101B* contains characteristics data on 178 vacuum power tubes, including forced-air- and water-cooled types with output capabilities up to 500 kw. Information on gas, mercury-vapor and vacuum rectifier tubes, gas and mercury-vapor thyratrons, ignitrons, magnetrons and vacuum-guage tubes is also included. Photographs of representative types and diagrams of either the tube base or envelope connections are included.

Commercial Engineering Dept., RCA Tube Div., Harrison, N. J., 20c.

TAPE LISTING

Livingston's catalog contains a listing of prerecorded tapes. It includes a large variety of two-channel stereophonic selections and material ranging from Latin-American music, Dixieland and popular to full symphonic works. All releases are at a tape speed of 7.5 i.p.s.

Livingston Electronic Corp., Livingston, N. J.

REPLACEMENT NEEDLE GUIDE

Recoton's fifth edition of the *Simplified Replacement Needle Reference Guide* lists all popular cartridges and phonographs and their needle replacements, cartridges, recording tape, recording blanks and phonograph accessories.

Recoton Corp., 52-35 Barnett Ave., Long Island City, N. Y., $2.50.

HIGH FIDELITY

High-Fidelity Home Music Systems contains data on Altec's AM–FM broadcast tuner, AM broadcast tuner, control preamplifier, power amplifier, Melodist record reproducer, Iconic speaker system, Biflex speakers, duplex speakers, etc.

Altec Lansing Corp., 9356 Santa Monica Blvd., Beverly Hills, Calif., and 161 6th Ave., New York 13, N. Y.

TV TROUBLESHOOTING

Servicing Television Receivers by Signal Tracing is a 68-page book on TV troubleshooting. It gives data on the Hickok *model 650C* video-r.f. generator.

Free to interested manufacturers, distributors, etc. Hickok Electrical Instrument Co., 10531 Dupont Ave., Cleveland, Ohio.

POTTING CONNECTORS

A 12-page two-color *Manual PM-1, Methods of Potting Cannon Plugs,* contains numerous illustrations and instructions on potting connectors for sealing against moisture. Ways to mix the sealant, potting forms, types of guns and various required time intervals are discussed in detail. Also included are both resilient and plastic-insert potting connector types with complete dimensional data.

Cannon Electric Co., 422 W. Avenue 33, Los Angeles 31, Calif.

CERAMIC MAGNETS

Catalog No. 15 gives in 4 pages the characteristics, design and application of the *Indox I* ceramic permanent magnet. It describes the manufacturing processes involved and lists the types of *Indox* magnets available for experimental purposes.

Indiana Steel Products Co., Valparaiso, Ind.

DIELECTRIC CAPACITORS

Bulletin XC-201-4 illustrates and gives complete technical information on the high-temperature 165°C *XC* plastic-film dielectric hermetically sealed tubular capacitors. Included are capacitance listings, dimensions and voltages, dimensional drawings and engineering data and typical curves.

Gudeman Co., 340 W. Huron St., Chicago 10, Ill.

RESISTORS

A bulletin on new glass-sealed carbon-film resistors *(PT 1000),* contains information on their stability characteristics, resistance values, matched networks, tolerances, temperature and voltage limits.

Pyrofilm Resistor Co., 8 Whippany St., Morristown, N. J.

SHEET METAL

Forming Sheet Metal for Fun and Profit by Louis E. Garner describes in detail methods of fabricating boxes, brackets and chassis from sheet metal.

Television Accessories Co., Dept. L, 1412 Great Northern Bldg., Chicago 4, Ill.

END

Books

COLOR TELEVISION FOR THE SERVICE TECHNICIAN, by Albert C. W. Saunders. Howard W. Sams & Co., Inc., Indianapolis, Indiana. 8½ x 11 inches, 110 pages. $2.50.

A fine text on color television, this book is beautifully balanced with the development of the color TV signal, and picture tubes, discussed in the first half and the color receiver covered in the second. A notable point is the constant technical level of presentation. While being very complete, it never is too technical, never oversimplified.

