

ELECTRONIC TECHNICIAN

WORLD'S LARGEST ELECTRONIC TRADE CIRCULATION



Tips on Color Servicing

Color TV Horizontal Problems

How to Choose and Use Controls

Troubleshooting Transistor Circuits

MAY 1965

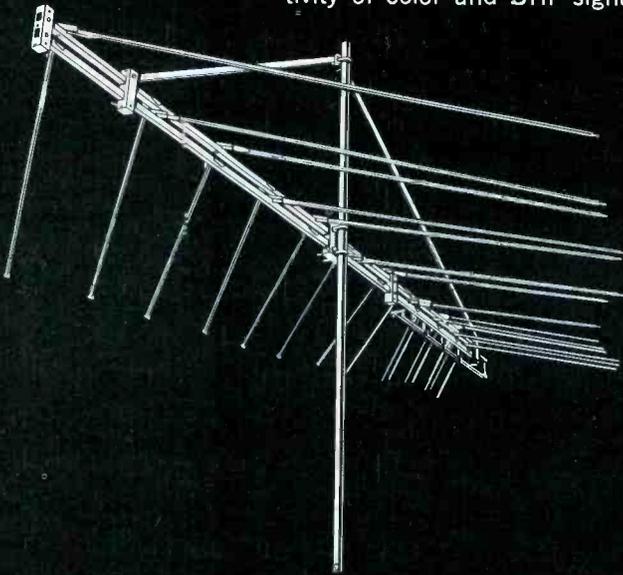




The quality goes in before the name goes on

FOR THE FINEST COLOR AND UHF RECEPTION INSTALL ZENITH QUALITY ANTENNAS

... to assure finer performance in difficult reception areas!
More color TV sets and new UHF stations mean new antenna installation jobs for you. Proper installation with antennas of Zenith quality is most important because of the sensitivity of color and UHF signals.



ZENITH ALL-CHANNEL VHF/UHF/FM AND FM-STEREO LOG-PERIODIC ANTENNAS

The unusually broad bandwidth of the new Zenith VHF/UHF/FM and FM-Stereo log-periodic resonant V-dipole arrays pulls in all frequencies from 50 to 900 mc—television channels 2 to 83 plus FM radio. The multi-mode operation provides high gain and good rejection of ghosts.

These frequency independent antennas, developed by the research laboratories at the University of Illinois, are designed according to a geometrically derived logarithmic-periodic formula used in satellite telemetry.



ZENITH QUALITY HEAVY-DUTY ANTENNA ROTORS

Zenith quality antenna rotors are heavy-duty throughout—with rugged motor and die-cast aluminum housing. Turns a 150-lb. antenna 360 degrees in 45 seconds. The weather-proof bell casting protects the unit from the elements. Each rotor mounts easily to either a mast or tower without an adapter.



ZENITH QUALITY WIRE AND CABLE

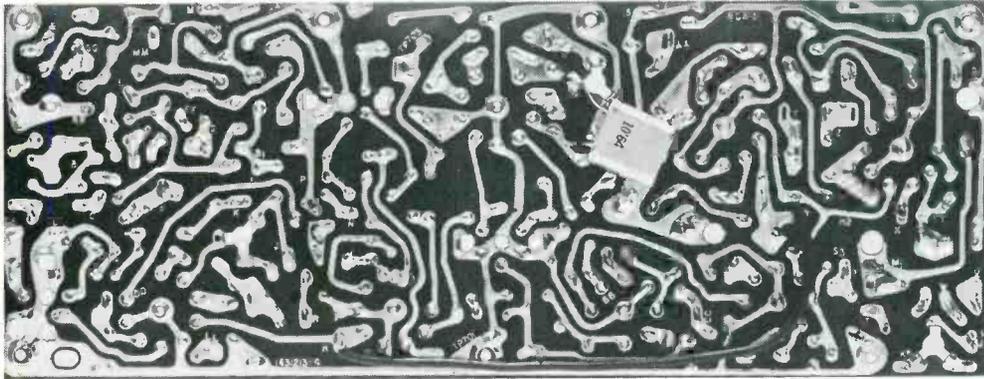
Zenith features a full line of quality packaged wire and cable. Also especially designed UHF transmission wires, sold only by Zenith. Zenith wire and cable is engineered for greater reception and longer life, and is available in various lengths to suit every serviceman's needs.

Check the Yellow Pages for the Zenith Distributor nearest you.
Or write to Zenith Sales Corporation, Parts and Accessories Division,
5801 West Dickens Avenue, Chicago, Illinois 60639,
for Distributor name plus complete catalogue and technical
information on Zenith Quality antenna installations.

Specifications subject to change without notice.

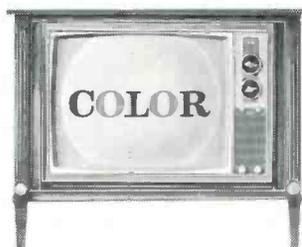
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RCA Solid Copper Circuits



**replace old-fashioned
"hand wiring"...give TV
space age
dependability.**

RCA Solid Copper Circuits are made by methods as modern as tomorrow. They give greater dependability . . . better TV performance. It's typical of the advanced design you'll find throughout every RCA Victor home instrument. It all adds up to sets that are easier to service so that owners are more satisfied with results.



The Most Trusted Name
in Electronics Trm(s)®



More TV servicemen own RCA Victor Color TV than all other leading makes combined



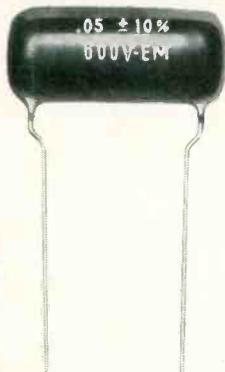


4 good reasons that spell **QUALITY** and **SERVICE...**

1.

ARCOLYTIC superior quality electrolytic capacitors are made of 99.99% pure aluminum foil... designed to operate at 85°C, and withstand high ripple and surge voltages. All are made and tested to EIA RS-154. Premium grade materials and construction make Arcolytics last longer... on the shelf... and in the set! Over 1400 values to meet all requirements for tubular and twist-mount electrolytics — single, dual, triple or quadruple capacitance in voltage combinations for radio, tv and industrial electronics. All unconditionally guaranteed! No extra charge for this high quality.

2.



ELMENCO Dipped Mylar-Paper (DP) capacitors give missile quality at commercial cost. Over 100 million are now in use. Whether for radio-TV repairs or critical industrial circuitry, reliable, dependable, rugged Elmenco capacitors eliminate profit-killing call-backs and customer complaints. Elmenco DP capacitors operate at 125°C without derating, are completely moisture proof, and are up to 50% smaller than comparable types.

3.



ELMENCO High Voltage Dipped Silvered Micas are solidly impregnated with corona resistant material. They operate to 125°C compared with 85°C for older molded silvered types. Greatly reduced size and radial leads make them ideal for printed circuit use. Extra reliability is assured through maximum moisture resistance. Capacitance, tolerance and working voltage are stamped on every unit.

4.



ARCO general purpose Type CCD ceramic disc capacitors have improved ceramic bodies which assure longer life and greater stability. The standard CCD line has a $\pm 10\%$ tolerance and 1000 VDCW rating. It makes possible a single ceramic disc stock for universal use. The "space-saving" size of Arco discs is another feature designed to offer greater service convenience with complete safety of operation. Higher voltage ratings are available upon request.

You can get your Arco and Elmenco capacitors in any quantity within 24 hours from coast to coast. They're stocked in depth at Arco's reserve warehouses (New York-Dallas-Los Angeles) serving authorized Arco distributors throughout the nation. Call your Arco distributor today!

ARCO

electronics inc.

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ELECTRONIC TECHNICIAN

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ELECTRONIC TECHNICIAN

WORLD'S LARGEST ELECTRONIC TRADE CIRCULATION

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Cover

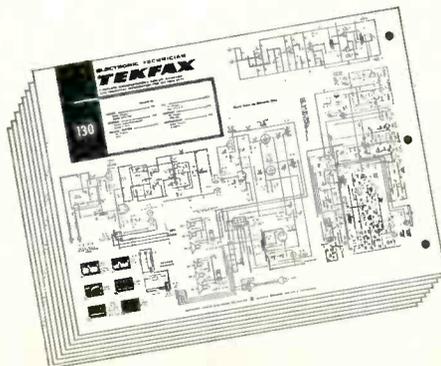
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MOTOROLA: Color TV Chassis TS-908C-02 thru D-02

SYLVANIA: Color TV Chassis DO1-1, -2

ZENITH: Color TV Chassis 25MC36



**New RCA WR-64B
Color Bar / Dot /
Crosshatch Generator**



**THE ESSENTIAL COLOR-TV
TEST INSTRUMENT**

Now in a new model with more features for greater stability and versatility

- Crystal-controlled RF oscillator for stable picture carrier.
 - Three additional crystal oscillators are used to produce the sound carrier, color sub-carrier signal and the three patterns.
 - Convenient front-panel gun killing switches to aid individual gun testing as well as convergence and purity adjustments.
 - Sound-carrier signal unmodulated for accurate adjustment of fine tuning control of TV receiver... accurate setting of the fine-tuning control is essential for checking the performance of the receiver.
 - Generates all necessary test patterns: COLOR BARS for checking and aligning color circuits; CROSSHATCH for adjusting vertical and horizontal linearity and raster size; and DOTS for accurate convergence.
 - Color-phasing adjustments may be made with this instrument in the home without a scope.
 - The standard of the Color-TV servicing industry: much of the practical information available for trouble-shooting color circuits is based on the RCA Color Bar Generator.
- Only \$189.50***

ASK TO SEE IT AT YOUR AUTHORIZED RCA TEST EQUIPMENT DISTRIBUTOR

*Optional distributor resale price. All prices subject to change without notice. Prices may be slightly higher in Alaska, Hawaii and the West.

RCA Electronic Components and Devices, Harrison, N. J.



The Most Trusted Name in Electronics

**LETTERS
TO THE EDITOR**

Slight Misunderstanding

Enclosed check to renew my subscription to ELECTRONIC TECHNICIAN.

I am very sorry about the misunderstanding and I thank you for your nice letter with explanation. . . .

Your policy . . . has no parallel that I know of in the technical publishing business. This makes me proud to do business with a very fine organization. Even if I had to pay double for my subscription it would be worth the money as your magazine has helped me more than a score of times.

BILLY ALEXANDER

Houston, Texas

Something Wrong?

Isn't there something wrong with the captions at the top of page 46 in the February issue of ELECTRONIC TECHNICIAN?

JOHN HASKELL

New York, N. Y.

There sure is. The references are wrong on Fig. 4 and Fig. 5. The antenna to the right is a cylindrical parabolic. The one shown below the captions is a log-periodic type antenna. —Ed.

From Out of the Brush

I'm doing experimental work so far in the brush I almost have to carry a ball of red string to find my way back to the nearest town.

Have no contact with the outside world (only Spanish spoken in this village) except Amateur Radio. Needless to say there's a need to know. I am a new member of a group that must be large indeed, the people that look to ELECTRONIC TECHNICIAN for the answer . . . You have it and there's no finer publication . . . Just thought I'd say thanks . . . From format to subjects covered, selected ads and highly readable editing of articles, you're just right for a large number of readers like myself looking forward to next month . . .

HUGH CABOT

Villalobos Monitor Station
WA5KSQ — WA5KSP — NXME
Shafter, Texas

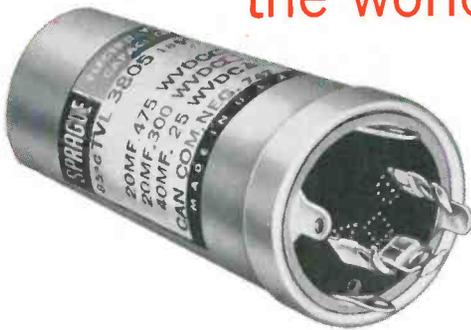
Liked March Issue

Your March edition was a hum-dinger! The best you have had in one edition in some time. Robert Mueller's piece on "Comes the Revolution" should be removed from ET and

QUESTION: When it comes to electrolytic capacitors, why do more than half of the nation's Radio-TV Service Technicians prefer to do business with Sprague Distributors?

ANSWER: Because they don't want makeshift substitutions or multi-rating "fits-all" capacitors. They insist on exact replacements, which are always available through Sprague Distributors everywhere.

SPRAGUE **TWIST-LOK**[®] CAPACITORS...
1863 different ratings and sizes...
the world's most complete selection
of **EXACT** replacements!



Wouldn't you really rather have what the set manufacturer recommends? An exact replacement in capacitance, voltage, and size is easier to install and less expensive, in most cases, than substitutes!

We don't have to tell you that it's easier to service with exact replacements. And we don't have to tell you that it's better, too. When sets are designed, specific capacitance values are used for peak operation, so it takes exact replacements to restore original set performance.

And who better than Sprague knows which values and sizes are needed in the replacement market? Sprague, the world's largest component manufacturer, has the most complete specification file on original set requirements. That's why you're always right when you service with Sprague TWIST-LOK exact replacements!

GET YOUR COPY of Sprague's comprehensive Electrolytic Capacitor Replacement Manual K-107 from your Sprague Distributor, or write Sprague Products Company, 65 Marshall Street, North Adams, Massachusetts.

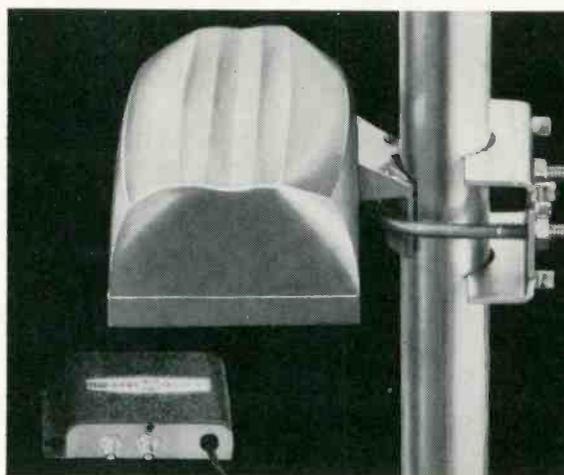


WORLD'S LARGEST MANUFACTURER OF CAPACITORS

65-127-43 R2

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“What our business needs is a good UHF VHF amplifier.” “What our business needs is a good UHF-VHF amplifier.” “What our bu..”



“Say no more.”

“You mean there’s an amplifier that covers all TV channels from 2 to 83?”

“You bet. In fact there are two—the outdoor U/Vamp-2 and the indoor V/U-ALL2.”

“Suppose I live in an area where there’s only VHF?”

“Your motto should be ‘Be Prepared’ because there are a lot of new UHF stations soon to come on the air. These all-channel amplifiers are obsolescence-proof.”

“Anything I should know about the U/Vamp-2?”

“Well, the U/Vamp-2 is compact and easy to install on the antenna mast. Has a remote AC power supply.”

“How about performance?”

“Two transistors give you all the power you need for better reception on VHF and UHF. Also protect against overload. Lists for \$49.95.”

“Supposing I don’t want to put an amplifier up on my antenna mast?”

“Then use the V/U-ALL2. Not as effective as the U/Vamp-2, but you don’t have to climb a ladder . . . and it delivers signals to two TV sets. Only \$42.50 list.”

“Guess I’ll rush down and get one of the new Blonder-Tongue UHF/VHF amplifiers.”

(This message was paid for out of the gross profits of BLONDER-TONGUE, 9 Alling St., Newark 2, N.J.)



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LETTERS TO THE EDITOR

framed by most technicians. Many “technicians” don’t know how a transistor or “diode” works, and they have shied away from learning . . . It won’t be many years before everything coming in for repairs will be sans tubes . . . Another fine item in this edition was Robert Coy’s “Selecting Replacement Yokes.” This article should also be dismantled from the magazine and studied by TV technicians. The article “You and Color TV” should also be an introduction to the average technician to ‘git busy’ and learn something about color systems . . . Suggest you consider reprinting all of the schematics you have done in the past. I am sure that the newcomers to the field would appreciate the move . . .

HORACE D. WESTBROOKS
Griffin, Ga.

Thanks. We’re thinking about reprinting a lot of TEKFAK schematics into bound volumes and making them available to the entire field.—Ed.

Wants 2-Way Articles

Have subscribed to ELECTRONIC TECHNICIAN for some time and think you do a fine job of keeping service technicians up to date. I have been in TV-radio servicing for over 13 years. Received my commercial radio telephone license and now do two-way work . . . Would like to see at least one article on two-way radio each month . . .

LAWRENCE J. ROSE
Wellfleet, Mass.

Wants TEKFAK Items

I have all TEKFAK from July 1963 to date. Am looking to buy some printed *before* that date. Let me know via ELECTRONIC TECHNICIAN.

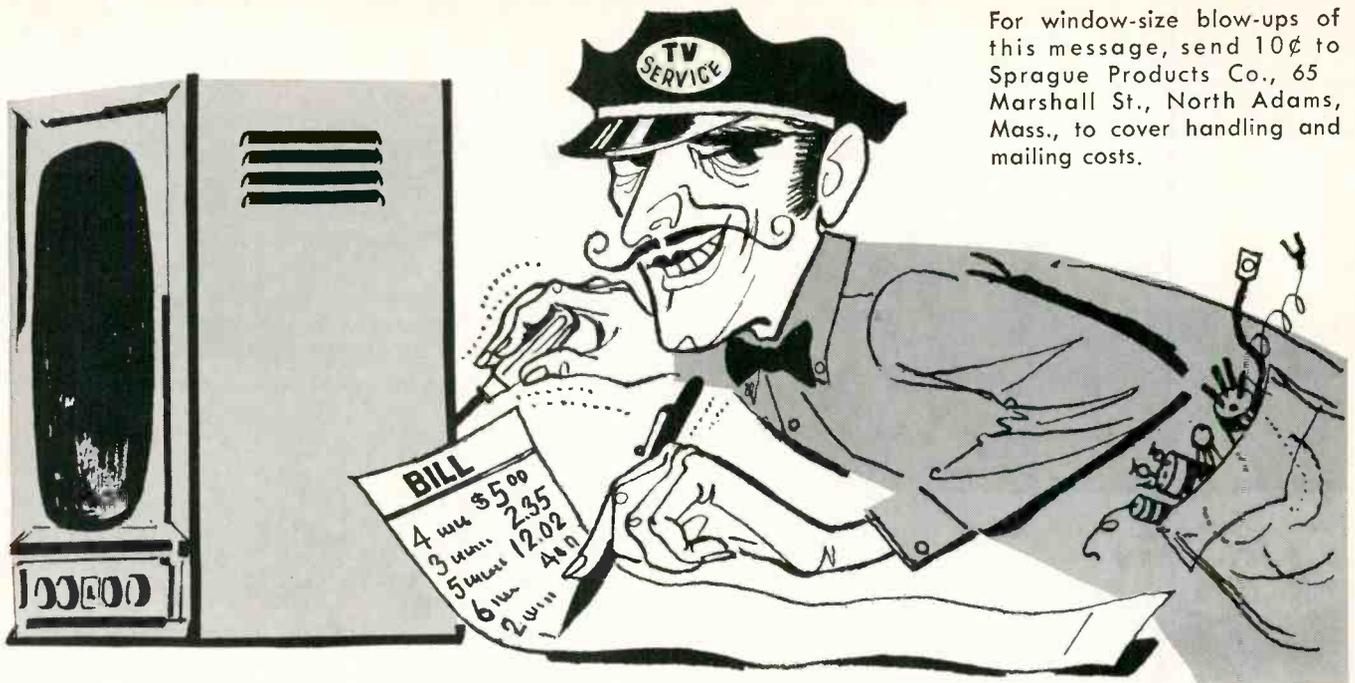
FRANK CARINGTON
Commerce City, Colo.

Have TEKFAK — Will Sell

Have old ETs from July 1961 to March 1964 and Circuit Digests (TEKFAK) groups 95 through 139 will sell. Also volumes 101 and 103 of schematics. Please make offer via ET.

DAVE HUDDLESTON
Fox Park, Wyoming

Like some other technicians, I’m getting up there and retiring. Have a full set of TEKFAK from No. 1 to 908 will sell. All filed in a portable metal filing case and indexed . . . Sell the



For window-size blow-ups of this message, send 10¢ to Sprague Products Co., 65 Marshall St., North Adams, Mass., to cover handling and mailing costs.

ARE TV SERVICE DEALERS GYPS?

Every so often, some magazine or newspaper sounds off about TV-radio service shops.

"Service technicians are a bunch of gyps," is the general theme. "They'll clip you if you don't watch out."

They might just as well write the same thing about doctors, lawyers, storekeepers, auto mechanics—or anyone else. There are gyps in every line of business. Actually the percentage in TV-radio is lower than in most.

The average service technician is a hard-working, straight-shooting individual. Rather than gyp customers, he is far more likely to spend more time on a job than he knows he will be paid for—simply as a matter of personal pride in doing things right.

We recently heard about someone's TV set going bad. A service technician called for it with his truck and returned it in good working condition within 48 hours. His bill came to \$10 for service plus \$2.68 for replacement parts.

The set owner argued that this was too much—yet he would never dream of complaining to the medical specialist who charged him \$10 for a 15-minute office visit; the lawyer whose bill for writing a simple will was \$75; or the garage man who laughingly admits that he charges \$5 for "just raising the hood" of a car.

In one of our very large cities, the Better Business Bureau received fewer than 500 complaints about serv-

ice in a year. Most of the complaints came from folks who expected first-class reception in doubtful fringe areas; who tried to operate their sets without suitable antennas; or who had bought sets "wholesale" at ridiculously low prices from cut-rate dealers who could offer little or no service.

Actually, it takes almost as long to become a good service technician as it does to train for any other profession. Beyond this, it calls for regular study to keep up with the constant stream of new developments. Also, it requires a surprisingly big investment in test instruments, manuals, and other shop equipment. The modern TV or radio receiver is by far the most intricate piece of equipment the average person ever owns or uses.

Service technicians are not fly-by-night businessmen—99 out of 100 run their businesses properly. The other one per cent—the gyps—can usually be spotted a mile away. Nine times out of ten, they are the shops that feature "bargain" prices and ridiculously liberal service contracts. And their victims are generally set owners who expect to beat the game by "getting something for nothing."

Good television sets or good TV service are not things to be bought on a "bargain counter" basis. Set owners who recognize this aren't likely to get gyped.

Instead, they'll find that they get more real value for their television entertainment dollars than for any other dollars they spend!

THIS MESSAGE WAS PREPARED BY SPRAGUE PRODUCTS COMPANY,
DISTRIBUTORS' SUPPLY SUBSIDIARY OF SPRAGUE ELECTRIC COMPANY, NORTH ADAMS, MASSACHUSETTS, FOR . . .

YOUR INDEPENDENT TV-RADIO SERVICE DEALER

65-123-63

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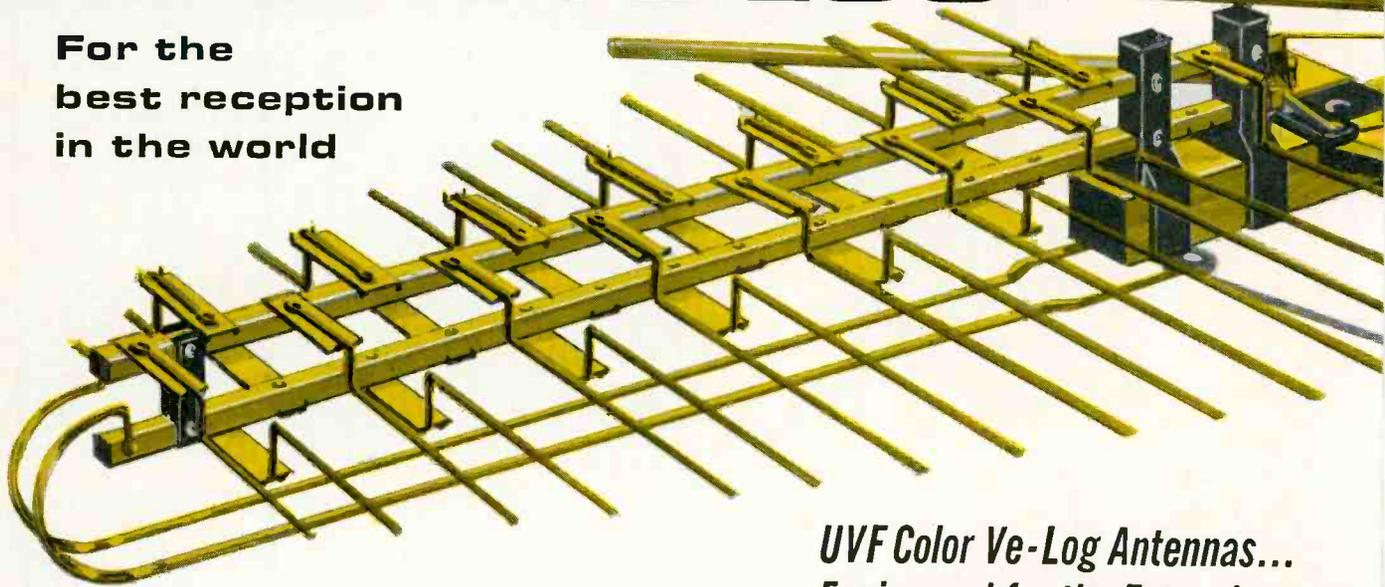
A major breakthrough in

FINCO ALL-BAND

UHF • VHF • FM

"COLOR VE-LOG"

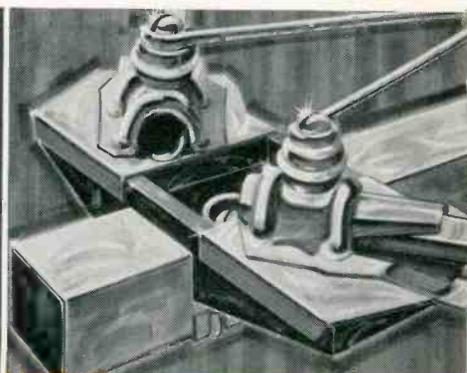
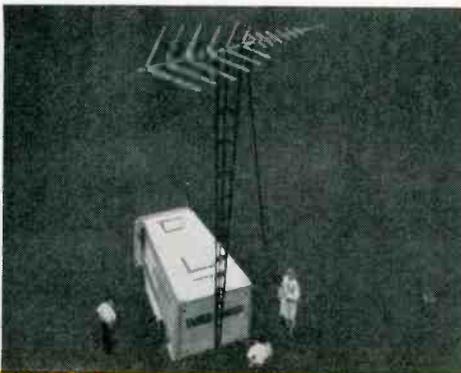
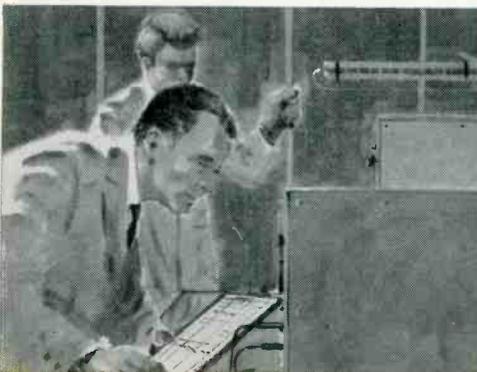
For the
best reception
in the world



Finco's new All-Band Color Ve-Log Antenna does the work of three—gives startlingly clear black and white pictures and beautiful color on **both** UHF and VHF television channels. Its superlative design also assures the finest in stereophonic and monophonic FM sound reproduction. Comparison tests have proved the superiority of the All-Band UVF Series—superiority backed by Finco's guarantee of supremacy and unquestioned warranty.

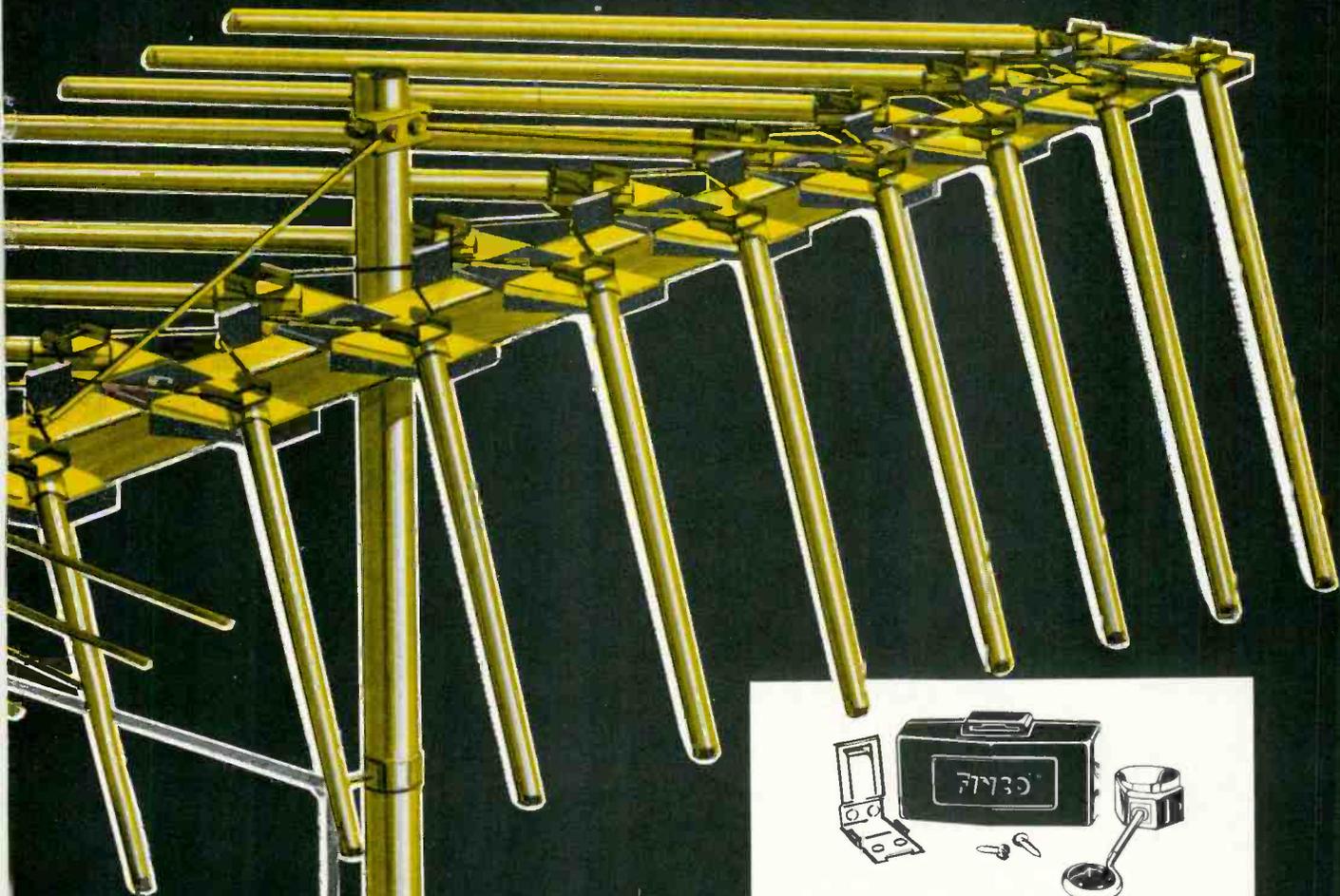
UVF Color Ve-Log Antennas... Engineered for the Future!

- Revolutionary new UHF Section
- Heavy Aluminum reinforced insulator insert cup and heavy duty rivet
- Back-up bracket and square boom
- Finco's exclusive triple thick sleeved elements
- Lock-tite no-tilt saddle bracket
- Finco's exclusive double contact to drive line
- Continuous one-piece drive line and exclusive air insulated polystyrene cross-over spacer



Write for beautiful color brochure Number 20-322 and Coupler-Splitter Specification sheet Number 17-2308G

Antenna design!



