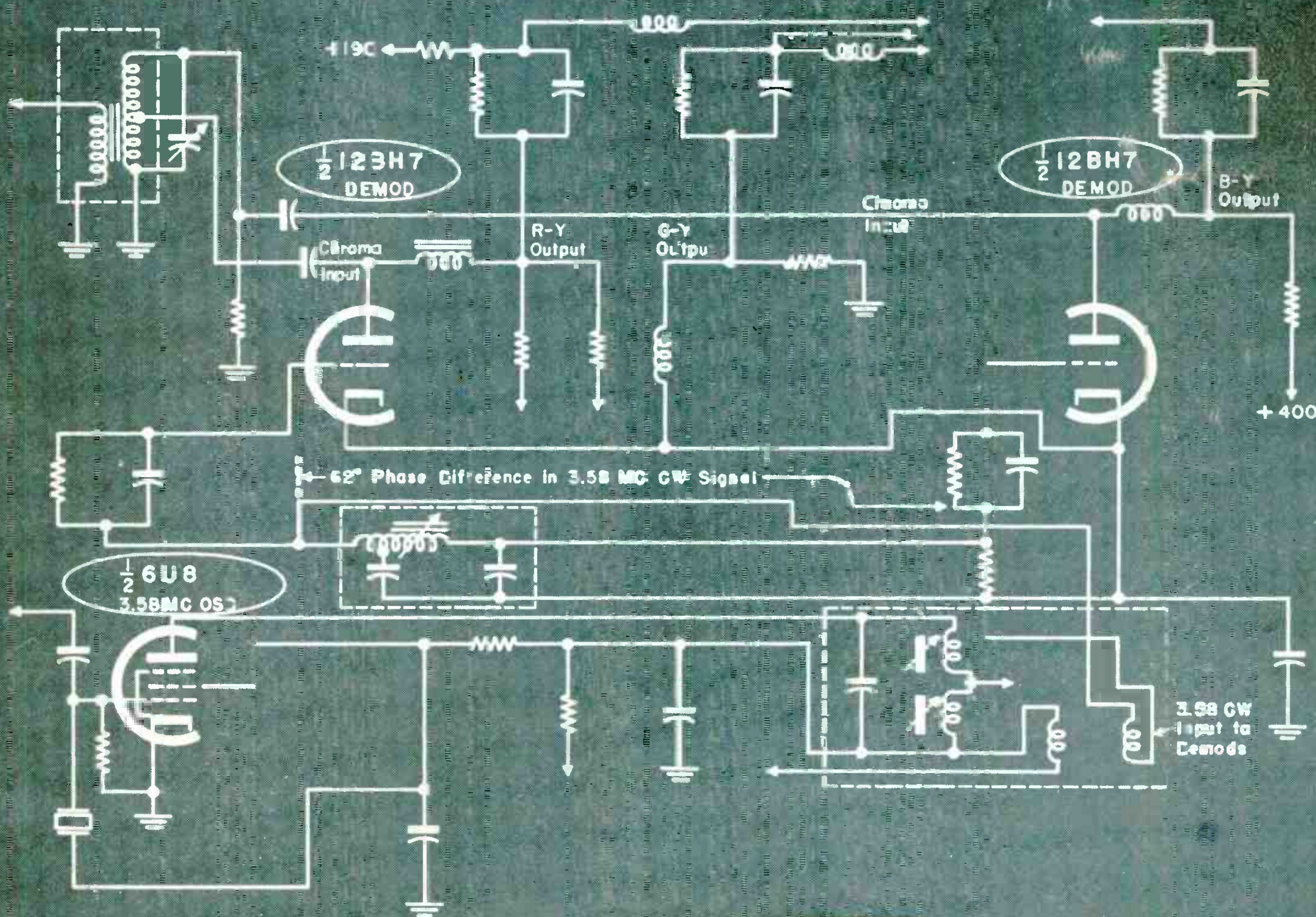
SEPTEMBER, 1955

# SERVICE

The Technical Journal of the Television-Radio Trade




Cathode-coupled demodulators in chrominance-channel circuit of 21-inch color TV chassis. (See circuit analysis, this issue) the **BIGGEST**