The opening half of the book covers colorimetry, color television, the color carrier, color signal analysis and the tricolor picture tube. The text is heavily supported by illustrations.

The section on the color receiver is well done with numerous block diagrams showing the general principles of the receiver, followed by representative schematics from current color TV receivers. In one respect this section falls short: The manufacturer's installation adjustments for several receivers are given. This makes for tiresome reading for those technicians—and there are many—who have never worked on a color TV set. This type information will not be retained by the reader as will, for example, that on theory and circuitry of color television that is supported with photographs and schematics.

This book will surely benefit those who study it. The general circuitry described is unlikely to be changed for some time to come.—*JK*

COLOR TV SERVICING, by Walter H. Buchsbaum. Prentice-Hall, Inc., 70 5th Ave., New York, N. Y. 6 x 9 inches, 257 pages. $6.35.

The title is somewhat misleading in that a comparatively small part is devoted to color TV servicing. The author does a good job of describing the overall operation of the color TV receiver, using numerous schematic diagrams of current-model color TV sets and many illustrations. This makes for instructive reading but does not add a great deal to the technician's ability to service color receivers.

Buchsbaum opens his book by following the beaten path through an introduction to color television. He follows this with principles of colorimetry and the composition of the color TV signal. Unfortunately, the text at several places becomes much too complex for easy reading. From this point on the book covers the various sections of the color TV system including chapters on color picture tubes and circuits, a typical color TV receiver, the color decoder and color synchronization.

The final chapters follow the intent of the title, including installation, r.f.-i.f. alignment, color decoder adjustment, troubleshooting monochrome operation, wrong-color defects and miscellaneous troubleshooting. Included are some excellent color photos.—*JK*

SWEEP AND MARKER GENERATORS FOR TELEVISION AND RADIO by Robert G. Middleton. (Gernsback Library No. 55.) Gernsback Publications, Inc., 25 W. Broadway, New York 7, N. Y. 5½ x 8½ inches, 224 pages. $2.50.

As its name implies, this volume is concerned mainly with equipment, not technique. Most service books assume that the technician is using perfect test equipment. Here the author points out possible faults and errors in the generator signal, how to test for them, how to correct them.

Of all service shop equipment, the sweep generator is probably the most critical. If it does not put out the signal expected of it, it may cause serious errors in alignment and adjustment of the receiver. Among the requirements and characteristics clearly discussed here are: flatness, calibration, shielding, attenuation, termination, stray effects. Many photos illustrate the effects caused by poor design or equipment failure.

The last two chapters cover alignment procedure. One is for AM and FM radios (shortwave and broadcast), the other describes visual-alignment methods. Diagrams show typical setups and response curves.

EXPLAINING THE ATOM, by Selig Hecht. Revised and expanded by Dr. Eugene Rabinowitch. Viking Press, New York, N. Y. 5½ x 8½ inches. 237 pages. $3.75.

The atomic bomb *can* be described in everyday language. It is done effectively with the aid of simple illustrations in this revised edition that brings the subject right up to date.

The prologue emphasizes that the atomic bomb didn't happen overnight but is the result of more than 50 years of scientific thinking and discoveries. Chapter 1 describes early theories, and later it turns out that the atom is not nearly as simple as first supposed. The nucleus, various particles, charges and isotopes are clearly discussed. Then the relationship between mass and energy prepares the reader to understand the bomb itself. Later chapters discuss peacetime applications of atomic energy and the H-bomb.

One chapter reveals efforts in 1939 by top scientists to interest officials in the military possibilities of atomic energy and how an appeal was finally made direct to President Roosevelt. Also described are postwar efforts to outlaw the bomb and how they failed.

HIGH-FIDELITY HOME MUSIC SYSTEMS, by William R. Wellman. D. Van Nostrand Co., Inc., 250 Fourth Ave., New York 3, N. Y. 5½ x 8½ inches, 177 pages. $3.95.

This book shows how to save money in a hi-fi installation. It describes the construction of various speaker enclosures and tells how to install in a bookcase, fireplace or wall. It includes suggestions for choosing and caring for records and styli, the basic operation of a tape recorder, brief descriptions of tone controls, etc.