Finco Model
UVF-24

For Near Fringe and
Deep Fringe Areas

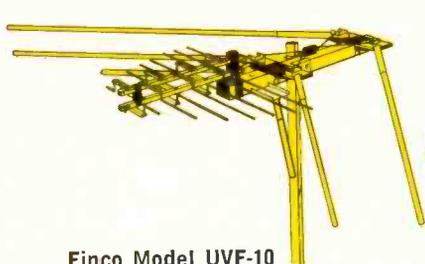
- 15 UHF Elements
Channels 14 thru 83
- 9 VHF Elements
Channels 2 thru 13
- FM Monaural and
Stereophonic
List \$59.95



For maximum performance use these
FINCO VHF - UHF - FM Coupler-Splitters

Model 3014	
UHF-VHF Coupler-Splitter	\$4.25
Model 3017	
UHF-VHF 2 Set Coupler-Splitter	6.95
Model 3018	
UHF-VHF-FM Coupler-Splitter—Low Loss	8.95
Model 3019	
UHF-VHF-FM Coupler-Splitter—Strong FM Signal	5.50

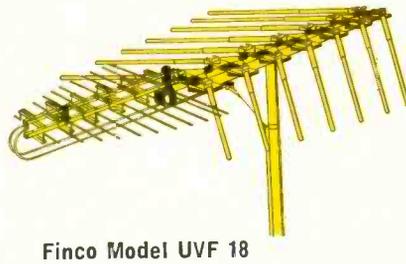
Featuring Finco's Exclusive Gold Corodizing



Finco Model UVF-10
For Metropolitan Areas
List \$18.50



Finco Model UVF 16
For Local and Suburban Areas
List \$30.50



Finco Model UVF 18
For Suburban and Near Fringe Areas
List \$42.50

Prices and specifications subject to change without notice

The FINNEY Company • 34 Interstate Street • Bedford, Ohio

Dept. 110

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247 WAYS TO MAKE MORE

From now on, color-TV work is going to bring in a bigger and bigger part of your income. And RCA has EVERYTHING to make color-TV service MORE PROFITABLE for you.

To save you money and manhours.

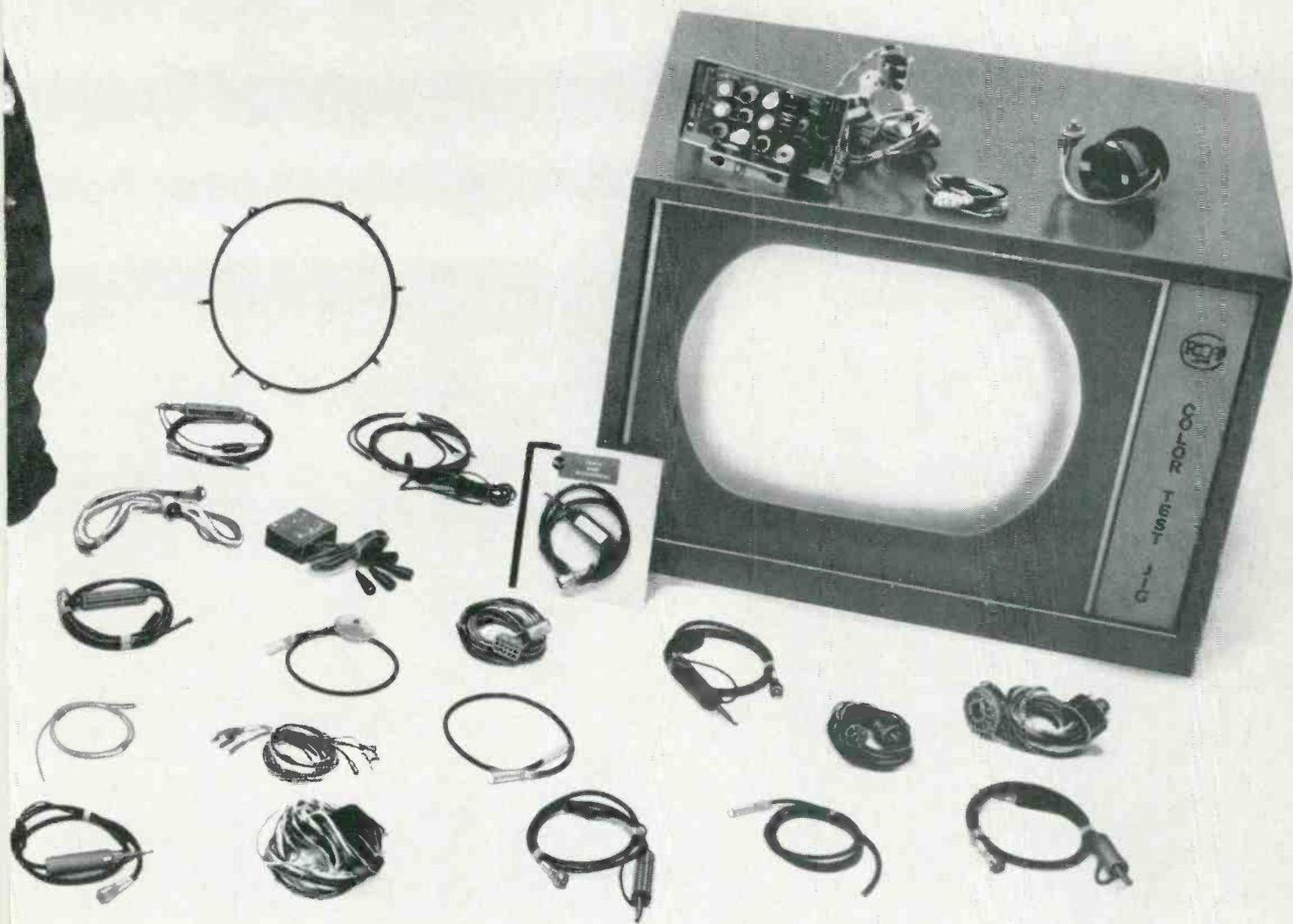
To increase your efficiency so you can get more jobs out in the same time.

To eliminate those time-wasting extra phone calls and trips to the distributor.

Take the famous RCA Color-TV Test Jig (large unit at right). *It cuts manhours in half* on a color house call. With-

out it, when you have to pull a set into the shop, it takes two men. With it, it takes just one (you pull the chassis only—leave the color tube and the cabinet). That means MONEY ... extra money for you.

Take the RCA Color Parts Rack (large unit at left). The rack is FREE when you buy the basic complement of 120 most-needed color service parts. Keeps your color parts neatly organized, all in one place. Simplifies restocking, lets you know what you're short of. No more running out of a vital part just when you need it—which slows down a job.



MONEY IN COLOR-TV SERVICE

That means MONEY... *extra money for you.*

Take the other color service parts arrayed in the photo and listed at right. Degaussing coils, transformers, chokes, yokes, connectors, cables, replacement parts... each with a special function to save you time, to increase the quality and accuracy of your work, to help you cut down on call-backs. That means MONEY... *extra money for you!*

245 specialized color service parts in all. The Rack and the Jig make it 247. And all of them mean MONEY... *extra money for you.*

RCA PARTS AND ACCESSORIES, DEPTFORD, N. J.



The Most Trusted Name in Electronics

RCA Parts and Accessories for color-TV service include:

Color Test Jig—to test all RCA color-TV chassis • *Color Parts Rack*—sturdy, well-organized unit containing complement of 120 most-needed color-service parts • *Degaussing coils*—to demagnetize picture tube and chassis • *Special-purpose extension cables*—to extend kinescope socket, deflection yoke, convergence magnet and kinescope high-voltage leads when chassis is removed from cabinet for servicing • *Special alignment probes*—video detector test blocks, IF test blocks, sound detector test blocks, mixer grid matching pad, tuner IF input head • *High-voltage interlock plug*—to by-pass high-voltage shorting switch • *Plus sockets, transformers, fixed and variable capacitors, reactors, resistors, diodes, switches, coils... EVERYTHING to save you time and make more money for you in color-TV service.*

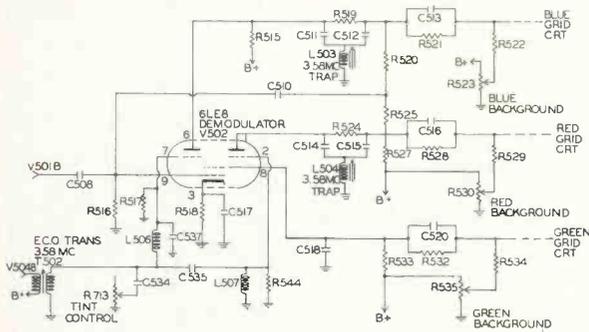
TECHNICAL DIGEST

ADMIRAL

Color TV Chassis G11 — Color Demodulator — Circuit Description

Demodulation of the chrominance information is accomplished by one tube (6LE8) and its associated circuitry. The output signals, namely, the R-Y, G-Y and B-Y are applied directly to the respective control grid of the picture tube. The 6LE8 provides amplification of all three signals.

To better understand the operation of this multi-function stage, let's first examine the 6LE8 tube. We must con-



sider the two plates as being two separate tubes, each having a separate suppressor grid. The control grid and cathode are common to both tubes as indicated by the drawing. The left-hand section of the tube is the B-Y demodulator while the right-hand section is the R-Y demodulator. G-Y signal is developed at the screen grid (Pin No. 8). We, in effect, then have a third plate, this plate of course being Pin No. 8.

Chrominance and high frequency information from the bandpass amplifier is applied to the control grid (Pin No. 9). The 3.58 Mc reference signal is applied to the suppressor grids (Pin No. 7 and No. 2). The phase shift network provides approximately 90 deg phase shift between the two reference signals. During color this 90 deg phase difference in the signals at Pin No. 7 and Pin No. 2 allows only one-half of the tube to conduct at a time. This action results in the reproduction of the B-Y signal at Pin No. 6 and the R-Y signal at Pin No. 1.

The G-Y signal which is developed at Pin No. 8 is a result of several things. First of all, we must realize

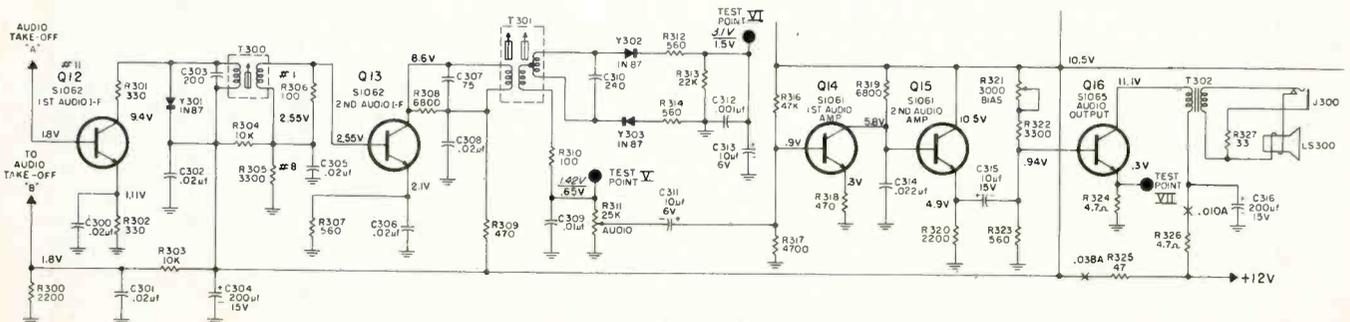
that the signal when developed at Pin No. 8 will be a result of a change in the amount of current flow to the screen. This change in current will change the screen voltage and a varying signal will result. Current flows from cathode to Pin No. 8 because of the positive voltage on Pin No. 8. When the plates (Pin No. 1 and No. 6) are alternately attracting electrons from the cathode, less will go to the screen. This decrease in screen current raises the screen voltage. During the period that Pin No. 6 stops attracting electrons and Pin No. 1 is not yet attracting them, the electrons will be attracted to the screen grid. This increase in screen current will lower the screen voltage.

An additional factor is also important in the reproduction of the G-Y signal. This is feedback from the B-Y and R-Y demodulator plates to the control grid (Pin No. 9). This feedback network is made up of R520, R525, and C510. Matrixing takes place between the B-Y and R-Y which is the equivalent of $-(G-Y)$ being applied back to the grid. All of these things combined result in the full G-Y signals redeveloping at Pin No. 8. Adjustable traps are provided in the 6LE8 plate circuits to remove the 3.58 Mc component.

GENERAL ELECTRIC

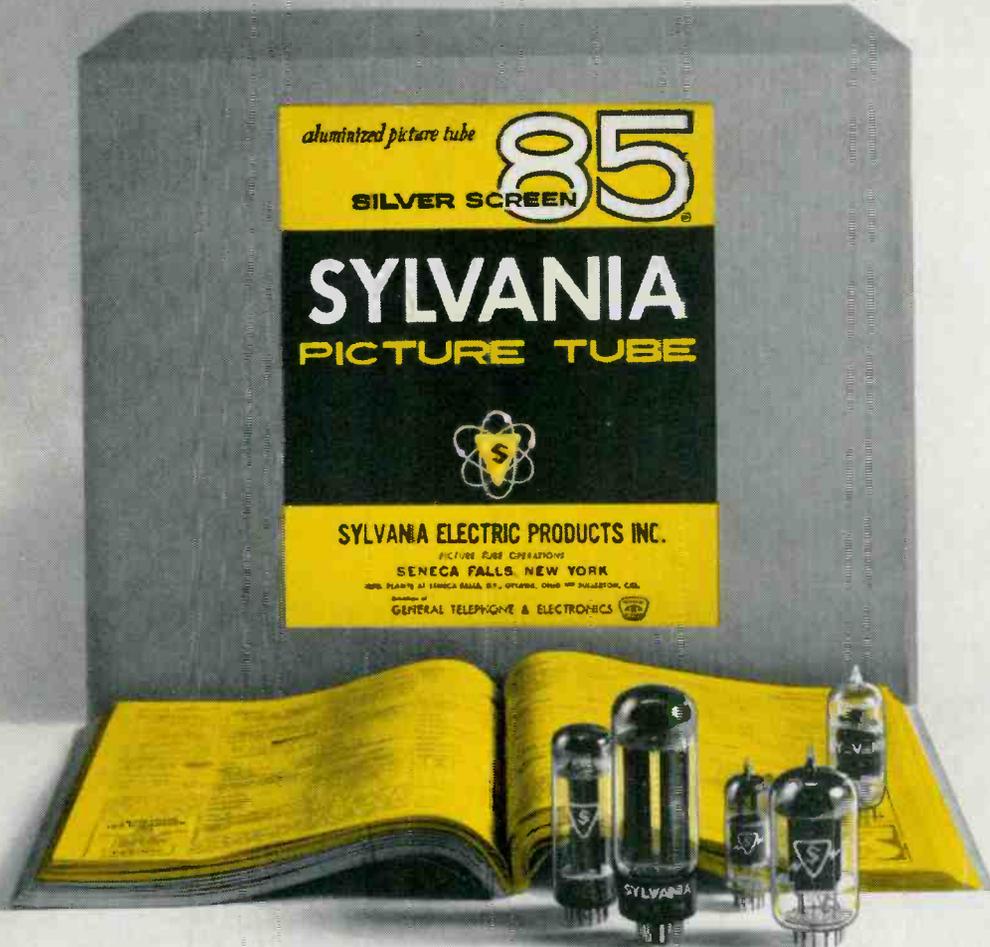
TV Chassis TA — Sound IF, Ratio Detector and Audio Stages — Circuit Operation

First Sound IF Amplifier: Q12, an NPN silicon transistor, is the first sound 4.5 Mc IF amplifier. The signal from the secondary of T108 is connected to the emitter-base junction which is forward biased by the voltage obtained from the dividing action of R300 and R303. The collector-base junction is reverse biased through the series connection of R301 and the primary winding of T300. The amplified 4.5 Mc FM sound signal appears in the collector circuit of Q12 across the primary winding of T300. This same signal is inductively coupled to the secondary winding of T300 which is connected across the emitter base junction of Q13. The germanium diode Y-301 limits the amount of 4.5 Mc signal that can be developed across the primary of T300. It also tends to suppress any ac variations that might be present in the



Audio stages of General Electric TA chassis

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customers that you sell the dependable line of radio and TV tubes, including famous SILVER SCREEN 85® and *color bright 85®* picture tubes.

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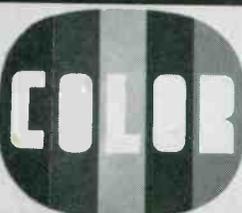
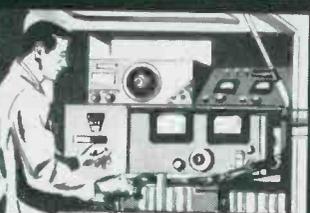
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TECHNICAL DIGEST

form of spikes or noise. The purpose of R302 is to stabilize the 4.5 Mc amplifier, thus preventing it from oscillating. C302 filters high-frequency ripple from the B+ line which may be present because of Y301 conduction. C300 is the emitter bypass.

Second Sound IF Amplifier and Ratio Detector: Q13 along with its associated circuitry serves as the second sound IF amplifier. The emitter-base junction is forward biased by the voltage obtained from the dividing action of R304 and R305. The collector-base junction is reverse biased through the series connection of R309 and the primary of T301. The primary of T301 is tuned to 4.5 Mc, the center frequency of the second FM signal. The amplified 4.5 Mc FM sound signal is inductively coupled to the secondary winding of T301.

The ratio detector, Y302 and Y303, is similar to and functions in the same way as the ratio detectors used in previous receivers. Signal from the secondary of T301 is applied to the two germanium diodes Y302, Y303. The detected audio signal is developed across C309 which also provides some de-emphasis of the high frequencies.

First and Second Audio Amplifiers: The audio signal developed across C309 is fed through the volume control R311 and coupling capacitor C311 to the base of Q14, the first audio amplifier. Base bias is developed from the voltage divider R316, R317. The emitter resistor R318 maintains a constant input impedance between the base and ground. If the emitter were grounded, differences in parameters of replacement transistors would change the base-to-ground input impedance.

The collector of Q14 is directly coupled to the base of Q15, the second audio amplifier. This is possible since Q15 is connected in an emitter-follower configuration with a high input impedance at the base which matches the output impedance of Q14. R319 is the common load resistor for Q14 collector and Q15 base. C314, like C309, de-emphasizes the high frequencies. R320 is the emitter resistor. Since Q15 is an emitter-follower, it has a voltage gain of less than one. Q15 is a power amplifier supplying power to the audio output stage.

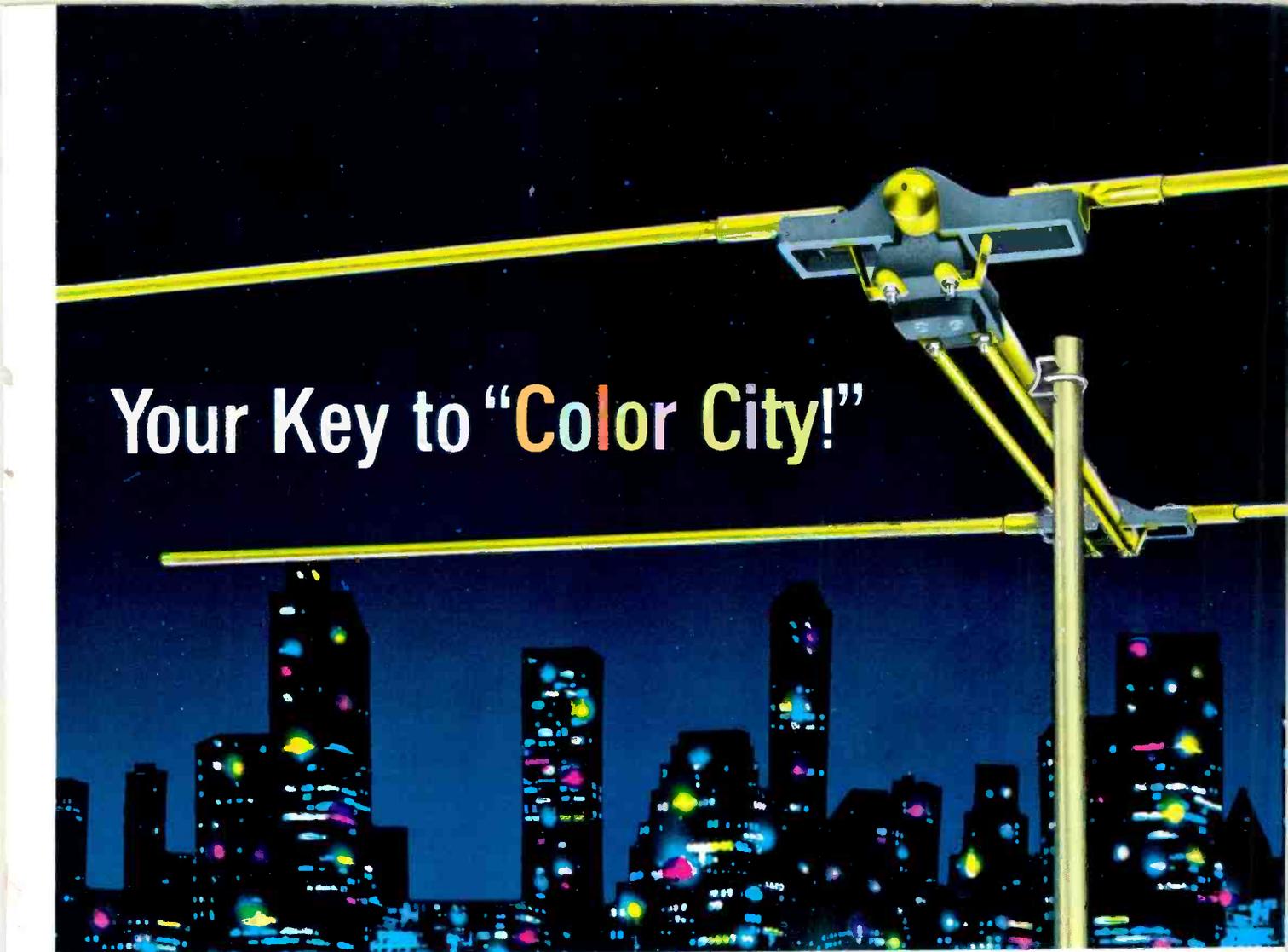
Audio Output Stage: The audio output stage uses a NPN silicon transistor, Q16, as a power amplifier. Its emitter-base junction is forward biased through the voltage dividing action of R323, R322 and the bias potentiometer R321.

It is important that this stage operate as a class A amplifier. It should be noticed that test point VII provides a convenient check point for emitter current. The voltage drop across the 4.7Ω emitter resistor, R324, is measured and current calculated. Without signal, the stage is adjusted for class A operation by rotating the bias potentiometer until +0.3 v can be measured across the resistor. The +0.3 volt across R324 indicates approximately 65 ma of emitter idling current.

The P-P audio current through T302 and Q16 is quite high. Therefore, the RC filter circuit consisting of R326 and C316 is used to prevent these peak audio currents from modulating the +12v supply.

R327 limits the power supplied to the accessory earphone which may be plugged into J300.

LS 300 is a 2¼ x 4 in. loudspeaker with a voice coil impedance of 8Ω. It is mounted on the left chassis side panel.



Your Key to "Color City!"

Model 3110-G

A new kind of ghost-killing antenna. Tailored to the Color Age. With a Power Equalizer Circuit that makes every other so-called metropolitan color antenna look pale by contrast.

Color is going over the top this year. More color sets than ever are being sold.

Ghosting—not gain—is the big problem in metropolitan areas, of course. And ghosts are even more trouble in color than in black-and-white.

Channel Master's Coloray licks both reception problems handily. It's honestly unique. Why? Because it's the most powerful antenna ever designed to knock out ghosts and interference—in black-and-white and color. It has a revolutionary Power Equalizer Circuit (which provides higher front-to-back

ratio than 10-element yagis cut to each specific channel). Thus its ghost-killing power in color is extraordinary. Obviously ghosts in black-and-white are a pushover.

What makes us so cocksure? Thousands of installations throughout the country. Time after time, they've proved the Coloray's ghost-killing ability. And in places where all other antennas have failed.

The Coloray puts the key to "Color City" in your hands. Use it to open the door to tremendous new sales.

- Front-to-back ratios up to 30 to 1.
- Protected by exclusive E.P.C. "Golden Overcoat."

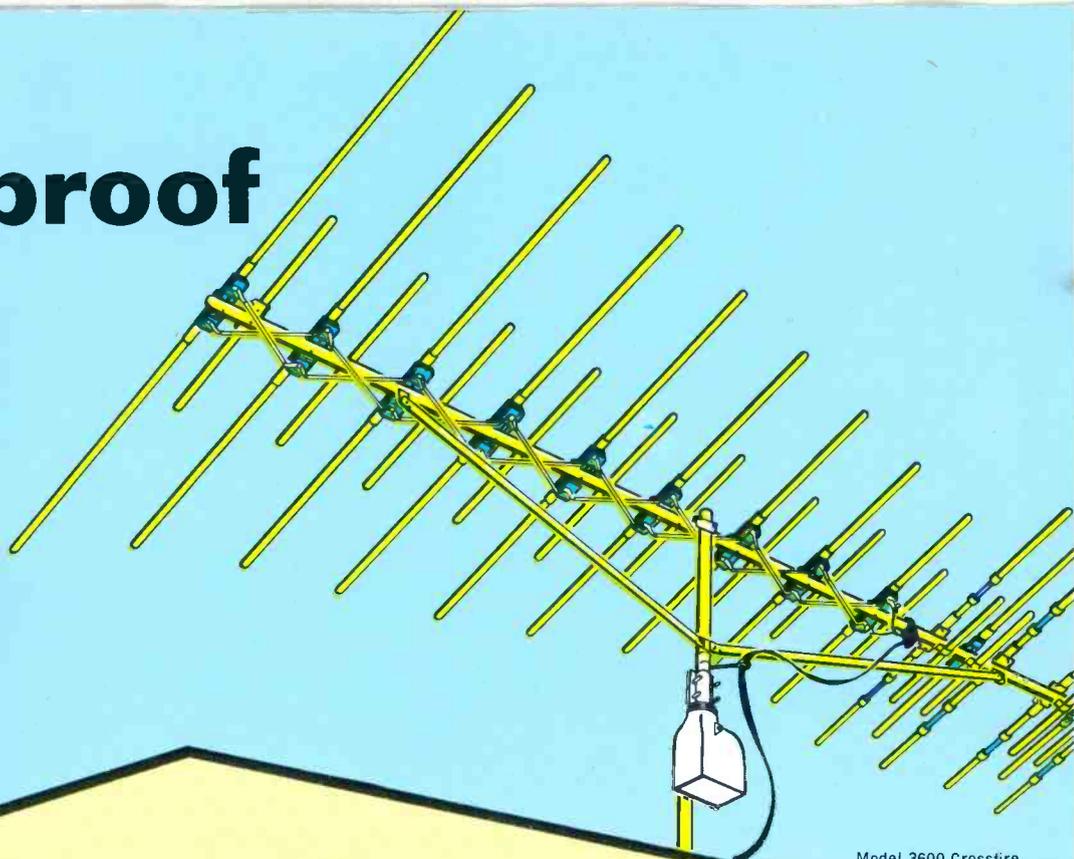
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The proof is on the roof!



Model 3600 Crossfire
28 elements

***CHANNEL MASTER* Crossfire** **outperforms, outlasts, and outsells** **every other antenna in the history of TV.**

In America's suburbs...fringes...far fringes...in COLOR, black-and-white, FM/stereo

People spend upward of \$350 just so they can enjoy color TV.

So doesn't it stand to reason that they would want the antenna that is capable of bringing out the best in their color set?

Sure it does. That's why... from metropolitan areas on out... the most powerful broadband antenna you can sell is the Channel Master Golden Crossfire. For both color and black-and-white.

By actual count, there are more Crossfire installations in America than any other antenna. The Crossfire, in fact, is the largest-selling antenna in the world. Why?

Proportional Energy Absorption! The Crossfire alone employs this unique principle. Because it

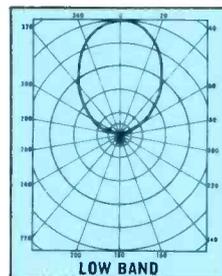
has more driven elements working with greater efficiency than any other antenna... it delivers the highest antenna gain of all time. On each high band and low band channel—and FM Stereo.

No color "suckouts" or dips! Flat gain. Perfect impedance match assures absolute minimum of variations on each channel.

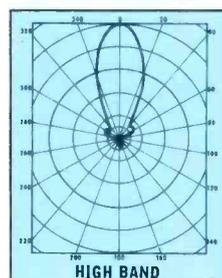
Outlasts all others! Super-rugged design and construction means extra durability. Exclusive E.P.C. "Golden Overcoat" protects against corrosion.

For color and for black-and-white, cover your market with the Crossfire—and you color your cash register green.

Clean Gain, too!



Extremely high front-to-back ratios... up to 16:1 on each band.

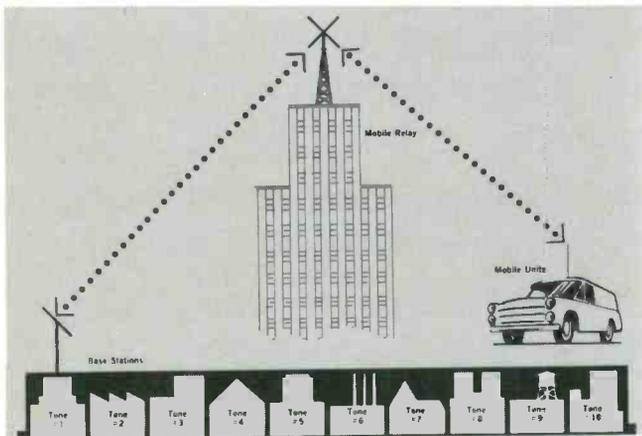


To fit every area need... Channel Master makes a complete line of Crossfires (including one with a built-in booster). Plus a complete line of super-powered Booster-Couplers... and Super-Torque Rotators (automatic and manual).

In-Band Repeater Expands 2-Way Radio Range

■ Installation of a UHF in-band shared community repeater system has greatly extended the reliable operating range for ten Chicago area FM mobile communications system users.

The single antenna for the shared repeater system is located on a tower 334 ft above ground, an important factor in the extension of operating range and the reduction of the effect of tall buildings on reception reliability. The economics to each subscriber are considerable according to Norman A. Sholseth, sales manager for Hallicrafters, who manufactured the equipment.



Repeater system designed by Hallicrafters

The system, owned and operated by Transurban Electronics Corp., is completely automatic, according to a firm spokesman.

Calls between an individual subscriber's base and mobile units are monitored by a tone coded call system. All receivers for a particular user are equipped to respond and "open up" when triggered by a specific additional overriding frequency tone gathered by a transmitter operated by the subscriber. Receivers for other subscribers are not triggered and thus remain silent.

The in-band community repeater system, with tone coded calling, in effect permits multiple usage of the same frequencies while reducing the volume of non-interest traffic for individual users. The only stipulation as to usage is that before any base or mobile transmission is made, the sender is required to monitor the frequency to avoid interference with a transmission already in progress. This is done by momentarily turning the automatic tone call switch over to the OFF position. ■

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The old familiar twinlead, that worked pretty well for black-and-white TV, is hopelessly inadequate for color reception. When your customers complain about changes in color, ghosting, and smearing of pictures, chances are the fault lies squarely with the twinlead connecting the set to the antenna.