# TV Spot Campaign

**is going to**

**pre-selling...**

# C·D·R TV antenna Rot

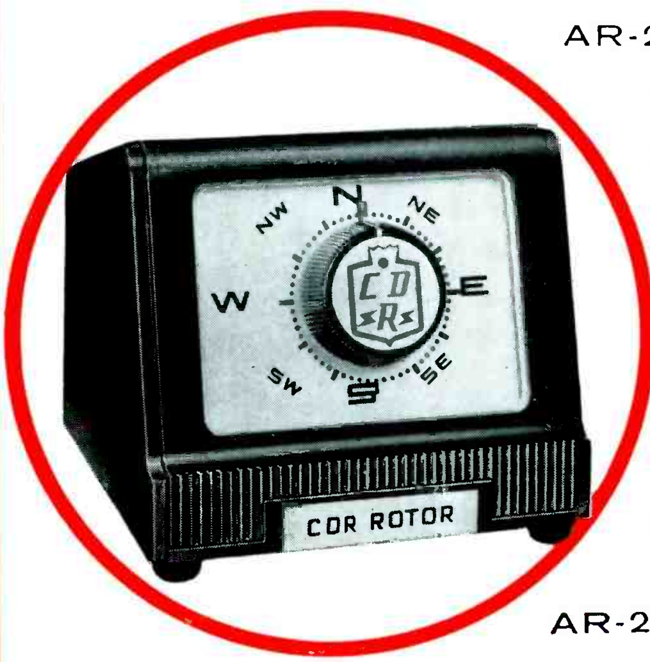
the complete line . . . a model

**TR-4** the heavy duty rotor complete with handsome modern cabinet with METER control dial, uses 4 wire cable.

**TR-2** the heavy duty rotor with plastic cabinet featuring "compass control" illuminated perfect pattern dial, uses 8 wire cable.

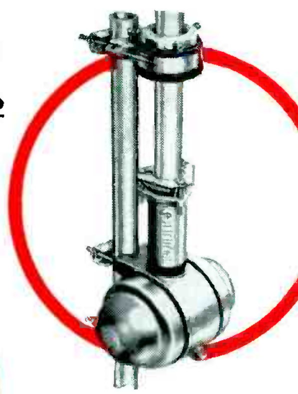
**TR-12** a special combination value consisting of complete rotor, including thrust bearing. Handsome new modern cabinet with meter control dial, uses 4 wire cable.

**TR-11** same as TR-12 without thrust bearing.

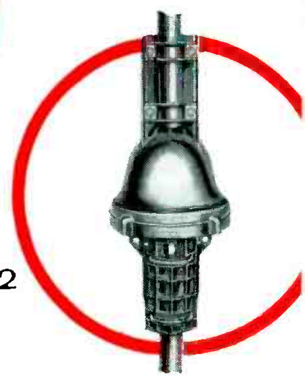



AR-1

AR-2



AR-22



**CORNELL-DUBILIER**

SOUTH PLAINFIELD, N.J.

# in Our History

**work for you**

# ors...

for every need

*featuring*

**C·D·R automatic ROTORS**

An outstanding group of rotors . . . three proven and tested models . . . ALL 40% SHARPER TUNING than ANY other automatic rotor. Handsome cabinet . . . dependable performance . . . proven and tested by thousands and thousands of satisfied users.

THE **RADIART** CORP.
CLEVELAND 13, OHIO

## to millions of TV viewers every week

We're going to make this the BIGGEST rotor year you've ever had! The CDR ROTOR line is COMPLETE in every detail . . . featuring SEVEN MODELS . . . A TYPE FOR EVERY NEED! And backing up this is the BIGGEST and most extensive consumer campaign in all our history! Millions of TV viewers will see the CDR rotor announcements on TV, pre-selling them for you. And a complete promotional kit of dealer aids to help you sell and feature CDR ROTORS! Plan now . . . for the BIGGEST CDR ROTOR year ever!

Vol. 24 No. 8 **SERVICE** September, 1955

The Technical Journal of the Television-Radio Trade

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## COVER CIRCUIT



## FEATURES



## DEPARTMENTS






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*"Super-sembled"* — with Channel Master's trigger-fast Snap-Lock Action.