The chapters on building an AM tuner, wide-range amplifier and preamp consist largely of a parts list, schematic and layout of essential components. Rather sketchy and often not too clear, they will not be much help to an advanced technician and a beginner may prefer to buy his own (perhaps in kit form) to avoid the many pitfalls. Also, the author fails to prescribe the necessary caution when dealing with a.c.–d.c. chassis.—*IQ*

ADDITIONAL 1955 TELEVISION SERVICING INFORMATION (Vol. TV-10), compiled by M. N. Beitman. Supreme Publications, 1760 Balsam Road, Highland Park, Ill. 8¼ x 10½ inches, 192 pages. $3.

This is the second volume of service data on 1955 television receivers. The first, *Most-Often-Needed 1955 Television Service Information* (Vol. 9), covered those receivers produced in the latter months of 1954 and the early part of 1955. Vol. TV-10 covers those sets not previously included and those produced during the latter months of 1955.

Like the previous volumes in the "Most-Often-Needed" series, this is crammed full of original manufacturers' schematic diagrams, alignment data, waveforms and response curves, troubleshooting and voltage and resistance charts and miscellaneous servicing information valuable to the busy TV service technician.

Many of the schematic diagrams are accompanied by a complete description of circuit action. In addition, some chassis contain detailed troubleshooting notes relating to specific components. —*RFS*

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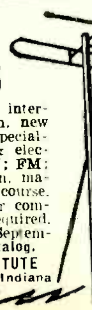

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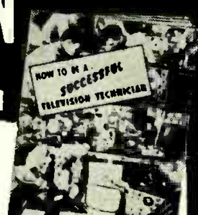

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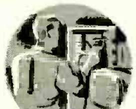

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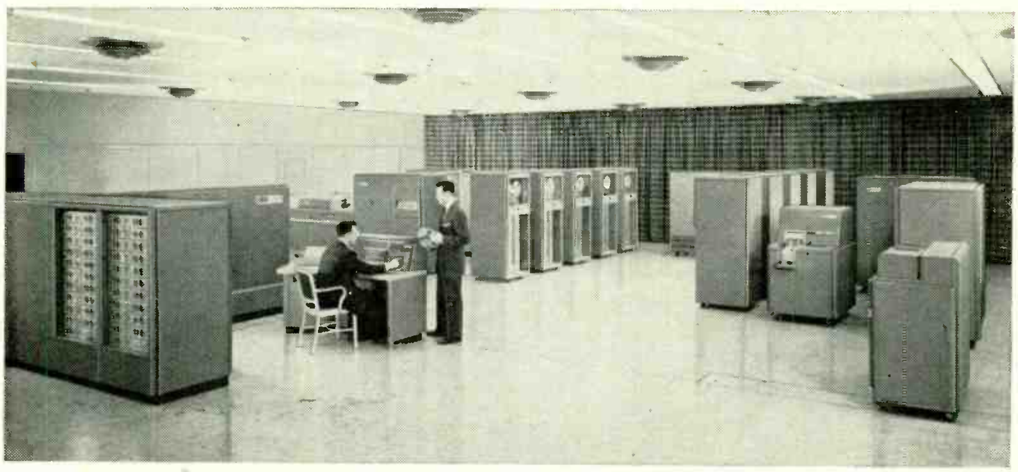

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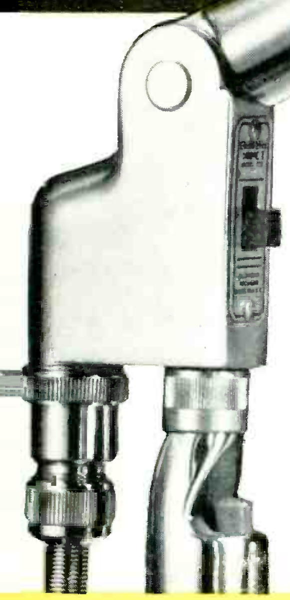

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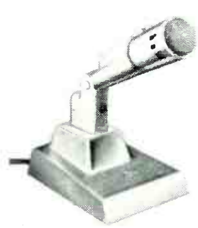

*EV Pat. Pend.