What's the answer? Jerrold announces the exciting Coloraxial TV Reception System—an absolute necessity for color, and also best for black-and-white and FM stereo. With Coloraxial, you can quickly convert any outdoor antenna to shielded coax operation. Installs anywhere in minutes, without need for standoff insulators or the fear of running near metal objects.

Your customers will welcome the predictable, perfect reception that's assured with a Coloraxial system. And you'll welcome the simplicity and profitability of a Coloraxial installation. Jerrold Coloraxial Kits give you everything you need for a quick, perfect job: 50 or 75 feet of sweep-tested, shielded RG-59/U cable with fittings already on; matching transformers for both ends of the cable—even Coloraxial (75-ohm) antennas and preamplifiers where the job calls for them.

Talk with your Jerrold distributor today about Coloraxial, or send coupon for complete information.

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New Inventory System

■ The time consuming process of taking inventory has been substantially reduced by a new method employing one instead of two persons. The system employs the Norelco "Carry-Corder 150," a lightweight (3 lb), cordless tape recorder.

According to Lee Rocke, president of the Newhope Corp., sales reps for Centralab, who developed the system, "inventory taking in our distributor warehouses is a vital part of our service. But it was a time consuming, two-man job — one man to count the stock and another to write it down.

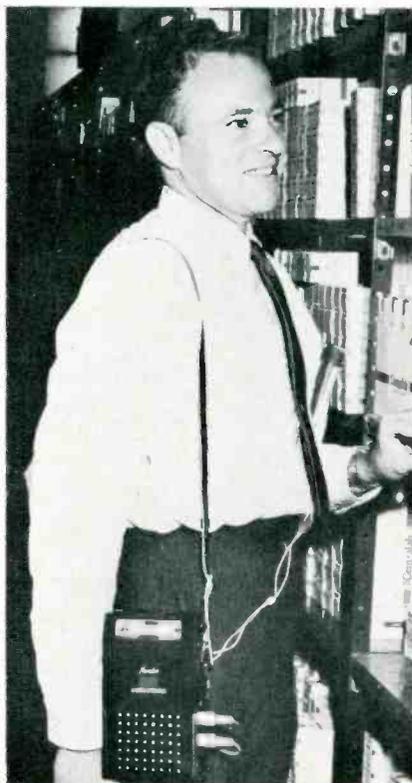
"Today, by using a portable tape recorder, the job requires only one man. And he gets it done in less time than it took two men by the old method," he added.

With the Norelco unit, the inventory taker merely snaps a tape cartridge in the machine, flicks a switch and goes down the shelves calling out part numbers and quantities of stock. He can go as fast as he likes.

Not only does this save actual man hours but it enables the company to maintain its sales pace by not having to bring a man in from the field and away from his normal selling responsibilities, says Rocke. In the past a salesman would be brought in for a full day to assist in taking inventory.

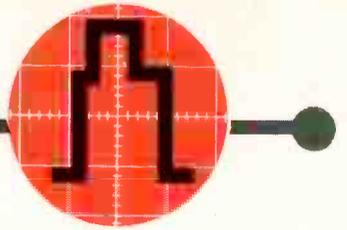
Additionally, the new method provides greater accuracy.

At the end of the inventory taking, the cartridges are marked and sent back to the office. The information is then transposed to an actual inventory sheet. The cartridge system not only insures simplicity and speed of operation but it also protects the tapes from accidental unwinding or other damage. The tape cartridge also is a positive record in case questions arise about the inventory and, at the next inventory time the cartridges can be reused. ■



Norelco portable tape recorder being used to take inventory.

SYNC ON BUSINESS



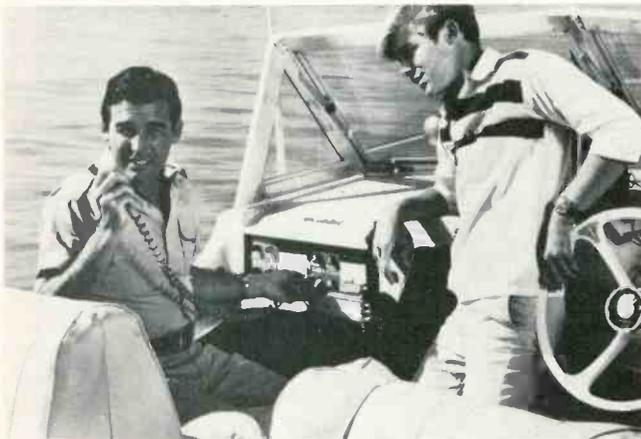
A repeating sound motion picture projector can tell your product story or sales message on a 10 in. screen in full color or black and white. An all silicon transistor amplifier gives undistorted sound from a whisper to audi-



torium volume. The unit weighs only 17 pounds. Film can be repeated without removing the magazine. Provides up to 22 minutes of color and up to 40 minutes of B/W film. Made by Electronic Audio-Visual Devices.

An average of 570 records were played by music lovers in the U.S. in 1964, according to Jensen Industries. The Beatles were the most played records, the survey indicated. A query also showed that 85 percent of the phonograph owners could not recall the approximate date that they had changed their phono needle last.

Pleasure-boat two-way radio is high-lighted in NBC TV's "Flipper" series. It's by Pearce-Simpson. Photo



shows Brian Kelly, (left who plays part of Porter Ricks, chief ranger of the Coral Key Park on the Florida Keys) communicating with a shore station as Luke Halpin, "Sandy," looks on.

A free wrench kit, ideal for radio and TV service work, is waiting at your distributor, according to Sarkes

Tarzian, Inc. It comes with the purchase of a special silicon rectifier package being offered at \$9.95 net. According to the company, the rectifiers would cost \$10.41 if purchased separately.

A four by five ft double-face vertical outdoor sign and a companion 15 x 50 in. single-face indoor sign, made



especially for promoting color TV, are available from Philco. A panel on the outdoor sign bears the dealer's name. At your Philco distributor.

Sound Reinforcement and the New Liturgy is an excellent booklet for public address system promotion. Is-



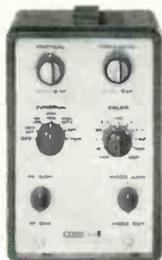
sued by Electro-Voice and available at your audio equipment distributor.

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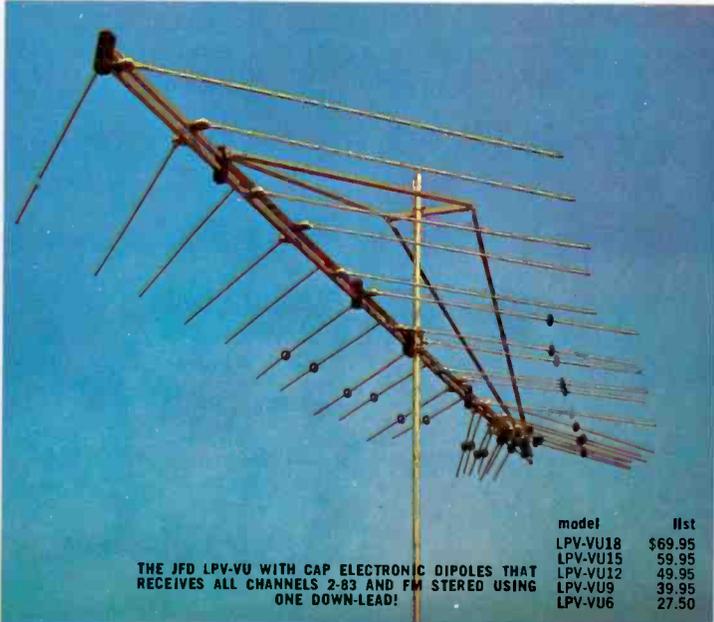
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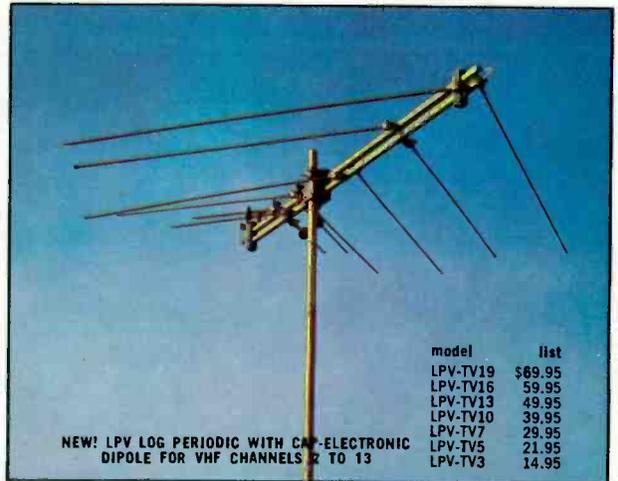


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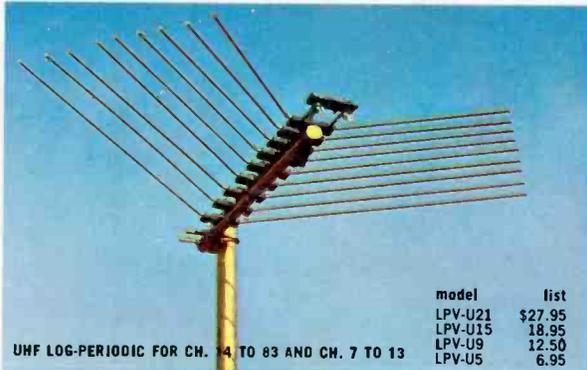
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NEW! LPV LOG PERIODIC WITH CAP-ELECTRONIC DIPOLE FOR VHF CHANNELS 2 TO 13

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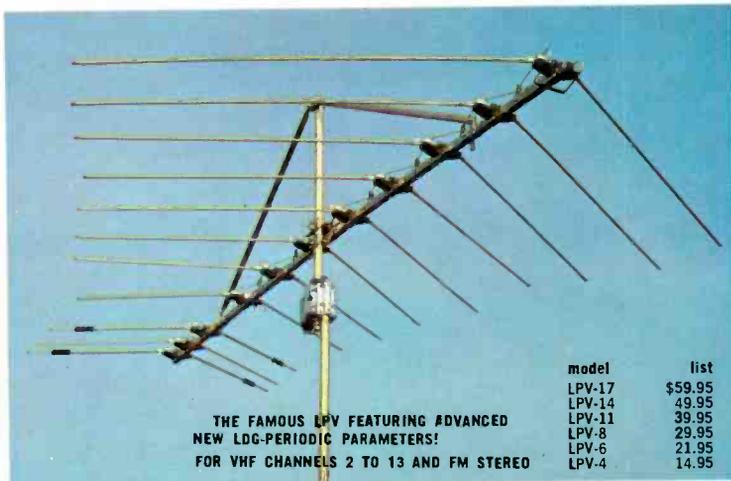
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ELECTRONIC TECHNICIAN

Basic Color Principles

Know your color TV fundamentals
and stay in the business

by K. L. Rivers

■ Those who fail to study and learn all about color TV will eventually fall by the wayside and ultimately face extinction in this business. Color TV will probably represent the major income potential for those who survive and who now concentrate on B/W TV.

To thoroughly understand color TV, it is necessary to learn all about basic color fundamentals of light and the capabilities of the human eye, for example. And these principles must be thoroughly digested if you ever hope to furnish the kind of color TV service that TV owners will be demanding in the future.

Light Spectrum

As we know, light waves exist in the electromagnetic radiation spectrum—the same as TV, radio and radar waves. But light exists at very high frequencies and has extremely short wavelengths. Light waves are measured in millimicrons. A millimicron is equivalent to one thousandths of a millionth of an inch. The wavelength of visible light, for instance, extends from about 400 to 700 millimicrons. Infrared light frequencies lie just below and ultraviolet light just above visible light frequencies in the electromagnetic radiation spectrum.

White light is composed of a continuous spectrum of colors, with red having the longest and violet the shortest wavelength (Fig. 1). The degree of sensitivity of the human eye to various frequencies of visible light is shown within the curve. As illustrated, the colors are pure, or spectral colors, and are seldom seen in this way. Colors appearing in nature are combinations



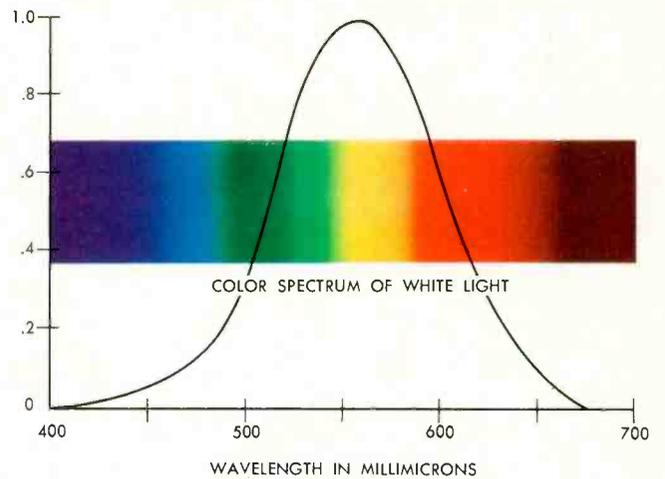
of these few so-called "pure" colors.

That white light is made up of all these wavelengths, can be demonstrated with a prism (Fig. 2). A white light beam passing through a prism goes from one transmitting medium to another — causing the beam to bend. Each individual light frequency has a different refraction index—causing each color to bend at a different angle. The lower frequencies — red, for example — do not bend as much as the higher light frequencies — in the direction of blue and violet. The color chart shown in Fig. 2 is somewhat distorted so a clearer presentation can be made. The bandwidth of each color has been shown nearly equal but actually some colors have a much narrower bandwidth than others. The process shown here can be reversed — the human eye has the facility to add all these wavelengths and "see" white light.

White light can also be obtained by using only three colors — one from the high frequency end of the spectrum, one from the low end and one from the middle area. This principle is applied in color TV.

Light Characteristics

A system has been established to define colors used in TV. It consists of three definite aspects of a color. *Brightness* is the total amount of light, regardless of color. *Hue* is the frequency of the color and *saturation* is defined as the *degree* of color purity. In color TV, hue and saturation are part of the *chrominance* signal and the brightness is sent as the *luminance* (B/W) signal.



↑
 Fig. 1—Frequency response curve of human eye across visible light spectrum. The eye is most sensitive to hues in the green-yellow area.

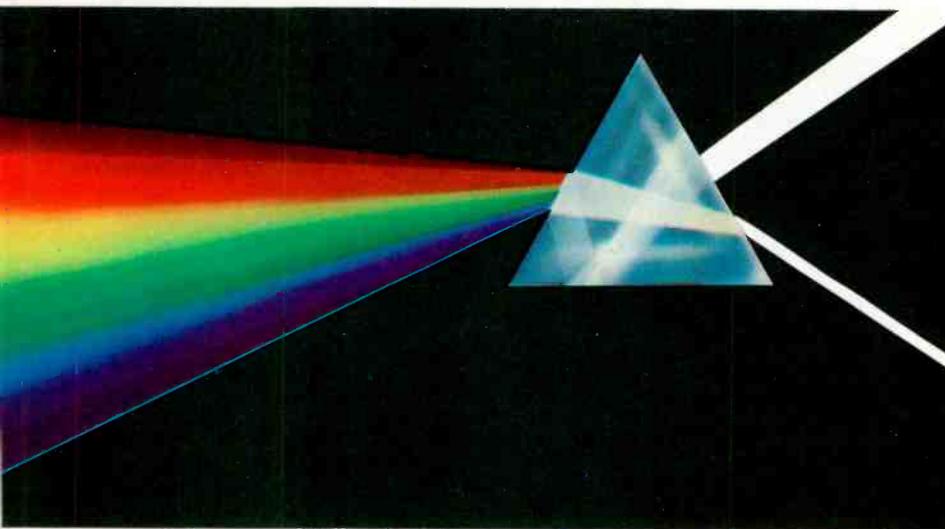


Fig. 2—A white light beam passing through a prism is divided into its component hues from deep red to deep violet.

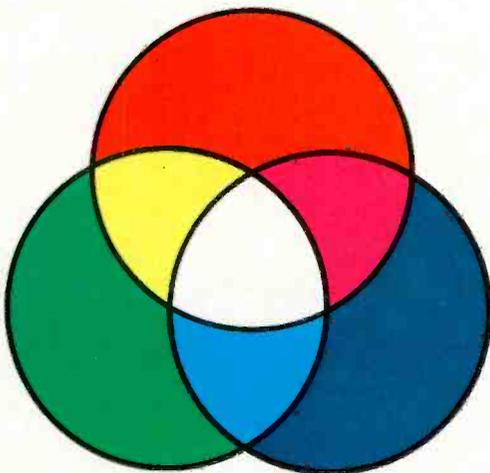


Fig. 3—When blue, green and yellow light are mixed in proper proportions, white light is produced. Where the red and blue beams overlap, a magenta hue is produced. Red and green mixes to produce yellow and blue and green produces a cyan hue. By varying the relative amounts of any two colors, various hues are produced.

Color Combinations

It is known that a combination of two different colored light beams will produce another color and that this color will be different than either of the other two. The color formed will appear as a complete color to the eye and neither of the original colors will be visible. But two colors limit the number of colors that can be formed. Addition of a third color greatly increases the number of available colors. In color TV, the three primary colors are red, green and blue. Experience has shown that combinations of red, green and blue offer the greatest selection of colors. When all three colors are mixed, the resultant is white and the combination of two individual colors produces additional colors (Fig. 3). Four or more primary colors could have been used with better color rendition but when we consider human-eye limitations it is found that three basic colors can produce a highly acceptable variety of colors.

As shown in Fig. 3, a combination of green and blue produces cyan. By combining red and green, we produce yellow and from a combination of red and blue we obtain magenta. By varying the amounts of

individual colors, almost any color the eye can detect can be produced.

The Eye

The human eye is a very complex organ but it has some limitations which are taken advantage of in the color TV system. Light rays enter the eye and the impressions created are transferred through the nervous system to the brain, producing color sensations for the individual. The eye reacts differently to each light frequency.

Some colors are more easily seen than others. The response curve (Fig. 1) illustrates the reaction of the eye to the various colors of the spectrum. The greatest sensitivity is experienced in the green-yellow region. This fact was also taken into consideration when compatible color standards were established. Unequal amounts of each primary color are used to make up the luminance (brightness) or "Y" portion of the color TV signal. In fact, 59 percent green, 30 percent red and 11 percent blue are mixed to obtain a monochrome (B/W) picture.

When viewing a color picture, the eye is unable to resolve fine color details. The larger the color area is in a picture, the easier it is for the eye to identify the colors. For these reasons only the larger areas of color information need be transmitted in our color TV system. The fine detail portion of the picture is included in the brightness part of the signal. The hue and saturation of only the larger areas are transmitted as a separate signal. Because of eye limitations, the color portion of the signal may have a narrow bandwidth. This portion of the signal is used to modulate a color subcarrier and both this and the brightness

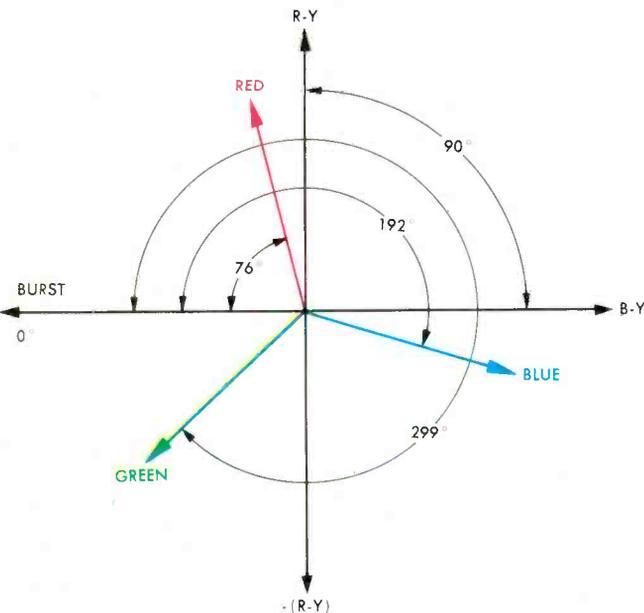


Fig. 5—Rotating vector diagram showing relationships of the three basic colors to R-Y and B-Y axes and phase angle relationships of the three basic colors from burst reference.

Fig. 4—Approximate range of printing inks compared to NTSC range of all hues and saturations with respect to white. Triangle indicates color TV chromaticity range.

signal are transmitted within the 6 Mc passband allotted to a TV channel.

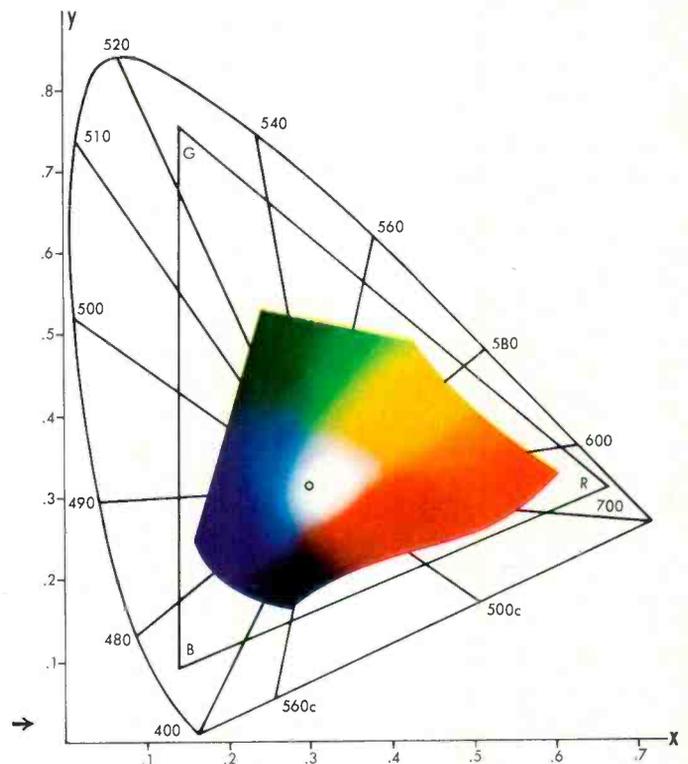
Chromaticity Diagram

A chart devised to easily obtain color mixing information is shown in Fig. 4. The wavelengths of the various spectral colors are indicated on the outer edge of the curve. Any point not on this curve but located within the diagram is not a pure color but a mixture of spectral colors. Pure white, a mixture of all colors, is located near the center of the color triangle. This color triangle, located within the horse-shoe shaped diagram, represents the range of colors we are able to reproduce in our color TV system by using the standard wavelengths of red, green and blue primaries. The wavelengths chosen as standard are 700 mμ for red, 520 mμ for green and 400 mμ for blue. Any color value not included in the triangle cannot be reproduced by any combination of the three primary colors chosen.

The chromaticity chart is plotted in values along an X and Y axis. Any color can be identified in terms of an X and Y value. For example, 0.5X plus 0.3Y would represent a shade of red. Any given color could be reproduced exactly by transmitting these X and Y values to another location.

Take the color triangle and cut a circle from the center and draw two intersecting axes with pure white at the point of intersection (Fig. 5). Label the axes B-Y and R-Y instead of X and Y. Now any color can be identified in terms of B-Y and R-Y. In actual color TV practice, the phase angle represents the hue of a scene and the amplitude of the resultant represents saturation.

ELECTRONIC TECHNICIAN will go deeper into this subject in forthcoming issues. ■



You and Color

■ The chrominance (chroma, or color) circuits of a color TV receiver are designed to process color information telecast by TV stations. Some changes have occurred in these circuits over the years, but basic functions remain the same: the circuits amplify, detect and mix in correct proportions the color signals sent out by the transmitting station.

The diagnose, isolate and repair approach of every skilled technician—mentioned in the introductory article of this series—(ELECTRONIC TECHNICIAN, page 60, March, 1965) also holds true for chroma circuitry. And the proper application of a color-bar/dot generator, scope and VTVM, should solve any service problem encountered in this area.

To effectively troubleshoot chroma circuits, however, you'll need to understand the basic operating principles of each section and the part each plays in the over-all color reproduction job. As shown in the simplified block diagram (Fig. 1) the chroma portion of a typical color TV receiver is composed of eight major circuits. The color burst, killer, etc., circuits are not shown here.

Before we proceed, however, to the essential functions of each block let's briefly recall, in a very simplified way at this point, that color information is interleaved between regular black-and-white information. This is done in a special way, primarily by employing a carefully established 3.579545 Mc (3.58) subcarrier placed near the high end of the video passband. This subcarrier is used to generate color-signal sidebands through a *two-phase* modulation system at the TV transmitter. In effect, two chroma components, having the same fre-

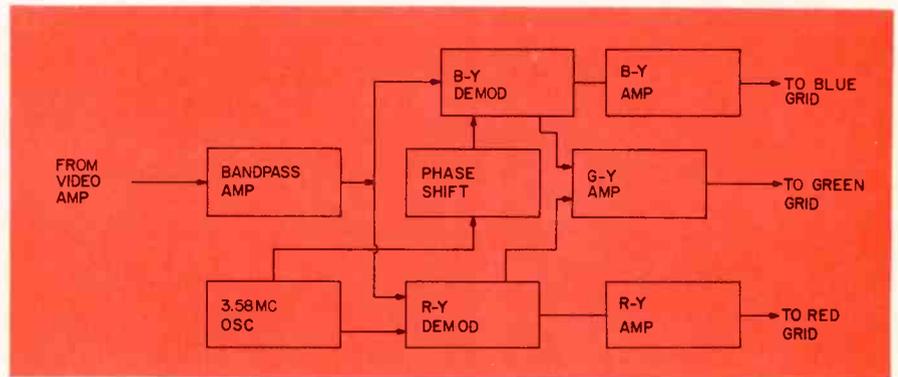


Fig. 1—Block diagram of chroma circuits of a typical color set.

quency, but displaced 90 deg out of phase, are produced. The two components are then combined into a single component which varies both in amplitude and phase. This system suppresses the 3.58 Mc subcarrier and transmits the chroma information as upper and lower sidebands. This will be discussed later in greater detail.

The primary purpose of our color TV chroma circuitry, in a few words, is to "decode" and separate color information from the composite video information—to reproduce a replica-scene on our color receiver's CRT—precisely like that televised in the transmitting station studio. But let's take a closer look at some of the circuitry involved in this process.

Bandpass Amplifier

Our color "decoding" process begins by taking a composite video signal from the video detector or first video amplifier output and applying it to a special bandpass amplifier. The bandpass stage (or stages) amplifies the chroma information contained in the 3.58 sidebands and filters out the unwanted monochrome (B/W) portions of the video signal. This stage is similar to most wideband IF amplifiers with adjustable input and output. It is normally tuned to a center fre-

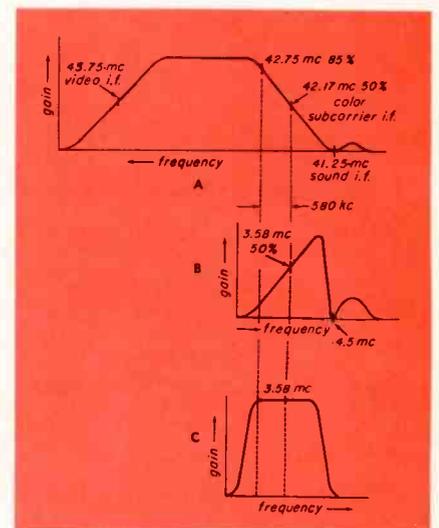


Fig. 2 (A)—IF response curve of a typical color receiver. (B)—Response curve of a color TV bandpass amplifier. (C)—Over-all chroma response of a color TV set.

quency of 3.58 Mc and is usually designed to pass a band of chroma signals approximately 1.2 Mc wide. This circuit has a tilted response with the curve dropping off at the lower frequencies. The amount of tilt necessary to compensate for the IF attenuation (Fig. 2A) of the higher color frequencies is shown in Fig. 2B. The resultant over-all response of the amplifier is shown in Fig. 2C.

Many bandpass amplifier stages

TV

Know how chrominance circuits work and make your shop the 'official color center' in your area

by Don R. Borden

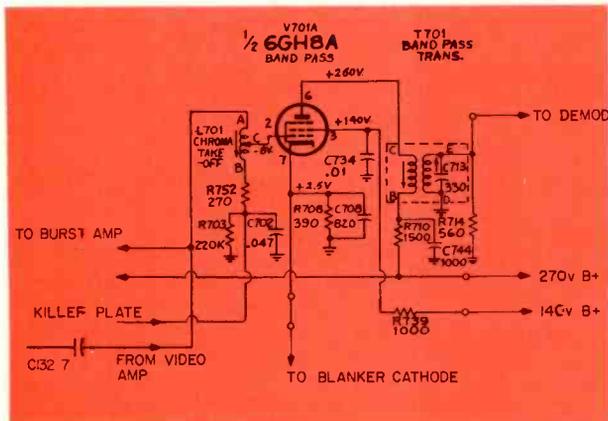


Fig. 3—RCA CTC 17 color chassis single stage bandpass amplifier.

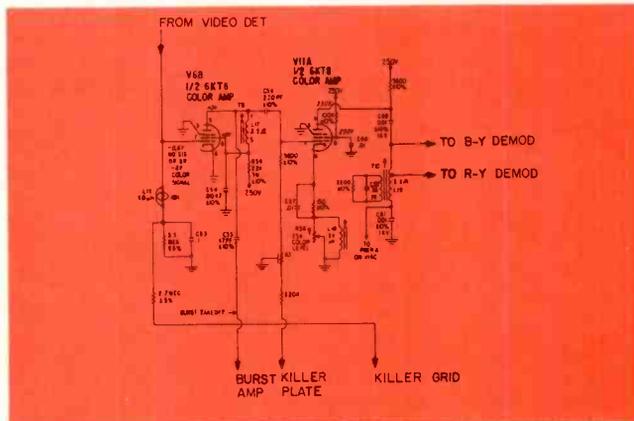


Fig. 4—Two stage bandpass amplifier used in Zenith 25MC30 television receiver.

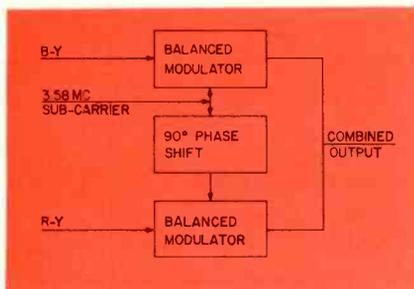


Fig. 5—Block diagram of a balanced modulator employed in a two phase modulation system.

in modern color receivers use ACC (automatic color control). ACC is similar to AGC in a monochrome receiver and its bias is dependent on the burst signal amplitude which is varied by the incoming signal level. The ACC voltage tends to make the color circuit's output independent of signal variations. But because individual color tastes vary, provision is made to manually adjust picture hue and saturation. The hue adjustment is usually accomplished in the color sync section. In most cases, saturation is adjusted by varying the bandpass amplifier gain.

A horizontal blanking pulse is also applied to the bandpass stage

to cut it off while the color burst pulse is being received. This prevents color information from appearing on the CRT during horizontal retrace.

A color killer circuit is also used to cut off the bandpass amplifier when B/W pictures are received. This prevents spurious noise from reaching the CRT. Without the color killer, noise would appear on the set's screen as colored dots or dashes—adversely affecting B/W reception.

Now let's look into the detailed circuit functions of an operating bandpass amplifier.

Single Stage Bandpass Amplifier

A single stage bandpass amplifier used in an RCA CTC 17 color chassis is shown in Fig. 3. Signals from the video amplifiers are coupled to the bandpass amplifier grid through L-701. The combination of this coil, the coupling capacitor, C132 and the interelectrode capacitance of the tube, form a tuned circuit which resonates at about 3.58 Mc.