**Never before — an antenna with such utterly . . .**

# Fantastic front-to-back ratios

**Low Band:** from **15:1** to **50:1** relative VOLTAGE (2500:1 relative power)

**High Band:** up to **13:1** relative VOLTAGE (169:1 relative power)

# CHANNEL MASTER'S new "K.O." all-channel antenna

### Knocks out venetian blinds and co-channel interference!

Channel Master's new "K.O." has the highest front-to-back ratios ever recorded for any TV antenna! The sensational "K.O." actually sets up an INVISIBLE BARRIER to signals coming in from the rear. Working with supreme efficiency on both VHF bands, it totally REJECTS rear signals, preventing venetian blinds and other picture problems caused by co-channel interference.

### Spectacular High Gain!

Low Band, 7 to 9 DB, single bay; High Band, 8.5 to 10.5 DB, single bay. True Yagi performance, combined with completely independent High and Low Band operation for maximum efficiency.

### Available 3 ways!

**Broad Band** model—model no. **1023** (includes HI-LO Matching Harness)

**Low Band** only—model no. **1026**

**High Band** only—model no. **1073**

Full descriptive literature available from your Channel Master distributor.

LICENSED BY KAY-TOWNES ANTENNA CO., ROME, GA.

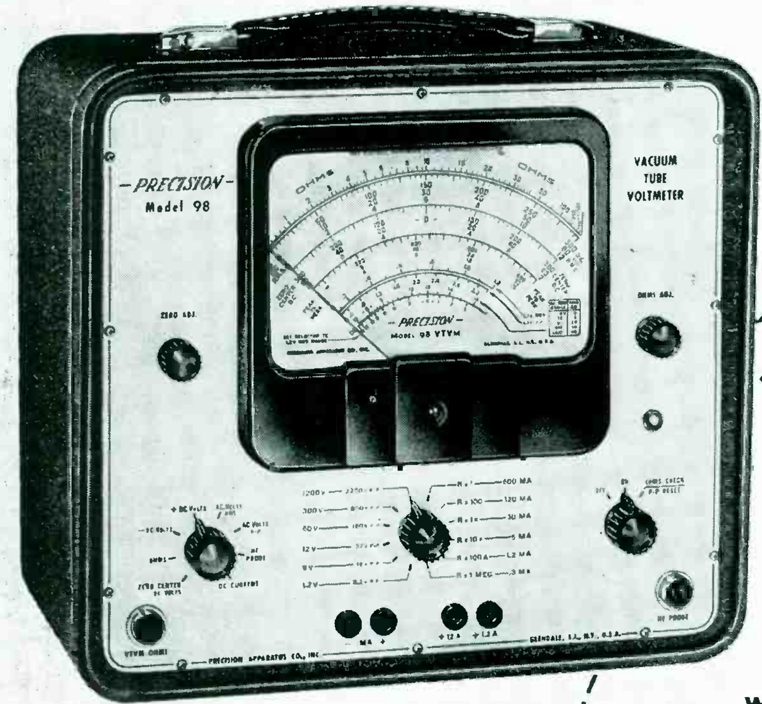
**CHANNEL MASTER CORP.** ELLENVILLE, N. Y.

The World's Largest Manufacturer of TV Antennas and Accessories


DELCO
ELECTRONIC
PARTS
A GENERAL MOTORS VALUE
SPEAKERS
AUTO RADIO AERIALS
VIBRATORS
CONTROLS
COILS
CAPACITORS
RECEIVING TUBES
TRANSFORMERS
CONDENSERS
PICTURE TUBES

# NOW ...MORE RELIABLE ELECTRONIC MEASUREMENTS

*including Peak-to-Peak Voltage Ranges to 3200 Volts*




## VACUUM TUBE VOLTMETERS by *PRECISION*

The Models 88 and 98 are wide-range, high-impedance, electronic test sets with specially engineered peak-to-peak voltage ranges for exceptionally accurate response to pulsed wave-forms encountered in color and monochrome TV and similar electronic equipment.