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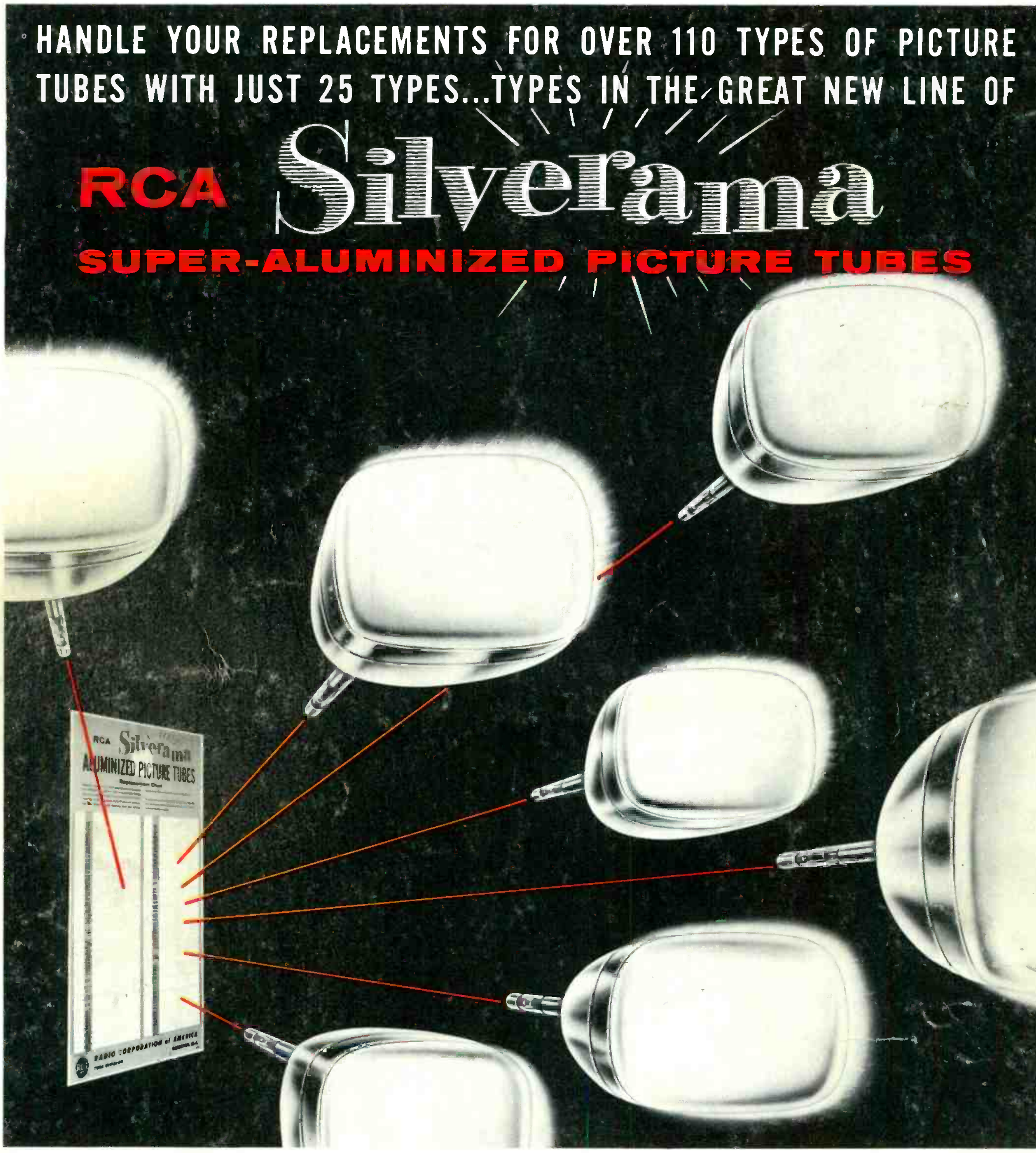

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