The plate load, transformer T701, is double-tuned and has a response of at least 1 Mc. Output at the trans-

former secondary, consisting of 3.58 Mc sidebands, is applied to the demodulators through the color control. The set owner can vary the color saturation with this front panel control.

Besides amplifying the color sidebands, two other functions are performed in this stage: When color signals are absent, a negative dc voltage is developed on the color killer plate and fed through the decoupling network (R752 and C702) to the tube grid. This cuts off the stage and prevents noise from reaching the CRT during B/W transmission. High positive pulses from the blanker stage are also applied to the cathode—cutting the tube off during the burst interval.

Two-Stage Bandpass Amplifier

A two-stage bandpass amplifier used in the Zenith 25MC30 color receiver, for example, is shown in Fig. 4. The composite video signal is taken from the video detector output. After passing through a 4.5 Mc trap, this signal is coupled through a 7 pf coupling capacitor to the first color amplifier grid. This capacitor passes all frequencies above 3 Mc and blocks all lower frequen-

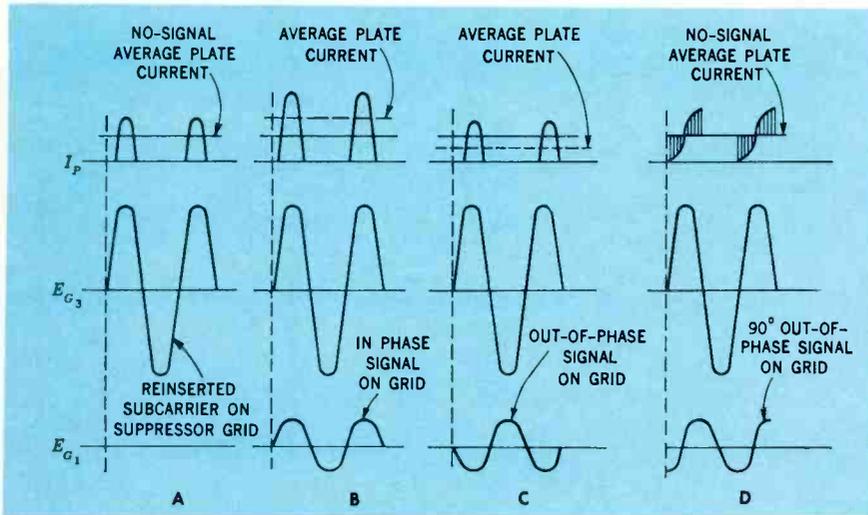


Fig. 7—Average plate current for various phase relationships of the two signals applied to a demodulator circuit.

cies. The 4.5 Mc trap prevents the 4.5 Mc sound frequency from affecting the color output. This frequency can cause an objectionable 920 kc beat interference on the CRT.

The single-tuned plate load (L17) of V6B and the double-tuned transformer (T10), are adjusted for the correct frequency response of the two stages. Coil L17, combined with tube and circuit capacitances, resonates near 3.1 Mc. T10, the plate load of the second stage, acts as a trap at 3.6 Mc — broadening the response in this area. The output of T10, going to one demodulator, is tapped. During transmission, color signals are reduced by unequal amounts to prevent overmodulation. This tap restores the two chroma voltages to equal amplitudes.

ACC action is introduced at the first amplifier grid. This is accomplished by tying the killer tube grid to the first stage grid. The voltage at the killer grid varies with burst-pulse amplitude. Thus, the amplifier gain varies with the strength of the burst pulses.

Maximum gain is obtained in the

first stage with a high gain pentode, a 6KT8, having no cathode bias. R36, a front panel control, varies the second stage gain. This control is used to adjust color saturation. Choke L18, in parallel with R36, prevents phase shift when the resistance is changed.

The second amplifier grid is connected through a decoupling network to the color killer plate. When B/W is being received, a high negative voltage is generated at this point. This voltage cuts off the second chroma stage during B/W reception.

During retrace time, blanking is accomplished by applying a positive pulse from horizontal discharge tube cathode through T10 to the demodulator grids. This causes the tubes to conduct heavily and lowers the plate voltage. This cuts off the CRT grids during horizontal retrace time.

Demodulators

Action of the demodulators can be described more easily by reviewing transmission principles a little more in detail.

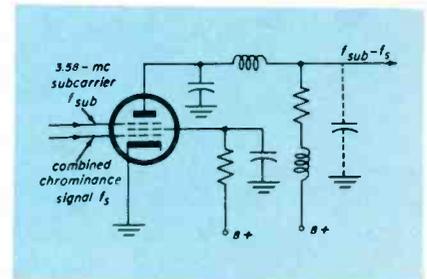
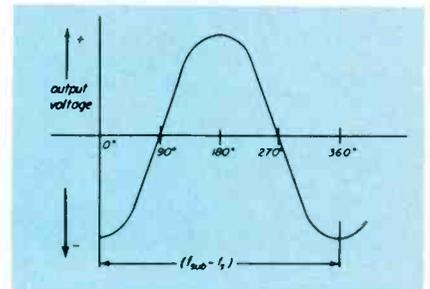


Fig. 6—Simplified diagram of a synchronous demodulator.

Fig. 8—Output voltage versus phase difference between color signal and 3.58 Mc signal applied to a color demodulator.



In developing compatible color TV standards, the National Television Systems Committee (NTSC) found it desirable to transmit color information in the existing 6 Mc wide channels without having to expand the bandwidth. In B/W transmission, video information appears in sideband clusters around the harmonic frequencies of the 15,750 cps horizontal sweep frequency. This leaves many open spaces in the frequency spectrum. These "holes" in the spectrum are used for transmitting color information by "interleaving" it between B/W video information. This is accomplished by shifting the horizontal scan frequency in color transmission to 15,734.264 cps, (vertical rate 59.94 cps) and choosing a subcarrier frequency of 3.579545, an odd multiple of one half of the horizontal sweep oscillator frequency.

The subcarrier chosen is modulated by balanced modulators with two different chroma signals, known as B-Y and R-Y. How these signals are produced will be detailed further in a forthcoming article. To simplify, for the moment, the theory of

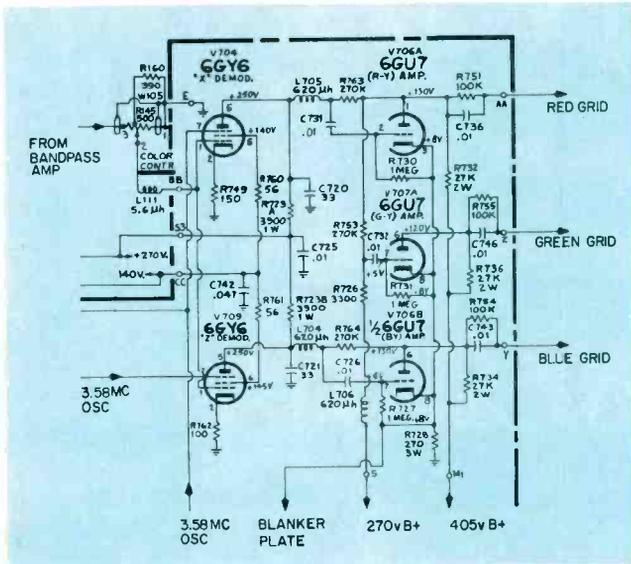


Fig. 10—Demodulator and color difference circuitry used in RCA CTC 16 color chassis.

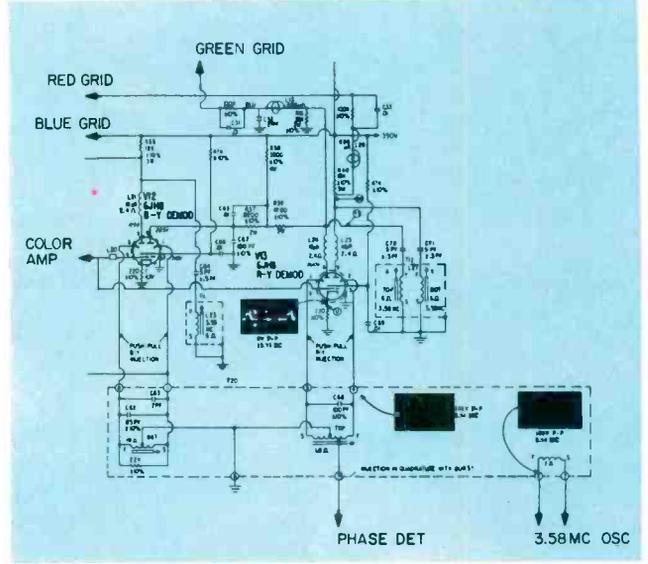


Fig. 11—High level demodulator used in Zenith 25MC30 color chassis.

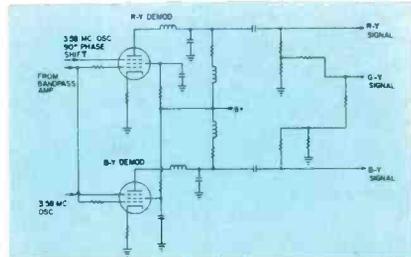


Fig. 9—A typical B-Y, R-Y synchronous demodulator.

balanced modulators (Fig. 5) we can say that the B-Y signal is applied to one modulator at a given time and the R-Y signal is applied to the other modulator at a different time (or difference in phase). Hence, we will have a series of sidebands of the 3.58 Mc carrier at each modulator output. The voltage at one modulator output lags the other by a given amount of time.

If we now synchronize the receiver with these signals, we then have a time base from which the receiver demodulators can operate. This sync information is transmitted in the form of a sharp burst pulse consisting of about 8 cycles of the subcarrier frequency. This pulse (color burst), when processed at the receiver, assures that the B-Y demodulator is operating when B-Y information only is present in the chroma signals and the R-Y demodulator is active when only R-Y information is present.

Outputs of the two modulators

are combined and the resultant amplitude modulates the main picture carrier. Without going into vectors at this point, the time relationship between the two signals is maintained during their path through the transmitter, through the air and into the receiver. The RF and IF stages amplify the composite signal containing the color components. The signal is detected and applied to the video amplifiers and on to the bandpass amplifier. The bandpass amplifier removes the brightness (B/W) components and prepares the color signal for the demodulators.

The signal at the demodulator grids is a duplicate of the resultant combination of the modulated B-Y and R-Y color information present at the transmitter. We are now interested in recovering the individual color signals. This is done by a circuit called a demodulator or decoder.

We recall that the time relationship between the two color signals is the same at the receiver as it is at the transmitter. If we can measure the resultant voltage at the same relative time (or phase) we will have a voltage at the B-Y demodulator plate varying at the same rate as the B-Y voltage at the transmitter. By the same token, the R-Y demodulator plate voltage will duplicate the R-Y voltage present at the transmitter. In effect, the de-

modulator stages do measure the resultant voltage at a prescribed time.

As the subcarrier was suppressed at the transmitter, it must be reinserted before demodulation can take place. The carrier is generated by a local 3.58 Mc oscillator. This oscillator is controlled by the pulse of sync information that was transmitted. This then duplicates the time (or phase) relationship that existed between B-Y and R-Y at the transmitter. Herein lies the key to proper color information decoding. The 3.58 Mc local carrier acts as a switching voltage for each demodulator tube. The tubes are switched on and off at the proper times. A phase shifting network is used to introduce a 90 deg phase (time) difference between the B-Y and R-Y switching voltages. This is called synchronous demodulation.

A simplified diagram of a synchronous demodulator is shown in Fig. 6. The resultant color signal is applied to the control grid and the 3.58 Mc subcarrier signal from the local oscillator is fed to the suppressor grid. A color receiver requires two of these circuits, one for each color difference signal.

Demodulator action can be explained with the aid of the wave forms shown in Fig. 7. The no signal condition is shown in Fig. 7A. With the subcarrier present on the suppressor grid and no signal

Continued on page 88



Tips on Color

by L. C. Powell

■ If you've been servicing color TV sets regularly for some time, you're thoroughly familiar with convergence, gray scale tracking, etc. But few of us are so good that an extra "kink" or two wouldn't be helpful at times.

I've been servicing color since the first sets trickled off the production lines. During that time I've picked up some tips that most technicians could use on house calls and on the bench almost every day. So, for what my experience is worth, here goes.

Blooming

Most color sets have a tendency to bloom near the end of their brightness control range. Some sets, however, bloom too early and the usable brightness range is limited to as little as a quarter of a turn.

The set owner is the first to complain of this and the last to understand that it's difficult to do anything about it because of a combination of set and CRT characteristics. But wait, it's not quite that bad!

Screen adjustments are the key controls in determining how much current the CRT will draw. This, in

turn, determines the point where the high voltage begins to bog down and the raster blooms. Consequently, if we can set the screens at a higher bias point, maximum brightness will then occur closer to maximum rotation.

Normally, the screen controls are set by placing the CRT bias switch to its highest position (minimum brightness) and then the screen controls are adjusted for proper cutoff. This is accomplished by first setting the service switch to SERVICE. You then turn all three screen controls to minimum. Each control is now turned up until the colored line is visible. And finally, each control is backed down again until the line just disappears.

If the highest usable brightness level occurs at too low a point it can be increased by following the same procedure — but the CRT bias switch must be set to its highest brightness position for set operation. If the maximum brightness level is not reached when the brightness control is set full clockwise, adjustments can be repeated with the bias switch in its center position for the screen control adjustments.

Gray Scale Tracking

The aforementioned screen adjustments are a part of the gray scale adjustments which gives us a B/W picture over the entire gray scale range. The drive controls also have an important part in the end result and technicians must know what to look for if optimum results are to be obtained.

The drive controls are normally set center-range while the screen adjustments are being made. After the screen adjustments have been completed, the drive controls are then adjusted to compensate for color tints in the picture highlights. If an IF tube is removed, the tint of the raster can be viewed without interference from noise or video, and by turning the brightness from a very low level to a high level, gray scale tracking can be observed. (Removing an IF tube is also a good idea when adjusting the screen controls.)

If the screen controls have been properly adjusted, low-level color should be gray. When the brightness is advanced to a high level, the screen should also remain gray. If it turns blue, then the blue drive

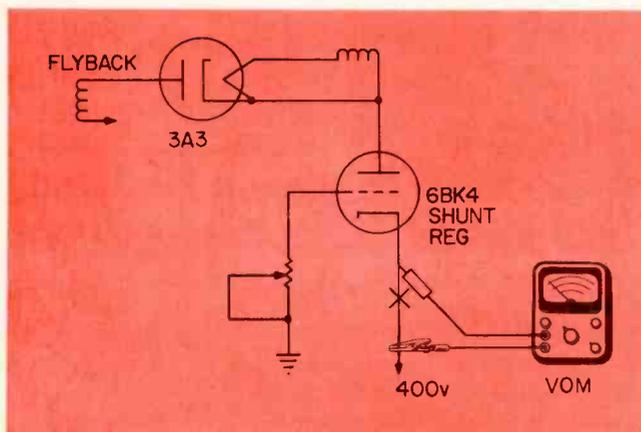


Fig. 1 — Current check on shunt regulator is important for 6BK4 shunt regulator tube.

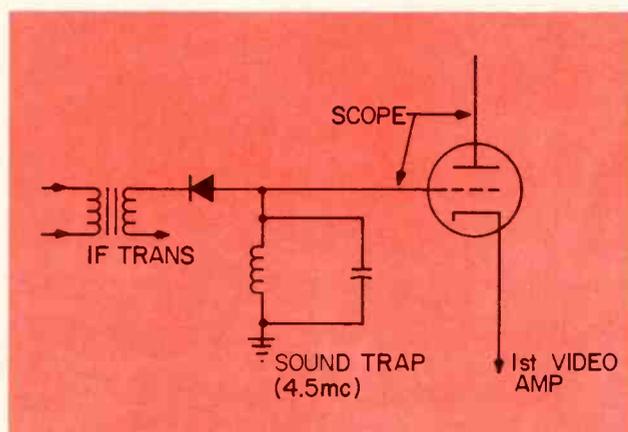


Fig. 2 — The 4.5 sound trap can be easily adjusted by observing the waveform on a scope at some point beyond the trap.

Servicing

Take a lesson from this old color pro —
he says experience is still the best teacher

control should be decreased. If the screen turns green, the green drive control should be decreased. Finally, if the screen turns red, both the blue and green drive controls should be increased.

Drive adjustments normally have little effect on the low brightness level screen tint but it should be checked after the drive adjustments. Dominant colors in the low level brightness should be counteracted by increasing or decreasing the appropriate screen control slightly.

Purity

Getting a good clean red screen can be a mighty tough job on some sets. And the 25 inch sets are even tougher than the 21s. Generally, a little more care in each of the normal steps will get you a little closer to the purest possible screen.

One of the most overlooked steps is degaussing. Now that automatic degaussing is available, some technicians have eliminated this step entirely from their set-up procedure. This will not give the most desirable results. In fact, it may be totally impossible to get a reasonably pure screen without first degaussing.

Those who remember the difficulty in obtaining purity on early color sets should have little trouble adapting themselves to the 25s. For best results these sets should be degaussed as usual — whether or not they have automatic degaussing — on both the inside and outside of the cabinet. This may seem like superfluous motion but it will get you better results in most all cases and in some cases will make the difference between acceptable and unacceptable pictures.

Purifying the 25s also calls for some of the "yoke-cocking" associated with early sets. It may seem to take three hands at times to hold

the yoke in a cocked position while you tighten it but, quite frankly, you have no choice. At present all rectangular tubes are more critical than the recent round tubes and it may take twice the time to set them up until you get used to the new "quirks."

High Voltage and Focus

Setting the high voltage properly and getting the best focus are two problems which bother technicians as much as any other. Interestingly enough, they are very closely related because, with improper high voltage, attaining good focus will be virtually impossible.

The high voltage on most sets should be 24 kv. On some new sets 25 kv is specified. The high voltage should never be less than 1 kv under the specified figure; that's less than 5 percent tolerance. Understanding this, you can see why it's very important that your meter is accurate. If you use a multiplier-type probe on a general-purpose VTVM, have it checked against a good electrostatic high voltage meter if at all possible.

Too much high voltage is rarely a problem. About the only faults generated by too much high voltage are frequent shunt regulator high voltage rectifier failures and insulation breakdown. Manufacturers' recommended procedures for high voltage set-up includes a current check through the shunt regulator (Fig. 1). This should not present a problem unless an error is made in procedure.

It will not be possible to obtain good focus unless the high voltage is properly set. And even when the high voltage is properly set, the focus may change slightly with brightness adjustments. To mini-

Continued on page 84

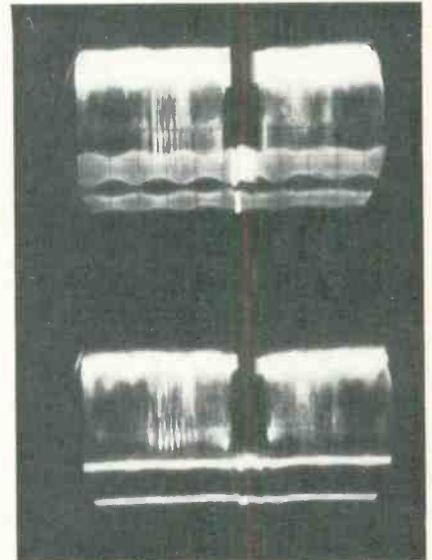


Fig. 3 (Top) — 4.5 Mc trap misadjusted, showing RF in waveform. A test pattern with a 400 cps tone was used as a signal. (Bottom) — The same signal with the trap properly adjusted for minimum 4.5 Mc RF.

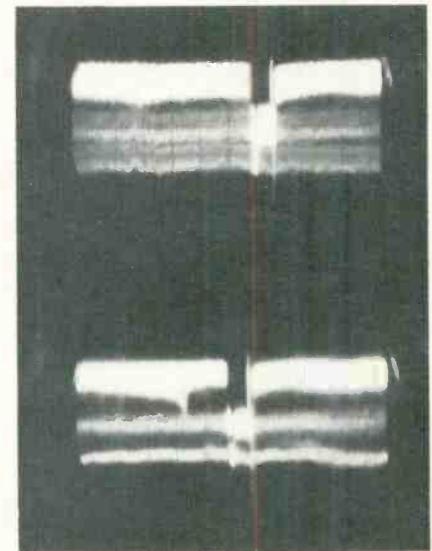


Fig. 4 (Top) — With conventional signal from the station and showing 4.5 Mc trap misadjusted. (Bottom) — Properly adjusted 4.5 Mc trap using station signal.

Spray It... Renew It!

Use these inexpensive service aids properly and speed your troubleshooting and repair work

■ Aerosol-type service aids — cleaners, cleaner-lubricants, high dielectric coatings, refrigerants and solvent-lubricants — are modern, chemical spray-can products that do a consistently effective job when used properly and they save valuable service time; which is the same thing as money. We can speak knowledgeably too of some liquid plastic cements although not packaged in aerosol cans. All are used by most successful service shops we have observed in recent years.

But some technicians have complained that prices are generally too high on these products. Actually, when used properly, they pay well and the relative cost is nominal. In some cases, the "high cost" complaint arises from over-application and waste. In other cases these products have been selected indiscriminately — the incorrect product being used on a given job. Most products conform to military specifications and state-of-the-art developments.

Aerosol-type spray-can products may be roughly divided into five categories as follows: cleaners, cleaner-lubricants, dielectric coatings, refrigerants and solvent lubricants.



No Noise Tape-Reco by Electronic Chemical Corp.

Cleaners

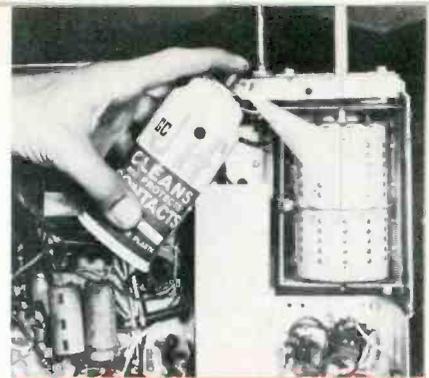
This group can be subdivided roughly into three presently available types. No doubt other types will be developed for additional specific purposes. One product is designed to remove oxide and tape lubricant deposits from tape recorder heads and another has been developed for cleaning and reducing "static" build-up on TV safety glasses, CRT face-plates, cabinets and phonograph records. The third item is a "dry" hand cleaner containing lanolin and germ-killing non-irritating chemicals. Some brand names include: **Glass-Mate**, **Kleen-Vue**, **Lens-Kleen**, **Mark-N-Glas**, **Mask-Glas** and **No-Noise Tape-Reco**.

Cleaner-Lubricants

This category can be subdivided into a number of somewhat similar products, some recommended for specific purposes by their manufacturers. The various products may be used for cleaning and lubricating electrical contacts—contacts that oxidize and develop semiconducting surfaces — preventing normal electrical contact. Applications include TV tuner contacts, carbon potentiometers, relays, multi-band switches, push-button assemblies and many others. All products are exceptionally economical and effective — when applied with a quick "swish" by momentarily pressing the can's push-button. Some brand names in this area are: **Clean-and-Quiet**, **Contact Kleen**, **De-Ox-Id**, **EC-44**, **Hush**, **Jif**, **Kleen**, **Kleen-Tune**, **Merit-Lube**, **No-Noise**, **Ox-Nox**, **Quiet-role**, **Spra-Kleen**, **Trol-Aid**, **Tun-O-Lube** and **Shield**.

The aforementioned cleaner-lubricants are not all formulated the same and some contain oils with solvents, some are siliconized.

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No Arc by Chemtronics, Inc.
Clean and Quiet by GC Electronics.

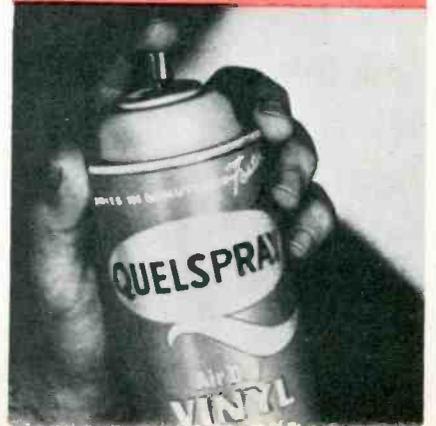


Spra-Freeze by W. E. Metzler Co.



Plasti Patch by Colman Electronic Products, Inc.

Quelspray by Quelcor, Inc.





Transistor Circuit Fundamentals

Eliminate functional details, understand basic operation and make your troubleshooting and repair jobs easier

by William R. Ganglinger Jr.

■ Many technicians successfully repair tube-type TVs and radios without knowing precisely how an electron tube operates. They know only that an increase in tube grid voltage causes increased conduction with a consequent lower voltage on the plate and vice versa — when there's sufficient voltage on the plate and a closed loop exists through the tube's cathode. And it is doubtful if a good benchman will ever find it necessary to consult an expert on space charges.

Simplified Approach

Transistor theory has been complicated by volumes of text material focusing on the physics of operation (primarily useful in solid-state design and manufacturing). Transistor knowledge has been additionally complicated by manufacturing transistor types that operate similarly, but which have opposite polarity power voltages.

I have been confused many times while engaged in design work and in troubleshooting. Hence, I have found it necessary to develop a system to keep the "little devils" in line and help me remember what to expect in the way of circuit voltages which appear on NPN or PNP types.

NPN/PNP

First, let's understand what NPN and PNP means. It will not be necessary to go into the atomic struc-

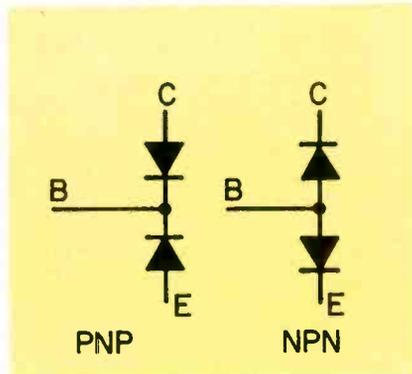


Fig. 1—A transistor is equivalent to diodes wired back to back.

ture of these units; we'll assume, as scientists do, that certain things are relatively true. To begin with, we'll assume that current flow is the reverse of electron flow. And we'll stick to "current flow" in this discussion to eliminate a more complicated discussion of "hole" theory.

Electrically, a transistor is equivalent to two diodes wired back to back. This is shown in Fig. 1. The NPN is shown with its "plates" tied together at their junction and the PNP is shown with its cathodes tied together. Now, although this is a long way from being a transistor, it is all we need to know about its construction. Actual transistor symbols are shown in Fig. 2. Note that the arrows in the transistor symbols point in the same direction as the diode equivalents.

Now let's see how a transistor must be wired in a circuit to work

as an amplifier or as an oscillator.

In either an NPN or a PNP transistor, the lower diode — the one equivalent to the transistor's emitter junction — must be forward biased and connected so the current flows easily through it. The top diode must be reverse biased. In other words, it must be connected so current will flow only through it by leakage. (See Fig. 3 and 4).

Normally, the emitter junction — the lower diode — is forward biased by only 0.2 v or so. And this is an important measurement. This bias is measured from the emitter to the base. If the applied voltage forward biases the diode more than 0.2 v the transistor will be saturated. If the voltage is less than 0.2 v the transistor's emitter junction may be cut off or tend to cut off on signals which drive it in that direction.

Polarities

Since you've read this far you are probably wondering about the polarity difference for NPN and PNP transistors and how you can tell the polarity of various biases applied to the transistor. It's very simple. We know that the emitter junction is always forward biased and the collector junction is always reverse biased. *This is true for both NPN and PNP transistors.*

Now here's a trick to remember which will help you to determine which type transistor should be con-

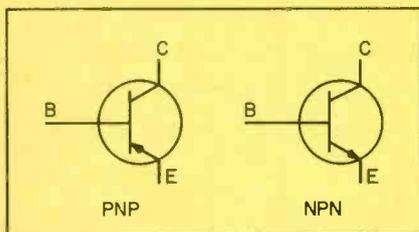


Fig. 2—PNP and NPN transistor symbols.

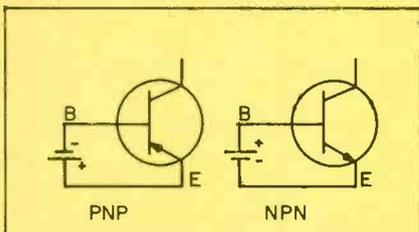


Fig. 3 (above) Fig. 4 (below) shows how PNP and NPN transistors are biased.

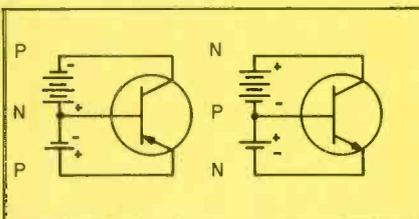
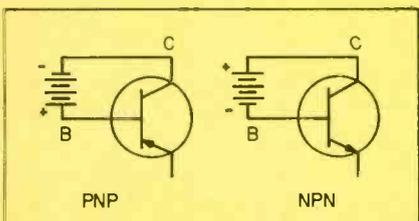


Fig. 5—Basic biasing of PNP and NPN transistors.

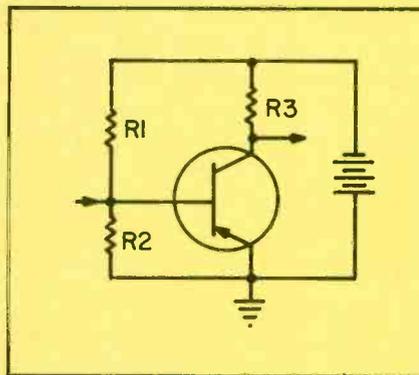


Fig. 6—Common emitter circuit.

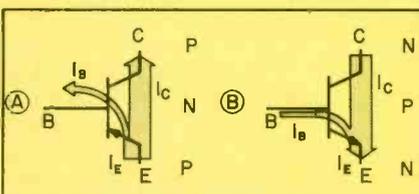


Fig. 7 (A)—A large percentage of the emitter current flows in the collector circuit of a PNP transistor. (B)—Similar flow in an NPN transistor.

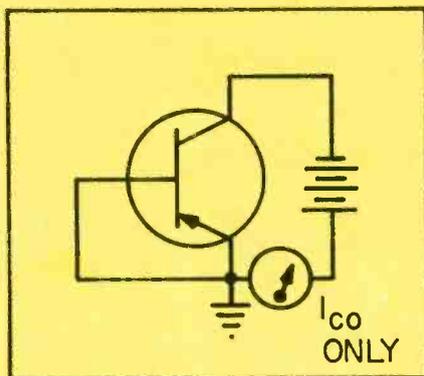


Fig. 8—Even with voltage on the collector it is reverse biased. Leakage current flows through the collector with the base at the emitter potential only.

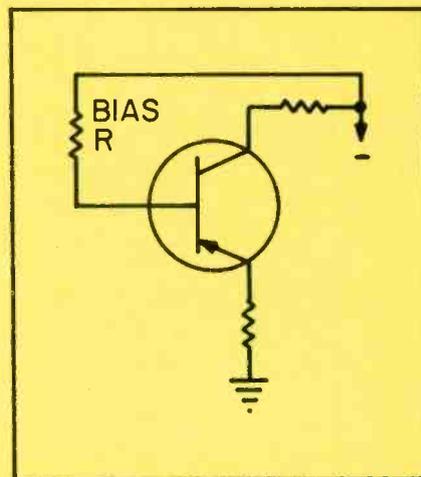


Fig. 9—Simple biasing system.

connected to a positive voltage supply and which is connected to a negative voltage supply. We only have to look at one transistor junction at a time. When the N section of the junction is connected to a negative voltage and the P is connected to a positive voltage, the junction is forward biased. (N for negative P for positive)

By applying this to a PNP transistor in a normal circuit configuration we can see that if the emitter is grounded, a small negative voltage will have to be applied to the base and the collector voltage will also be negative. (Remember, the collector junction is reverse biased.) The circuits for both PNP and NPN transistors are shown in Fig. 5.