## *PRECISION* MODEL 98

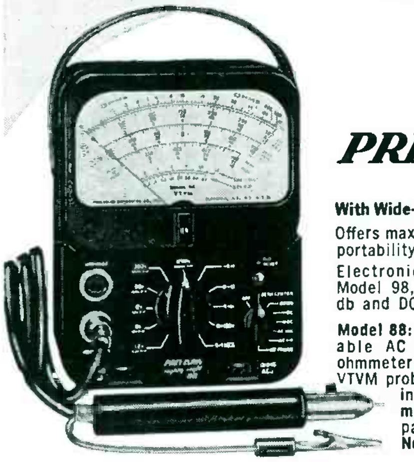
**WITH 7" FULL-VIEW PACE METER**

**9 Distinctly Separate Functions**
**55 Convenient Wide-Spread Ranges**

★ **6 True-Zero-Center DC Voltage Ranges.** 26⅔ Megohms input. 0 ±1.2 ±6 ±12 ±60 ±300 ±1200 volts.
★ **6 Electronic Ohmmeter Ranges.** 0–1000–100,000 ohms. 0–1–10–100–1000 Megohms.
★ **6 Minus and 6 Plus DC Voltage Ranges:** (Left-Hand-Zero) Constant 13⅓ Megohms input resistance. 0–1.2–6–12–60–300–1200 volts.
★ **6 High Impedance RMS AC Voltage Ranges:** 0–1.2–6–12–60–300–1200 volts.
★ **6 High Impedance Peak-to-Peak AC Voltage Ranges:** 0–3.2–16–32–160–800–3200 volts.
★ **5 Special High Frequency Probe Ranges:** Extends AC RMS reading facility to 300 Mc. 0–1.2–6–12–60–300 volts RMS. (Requires optional PRECISION RF-10A HF Probe.)
★ **8 DC Current Ranges:** 0–300 microamperes. 0–1.2–6–30–120–600 MA, 0–1.2–12 Amperes.
★ **6 Decibel-Output-Meter Ranges:** –20 to +63 DB
★ **One Universal, Coaxial AC-DC VTVM Probe** serves all electronic functions other than high frequency probe ranges.
★ **1% Multipliers and Shunts:** wire and deposited-film types.

**Model 98-MCP Deluxe:** (illustrated) In custom-styled, hooded cabinet and two-color satin-brushed aluminum panel. Case dimensions 11½ x 13 x 6⅝ inches. Complete with 3-way VTVM probe and manual. **Net Price: $109.50**

**Model 98-MCP Standard:** Complete as above except with black anodized panel in standard black ripple finished cabinet, 10½ x 12 x 6 inches. **Net Price: $104.50**



## *PRECISION* MODEL 88

**With Wide-Angle 5¼" PACE Meter**

Offers maximum compactness and portability.

Electronically similar to the Model 98, but does not include db and DC current ranges.

**Model 88:** Complete with detachable AC line cord, internal ohmmeter battery, 3-way coaxial VTVM probe and detailed operating manual. In custom-molded phenolic case and panel, 5⅜ x 7 x 3⅛". **Net Price ..........$69.75**

### ACCESSORIES AVAILABLE

**Model TV-8:** Super-High Voltage Safety Test Probe with X100 Cartridge for DC voltage ranges to 60 kilovolts. **Net Price: $14.75**

**Model RF-10A:** High-Frequency Vacuum Tube Probe. For direct measurements up to 300 volts and 300 MC. **Net Price: $14.40**

**Part No. ST-1:** (For Model 88 only) Retractable snap-on stand permits convenient 45° table mounting. **Net Price: $1.00**

PRECISION TEST EQUIPMENT — Standard of Accuracy

PACE — THE METER OF PRECISION

***PRECISION* Apparatus Company, Inc.**
70-31 84th Street, Glendale 27, L. I., N. Y.

Export Division: Morhan Exporting Corp., 458 Broadway, New York 13, U.S.A.
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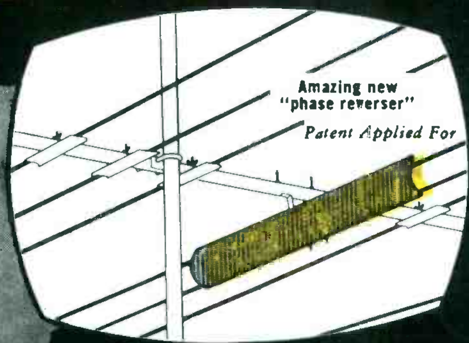
# EXCLUSIVE "PHASE-REVERSER" GUARANTEES