Now let's see how this is done in actual practice. The circuit shown in Fig. 6 is a common emitter circuit which is analogous to the common amplifier or grounded cathode tube circuit. Note that only one battery is employed and that R1 and R2 form a divider to set the base at its proper bias level.

With the proper forward bias, current flow in the collector emitter circuit is very heavy. A small percentage of the emitter current flows in the base lead. In most transistors, more than 95 percent of the emitter current (which is controlled by the base bias) flows in the collector circuit. This is shown in Fig. 7. Fig. 8 demonstrates that even though the collector has normal potential on it, it is indeed reverse biased. With the base at

the emitter potential, only leakage current flows through the collector.

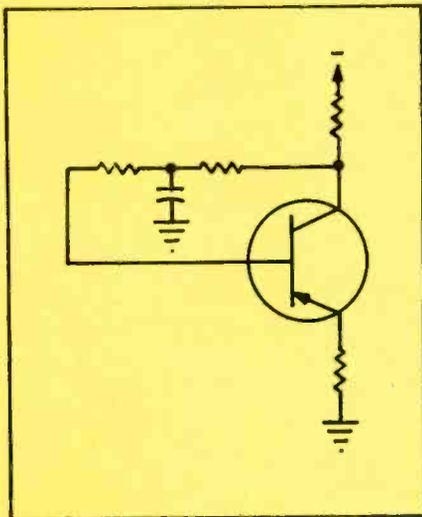
Bias and Stabilization

Even when proper voltages and polarities are applied to transistor elements, the transistor will not function properly unless the voltages are *proportioned* properly. This is the job of the biasing network. Biasing networks are in several forms but the purpose of each is the same: to maintain operating voltages which will allow the transistor to operate linearly over the desired range and under normal signal conditions without being driven into cut off or into saturation.

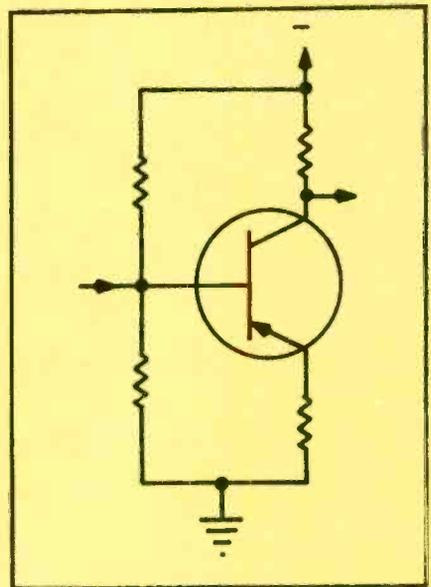
A stable network must be chosen as well since drifting biases can cause changes in the output linearity, amplitude, etc. Even more important, slight bias changes can cause an increase in collector current which raises junction temperature, in turn causing a further increase in junction temperatures and greater collector current. This type of feedback (thermal runaway) eventually causes transistor destruction.

The simplest type of bias is shown in Fig. 9. When a great deal of drift and non-linear frequency amplification can be tolerated, this arrangement can be satisfactory if the bias can be adjusted for the transistor and the ambient temperature can be controlled.

This same bias scheme can be employed however, with stabiliza-



←
Fig. 10—Circuit for eliminating degenerative feedback while maintaining stability.



→
Fig. 11—Voltage divider bias system which places increased drain on the battery.

tion, by simply connecting the bias resistor to the collector terminal. With this method, when the transistor current increases the collector voltage drops and a corresponding drop at the transistor base tends to overcome the increase and stabilize the transistor current.

The aforementioned bias method tends to cause degeneration. Since this is frequently desirable — to increase over-all stability and frequency response — it causes no problem. A circuit shown in Fig. 10 eliminates the degenerative feedback while maintaining the good stabilization qualities of the degenerative circuit. Filter values in this circuit will not interfere with any frequencies that are to be amplified.

Another common circuit is shown in Fig. 11. This is actually a simple voltage divider. A disadvantage of this circuit is the increased drain placed on the battery by the divider bleeder current.

Practical Circuits

Just as tubes have three basic circuit configurations so do transistors. They are: common emitter, common collector and common base. These are equivalent to the common cathode or standard amplifier, the common plate or cathode follower and grounded or common grid circuits respectively. All three basic configurations are shown in Fig. 12. Each of these circuits will be found in circuitry where the particular characteristics of that configuration is best suited. The fact

that one circuit is better for low noise while another has a better amplification factor need not concern the average TV technician.

The same phase reversals found in certain tube circuits are also found in transistor circuits. This is shown also in Fig. 12. Note that the common emitter circuit causes a 180 deg phase shift while the common base and common collector circuits present no phase shift between the input and output.

The impedance of transistor circuitry is, by nature of the device, very low. In some circuitry, the impedance is sufficiently low so that output transformers to speakers can be entirely eliminated. Input equipment must in many cases be adjusted for the low impedance too. Circuits have been designed, however, that have input impedances equivalent to vacuum tube circuitry.

Technicians that have finally awakened to the fact that transistors are not just a passing engineers' plaything still do not realize just how close the transistor is to their service bench. Soon transistors will be appearing in larger numbers in TVs. Already they are being successfully used in "tinyvision" and TV tuners; next year we are sure to see them in several regular TVs.

Although the information given here will not provide you with all the knowledge you need about transistors, if you know this much well, you'll have no trouble repairing all but the "doggedest" of the tough dogs. ■

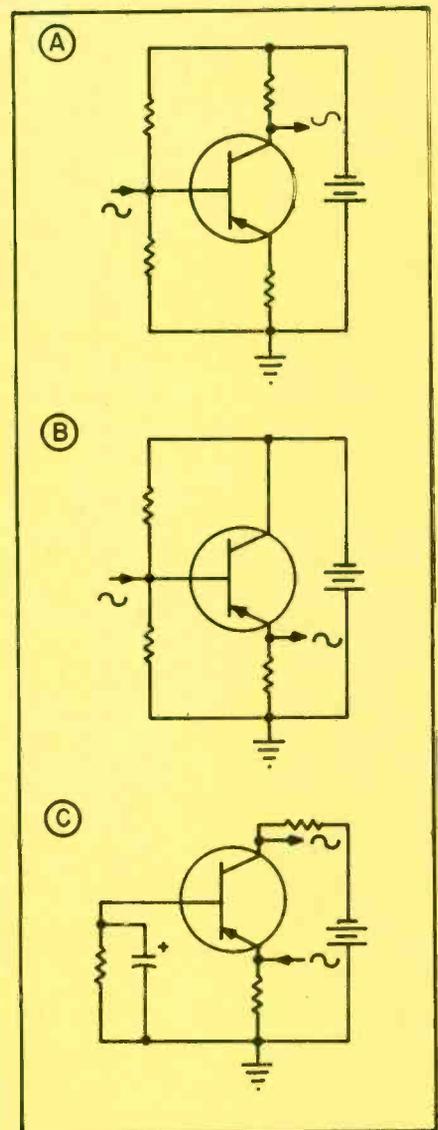


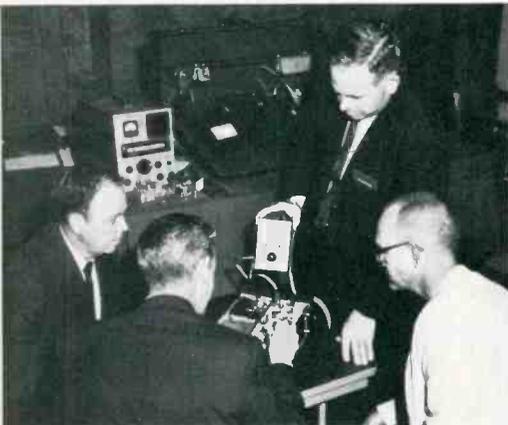
Fig. 12 (A)—Common emitter, (B)—common collector and (C)—common base transistor circuits.

Service Seminars For 2-way Radio

Space Age advances force technicians into continuing educational programs



Live demonstrations 'prove out' new techniques.



Technicians tune and align live units to get the feel of advanced equipment.



RCA's J. R. Alexander explains new techniques required to service transistorized mobile radios.

■ Modifications in basic two-way design are forcing service technicians to keep abreast of new developments. The traditional instruction-book-oriented approach to equipment service is inadequate for independent service organizations and self-servicing users.

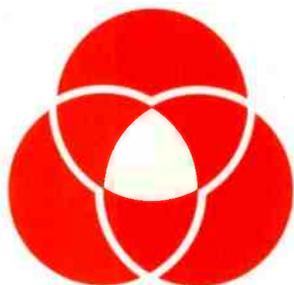
New techniques are required to service advanced units containing modular, noise suppression, highly selective and stable circuitry. Special seminars or "clinics" are being sponsored by manufacturers.

One service seminar, scheduled in major cities from coast to coast, is sponsored by RCA's Mobile Communications Department. Under the direction of J. R. Alexander, manager of field service, the service seminars give technicians an opportunity to learn more rapidly than would be possible from home study alone. Local technicians, with ex-

penses limited to short distance travel, can gain technical knowledge for servicing advanced transistorized units in a highly productive and efficient manner.

A typical one-day seminar usually covers circuit descriptions of advanced mobile units, alignment procedures and installation/servicing precautions and how to use test meters. Transistor servicing, noise clipper and selective calling decoder circuits are covered.

Comments received from service "clinics" indicate that the technical rundown on advanced equipment is of great value to field technicians who find it difficult to keep abreast of the many technical changes in mobile equipment. Technicians can obtain complete information and a schedule of cities to be visited by writing to RCA, Mobile Communication Products, Camden 2, N.J. ■



Color TV HORIZONTAL Problems

Get acquainted with the new clues that point
the way to various trouble areas

by Jay Shane

■ Horizontal deflection systems of color receivers differ from those in B/W sets only to the extent that the systems in color sets supply convergence pulses and focus voltage. Schematics of B/W and color flyback systems are shown in Fig. 1A and Fig. 1B. If you want to establish and maintain a solid relationship with those customers who will be switching to color, you'll have to learn how to eliminate trouble in these systems quickly and effectively.

Clue Number One

A common peculiarity of many current color receivers is that audio comes on before the raster appears. This is caused by slower heating of horizontal tubes. But the appearance of clear audio indicates the keyer (AGC) is operating normally, video information is present in the IF strip, and the horizontal oscillator is functioning.

Allow the set to warm up fifteen to thirty seconds. Turn the brightness control about two-thirds of the way up, the contrast half way down, and decrease the volume so it's just audible. If the screen fails to light, unplug the receiver and while it's cooling, substitute known-to-be-good tubes in the horizontal oscillator, the damper, HOT, HV rectifier, regulator and blanker stages.

Clue Number Two

Standing close to the rear of the receiver, plug it in and listen for the soft crackling sound that indi-

cates high voltage is getting to the CRT. This crackling is the magnetic attraction of the harness holding the CRT in place, and assures us that high voltage is being generated. If there's no crackling sound, then chances are no tubes are involved and the trouble exists elsewhere.

Leave the new tubes in the set until the problem has been solved and don't jump to the conclusion at this point that the flyback or yoke is faulty. These two components may very well not be involved.

Clue Number Three

After the receiver has been on for several minutes (not over five), observe the horizontal amplifier tube. If its plate turns cherry red, then the problem is most likely being caused by one of two things: *saturation in the flyback system or low B+*.

Like the B/W receiver, the color set's HOT will run red hot if it is underdriven. But *unlike* the B/W tube, it can be fully driven, have normal grid bias and still saturate. *This is a major difference between color and B/W sets.* Any loading in the flyback system of a color receiver will cause the HOT to draw too much current — a grim destroyer of both flyback and tube!

If B+ is suspected, and the receiver uses silicon rectifiers, cut one end of each rectifier loose and temporarily solder in new rectifiers. If rectifier tubes are used, replace them. Check B+ again. Still no satisfactory results? Then we move on to:

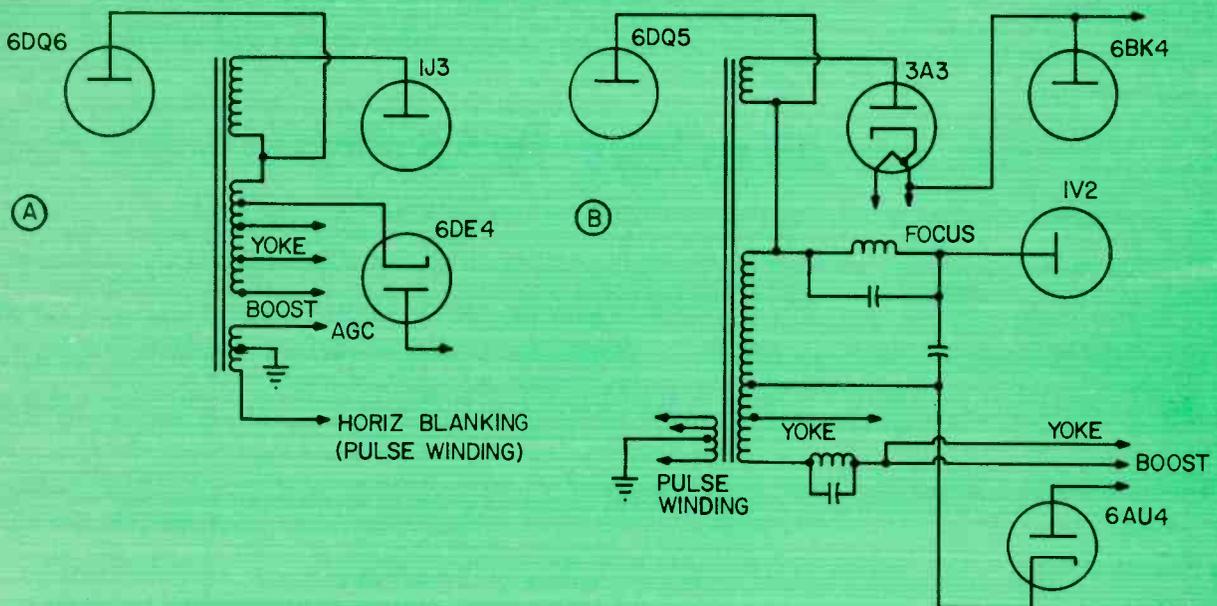


Fig. 1 (A) — Black-and-white flyback system. (B) — Color flyback system. Note similarity of both. Focus and regulator circuits are different in color sets.

Clue Number Four

The crackling sound that revealed high voltage will not necessarily indicate, for example, that the HV is decaying gradually. Remove the HV rectifier cap and try drawing an arc with an insulated handle screwdriver. *Do not touch the tool to chassis* as it may damage the flyback. If the arc is less than 1½ in., prepare to remove the chassis, or if the receiver has a bottom plate, stand the cabinet on end. This will upset purity and possibly convergence, but both of these should be checked anyway after *all* servicing.

At this point, disconnect the convergence yoke plug, and forget all other tubes in the receiver and concentrate on all parts directly involving the flyback system itself. If necessary, and if it's a clip- or plug-in type, the tuner can also be disconnected. It will have inconsequential bearing on the problem. Do not be concerned with the convergence panel because there's little chance that it has anything to do with the trouble. The horizontal windings of the yoke must be connected to gain full sweep voltage.

Troubleshooting — Step One

Leave the cap off the HV rectifier. Look at the schematic of a color receiver using two special high voltage silicon rectifiers as shown in Fig. 2. One is for boosted boost, the other for focus. No raster will appear if either of these diodes is open. No high volt-

age will be developed if either of these is shorted.

Disconnect one end of each diode and check for arc. If no arc or a small arc, forget about the diodes. Reconnect them.

Step Number Two

Check for boost. Keep the probe on the test point while the set is warming up. The boost voltage may start to build up and immediately collapse. If this happens, then it should be evident that a capacitor across the efficiency (linearity) coil is shorting. If you check for boosted boost or focus voltages, use a high voltage probe because we're dealing with 1100 to approximately 5000 v.

If either of the efficiency capacitors is rated at 600 v, replace them with identical values rated at 1000 v. If the set is over two years old, they may be thermal, and replacement may eliminate a future call-back.

Case Histories

A Packard Bell, chassis 98C7D, was kicking out the circuit breaker. The damper was arcing badly, so it was replaced. This, however, did not produce a raster, nor was there any crackling sound of high voltage build-up. Two minutes later the 6JE6 plate turned cherry red.

This receiver has a vertical chassis which can be swung out to get at its innards. The HV cage is easily

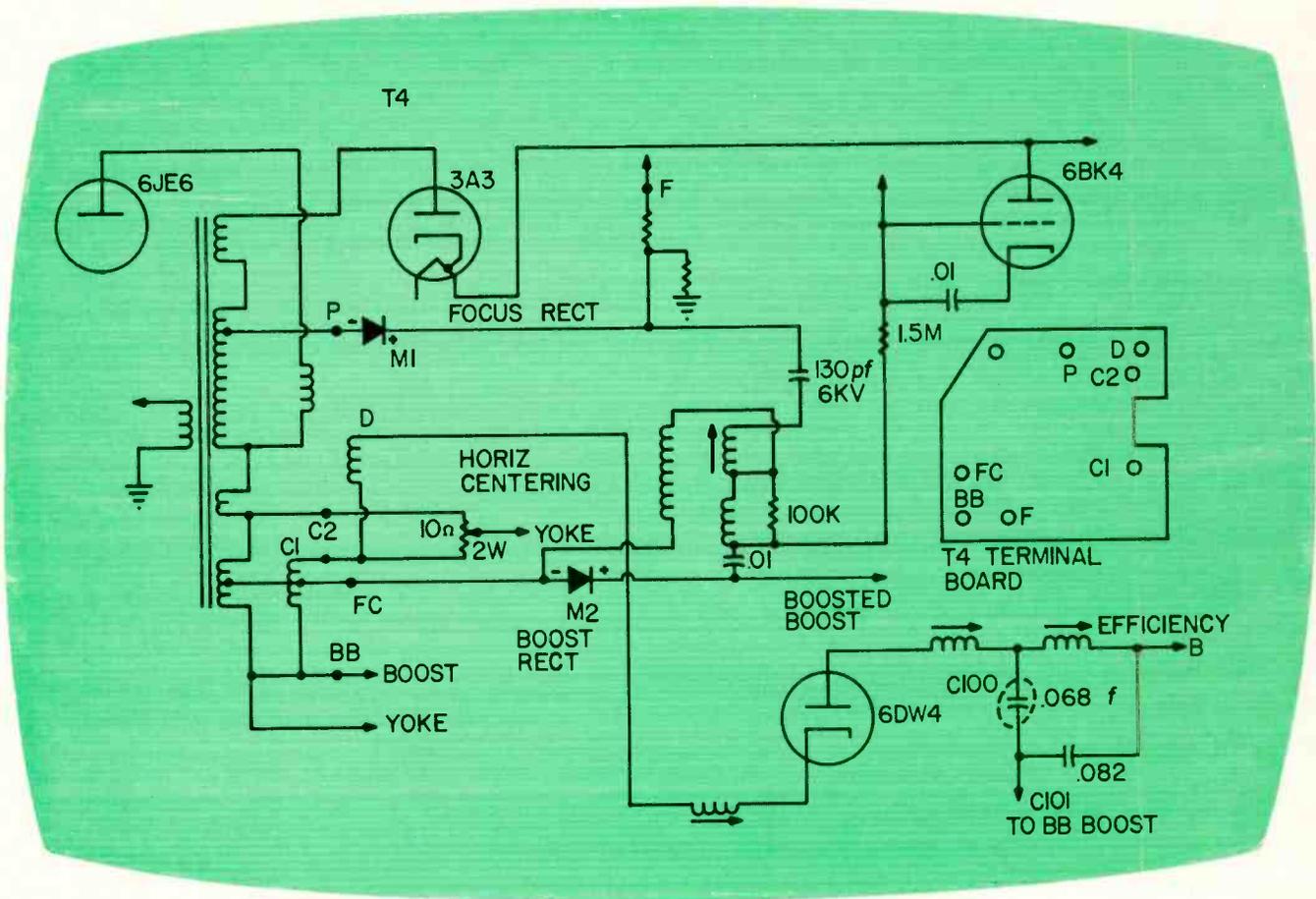


Fig. 2 — Schematic of focus and boosted boost section of Packard Bell 98C7D chassis. C100 was shorted out.

removed from the back by experienced technicians.

The horizontal layout of this receiver and the flyback terminal board is shown in Fig. 2. The boosted boost rectifier and linearity capacitors are located under the chassis below the convergence plug. The focus rectifier is located on top of the flyback.

By checking the schematic, we note that boost is obtained at point BB. In this case, no boost voltage existed.

Further checking revealed that two capacitors, C100, C101, were connected from this point to the efficiency (linearity) coil and that a resistance reading from "BB" to the plate pin-contact of the 6DW4 showed a low resistance continuity. Removing the chassis screws and swinging it out gave clear access to the bottom side. C100, 0.068 μ f, was shorted. Replacing it with a 1000 v capacitor of the same value eliminated the problem.

A Simple 'Toughie'

A Zenith, chassis 29JC20, CU, didn't have over a thousand volts at the cap of the 3A3. Tubes were substituted, all normal resistance and capacitance readings were checked. Boost was riding at 700 v when 850 v was specified. B+ seemed normal at 375 v. Just to make sure, the two 3DG4s were replaced. No change.

The cabinet was up-ended and the bottom plate re-

moved. First thing noted was the badly burned efficiency coil. It was replaced. That indicated serious load-down had taken place, with the possibility of the flyback being damaged.

But rather than jump to conclusions, a capacitor "sub-box" was readied. The cap of the 3A3 was left hanging, with a metal coil of solder placed about a half inch away from it. As each filter was jumpered, an eye was kept on the HV cap. Finally, when the choke output electrolytic was jumpered, an arc took off to the solder coil. Replacement of the electrolytic put the set into operation; no damage to the flyback at all.

The point here is that we had reverted right back to common-sense B/W servicing procedure. Obviously, the power factor of the original electrolytic had shot sky high, allowing the B+ to drop enough to prevent proper build-up of boost and high voltage. All the tubes were put back, with eventual replacement of the 6DQ5 to get proper width.

Other Causes

As you already know, the last video amplifier stage's grid is the source of brightness control in a color receiver. Failure of this tube will kill the raster. A bad regulator, weak high voltage rectifier, and in some cases a bad blanker tube, will cause serious blooming. ■

Choosing

by Norman Nelson

Centralab, Electronics Div.
Globe-Union

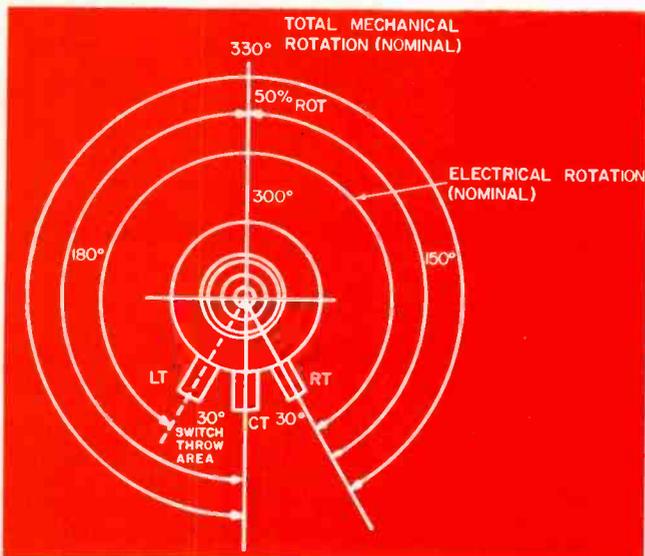


Fig. 1 — Electrical and mechanical rotation definitions for the popular 15/16 in. dia composition controls. The 50 percent electrical rotation point is 180 deg nominal from the CCW end or 150 deg nominal from the CW end (shaft end view).

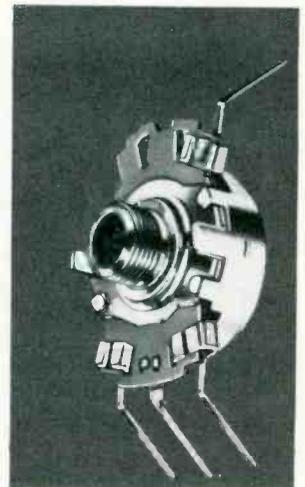
■ By properly choosing and using “off-the-shelf” replacement controls, shafts and accessories stocked by your parts distributor, you can save time, money, inventory space and capital, and even reduce your consumption of headache pills.

As a general guide, most TV receiver manufacturers adhere to the resistance tolerances standardized by the Electronic Industries Association (EIA) for variable composition resistors. Controls up to 100 K generally have a tolerance of ± 20 percent and all above 100 K are generally ± 30 percent. In many instances, the original receiver manufacturer will use ± 30 percent on the very low values.

Measurements and Tolerances

When measuring the resistance value of control at mid-rotation point it is important to remember that the EIA standards allow ± 3 percent rotation tolerance (approximately ± 9 deg). In addition to this, the 50 percent rotation resistance value can vary by the ± 20 percent or ± 30 percent tolerance of the control. Furthermore, nearly all the off-the-shelf replacement controls are designed to be used with or without an OFF/ON switch. Hence, the resistor element is designed with a zero resistance over the nominal 30 deg area required to actuate the switch. This means that the effective electrical rotation begins at approximately 30 deg clockwise from the CCW end (measured from the center terminal), whether or not an OFF/ON switch is attached. Inasmuch as the nominal total *mechanical* rotation is 330 deg, the total effective *electrical* rotation is 300 deg (330-30). Consequently, the effective electrical mid-rotation point would be 180 deg clockwise from the center terminal or 150 deg counter-clockwise from the right terminal. This, in effect, means that the internal contact wiper arm would be diametrically opposite the center terminal at 50 percent electrical rotation. This can be clearly seen in Fig. 1.

Fig. 2 — Bushing mounting controls.



Occasionally service technicians will encounter non-standard resistance values which have no off-the-shelf replacement. Since the wide tolerance of ± 20 percent or ± 30 percent was used in these original controls, it would seem logical that a replacement having a slightly higher or lower nominal value would cause no difficulty. This would hold true in the case of volume controls, where at full-on-volume, a higher nominal value would result in a slight increase in over-all gain, while the use of a lower value would result in a slight loss. When controls are used as voltage dividers and rheostats, however, the safest substitution would be to choose a replacement whose nearest nominal value is *higher*.

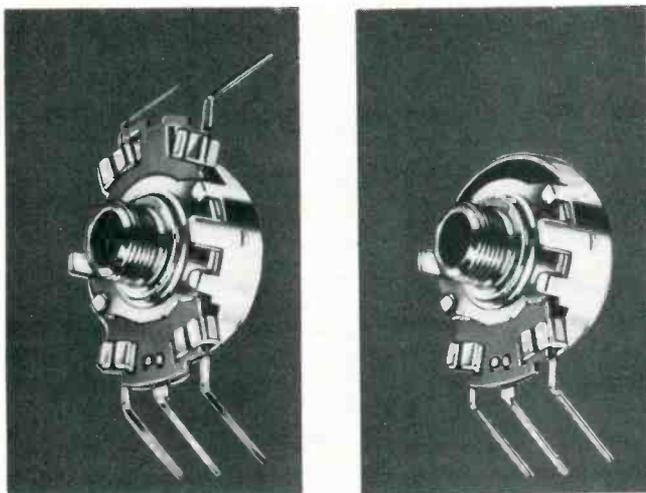
In choosing *tapped* volume control replacements, two important things must be considered: 1) The nominal resistance at the tap of the replacement should be close to the original, and 2) the same physical location for the tap on the resistance element is essential. This is necessary so the automatic bass compensation designed into the original set can be accurately duplicated. Because of the broad variety of taps and resistance used in original equipment, it is not always possible to find the exact replacement needed. A very simple method of obtaining a closer tap resistance match for a single tap control is to choose a dual tap control, one tap to closely match the desired resistance. The extra tap is disregarded.

Bushing Mounting Controls

Bushing mounting controls shown in Fig. 2 are currently popular replacements in $\frac{1}{2}$ w, 15/16 in. diameter. Until recently, the shafts available were of various combination mill types and in lengths which

and Using Controls

Save time, money and aspirin when replacing controls, shafts and accessories



enabled cutting to the specific length required. Unfortunately, cutting off and de-burring shafts involves time and time means money.

Exact length shafts for replacement in dual concentric contacts have been available for some time and their value and convenience has become well established. Recently, complete assortments of exact length *single* shafts have been made available by several manufacturers. The range of sizes and types is such that technicians should no longer have to cut a shaft to find one to fit a specific application. The range in size of one typical 1/4 in. metal shaft is shown in Fig. 3.

Insulated Plastic Shafts

A "non-switch" type control (Fig. 4) employs insulated plastic shafts which are essential in "hot-chassis" sets. (Please note that all sets of this type have a nominal electrical and mechanical rotation of 300 deg.)

There's a fairly comprehensive selection of these controls available to technicians from several manufacturers. With their increasing use in original equipment, however, there is an increasing likelihood that situations will be encountered where a replacement of the proper value and taper is not available. In these cases, replacement can be made by using the bushing mount type and merely adding a special adapter plate onto the bushing. The required metal or insulated replacement shaft is then plugged in, as shown in Fig. 5.

In many cases, chassis are punched with a hole



Fig. 3 — Size range of one typical 1/4 in. shaft.

large enough to accommodate a bushing type replacement. If a bushing type replacement is used, it is recommended that a "plug-in" insulated shaft be installed to eliminate possible shock hazards.

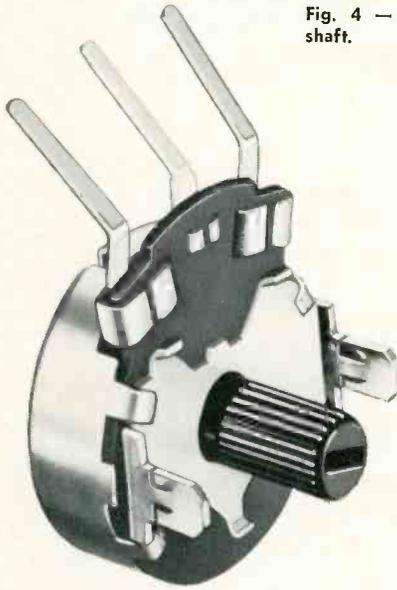
'Doghouse' Mounts

In the original equipment, the "doghouse" bracket is staked to a control with an unthreaded bushing and the 4-legs of the bracket and the PC terminals on the control are mounted and soldered into holes in the board. Even though the 4-leg bracket has spring-type clips, these legs are usually soldered.

To replace, use a replacement bracket available from major line distributors. Assemble the bracket to the proper bushing type control, equipped with either wirewrap or PC terminals, and use a mounting nut to hold the bracket in place. If a control with wirewrap terminals is used, bend the terminals to conform to original terminal configuration. Mount the control terminals and 4-legs into their respective holes in the PC board and solder control terminals and also the 4-legs of bracket, (only if all legs were originally soldered). If the original control has an OFF/ON switch, replace it with a conventional solder lug terminal switch, even though the original may have had PC terminals. Then run wire leads from the switch lugs to the proper points on the PC board and solder.

Frequently, removal of the bracket and control from the PC board, without damage to the wiring rib-

Fig. 4 — Non-switch type control with plastic shaft.



facing in the opposite direction from the shaft (towards the ears).

To adapt conventional bushing mounting controls to this type, an adapter plate is available which snaps on to the rear of the standard line of wirewrap terminal controls. (See Fig. 7.) Then a shaft is plugged in at the bushing end which becomes the normal operating end. After removal of the original control, simply bend the wirewrap terminals of the replacement to conform to original control terminal spacing and plug in a replacement insulated shaft to duplicate the original.

Dual Concentrics

A complete line of the off-the-shelf exact duplicate concentric shaft dual control replacements are available for almost every requirement.

A comprehensive variety of exact length inner and outer shafts is complemented by inner and outer shafts of the Universal type which can be cut off as required.

Exact length inner shafts for SPST *push-pull* switches are available to meet the demands for these popular replacements. Incidentally, there is no major replacement source for the *push-push* type switch for "plug-in" shafts. A few limited types are available, but these are not readily obtainable since the *push-pull* switch will serve equally as well as the *push-push* type in roughly 99 percent of the applications. As a result, the *push-push* type is not manufactured or stocked in the broad range of shaft lengths available in the *push-pull* type. ■

bon, can present a few problems on occasion.

From my experience, the safest and most expedient procedure is as follows: 1) Use a tin snips to cut off the 4-legs of the bracket adjacent to the PC board, 2) cut off the control terminals in similar manner using diagonal cutters, and 3) unsolder each individual bracket leg and terminal quickly, one at a time and remove.

Reverse Mounting Controls

This type of mounting has become quite popular in TV sets the past year or two. These controls have "ears" at the opposite end from the shaft. Usually they incorporate PC terminals parallel with shaft but

Fig. 5—Bushing-mount control with adapter plate and shaft.

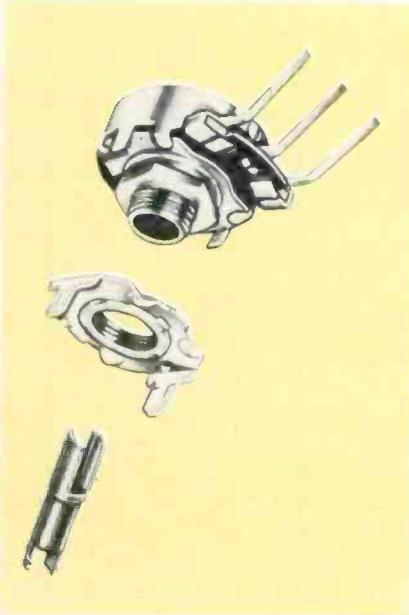
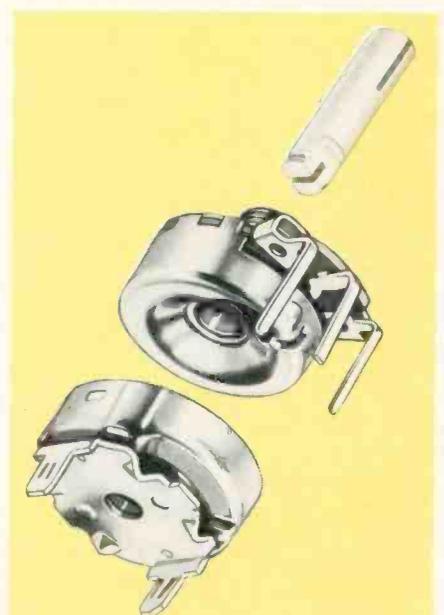


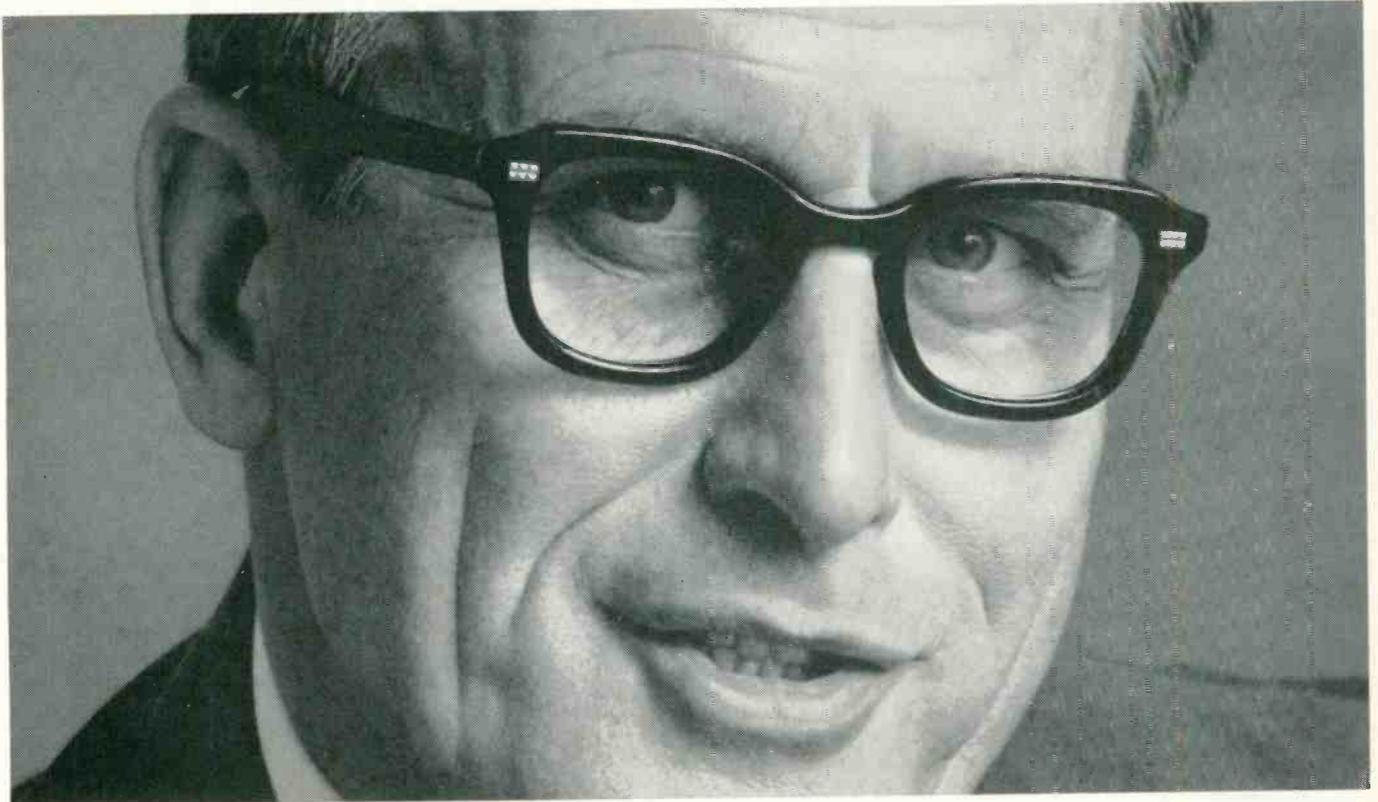
Fig. 6—'Doghouse' bracket.



Fig. 7—Adapter plate is snapped to end of bushing mounting control for reverse mounting to PC board.



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One of a series of messages depicting another growing service of The Greyhound Corporation.

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COLORFAX

ARB Color TV Study

The results of a survey of color TV viewing habits conducted by American Research Bureau show that prime nighttime color shows draw 80 percent more viewers in homes with color sets than in homes with B/W.

A survey of six NBC daytime shows revealed a 62 percent ratings advantage in homes with color receivers,

while Saturday children's programming had a 90 percent edge. NBC's *Tonight Show* scored an advantage of 89 percent in color homes.

The study financed by all three networks, also notes that NBC wins every half-hour in which it offers color programming, and in the 3 million color homes 14 out of the top 15 shows are NBC color properties. The only black and white show on the list is *Bewitched*, ranked number 15.

Translating the study in terms of color growth, it was pointed out that next year there will be 5 million color

TV homes. At that time, NBC's average rating in black and white homes (50 million) could be a 19, as compared with a 34 in color homes. This would give NBC a 1.4 rating point advantage over its rivals, and for every million color TV sets sold, NBC should gain 0.3 of a rating point.

The matter of whether or not the novelty of color TV wears off was also taken into consideration in the ARB survey, and the answer was "no." The average rating of NBC nighttime color programming is 39. The average rating among recent purchasers of color sets (one to seven months) was slightly higher at 44. For those who owned their sets from eight to 19 months, the rating was 40, while the rating for color veterans (20 months-plus) was 37.

NBC's nearest competitor in color programming is ABC, which offers approximately seven nighttime half-hours a week as compared with NBC's 39. Study showed ABC's own color homes advantage was only 9 percent.

Color TV Production in Japan

Our west coast sources disclosed that Japanese manufacturers have produced around 60,000 color TV sets during 1964, as compared to only 4000 in 1963. The report said that a sizable increase in 1965 production is expected with over 80,000 units a foreseeable figure.

Philco Ad Campaign

Philco Corp. is embarking on a color television advertising program which calls for 41 four-color, full page magazine ads and a newspaper campaign that will support color and B/W TV, and stereo high fidelity.

"We believe the TV market will be half color and half monochrome by 1970," said Charles S. Grill, director of advertising of the Consumer Products Div., "with dollar volume favoring color substantially before 1970.

"We will be heavy in national magazines that provide good coverage of the adult population. National advertising dollars allocated for local use will be programed in support of specific merchandising promotions."

Philco will run a total of 41 four-color, full page ads in these magazines: LIFE, SATURDAY EVENING POST, LOOK, READER'S DIGEST and TV GUIDE.

"Our advertising dollars will be concentrated on targets that research has identified as prime color TV customers," Mr. Grill said. "We determined the age and income characteristics of families that buy color television and selected media that reaches these families most effectively."



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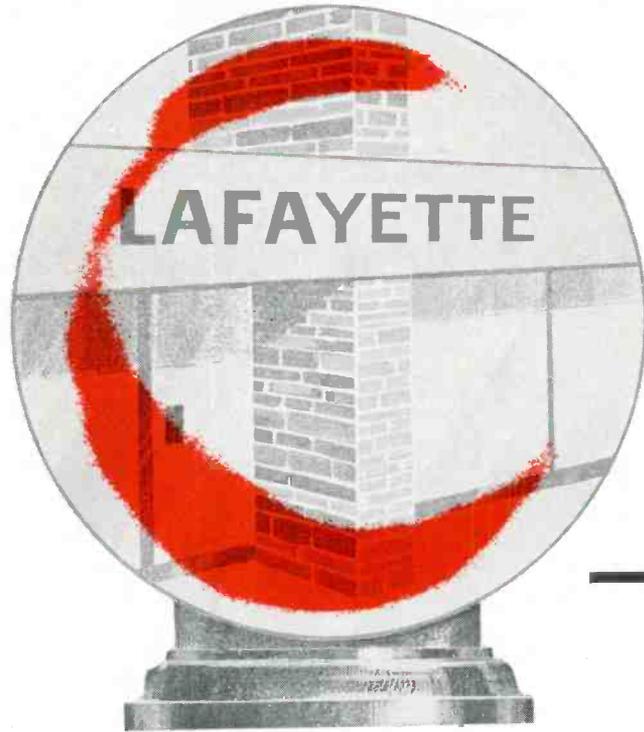
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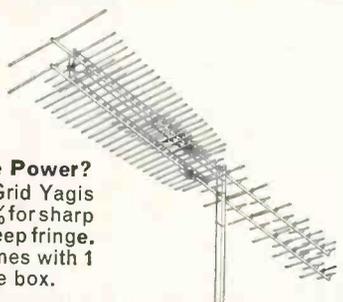
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Stacking Planar-Grid Yagis increases gain 41% for sharp pictures even in deep fringe. Every antenna comes with 1 stacking bar in the box.



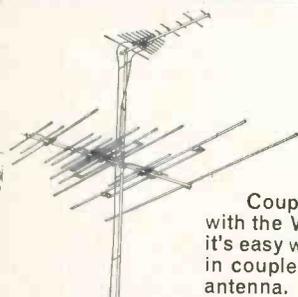
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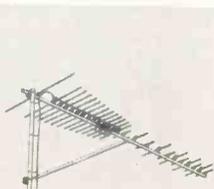
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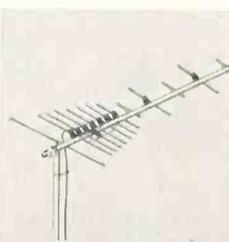
Couple a Planar-Grid Yagi with the Winegard Colortron . . . it's easy with Planar-Grid's built-in coupler. Couples to any VHF antenna.



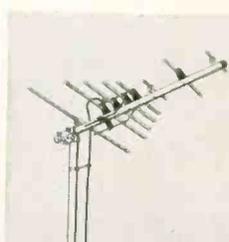
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Planar-Grid UHF antennas have arrived . . . a most significant advancement in UHF antenna design. These new UHF antennas have the power and critical characteristics necessary for consistently perfect color reception. And of course, the TV antennas that are best for color are best for black and white, too.

Here's how the new Planar-Grid Yagis eliminate the disadvantages of all existing UHF antennas! Examples:

THE 4-BAY BOW-TIE — and Collinear antennas lack bandwidth. They require at least two separate antennas tuned to opposite ends of the band to give good gain across the entire UHF band. Increasing the gain by stacking of a 4-Bay Bow-Tie is equally impractical because it further reduces bandwidth which is already inadequate. With Winegard's new Planar-Grid Yagis, you get the *highest gain* UHF antenna on the market **PLUS** complete bandwidth.

ORDINARY HALF-WAVE UHF YAGIS, while having high gain, are frequency sensitive and normally maintain top gain over only six or so channels. Winegard Planar-Grid Yagis are made a *full wave wide* to double the capture area. They give very high gain over *all 70 channels*.

PARABOLIC ANTENNAS, by increasing size, can theoretically increase gain, but a parabolic type comparable to the U-990 Planar-Grid Yagi would require an antenna of at least 10 ft. in dia. Parabolics are inefficient and impractical because of size, cost, high wind resistance.

CORNER REFLECTOR ANTENNAS are medium gain antennas and, unlike most basic antenna designs, an increase in size does not appreciably increase the gain. The gain of the Planar-Grid Yagis is directly proportional to size.

LOG PERIODIC AND "V" TYPE ANTENNAS, regardless of large size and total number of connected elements, have no more than two or three of their elements working on any one channel. This puts a low ceiling on the available gain for these types of antennas although they do have adequate bandwidth. Another disadvantage is the multiple lobe patterns, especially those antennas employing "V'd" elements working on the third and fifth harmonic mode. This type antenna is unable to reject interfering signals from the side because of these side lobes and can easily degrade picture quality — especially in color.

PLANAR-GRID YAGIS, in comparison, have the sharp uni-directional characteristics to insure clean, sharp pictures and perfect color. On the Planar-Grid Yagi, all parts of the antenna work together on every channel (Progressive Gain Accumulation Principle) giving it the highest gain and greatest bandwidth of any UHF antenna for a given size.

Highest Gain, Complete Bandwidth, Precision 300 ohm Impedance Match across the entire UHF band and Pin-point Directivity — are characteristic of the brand new Planar-Grid Yagis from Winegard . . . these are really color-quality UHF antennas.

WINEGARD CONSTRUCTION, TOO . . . Features include Winegard's exclusive wrap-around mast clamp, complete factory preassembly and our new Gold Vinylized finish to protect against weather wear.

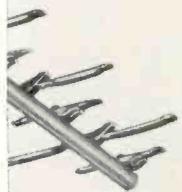
Enter the era of UHF now with the color-quality UHF antennas — Winegard Planar-Grid Yagis! Ask your distributor or write for spec sheets today.

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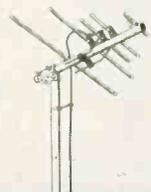
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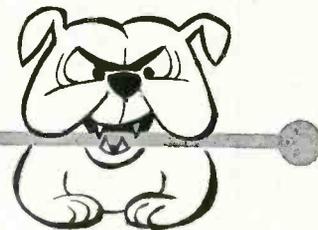
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Model No. U-950
Only \$5.95 list



Difficult Service Jobs Described by Readers

Worn to a Frazzle

I received a call from a new customer who said "the picture is not clear." I asked the owner to switch the set on and leave it on until I arrived. When I arrived, a glance at the screen showed a weak, "snowy" picture. Most channels looked the same — except some were worse than others. I switched the set off and checked the lead-in connections to the set and the leads from the set to the tuner input. I then changed the tuner RF and oscillator tubes. But this did not help. I substituted *another* RF tube. No improvement was noted. Since I didn't have a "rabbit-ears" with me, I reasoned that it was either a breakdown in the tuner or a bad antenna. I checked the lead-in from the set to the window and went to the roof and inspected the antenna—a conical. It appeared in good condition. And the lead-in, down the side of the apartment-house wall, also looked good. I noticed, however, that it had only one stand-off insulator at the roof top and one at the third floor where it entered the apartment window. It waved slowly back and forth a few inches in the breeze.

I went back down stairs and asked the owner one question.

"When did the trouble begin?"

"About two weeks ago," I was told.

I was also informed that the picture had been "flashing and jumping" for some time before the condition developed. The owner also confessed that three other TV men had looked at the set during a period of weeks. Two technicians said the set had to go to the shop for a checkup. The other one said it was a breakdown in the set or the antenna was bad. In any event, the owner was reluctant to do anything except call the fourth technician—which happened to be me. I was not thinking along the same lines as the third technician.

But one thought still bothered me, especially since the set had shown the "flashing and jumping" symptoms prior to developing snow. It *could* be trouble in the antenna system. But still . . . an intermittent capacitor could have finally broken down in the tuner. I did not want to take the antenna down without definitely

knowing that it was bad (because it had no folded dipole, lead-in continuity could not be checked at the set end). So then I went out the apartment window, to the fire escape and started checking the lead-in, inch by inch, up the wall. At the top floor, just below the flat tar-paper roof level, a cement ledge about 6 inches thick protruded from the brick wall outward about 4 inches. The lead-in rested flat against it—with no standoff to hold it away from the ledge. I grasped the lead-in at this point to examine it—and it parted! I found myself holding the piece that was attached to the set while the short 20 ft piece attached to the antenna dangled in the air!

It was obvious what had happened by observing the end of the lead-in I held in my hand. Over a long period of time the rough cement had cut through the poly and right through the copper strands as the lead-in waved back and forth in the wind. The only thing holding it together, finally, was a thin flat strip of polyethylene which parted altogether when I grasped it.

I spliced in a foot of good lead-in, taped a one-inch-diameter "roller" to the splice where it crossed the ledge (to keep the lead-in from rubbing against the cement) and the job was done. I collected \$7.50 for an hour's work, \$3 for a service call, and the customer was very happy. They sent me a number of good customers later. —*Jim Warner, New York City.*

Where Does a Circle Begin?

The 1951-1952 RCA TV AGC systems have always been tricky. So many stages are independent that overloading or other seemingly obvious AGC problems make it difficult to know where to begin. I've worked on many of these sets and thought that I knew them inside-out until I tangled with a KCS72 recently.

When this set was first switched on it had a perfect picture. As it warmed up the picture would slowly darken and begin to pull. But when the AGC control was turned back a bit the picture snapped back straight again. It would stay good for a while and then overload. Again the control was

turned back. This would go on until the AGC control was finally all the way to minimum. Then the picture went into complete overload.

Tubes were changed from the 6J6 on back. It was not being caused by a tube in this area. I then brought the set to the shop.

It took only a few minutes for me to come to the foreboding conclusion that this was going to be another one of those "you-know-whats." But it was obvious what was happening — partly obvious, that is. As the set warmed up, the video signal at the detector output gradually increased until it tripled its amplitude. This heavy detector output, directly coupled to the video amplifier grid, gradually decreased the 6AG7 current flow and increased the tube's plate voltage. This rising voltage, directly coupled to the sync separator grid, caused current flow to increase in this tube. Because of this increase, the separator tube's cathode voltage also rose. Since the AGC amplifier's grid voltage was supplied by a divider in the separator's cathode circuit, it too was rising while all this was going on. Naturally, once the grid voltage on the amplifier tube was upset, the whole AGC system went berserk. This further contributed to the cycle by increasing IF gain.

But where was it all beginning? A slight variation in any one of these interrelated stages could have started the ball rolling. After fruitless searching I realized that I was getting nowhere fast. All the old tricks failed and so did some new ones. While checking around the 12AU7 detector tube, I noticed that, although the grid and cathode of this tube acted as the detector diode, the plate of the same triode section was tied into the 6BQ6 grid through a 2.2 M Ω resistor. I checked voltage on both sides of this resistor and discovered to my amazement that the 6BQ6 grid read zero! I put in a new 6BQ6 and the set worked perfectly. I was delighted but completely flabbergasted.

I put back the old tube and reviewed the situation again. But I still can't figure out why the sides of the picture didn't shrink — not even a sixteenth of an inch. — *Frank Salerno, N.Y.C.*



multiple socket
SPEED plus
Gm* ACCURACY
 CREATES
MORE
PROFIT



Basic for the professional service shop

Sell more tubes per customer | Save call-backs | Satisfy more customers

**B & K MODEL 700 DYNA-QUIK
 DYNAMIC MUTUAL CONDUCTANCE TUBE TESTER
 with obsolescence protection**

**Makes test under actual set-operating conditions*

Everyday use by thousands of professional servicemen has proved its speed . . . its accuracy . . . its efficiency.

You can quickly check all the tubes in the set, detect hard-to-locate weak tubes that need replacement . . . and sell more tubes. Provides multiple-socket section to quick-check most of the TV and radio tube types the true dynamic mutual conductance way*—plus simplified switch section to check new tube types in Dyna-Quik emission circuit. Also includes provision for future new sockets.

Makes test under set-operating conditions. Checks each section of multi-section tubes separately. Checks for all shorts, grid emission, leakage, and gas. Makes quick "life" test. Exclusive adjustable grid emission test provides sensitivity to over 100 megohms. Insures your reputation. *Quickly pays for itself.* Net, **\$179⁹⁵**

-  **TESTS** All TV and Radio Tubes, Old and New
-  **TESTS** Nuvistors and Novars
-  **TESTS** 10-Pin Tubes
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-  **TESTS** European Hi-Fi Tubes, Voltage Regulators, and Most Industrial Types

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 Canada: Atlas Radio Corp., 50 Wingold, Toronto 19, Ont.
 Export: Empire Exporters, 123 Grand St., New York 13, U.S.A.

... for more details circle 17 on postcard

NEW PRODUCTS

Actuator

An actuator for electric counters is announced. The ES4 switch can operate counters, signaling devices, pi-

200

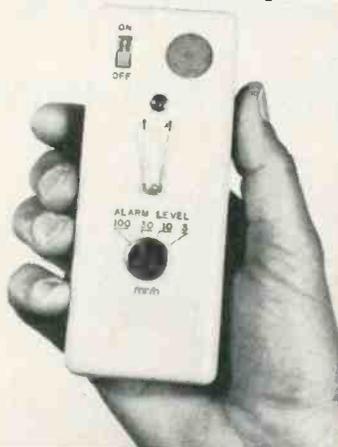


lot circuits, folding machines and towel mangles. It has a rated speed of 300 counts per minute. ITC.

Radiation Detector

Radiation warning at a preset alarm level is given by this pocket radiation rate monitor. You can set this pocket-

201



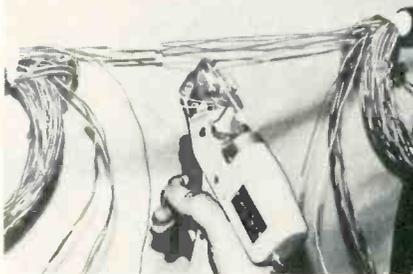
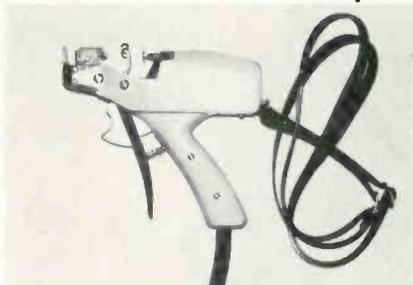
size beta-gamma detector to buzz when an alarm level of 3, 10, 30, or

100 mr/hour is exceeded. Weighing 5 oz., the unit detects and measures radiation with a halogen-quenched Geiger-Mueller tube. Gelman.

Splicer

This splice gun will splice cable sizes 16 to 30 in an automatic operation. The two conductors to be joined

202



are inserted into the jaws of the gun without twisting and stripping the insulation beforehand. Operation of one trigger actuates an electric motor which twists the conductors together for a set number of turns. Operation of a second trigger applies battery potential to the twisted conductors which burns off the insulation, cuts off surplus conductor and welds the two conductor ends together. Jonard.

Aerosol Spray

An insulating spray for protecting high voltage components such as fly-back transformers, yokes, etc. has been introduced. "NO ARC" is used for electronic applications in high volt-

203

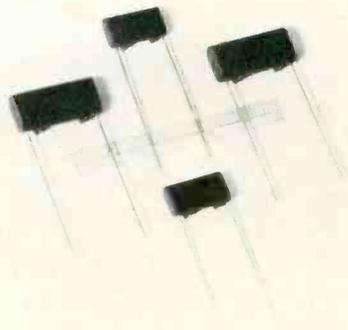


age circuits, microwave tubes, transmitting tubes, for static voltage generation, masking pointed or sharp high-voltage sheets' metal corners and for electrical applications in motor, generator, and transformer windings, and overcoating non-active parts of switches, contacts and terminal strips, and for coating automotive and other wires where maximum insulation is required. Chemtronics.

Capacitors

A line of encapsulated capacitors is announced. The capacitors are designed for test and measurement,

204



control, communications and consumer products applications and are initially available in two case sizes with ratings from .001 to 1.0 μf and from 100 to 600 vdc at 85 deg C. GE.

TWO OF A KIND

ENGINEERED for Today's Requirements

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New Super

HUSH

Selected Solvent*

100%

Silicone Oils
8 oz. & 16 oz.
Spray Can



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metals, elastomers and nonflammable virtually non-toxic. With excellent dielectric properties to the flow of electric current.

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MATAWAN, NEW JERSEY

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NOW

*convergence and color adjustments
are easier, faster, more accurate!*

NEW B&K MODEL 1240 LOW PRICED PORTABLE COLOR GENERATOR

with crystal-controlled keyed rainbow color display!



Thinnest Horizontal Lines! Smallest Visible Dots!
(Just one raster scanning line thick)

**Simplifies In-Home (or Shop)
Color TV Set-Up and Servicing**

You're the color TV expert when you use the "1240." You have the advantage of B&K quality—with features not available before at such surprisingly low cost.

Provides crystal-controlled keyed rainbow color display on TV screen to test color sync circuits, range of hue control, and align color demodulators. Shows ability of TV receiver to display color values.

Provides dot pattern, crosshatch, horizontal and vertical lines. Highly stable crystal-controlled count circuit with small-step count assures greater reliability and stability of color, dots, and lines. All horizontal lines and

only
\$134⁹⁵
NET

dots are just one raster scanning line thick. Lines begin off-screen and end off-screen, with no break in line. Dot brightness is adjustable with easily accessible control. Chroma Level Control simplifies color sync trouble-shooting.

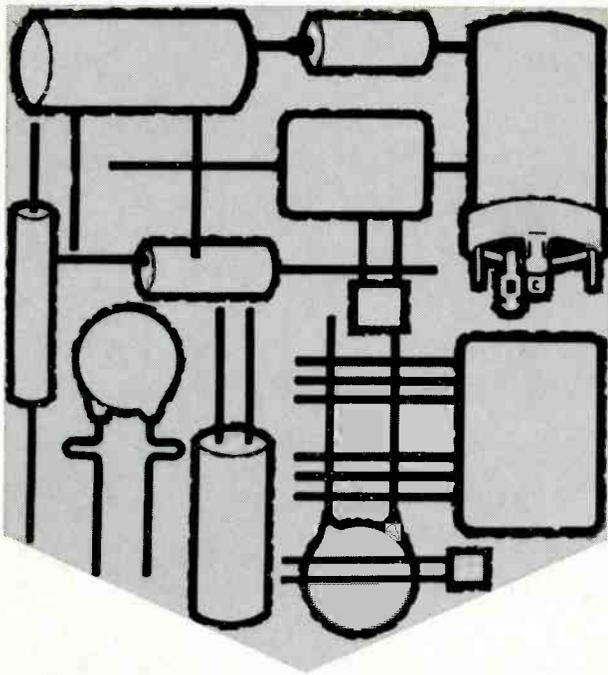
Operates on channels 3, 4, and 5, and adjustable without removing cabinet. No connection inside TV set is needed. Power transformer operated and line isolated to prevent shock hazards. Operates reliably on 105-125 VAC, 60 cps. (Color Gun Killer is available as optional accessory.) Extreme lightness and portability (9 lbs.) make it ideal for in-home servicing.



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High Voltage
Temperature Compensating
General Purpose Discs
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MICA CAPACITORS

Molded
Axial Lead
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NEW PRODUCTS

Oscilloscope 205

A miniature monitor oscilloscope measuring 7 x 5 x 3 in. is introduced. Utilizing a two in. CRT, the scope



has application in the CB and amateur radio applications. Control Products.

Inverter 206

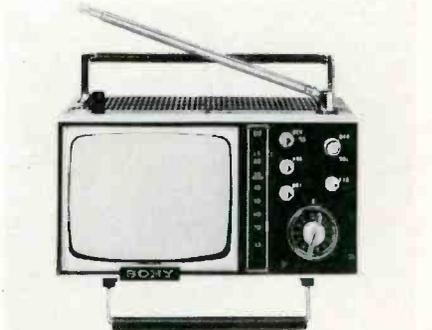
An inverter which operates from 12 vdc and delivers 110 vac 60 cps at 140 w maximum is announced. The



inverter is used for operating most 11 in. to 13 in. portable TV sets in automobiles, boats, mobile homes, buses, trucks, trains and planes. ATR.

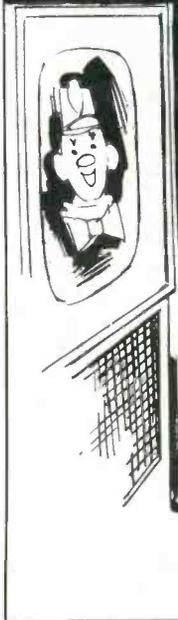
Portable TV 207

An eight lb portable television set with a built-in UHF tuner is introduced. The TV operates on regular

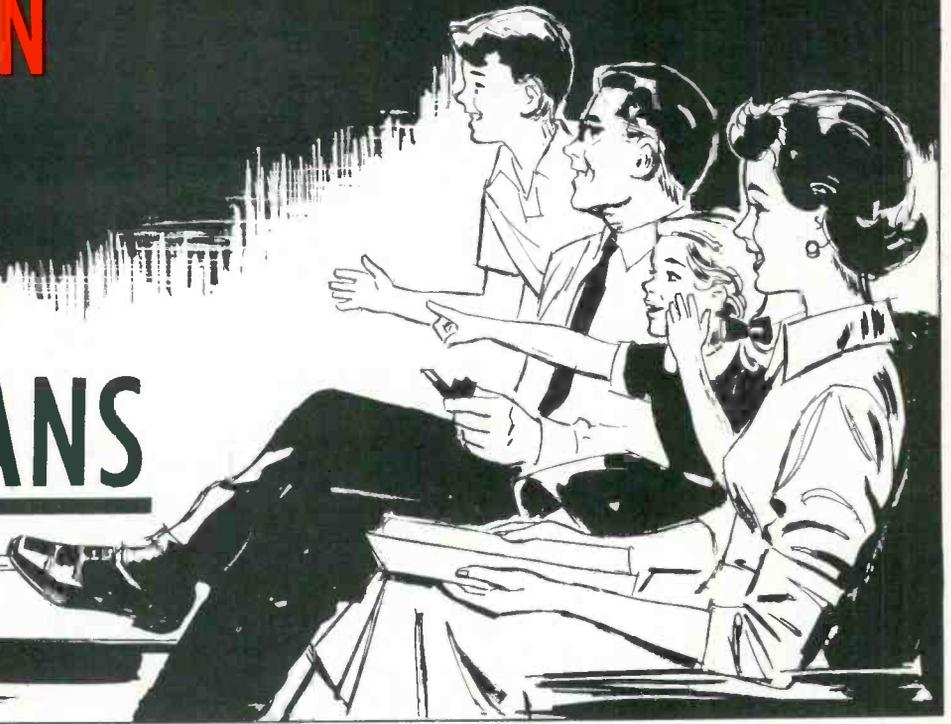


house current (ac), snap-on battery, 12 v auto or boat battery. The unit has automatic gain control circuitry, aluminized 5-inch tube, telescope antenna for both VHF and UHF, and 28 transistors. Size is 8 $\frac{3}{8}$, 4 $\frac{1}{4}$ and 6 $\frac{5}{8}$ in. Sony.