# THE NEW WALSCO WIZARD

# THE MOST ADVANCED, MOST POWERFUL

# SUPER FRINGE ANTENNA

# IN THE WORLD




*here's positive proof!*

**Actual comparison of fringe antenna performance**

| Channels | Gain (db) Single Bay 2 | 4 | 6 | 7 | 9 | 11 | 13 |
|---|---|---|---|---|---|---|---|
| Walsco Wizard — Imperial | 6.1 | 6.9 | 8.2 | 11.9 | 11.6 | 10.8 | 12.6 |
| Antenna "A" With 3 Phase Reversing Dipoles | 6.3 | 6.6 | 8.1 | 10.5 | 10.2 | 10.6 | 12.4 |
| Antenna "B" — Yagi Type with Phasing Loops | 5.1 | 5.5 | 6.8 | 7.5 | 9.6 | 8.8 | 11.2 |
| Antenna "C" — Yagi Type with Loading Coils | 5.9 | 6.9 | 8.6 | 9.1 | 8.6 | 9.6 | 7.8 |

The new Walsco Wizard performs as 3 separate antennas combined in one to give the very finest, all-channel picture reception ever seen on any television screen. Extra dipoles, complicated harnesses, or phasing stubs are completely eliminated. And the Wizard is the easiest to assemble and install.

Walsco guarantees the Wizard for 3 years.

| Model | Price |
|---|---|
| Wizardette #4110 | $14.90 list |
| Wizard #4220 | 19.50 list |
| Wizard Imperial #4230 | 34.90 list |

**ASK YOUR JOBBER FOR FULL INFORMATION AND TECHNICAL BROCHURE ... OR WRITE DIRECT TO WALSCO.**

Walsco
ELECTRONICS CORPORATION
A SUBSIDIARY OF Telautograph CORPORATION
3602 Crenshaw Blvd.,
Los Angeles 16, California
IN CANADA: Atlas Radio Corp., Ltd

# HYCON MODEL 622

## 5" OSCILLOSCOPE

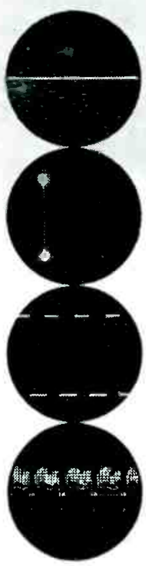
Now, Hycon brings you a really *new* oscilloscope, particularly adapted to random signals or low duty cycle pulses. Its unique *automatic triggered sweep* reduces adjustments, makes synchronization positive, protects phosphors in the absence of signal.

# GOODBYE TO SYNC PROBLEMS


*See and operate the new Model 622 at your local electronic parts jobber.*

**THE NEW 622 OFFERS...**

- preset TV sweep frequencies
- 6 mc (±3 db) vertical bandpass
- 5" flat face CRT... undistorted edge to edge
- illuminated graticule with dimmer
- electronically regulated power supplies
- unusually light weight
  and
- AUTOMATIC TRIGGERED SWEEP



1 **No signal... a stable sweep condition provides reference trace**

2 **Signal on Y-axis... monostable sweep mode automatically assumed**

3 **Triggered sweep (square-wave input) obtained by simply turning sync-level control**

4 **Typical TV signal (off air pickup by receiver) across full CRT screen. Can be expanded across X-axis if desired.**

### BASIC SPECIFICATIONS

**VERTICAL AMPLIFIER**
Frequency Response: 6 cps to 6 mc ±3 db; down less than 0.5 db @ 4 mc
Sensitivity: 10 mv rms (28 mv peak-to-peak) per inch
Input Impedance: 1 megohm, 40 mmf (±2 mmf) over entire attenuator range

**HORIZONTAL AMPLIFIER**
Frequency Response: 1.5 cps to 500 kc ±3 db
Sensitivity: 75 mv rms (210 mv peak-to-peak) per inch
Input impedance: 100k, 25 mmf