BETTER RECEPTION



MEANS



MORE SALES!

**IT'S AS SIMPLE AS THAT! And with ANTENNACRAFT
Antennas Reception is at its very BEST.**

Just a little extra care and a little extra effort goes into Antennacraft — and it shows — in the appearance of the product and in the sharp, clear pictures on your customer's television set.

The new UHF-VHF TV sets need a combination UHF-VHF antenna to take advantage of the total programming available. Antennacraft's Channel-Spanners are all channel antennas, VHF 2 to 13 and UHF 14 to 83 and are designed to be used with these new sets with only one lead-in.

Antennacraft's Channel-Spanners produce snow-free, ghost-free pictures to the far edge of the UHF class B signal area. Maximum signal response is obtained from VHF and FM stations together with good picture quality at the class B distance and throughout the medium fringe areas.

If you are not already using Antennacraft products, contact your distributor for full information on all fine Antennacraft products. Find out for yourself how that "little extra" pays off in bigger profits for you.

FOR CHANNELS 2 TO 83
UHF - VHF - FM



ONLY
\$24.95

ANTENNACRAFT
CHANNEL-SPANNER



ONLY
\$17.95



BETTER BUILT FOR BETTER PERFORMANCE

ANTENNACRAFT

Automatic Channel Selector
TV ANTENNAS
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**EFFICIENT!
SAFE!
FAST!**

AUTOMATIC STAPLE GUNS

For Fastening Any Inside or Outside
Wire Up to 1/2" in Diameter

- UP TO 3/16"
No. T-18
- UP TO 1/4"
No. T-25
- UP TO 1/2"
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- Telephone wire
 - Intercom wire
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 - Hi-Fi, Radio & TV wires
- Tapered striking edge gets into close corners!

Available in:
Brown, Ivory, Beige,
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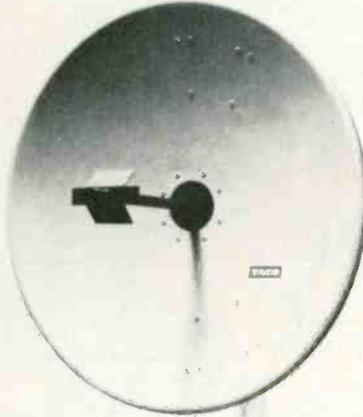
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NEW PRODUCTS

ETV Antenna

208

A two foot parabolic receiving antenna covering the frequencies between 2500 and 2690 megacycles is



introduced. This is the band recently assigned to Educational Television use. Gain of the antenna is a minimum 21 db relative to a linear isotropic radiator, the manufacturer claims. The antenna may be positioned for either vertical or for horizontal polarization. Tace.

Holding Fixture

209

A fixture designed to hold chassis, rectangular objects, and irregular objects, up to 500 lbs is introduced. The



fixture is available with three different types of clamps: a universal chassis clamp that fits all standard RETMA type panels; a scissors clamp for straight sided items; and a 2 x 12 1/2 in. slotted mounting plate for holding custom parts. According to the manufacturer, the fixture is fully equipped with disc brakes to lock high torque loads. Sandefur Engineering.

Recommend and Install Turner CB Microphones

Your reputation is based on quality of workmanship, true, but equally important is the quality of materials you use. That's why, when it comes to microphones, you can always feel confident with Turner — for many years the industry leader. Turner microphones don't let your customers — or your reputation — down.



THE TURNER 355C

The popular original equipment CB mobile microphone with exclusive grip-to-talk switch. Response: 80-7000 cps. List price, \$12.50.



THE TURNER 333

A noise-canceling mobile microphone for CB, amateur and 2-way radio. It's the only professional communications microphone now available for CB. Response: 300-3000 cps (Voice - frequencies). List price, \$21.50.

THE TURNER 454X

Outstanding single-sideband base station microphone. Response: 300-3000 cps. List price, \$26.50. For more fine Turner microphones, send today for the Turner catalog.



THE TURNER MICROPHONE COMPANY

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100% G_m TESTS . . .
*No Emission Tests,
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*Realistic, Practical
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**MULTI-SOCKET
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*No Compromise
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MORE PROFIT
*Because You'll Sell
 More Tubes . . .
 Sell Them
 Honestly!*

**NEW
 HIGH-SENSITIVITY
 LEAKAGE AND
 GAS TESTS!**

MODEL 799



Mustang

\$199⁹⁵

From the laboratories of the world's leading tube tester manufacturer comes the model 799 "Mustang" —a completely new tube tester.

Multi-socket tube testers used to have two serious drawbacks: circuit limitations made them obsolete overnight and, at best, no more than 10% of their tests were actually mutual conductance. But the Hickok "Mustang" doesn't compromise; it delivers *honest* mutual conductance tests. And a unique circuit approach, together with an easily replaceable accessory socket panel, makes it "circuit ready" for

any possible new tube types.

A solid-state power supply gives increased accuracy and dependability. An all-transistorized gas and leakage test circuit sets a new standard of reliability for spotting "tricky" tube defects that can "chew up" your profit. You can actually read interelement leakage to 50 megohms; gas/grid leakage effects to 0.1 μ a!

We call it the "Mustang" because it uses fresh, new engineering ideas and because it gives you a real opportunity to break into new profits.

See it at your Hickok distributor or write for circular TT799.

HICKOK

**THE HICKOK ELECTRICAL
 INSTRUMENT CO.**

10566 Dupont Avenue, Cleveland, Ohio 44108

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Our CB story this month
is short and sweet:

the
beauty of
this baby
is its
18" length!



M-130

"Mighty Mite"

18" Mobile CB antenna

- Capacity-matched to car body for excellent VSWR
- Fine-tuning adjustment
- Professional-type, 2½" stainless steel shock spring



M-130 "Mighty Mite"

¾" snap-in mount—
no soldering

M-131 "Maggie Mite"

Gutter clip mount—
hang it anywhere

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antenna
specialists co.



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"stripes of quality" ®



... for more details circle 11 on postcard

NEW PRODUCTS

Reversible Drill 210

An industrially-rated, ½ in., four-speed drill is introduced. Double reduction gears and electronic speed con-



trol are combined to provide four speeds of 630, 730, 2200, and 2400 rpm with no load. Speed changes are made with a gear shift control located on the back of the handle. It measures 11 x 8½ x 3½ in. Weight without cord is 6½ lbs. Three-wire cord is 6 ft long. Wen.

Color TV Crystals 211

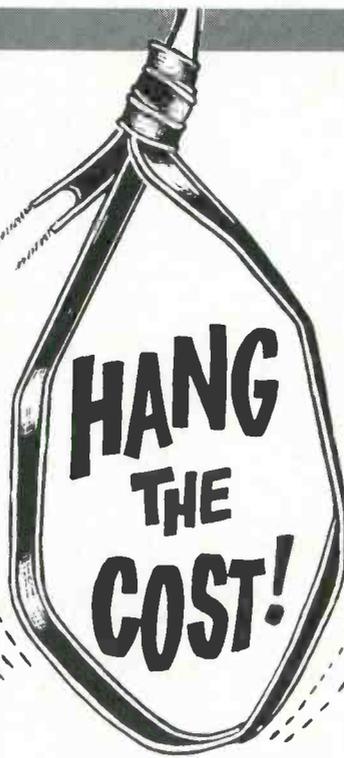
A line of TV color control crystals is announced. They are designated #CTV358 and are supplied in a hermetically sealed case with two-inch leads. The crystals are for use in the color burst circuitry of modern color TV receivers. Semitron.

Tube Kit 212

A package offering an assortment of the 17 most popular color receiving tube types is introduced. Tube types included are: IV2, 3A3/3B2,



3AT2, 6AW8A, 6BK4A, 6DQ5, 6GF7, 6DW4, 6EA8, 6EW6, 6GH8A, 6GM6, 6GU7, 6GY6, 6HF5, 6JE6 and 12BY7A. The kit of tubes is packed in a fibreglass thermo-insulated utility bag. RCA.



Columbia Wire's Permaline television transmission cable costs a few cents more, but it's well worth it. Permaline is the only television wire available of such quality that it can be guaranteed, in writing, for 15 and 25 years.

Columbia Wire is proud to say that in ten years we have never had to replace as much as one foot of Permaline for reasons of deterioration.

Columbia Permaline has electrical characteristics similar to those of ordinary brown polyethylene lines but the difference is, a small amount of carbon black that is added to a virgin compound to protect the transmission line from ultraviolet rays of sunlight.

Install Permaline and you will be assured of a happy customer and repeat business . . . but not for a new television cable.

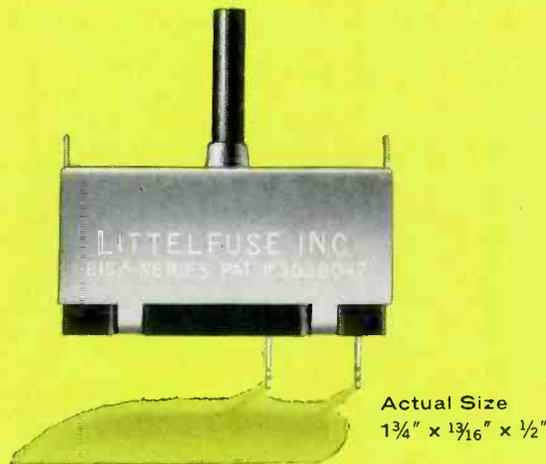
Permaline is Available From Your Local Distributor. Write for samples and literature.

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Introducing a Complete Line of Littelfuse Quality Circuit Breakers



Exact replacement from factory to you

Designed for the protection of television receiver circuits, the Littelfuse Manual Reset Circuit Breaker is also ideally suited as a current overload protector for model railroads and power operated toy transformers, hair dryers, small household appliances, home workshop power tools, office machines, small fractional horsepower motors and all types of electronic or electrical control wiring.

LITTELFUSE

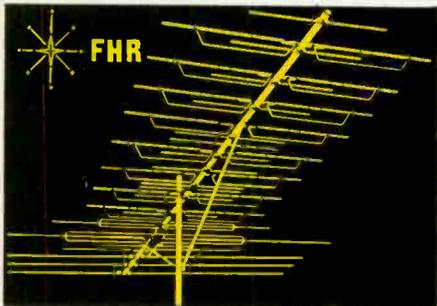
DES PLAINES, ILLINOIS

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THE **MAGIC**
OF
COLORMAGIC
TV ANTENNAS
ADVANCED
ENGINEERING
DESIGN

BEST FOR COLOR AND BLACK AND WHITE



Only Colormagic...

has been top-rated in independent consumer publications for broadband performance, gain, front/back ratio, beam width, impedance match, construction and ease of assembly, etc.

Only Colormagic...

has FHR which is the exclusive development of GC Electronics for process applied to all Colormagic series of antennas, to provide a resonating action within the elements of the fundamental harmonics of both the high and low bands.

Only Colormagic...

has the outstanding Award Winning Carton in which all Colormagic series antennas are carefully packed.



Only Colormagic...

has the endorsement from Philco, one of the leading manufacturers of TV receiving equipment. Colormagic antennas are recommended and approved for all Philco TV Color and black and white installations.



Write now for free four page color brochure which describes the entire Colormagic series of antennas.



Dept.: BMW

GC ELECTRONICS
400 South Wyman Street Rockford, Illinois



NEW PRODUCTS

Tool Stands

A line of steel tool stands is announced. Tool stand sizes are either 20 in. wide by 28 in. deep or 24 in.



wide by 36 in. deep. Both are 34 in. high on floor glides or 36½ in. high on casters. Penco.

Tape Recorder

A camera sized standard speed tape recorder is introduced. It operates at



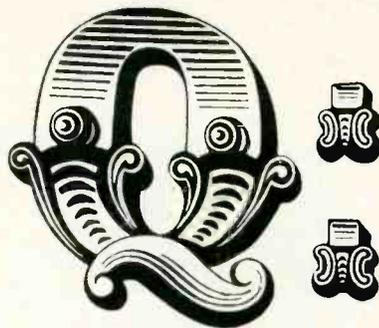
a speed of 1½ ips, weighs two lbs and uses four "C" size flashlight batteries. Price \$39.50. Concord.

Pocket Voltmeter

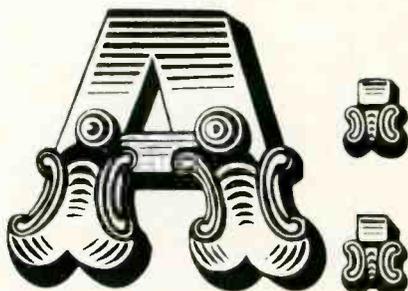
A pocket-size voltmeter is announced. The model number VT-101 can be used to check TV, radio and other electrical appliances. It measures 65 to 800 v, ac or dc. Net price \$1.49. IEH.

Guard Rail Cart

A guard rail cart made of stainless steel is designed to carry and store instruments, supplies and equipment that must be wheeled from area to area for use. Specifications of the Model #316 include: shelf size, 15½ x 24 in.; number of shelves, three; over-all size, 16¾ x 27¾ x 33¼



What Can Make
an MATV Installation
Easier, Cheaper,
and Better?



A System Designed
and Equipped
by VIKING!

Every piece of MATV equipment has been designed to save the technician valuable time and money. Each component is manufactured and tested under rigid quality control methods so that they match perfectly from the antenna to the set.

When it comes to laying out the MATV system you can't beat Viking's "know-how" and experience. Best of all, it doesn't cost a cent to consult with us. Immediate and courteous attention will be given to any problem.

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ELECTRONIC TECHNICIAN



in.; shipping weight, 30 lbs; capacity, 200 lbs. Lakeside Mfg.

Cartridge

217

A stereo cartridge that incorporates an elliptical stylus is introduced. The manufacturer claims that this car-



tridge can be used at the higher tracking pressures required by automatic record changers. Audio Dynamics.

CB Transceiver

218

A CB transceiver is announced. The CB-212 utilizes crystal controlled transmit and receive functions on any



six of the available CB channels. A front panel switch determines the channel in use. A dual power supply is provided with 117 vac input for fixed station applications and 12 vdc for mobile applications. Hammarlund.

Oscilloscope

219

A portable oscilloscope is announced. The type 422 weighs approximately 20 lbs with "A" Supply, including power cord and panel cover. The dimensions are 6¾ by 8½ by 16 in. It has a bandwidth of dc to 15 Mc, sensitivity to 10 mv/dv and dual-trace operation. A 4 in. rect. CRT, with illuminated graticule, provides 8.2 sq. in. of display area. Tektronix.

Portable Stereo

220

A portable stereo phonograph is announced. It can play any size or speed of record and a 45 rpm adapt-

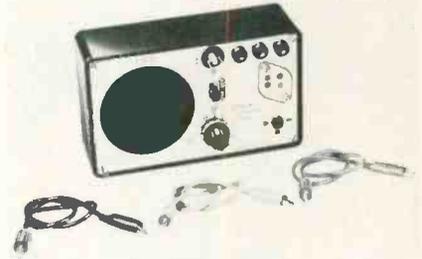


or spindle is included. The dual channel amplifiers drive two 4 x 6 in. speakers. It is finished in pyroxylin, and the carrying weight is 20 lbs. VM.

Transistor Tester

221

A transistor tester which tests transistors in or out of circuits is an-



nounced. The Model XT-1 uses an audible tone for indicating relative gain of a transistor. ESO.

easily service transistor radios...and make money!

Model 960



TRANSISTOR RADIO ANALYST

with Exclusive

Dyna-Trace Single-Point Probe and Built-in Metered Power Supply and VTVM.

Check all circuits - Pinpoint any trouble ... in minutes

This is the way to profit from transistor radio servicing. *There's no hit or miss, no waste of time and work.* The B&K "960" Analyst gives you a complete transistor radio service shop in one easy-to-use instrument. It provides signal-generator, power supply, milliammeter, VTVM, battery tester, ohmmeter, and both in-circuit and out-of-circuit transistor tester—*all in one.* Also speeds servicing of tube-type radios. Brings you new customers, and net profit. **Net \$9995**

Unique Point-to-Point Signal Injection
Easily enables you to troubleshoot any stage of any transistor radio—fast.

Built-in Metered Power Supply
Makes it easy to operate radio under test. Provides from 1 to 12 volts in 1½ volt steps. Supplies bias taps.

Simplifies In-Circuit Transistor Test
Dyna-Trace single-point probe needs only the one contact to transistor under test. Gives fast, positive meter indication.

Built-in VTVM
Includes essential high-input-impedance vacuum-tube voltmeter for correct servicing.

Test All Transistors Out-of-Circuit
Meter has "good-bad" scale for both leakage and beta; and direct-reading beta scale. Also automatically—determines NPN or PNP. Meter is protected against accidental overload and burn-out.

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DIVISION OF DYNASCAN CORPORATION

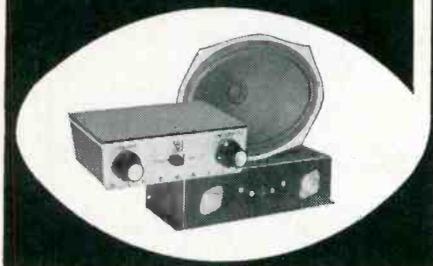
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"Improves radio 100%!"*



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America's Prestige

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Electronic Projects 303

This catalog lists a number of electronic projects. The description and price of each project is included. Henry Francis Parks.

Soldering Gun 304

A two-page, three-color bulletin, gives specifications and applications of a 25 to 450 w soldering gun. Wen.

Voice Actuated Switch 305

A voice actuated switch which will start and stop a tape recorder as you speak is announced. The unit can be used with almost any tape recorder on the market, the manufacturer says.

CCTV Camera 306

This bulletin contains specifications and characteristics of a CCTV camera. Applications and mechanical dimensions are also included. GBC.

Microphones 307

A 16-page catalog features a line of microphones for use in many fields — CB, broadcasting, amateur, professional and home recording. Turner.

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A two-color data sheet describes two CB transceivers. Features and specifications of each model are included. Metrotek.

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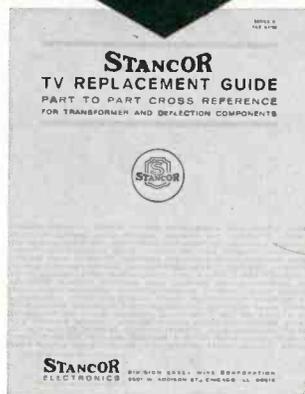
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Selective Cavities**310**

This booklet describes selective cavities and how they function. It is designed to provide persons in the two-way radio industry with a working knowledge of selective cavities. Decibel.

Power Resistors**311**

A 12-page, two-color catalog describes a line of vitreous enamel wire-wound power type resistors for various applications. Stock resistance values, prices and dimensions are given for resistors ranging from 1 to 200 w. Ward Leonard.

HV Components**312**

Descriptions and technical data on power supplies, volt boxes, zener regulators, insulation test sets, kilovoltmeters, connectors and switches are

included in this six-page folder. Industrial Instruments.

RF Interference**313**

This illustrated 24-page book describes the problems and solutions of radio frequency interference on mobile rigs. Hallett.

Power Supplies**314**

This catalog contains specifications for a line of voltage and current regulated power supplies. Also included is a glossary of power supply terms and explanations of regulated power supply capabilities. Kepco.

Diode Cross Reference**315**

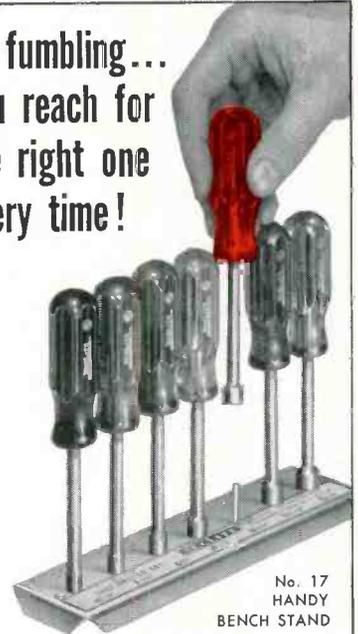
This 19-page cross reference and interchangeability for zener and reference diodes guide, lists over 4000 device types, together with their nearest equivalents and recommended replacement types. Motorola.

Antennas**316**

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TIPS ON COLOR . . .

Continued from page 53

mize focus-change troubles, the focus should be set to normal viewing levels with normal picture content. If this procedure is used, minimum noticeable focus variation will be obtained when the brightness is changed over a reasonable range.

Convergence

Convergence was a dirty word with most technicians only a couple of years ago. Now, most technicians are fairly proficient at it. A set

comes in the shop once in a while, however, that refuses to converge well. I can tell you with one sweeping statement that your problem, in most cases, is the yoke. Don't try to analyze the yoke, though. You won't find a thing wrong. Generally, the windings in the yoke are very slightly skewed and the effect on each gun in the CRT is slightly different. This causes a separation of one or another gun which cannot be counteracted by the convergence controls. Such trouble is most often observed at the left or right side of the screen.

Vertical and horizontal centering sometimes inject their own "kinks" into an otherwise easy procedure. Vertical centering is the worst offender, and if it is turned off by as much as one quarter to half an inch, the resulting convergence may be totally unacceptable. It is generally a good idea to use a rule and actually measure the position of the horizontal line position when the NORMAL-SERVICE switch is thrown to SERVICE. The line, of course, should be accurately leveled and centered vertically.

Adjusting 4.5 Mc Trap

In color work, the 4.5 Mc trap adjustment is more critical than in B/W because the 3.58 oscillator frequency beats and generates a very noticeable 920 kc pattern in the picture. This shows up as broad herringbone interference running through color pictures.

Many manufacturers have complicated adjustment procedures which require accurately calibrated equipment. I use a simpler method in which only a good scope (reasonably flat to about 4.5 Mc) and a station signal are required. The results are at least as good as any

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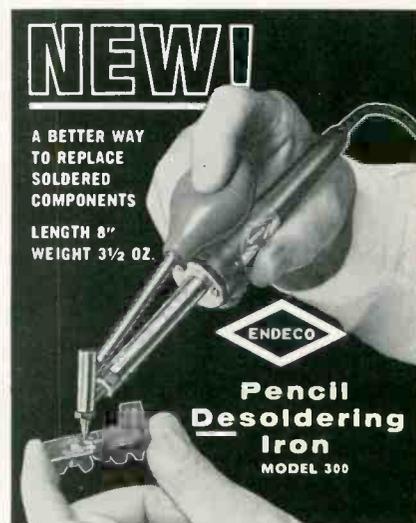
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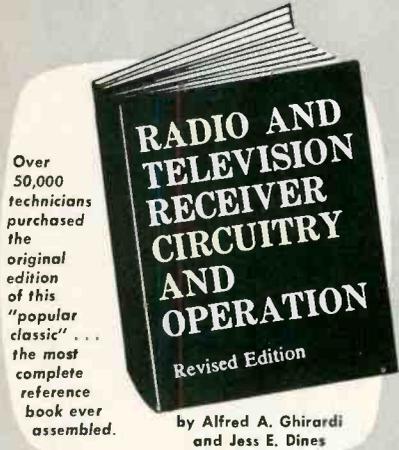
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other method and better than most. Use a monochrome signal if at all possible. If a color signal is used be sure to turn the chroma gain down. Try to find a strong station signal which has a reasonably still picture. This will make the adjustment results a little easier to see.

Adjust the fine tuning until a noticeable 4.5 Mc hash appears in the picture. Attach the scope to the video detector output—almost any point beyond the detector will do (Fig. 2). Sync the scope at the vertical rate. Now observe the scope. Turn the 4.5 Mc trap adjustment and note the "hash" on the sync and in the video. Adjust the trap for minimum 4.5 "hash."

If a test pattern is available, this is an excellent signal source. When the trap is misadjusted you can actually see the tone modulation on the "hash." If a pattern generator with a crystal controlled 4.5 Mc sound source is available, this too will make an excellent signal source. (See Fig. 3 and 4.)

Chroma Tips

Neophytes and pros alike are still perplexed by insufficient tint control range, tint control normally located at one end and too little chroma. Only three adjustments cause most of the trouble: The bandpass amplifier coils—follow the manufacturers recommended procedure here—and the 3.58 Mc output transformer adjustment.

This transformer can normally be adjusted on a color program with the tint control set to mid-range. Simply turn the slug until the flesh-tone tints are normal. If it is not possible to get normal flesh tones in this manner, the 3.58 bandpass amplifier may be misadjusted. Again, it is best to follow manufacturers' adjustment procedures for this one.

Several manufacturers are now designing and building their own color chassis. In all probability, more color sets will be manufactured this year than in past years combined. Many technicians are now making a good living by specializing in color sets. And I believe those who have shunned color servicing up to now are missing the color train. I think the multi-colored caboose will soon pass them by—unless they get aboard without further delay. ■

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And with this superb set, you go a step further. The big 1 1/4 lb., 138-page instruction manual is an education itself on color TV operation & theory. Hubert Lockett aptly describes it in an article from *Popular Science*: "The manual provided with the kit is a masterpiece. It is nearly a half-inch thick and lavishly illustrated with drawings, photographs, X-ray views of circuit boards, and even 32 plates in full color. Only 28 pages of the 138-page manual are devoted to the usual step-by-step procedures. The rest covers the theory of operation, detailed descriptions of each circuit, trouble-shooting, service information, adjustments, and operation." (See the Heathkit Color TV article in this issue!)

And The Performance? TV serviceman E. C. Van Dyke of Baltimore wrote: "After constructing Kit #GR-53A, I can truthfully say that I have

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YOU AND COLOR TV . . .

Continued from page 51

on the control grid, the plate current consists of a series of half-cycle pulses with average value.

When an in-phase signal is applied to the control grid, this signal adds to the sub-carrier amplitude and causes the tube to conduct more heavily. A corresponding increase in the average plate current is then noted. The average plate current in this situation (Fig. 7B) will vary with the applied signal amplitude.

When the two signals are 90 deg out of phase (Fig. 7D) the average plate current is the same as the no signal value. This is true because in this situation the two signals subtract for half the conduction period and add during the other half. In effect, these changes cancel each other out so the average plate current remains constant. A 180 deg phase differential is shown in Fig. 7C. In this case you will note that the color signal will subtract from the subcarrier voltage and cause the average plate current to be less.

Again, the average plate current will be dependent on the amplitude of the control grid signal.

From this we find that the average plate current varies from a maximum at 0 deg phase differential between the two signals to a minimum when they are 180 deg out of phase. The relationship between the signals, phase differential and output voltage is shown in Fig. 8.

When we apply this relationship in actual practice, the B-Y demodulator tube is biased so that the sub-carrier voltage causes the tube to conduct.

In practice, the color signal (as previously stated) is composed of B-Y and R-Y voltages added to form one resultant. This voltage, varying both in amplitude and phase, is fed to the control grid of each demodulator tube. A simplified demodulator circuit is shown in Fig. 9. The B-Y demodulator tube is biased so that the subcarrier voltage causes the tube to conduct for a short period every positive half cycle. During this time, the output voltage is dependent on the color signal phase and amplitude.

With proper synchronization, the B-Y demodulator will be conducting when the resultant color signal applied to the control grid is composed of only B-Y components. This will cause the output voltage of the B-Y demodulator to vary at the B-Y rate.

The R-Y component at this instant will be zero so the B-Y output is unaffected by R-Y voltages. The R-Y demodulator suppressor at this time is negative so the R-Y tube is cut off and has no output.

The R-Y demodulator operates in a similar manner except that it is pulsed into conduction at a different time and when it is conducting the color signal is composed of only R-Y voltages. The output, therefore, at the R-Y plate is varying at the R-Y rate. The B-Y tube is cut off while the R-Y tube is conducting. This action is repeated once every cycle for each tube.

Our detection process is then complete with a reproduction of the original B-Y voltage appearing at the B-Y demodulator plate and a replica of the R-Y voltage at the R-Y plate. These voltages are then matrixed to form a G-Y voltage with the three difference voltages then fed to the three CRT grids.



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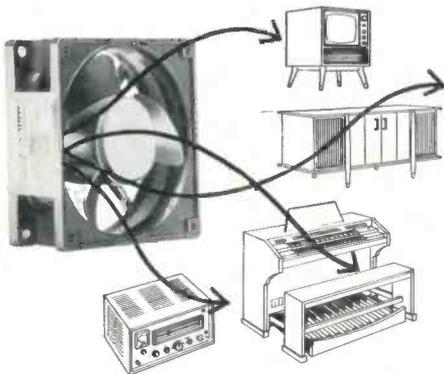
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MAY 1965

The difference signals are either amplified (low level demodulator) before application to the CRT or, in the case of a high level demodulator, fed directly to the CRT grids. Let's take a close look at a practical color demodulator.

Demodulator Circuitry

Recent RCA chassis and many other sets demodulate on the X and Z axis, instead of the B-Y and R-Y axis. These axes were chosen to fulfill the needs of a special adder system employed to matrix the difference voltages.

The demodulator and color difference circuitry employed in the RCA CTC 16 chassis is shown in Fig. 10. In the 6GY6, a pentode, the suppressor grid is designed to control current flow in the tube along with the control grid. The control grid determines the total amount of cathode current that will flow, that is, to both screen and plate while the suppressor controls the number of electrons that finally reach the plate.

The color signals are taken from the center tap of the color control, R145, and applied to the control grids of both demodulator tubes. The local 3.58 Mc oscillator signals are applied to the X and Z demodulator suppressor grids with the proper phase relationship.

On a vector diagram, the X axis lies 280.9 deg from the reference burst phase and the Z axis lags the X axis by 62.1 deg. The voltage appearing at the outputs of the X and Z demodulators is not true B-Y and R-Y voltage. Correction voltages are applied in the color difference amplifiers and true color difference voltages are applied to the CRT grids.

The cathode resistors in each stage, R749 and R762 are unby-passed and have a degenerative effect on the control grid signal. This action improves the linearity of the control grid characteristic.

The screens are returned to B+ through R760 and R761. The screen supply must be well-regulated to prevent screen current changes from affecting normal tube operation.

At their positive peaks, the sub-carrier signals applied to the suppressor grid causes heavy current flow in the plate circuit. During the

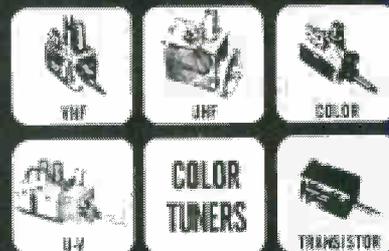
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negative peaks all the cathode current flows to the screen. Detection is achieved because the chroma signal applied to the grid adds to or subtracts from, depending on phase and amplitude, the carrier signal during plate conduction. This results in a varying color signal at the plate.

The demodulator plate load resistors are limited to 3900 Ω because a 500 kc bandwidth must be attained. C720 and L705 provide the necessary low pass filtering in the X demodulator output. This prevents the high frequency components present in the output from affecting the picture. A similar filter is used in the Z demodulator output.

This type circuit is called a low level demodulator, that is, the signal present at the output is not strong enough to drive the CRT grids. In high level demodulators the CRT grids are driven directly from the stage output. A circuit of this type will be described later.

Color Difference Amplifiers

The signal present at the plates of the X and Z demodulators will have to pass through another stage for two reasons. First, the signals are not true color difference information and second, further amplification is necessary to drive the CRT grids.

Three stages called color difference amplifiers (Fig. 10) are used to matrix the signals and also prepare them for application to the CRT. V706A and V706B receive their color signals from their respective demodulators. No direct demodulator signal is applied to V707A, the G-Y amplifier. The cathodes of the three tubes are tied together and return to ground through R728. Since the grid of V707A is essentially at ac ground, this results in the G-Y amplifier being cathode driven by a portion of the R-Y and B-Y signals. A true G-Y signal is produced at the plate of V707A. By the same token, since R728 is common to V706A and V706B, a G-Y component is introduced into these stages. When the G-Y component present at the cathode adds to the X signal being applied to the grid, true R-Y voltages appear at the output. The same is true when the G-Y component at the cathode of V706B mixes

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ELECTRONIC TECHNICIAN

with the Z component present at the grid — true R-Y voltages appear at the plate. Choice of the X and Z axis permitted this voltage addition to take place. The output of each difference amplifier is the dc coupled to its proper CRT grid. The signals on the grids of the CRT are then *mixed with the Y* (luminance or B/W) signal present at the cathodes and the desired color picture is obtained.

Another function performed by these difference amplifiers is dc restoration. A high negative pulse from the blanker plate is applied to the common cathodes during horizontal retrace time. This causes the three tubes to conduct heavily and draw grid current. This charges coupling capacitors C731, C732 and C726 to a constant potential. Thus, the bias of the tubes is at a fixed level dependent only on the blanking pulse and not on the variable color signal. This action reinserts the dc component of the signal and it is maintained through to the CRT by direct coupling.

High Level Demodulator

A Zenith high level demodulator schematic, chassis 25MC30, is shown in Fig. 11.

A signal from the local 3.58 Mc oscillator drives the deflection plates of each individual demodulator tube (6JH8 beam deflection type) push pull through the quadrature transformer. The chrominance signal is fed to the grids of V12 and V13. Each demodulator tube has two outputs which are 180 deg out of phase. Pin 9 output of V12 is the detected B-Y color difference signal and the R-Y signal appears at Pin 9 of V13. These color difference signals are applied through filters to the proper CRT grids.

The G-Y signal is obtained by combining the —(R-Y) and —(B-Y) signal outputs at the plates (Pin 8) of the respective demodulator tubes. Resistors R16, R37, R38 and R39 form the mixing network to produce the proper G-Y signal which is applied to the green guard.

Output of the high level demodulators is great enough to drive the CRT grids without requiring additional amplification. *Illustration Credit: RCA Institutes and "Color Television Fundamentals," by Milton S. Kiver, McGraw-Hill Book Co.* ■

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A true breakthrough in product design, ATLAS SOUND's EC-10 is an *all-American* value in performance and price. Outstanding in established applications, it opens up brand-new uses for horn speakers—in intercoms, low-power paging and talkback systems, mobile and Citizens Band transceivers. Use instead of cones. Install these extras:

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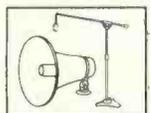
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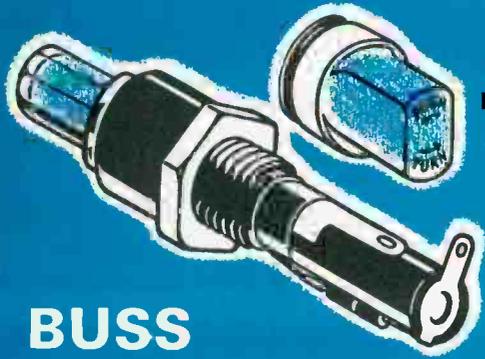


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Quick, positive, visual identification of faulted circuit. Bayonet type, *transparent* knob permits indicating light to be readily seen.

Fuseholder designed to withstand severe vibration. Terminals held mechanically as well as by solder.

Holder can be used in panels up to 3/16 inches thick.

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president of Corning Glass International said construction will begin immediately on a 40-acre site at Suzano, 28 miles east of Sao Paulo. The 128,000 sq-ft plant is expected to be in full operation by mid-1966, and will employ approximately 400.

TV Picture, Receiving Tube Sales

Factory sales of TV picture tubes increased 14.4 percent in December 1964 to 761,925 units as compared to 665,990 units in December 1963, the Electronic Industries Association's Marketing Services Dept. reported. Dollar volume was up, too, but only slightly (0.5 percent from \$12,461,408 to \$12,521,528).

Unit sales of picture tubes for the full year of 1964 were up 6.2 percent to 9,513,121, as compared to 8,955,434 for 1963, but dollar volume declined 1.5 percent from \$167,269,408 in 1963 to \$164,790,701 in 1964.

Factory unit sales of receiving tubes for December 1964 increased 2.8 percent to 31,423,000 from 30,557,000 in December 1963. Receiving tube sales for the full year, however, were down 7.1 percent to 367,788,000 in 1964 from 395,544,000 in 1963.

Bendix High-Voltage TV Transistors

High-voltage transistors for television receiver circuits have been developed by the Bendix Semiconductor division.

The silicon and germanium transistors, designed for horizontal and vertical deflection circuits, "can provide lower driver power levels, simplify yoke design, and reduce the size and cost of the output capacitor and transformer."

BUSS : the complete line of fuses . . .

NEWS OF THE INDUSTRY

Norman Triplett Elected President AEM

Norman Triplett has been elected president of the Association of Electronic Manufacturers, Inc. — Central Division. Mr. Triplett is executive vice president of marketing, the Triplett Electrical Instrument Company, Bluffton, Ohio. He has been active for many years in the organization of manufacturers who sell their products through electronic parts distributors; he has served as a vice president and director of AEM-Central and its predecessor organization, the Association of Electronic Parts and Equipment Manufacturers, Inc.

Triplett succeeds Walter A. Clements of Littlefuse, Des Plaines, Ill., in the presidency. He will serve a one year term. He has also been elected to represent AEM-Central on the Board of Directors of Electronic Industry Show Corporation.

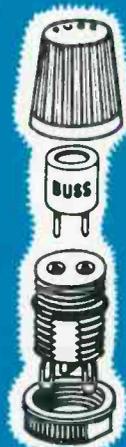
Corning To Build Plant in Brazil

A plant to manufacture glass television bulbs for the Latin American market will be built near Sao Paulo, Brazil, by Vidros Corning Brasil, S.A., a subsidiary of Corning Glass Works.

Robert D. Murphy, chairman, and Forrest E. Behm,

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Holder can be used with or without knob. Knob makes holder water-proof from front of panel.

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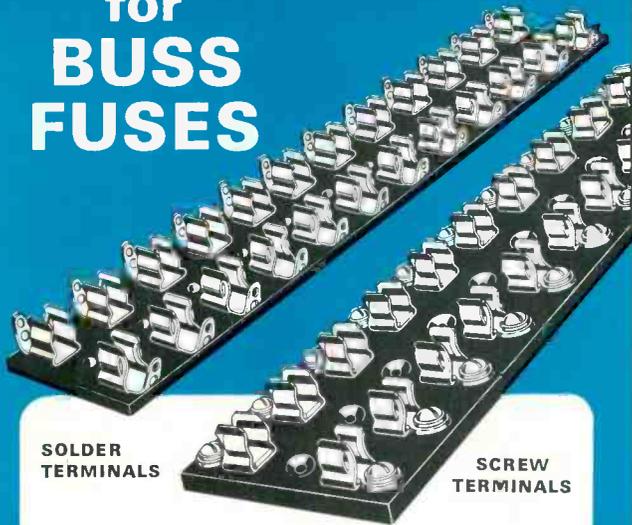
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uniformity in records and needles to simplify marketing and increase sales of records and replacement needles. All that remains is to achieve unanimity in future manufacturing," observes Jensen. "I believe that the chances of agreeing on one speed and one size for records is better than anytime since the introduction of the L-P record."

Jensen feels that 33 rpm will become the standard speed for records played on a single size spindle. As for record sizes, he believes that the seven-in. and ten-in. sizes will eventually give way to the larger 12-in., despite the teenage trend to favor the smaller seven-inch 45s. As far as needles are concerned, Jensen notes that currently 15 types of needles make up 85 percent of all needle sales and he predicts that these will "boil down" to about ten needles covering all phonograph types.

Belden Earnings

Belden Manufacturing Company today reported that its earnings and sales set new company records in 1964. Net profit for the year increased 39 percent to \$2,350,427 or \$2.91 per share compared with \$1,692,740 or \$2.10 per share a year ago. The previous high of \$2.70 per share was established in 1962. Sales for the period ending December 31, 1964, rose to \$42,256,221 compared to \$35,924,858 last year, an increase of 18 percent.

Construction of a 39,700 square ft building was completed in August, 1964, at the firm's plant in Richmond, Indiana. In 1965, as previously announced, the company will construct two additional buildings at Richmond which will add approximately 93,200 sq ft. These three buildings are expected to provide for the expansion of manufacturing facilities for about five years.

... of unquestioned high quality

according to the announcement by James E. Harrison, marketing manager of the division.

He said the new transistors also will enable engineers "to design circuits for higher output voltages with increased power supply efficiency at lower cost."

The new line, he said, includes silicon NPN transistors that feature collector-to-emitter voltages to 700 v and germanium diffused alloy power (DAP) PNP transistors with collector-to-emitter voltages to 325 v. Switching is accomplished in less than two microseconds at 6 amperes.

Philco Cabinet Plant Addition

Philco Corporation will begin a half-million dollar addition to its Watsonstown, Pa. cabinet plant this spring Robert Austin, plant manager, announced.

The money will be used to construct an 80,000 sq ft warehouse at the plant site. The appropriation is in addition to a \$150,000 modernization program in progress at the plant.

"The warehouse," Mr. Austin said, "will be used for the storage of finished wood cabinets used for television, high fidelity phonographs and radio sets assembled at Philco's consumer electronics plant in Philadelphia.

Jensen Predicts Record Uniformity

Phonograph records will all become uniform in speeds and sizes within the next five years.

So predicts Karl Jensen, president of Jensen Industries. Jensen also sees the day when no more than ten types of needles will be used in phonograph equipment.

"Everyone in the industry agrees on the need for more

Screw type knob designed for easy gripping, even with gloves. Has a "break-away" test prod hole in knob.



Screw type slotted knob that is recessed in holder body and requires use of screwdriver to remove or insert it.

BUSS Space Saver Panel Mounted Fuseholders

- Fuseholder only 1 1/8 inches long, extends just 29/32 inch behind front of panel. Takes 1/4 x 1 1/4 inch fuses. Holder rated at 15 ampere for any voltage up to 250.
- Military type available to meet all requirements of MIL-F-19207A.

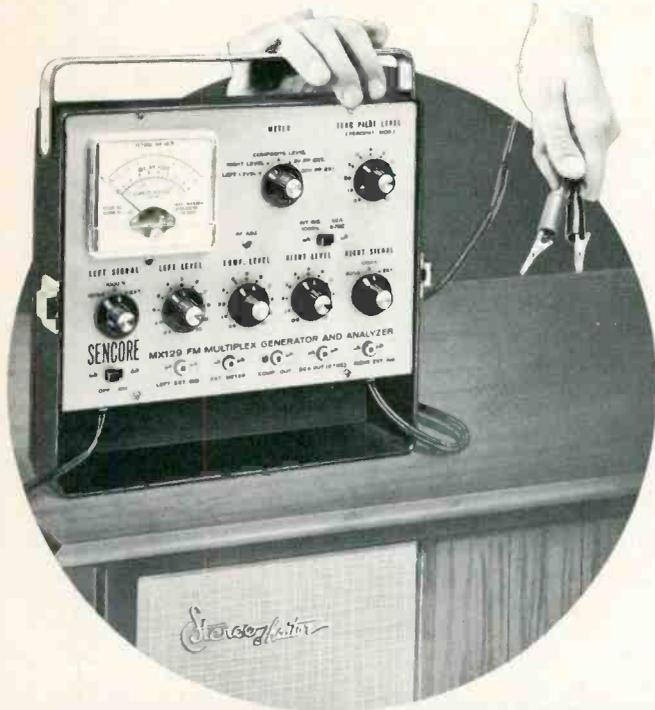
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add an fm-stereo service center
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FM-Stereo growth continues to mount and is fast becoming as big a field as Color TV. This means more FM-Stereo service business for you, now and in the future. Is your shop equipped? It can be — completely and economically — with the MX129, the FM-Stereo "Service Center in a Case." The instantly stable, 19-Transistor, crystal controlled MX129 is the most versatile, most portable (only 7½ pounds), most trouble free and efficient multiplex unit on the market — just like having your own FM-Stereo transmitter on your bench or in your truck. Powered by 115 volts AC, it produces all signals for trouble shooting and aligning the stereo section of the FM receiver . . . can be used to demonstrate stereo FM when no programs are being broadcast. Self-contained meter, calibrated in peak to peak volts and DB, is used to accurately set all MX129 controls and as an external meter to measure channel separator at the FM-Stereo speakers. **NO OTHER EQUIPMENT IS REQUIRED.** **\$169⁵⁰** only

SIGNALS AVAILABLE FOR ALIGNMENT, TROUBLE SHOOTING AND ANALYZING:

- FM-RF carrier with composite multiplex audio signal with 38kc suppressed carrier, 19kc pilot and 67kc SCA signals
- Multiplex signal formed by 60 or 1000 cycle internal tones or any external signal
- Full control over left and right channel amplitude (modulation)
- External 67kc SCA signal available for trap adjustment
- Composite signals available for signal injection FM detector

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NEWS OF THE INDUSTRY

'Friends of Service' Award

For the third consecutive year Philco Corp.'s Parts and Service Department has received the "Friends of Service" Award of the National Alliance of Television and Electronic Service Assns. (NATESA).

C. Howard Tomlin, Philco's general service manager, received the award on behalf of the company after addressing NATESA's 1965 Spring Director's Conference at the Lafayette Hotel in Little Rock, Ark. The presentation was made by Lyle Green, NATESA's East-Central vice president.

Norelco Appointments

Two appointments of manufacturer's representatives for Norelco radios were made today by North-American Philips Co., Inc.

Charles W. Butler, 336 Fourth Avenue, Pittsburgh 27, Pa., will handle the Norelco radio line throughout western Pennsylvania, West Virginia and western Maryland.

Morecock-Whitson, Inc., 1601½ East Boulevard, Charlotte 3, N.C., will serve as manufacturer's representative for North and South Carolina.

Norelco markets a line of AM/FM and FM stereo radios including portables, table models and console combinations.

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Fidelitone Representative

H. A. Prince, sales manager of Fidelitone, Inc., Chicago, has announced the appointment of a new representative, the Steve Fisher Sales Company of Brooklyn, N.Y. They will represent the company in the five boroughs of New York City, calling on distributor accounts. In addition they will cover all of Long Island, Westchester County, Rockland County, Northern New Jersey and as far south as Trenton.

Zenith Hearing Aid

Zenith announced the development of the Vocalizer, a new hearing device to improve the voice of profoundly deaf children and adults who previously were unable to hear and recognize "auditory clues," thus preventing them from controlling their voices.

Announcement was made by E. M. Kinney, president of Zenith Hearing Aid Sales Corporation, to clinicians and Zenith dealers throughout the country. He reported the results of extensive Zenith Laboratory testing and a special pilot program at a major school for the deaf.

Harman-Kardon Rep

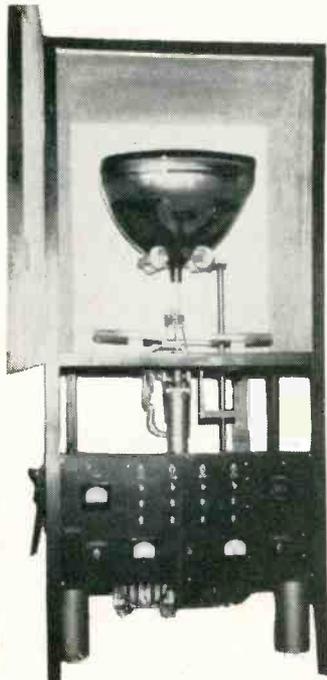
Harman-Kardon has appointed the Cartwright & Bean Company as its Florida representatives for the Commercial Sound Div.

The firm presently represents Harman-Kardon in the southeastern states. They have offices in Memphis, Tenn.; Atlanta, Ga.; Metairie, La.; Charlotte, N.C. and Miami, Fla.

The announcement was made by William Menezes, sales manager of the Commercial Sound Div.

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NEW IMPROVED SENCORE CR133 CRT CHECKER & REJUVENATOR

The new, improved CR133 CRT Checker is designed to test all present picture tubes — and it's ready for future tubes too! Two plug-in replaceable cables contain all sockets required. The compact, 10 lb., CR133 checks CRT emission, inter-element shorts, control grid cut-off capabilities, gas and expected life. Checks all tubes: conventional B&W, new low drive B&W, round color tubes and new rectangular color picture tubes. Exclusive variable G2 Volts from 25 to 325 Volts insures non-obsolescence when testing newly announced "semi-low" G2 tubes. New Line Voltage Adjustment insures the most accurate tests possible. Uses well-filtered DC for all checks to avoid tube damage and reading errors. Color guns are individually tested as recommended by manufacturers. Exclusive automatically controlled rejuvenator applies rejuvenation (ACR) voltage as required by individual tube condition; precisely timed to prevent over-rejuvenation or tube damage. The ACR feature is most useful for color tube current equalization to insure proper tracking. Hand-wired and steel-encased for protection of meter and panel in truck or shop, the new improved CR133 is only . . . **\$89⁹⁵**

The famous CR128 CRT Checker and Rejuvenator is similar to above, but with a three position G2 slide switch and without Line Voltage Adjustment at \$69.95

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america's most popular
tube tester

... because it
finds the
"tough dogs"
others miss!



**THE NEW SENCORE TC130
MIGHTY MITE III TUBE TESTER**

New in looks and compactness, updated with many exclusive features. The MIGHTY MITE tester, long America's most popular tube checker because it has the versatility and reliability professional servicemen demand! The MIGHTY MITE III checks them all — more than 2,500 tubes plus picture tubes, including the new frame grid tubes (has four extra sockets for latest tubes). It's fast and thorough, checks for control grid leakage, then, with the flick of a switch, tests for interelement shorts and cathode emission at full operating levels. Uses costly moving coil meter for high sensitivity (100 megohms) to find those "tough dog" tubes other low-sensitivity testers miss. In versatility, reliability, portability and operating simplicity, the TC130 is your best buy in tube checkers at **\$74⁵⁰**

COMPARE THESE MIGHTY MITE III FEATURES:

Lower voltage for Nuvistors and all frame grid tubes • Unique circuit tests for inter-element shorts, each and every element • Checks cathode emission at full operating levels • Checks control grid leakage at 100 megohms sensitivity, like "eye tube" testers.

Speed-indexed set-up cards greatly reduce look-up time • Simplified panel layout speeds checks, prevents errors • Burn-out proof, stick-proof meter • Sturdy, all-steel case, rubber feet • Styled for modern, professional look

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NEWS OF THE INDUSTRY

G-E Silicone Distributor

R. V. Weatherford Co. of Glendale, Calif., has been named a distributor of General Electric silicone products for California. The firm is a distributor serving the electronic industry in California, Arizona and Nevada.

The announcement was made jointly by R. T. Daily, general manager of G-E's Silicone Products Dept. and R. V. Weatherford, president of the R. V. Weatherford Co.

USL Appoints Sales Reps

United Scientific Laboratories announces the appointment of 23 sales representatives throughout the U.S. According to Bernard Levine, president, additional representatives will be appointed. These reps are marketing the company's line of CB transceivers.

Olympic Adds 12-in. Portable

A new 12-in. personal portable television set in a choice of three color combinations has been added to Olympic's portable television line, according to Morton M. Schwartz, president of Olympic Radio & Television Sales Corp. This model is Olympic's first entry into the small screen television category and expands the line which now includes 12, 16 and 19 inch portable units.

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CALLBACKS**

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TUN-O-LUBE**

Cleans Faster, Lubricates Longer!

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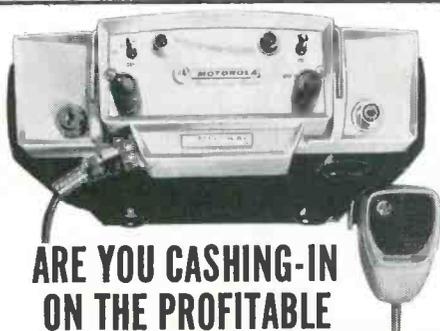
Olympic Sales Manager

Bill Briggs has been appointed sales manager of Olympic of Southern Calif., wholly-owned subsidiary of the Olympic Radio & Television Div. of Lear Siegler, Inc. A veteran of the TV industry, Briggs has been with the Olympic branch since its opening in 1958.



Our Cover

Our cover this month was supplied by Motorola. Equipment includes a Motorola color TV chassis. Test instruments: (A) Audio generator, (B) VTVM, (C) color generator, (D) scope, (E) color generator, (F) CRT tester, (G) variable ac power supply.



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- ★ Send for our FREE EVALUATION EXAM. Prove to yourself that you are ready to learn FM 2-way radio servicing.

Opportunities in 2-way radio servicing are virtually unlimited. ■ Just one of the hundreds of successful Motorola Service Stations writes, "we would be pleased to interview any graduate of your school that has received some training in 2-way radio maintenance. We are an established firm, 10 years old, with a promise of expansion governed by our ability to obtain competent technicians." ■ Get all the facts today. There is no obligation and no salesman will call.



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instant color patterns
at your finger tips...
zero warm-up time



THE ALL NEW SENCORE CG135 DELUXE TRANSISTORIZED COLOR GENERATOR

The big push is on in Color TV. Equip yourself now with the new, solid state Sencore CG135 and cash in on the zooming volume of new service business as Color-TV booms! Instant, service-ready RCA standard color bars, cross-hatch, white dots and individual vertical and horizontal bars enable you to set up or trouble-shoot more Color TV sets per day; earn top money in this fast growing service field. It's an analyzer too: Color gun interruptors, unmodulated video for chroma circuit trouble isolation and unmodulated sync pulses to keep Zenith receivers in sync for this test, make color trouble shooting a snap. Sturdy all-steel construction for rugged, heavy duty in the field or shop. Another Best Buy in profit-building service instruments from Sencore at

\$149⁹⁵

COMPARE THESE FEATURES: SEE WHY THE CG135 IS IN A CLASS BY ITSELF

- Solid state construction employs high priced GE "Unijunctions" to develop six "jump out proof counters" that guarantee stable patterns at all times with no warm-up
- Standard RCA licensed patterns as shown on schematics throughout the industry
- Handy universal color gun interruptors on front panel
- Lead piercing clips insure non-obsolence
- CRT adaptors optional
- Crystal-Controlled 4.5mc Sound Carrier Analyzing Signal to insure correct setting of fine tuning control
- RF output on Channel 4 adjustable to Channel 3 or 5 from front of generator when Channel 4 is being used
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color TV test instrument
ever developed



- OBSOLETES ALL OTHERS
- ELIMINATES ALL GUESSWORK

LECTROTECH V7*

A sensational new color generator with 4 major Lectrotech exclusives . . . plus all of the time-proven standard features . . . in one compact, portable unit. For the first time, you can install and service color TV completely, accurately and faster! Here are the facts:

EXCLUSIVE—COLOR VECTORSCOPE—Until now, available only in \$1500 testers designed for broadcast. Accurately measures color demodulation to check R-Y and B-Y plus all 10 color bars for color phase angles and amplitude. A must for total color and those hard to get skin tones.

EXCLUSIVE—SELF-CALIBRATING — Adjust timing circuit without the use of external test equipment. No need to return unit to a factory for adjustment.

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SPRAY IT . . .

Continued from page 54

Dielectric Coatings

The third group breaks down into two types, one specifically for high voltage applications and the other a general-purpose high dielectric for broad application — particularly for protecting electronic components from moisture absorption. The first product is useful on flyback transformers and yokes for eliminating high-voltage arc-over and corona discharge. The second comes in a variety of colors and the clear variety (Vinyl Copolymer), is particularly useful for sealing out moisture and corrosive fumes in electrical, electronic and various other equipment. Some brand names are: **Hi-Volt, Insul-Volt, K-29, Koloid, No Arc and Quel-spray.**

Refrigerants

This group is relatively new and most technicians say these products, when used intelligently and not in a haphazard guessing game, are real timesavers. A suspected intermittent capacitor, for example, can be frozen to approximately -50°F in one or two seconds — revealing defects almost instantaneously. These products are also used in mechanical applications — shrink-fitting bushings, shafts, sleeves, etc. They are also useful when soldering delicate parts. Some brand names include: **Chill-It, Freeze-Mist, Frost Aid, Merit-Kool, Spra-Freeze, and Zero-Mist.**



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Solvent-Lubricants

One of the oldest groups in application, perhaps, includes solutions for removing and preventing rust and corrosion, for removing "locked" screws and nuts. Some types make it possible to easily remove "frozen" yokes that otherwise defy removal from CRT necks without damage to the yoke. Some can be used on tape recorder and record changer mechanisms to prevent corrosion in humid and chemically-contaminated atmospheres. Some brand names are: **Chem-Oil, E-Z-Off and Pen-A-Lube.**

Plastic Cements

Although these products are extensive and exist outside of the general aerosol category, two relatively new products should be mentioned here as useful service aids. Called "Magnetic Cement," this product is designed to repair flyback and yoke cores, broken loopsticks, powdered iron cores and slugs. The manufacturer claims the product will renew the broken component to its original performance and efficiency.

The second product, called "Plasti-Patch," is said to be composed of a powdered plastic and a liquid plastic. When mixed together, the two plastics form a jelly-like mass that can be used as a cement or as a molding material to repair broken knobs, radio cabinets, meter cases, screw mounts on cabinets and plastic tuner shafts. When it hardens, the manufacturer says, it can be filed and drilled.

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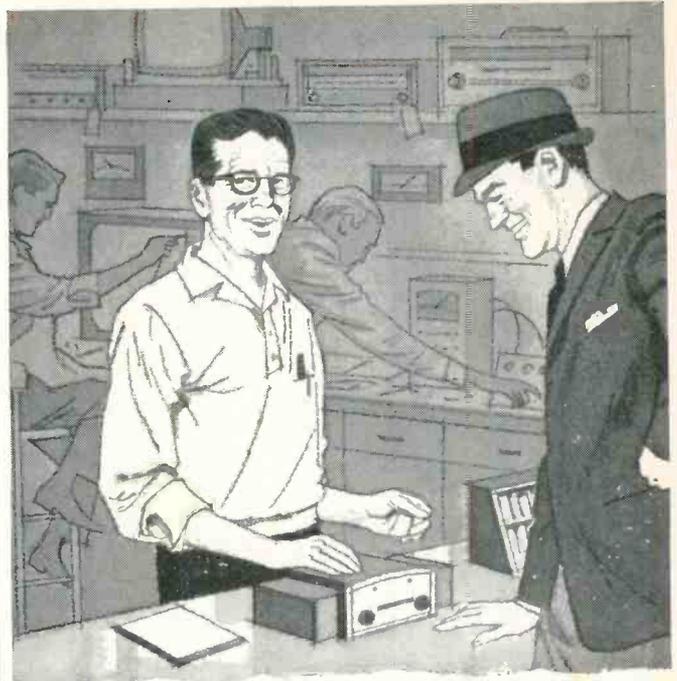
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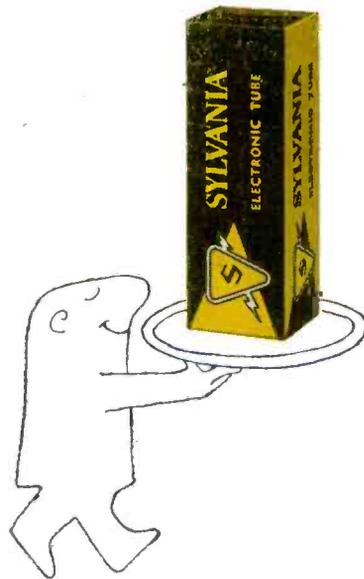
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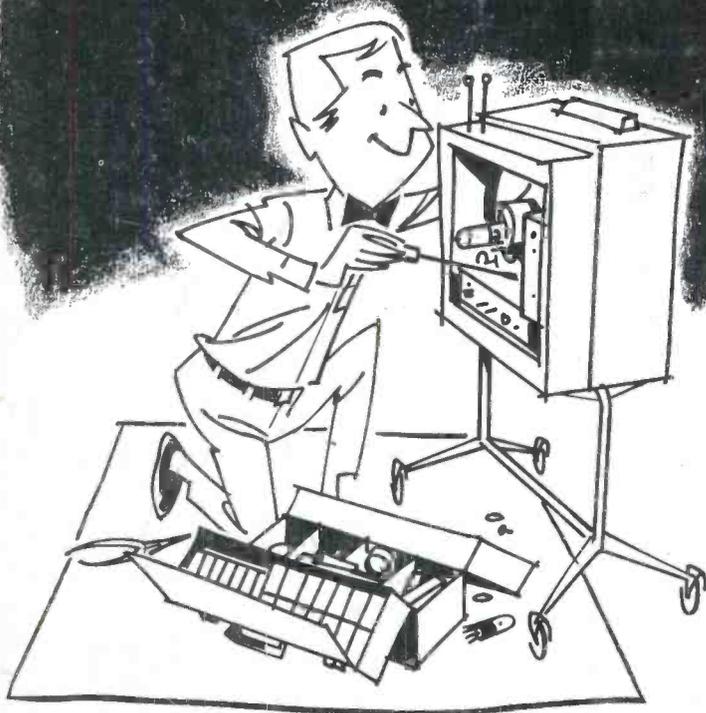
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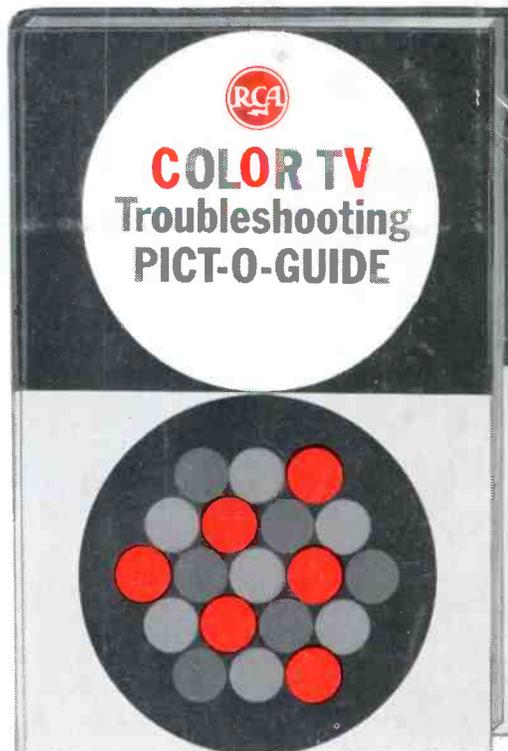
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