**SWEEP CHARACTERISTICS**
Usable writing speed... 0.03 sec/in to .3 μsec/in
Ranges...
a. 10 cps to 300 kc
b. Preset H & V television @ 7875 and 30 cps
c. 60 cps, variable phase line
Type... automatic triggered or straight triggered (by switching)

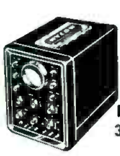
**SYNCHRONIZATION**
Internal, external, positive, negative or AC line

**CALIBRATION**
Internal 60 cps square-wave .05 volts peak-to-peak ±3%

**POWER REQUIREMENTS**
115 volts, 60 cycles, 175 watts

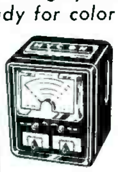
**SIZE... WEIGHT**
13⅝" x 10½" x 18¾"... 32 lbs.

**HYCON** *also brings you these test instruments... ready for color TV servicing*



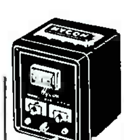
**Model 617 3" Oscilloscope**

High deflection sensitivity (.01 v/in rms); 4.5 mc vertical bandpass ±1 db; internal 5% calibrating voltage. **Flat face 3" CRT for usable trace edge to edge.**



**Model 614 VTVM**

Has 21 ranges (28 with peak-to-peak scales); 6½" meter; 3% accuracy on DC and ohms, 5% on AC; response with auxiliary probe to 250 mc. **Test probes stow inside case, ready to use.**



**Model 615 DIGITAL VTVM**

Reads out in numerical form... no interpolation, no reading wrong scale. Has 12 ranges; 1% accuracy DC and ohms, 2% on AC. **You CAN'T read this meter incorrectly.**

## Hycon Mfg. Company

**2961 East Colorado Street • Pasadena 8, California**

*"Where accuracy counts"*

**ORDNANCE • ELECTRONIC TEST INSTRUMENTS • AERIAL CAMERAS • GO NO-GO MISSILE TEST SYSTEMS • AERIAL SURVEYS • BASIC ELECTRONIC RESEARCH • ELECTRONIC SYSTEMS**

# TUNG-SOL "Magic Mirror" ALUMINIZED PICTURE TUBE

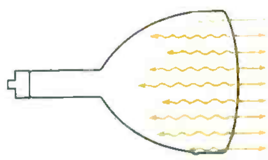
**BRIGHTER-SHARPER**
**MORE DETAIL**
**MORE CONTRAST**

The "Magic-Mirror" Aluminized Picture Tube creates the brightest, most realistic TV picture you can bring into the homes of your customers. The "Magic-Mirror" tube effectively utilizes *all* the light generated by the phosphor screen.

Tung-Sol has developed a unique "fogging" method of backing up the phosphor screen with a mirror-like aluminum reflector. This reflector prevents light radiating uselessly back into the tube. It brings out all the detail of which the receiver circuit is capable. So smooth and true is the Tung-Sol aluminum reflector that mottling, streaks, swirls, "blue-edge", "yellow-center" and other objectionable irregularities are eliminated.

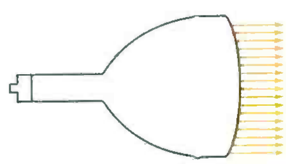
Tung-Sol pin-point-focused electron gun assures a steady, brilliant picture—free from alternate fading and overlighting. Tung-Sol's exacting standards of quality control, manufacture and testing further guarantee the high uniformity and maximum performance of the "Magic-Mirror" TV Picture Tube.

For further details, including Tung-Sol's sales aids and advertising support, call your Tung-Sol supplier today.



**ORDINARY TUBE**—Only *half* the light produced by the phosphor screen is utilized in the picture. Other half radiates wastefully back into tube.

**RESULT**—A light background within the tube which reduces picture contrast.



**MAGIC-MIRROR ALUMINIZED TUBE** — Aluminized reflector allows electron beam through. Blocks wasted light from backing up into tube. Reflects *all* the light into picture.

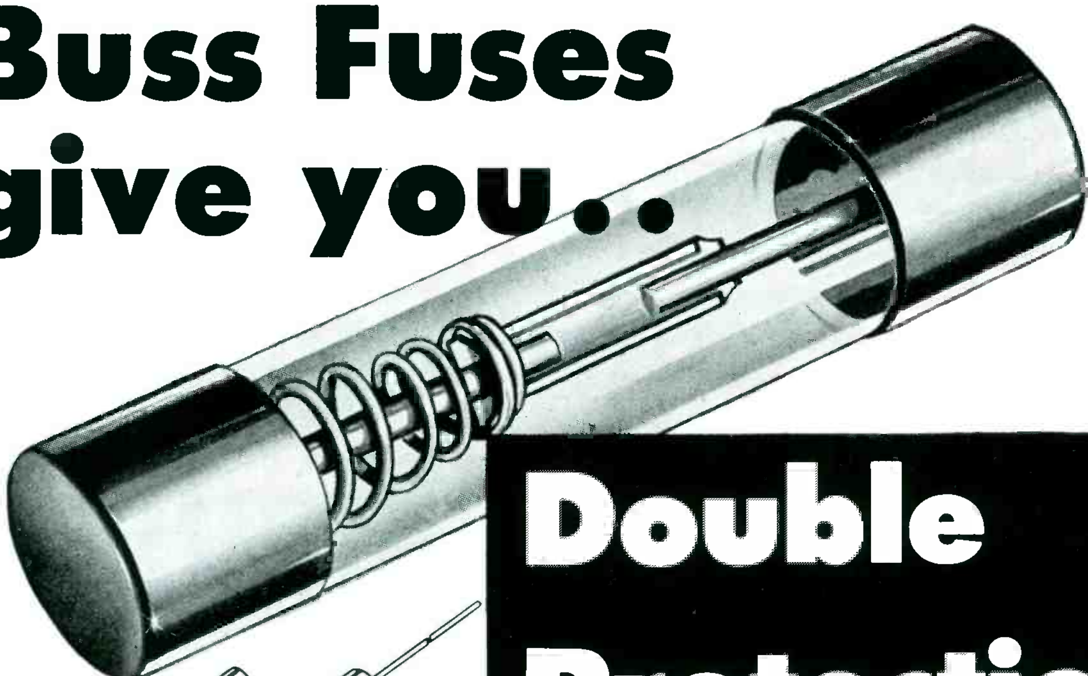
**RESULT**—Pronounced increase in contrast to make a bright, clear, more realistic picture.

## TUNG-SOL ELECTRIC INC., Newark 4, N. J.

Sales Offices: Atlanta, Chicago, Columbus, Culver City (Los Angeles), Dallas, Denver, Detroit, Montreal (Canada), Newark, Seattle.

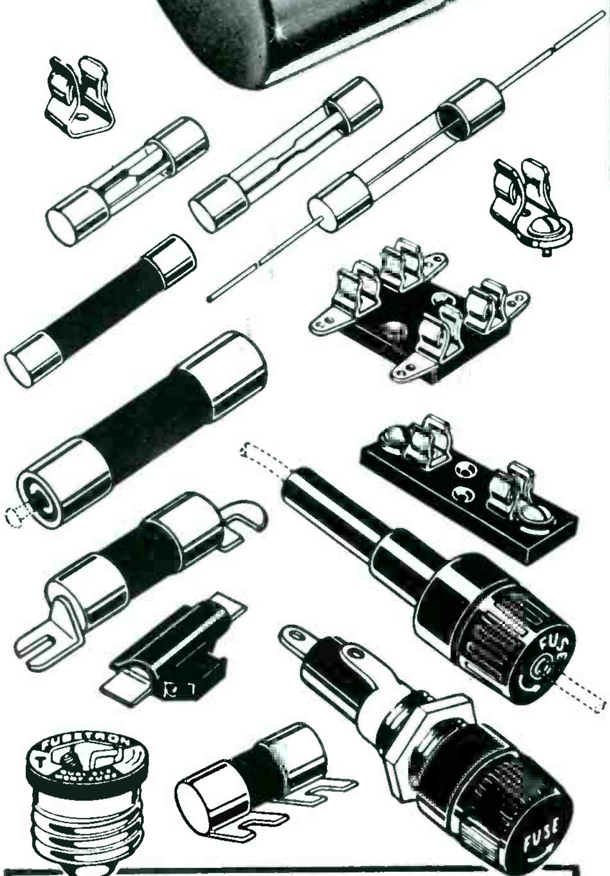
**Tung-Sol** makes All-Glass Sealed Beam Lamps, Miniature Lamps, Signal Flashers, Aluminized Picture Tubes, Radio, TV and Special Purpose Electron Tubes and Semiconductor Products.

# Buss Fuses give you . .



# Double Protection

## . . Against loss of Customer Satisfaction




To make sure of proper operation under all service conditions — every BUSS fuse normally used by the Electronic Industries is tested in a sensitive electronic device. Any fuse not correctly calibrated, properly constructed and right in all physical dimensions is automatically rejected.

That's why BUSS fuses won't blow when trouble doesn't exist. Useless shutdowns caused by poor quality fuses blowing needlessly are not only irritating to customers — but customers' confidence in your product or service could be jolted.

However, when there is an electrical fault BUSS fuses open to prevent further damage to equipment — saving users the expense of replacing needlessly damaged parts.

When you standardize on BUSS fuses, you are doubly safe.

### BUSS IS THE PROFIT LINE TO HANDLE

Millions upon millions of BUSS fuses used in home, farm and industry over the past 41 years have firmly established BUSS as the *Known* brand.

This means sales are easier to make and with never a "comeback".

And BUSS offers a complete line to meet all your needs.

Be sure to get the latest information on BUSS and FUSETRON small dimension fuses and fuseholders . . Write for bulletin SFB.

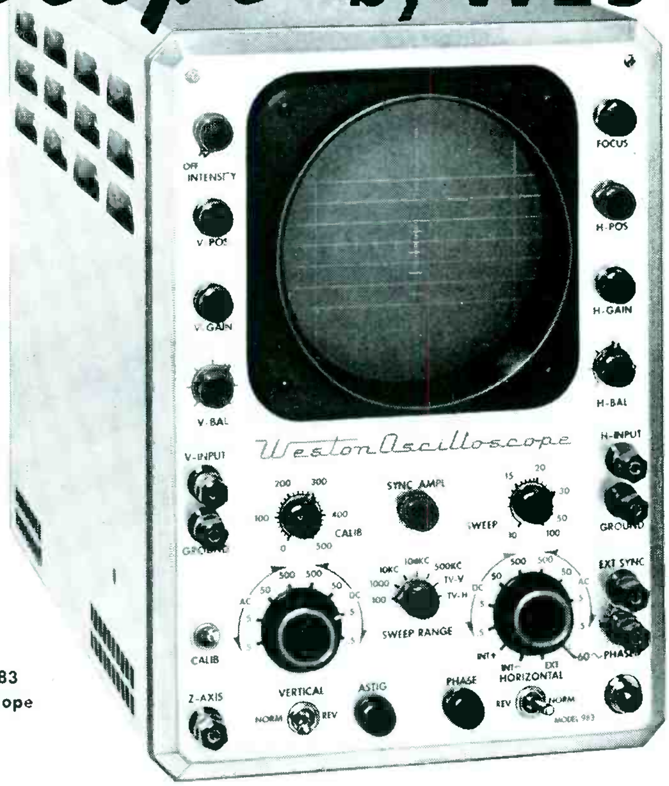
MAKERS OF A COMPLETE LINE OF FUSES FOR HOME, FARM, COMMERCIAL, ELECTRONIC, AUTOMOTIVE AND INDUSTRIAL USE.

S-955

**BUSSMANN MFG. CO.** FUSETRON TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION BUSS Div. McGraw Electric Co.

University at Jefferson St. Louis 7, Mo.

# NOW...*the All-purpose 'Scope* by WESTON




Weston
Model 983
Oscilloscope

Model 983 is a high gain, wideband Oscilloscope designed to accurately reproduce waveforms comprising a wide band of frequencies. High sensitivity of 15 millivolts per inch RMS makes this "scope ideal for—SETTING RESONANT TRAPS...SIGNAL TRACING IN LOW LEVEL STAGES...AS A GENERAL NULL INDICATOR...for PHASE CHARACTERISTIC MEASUREMENT IN INDUSTRIAL APPLICATIONS...and for SWEEP FREQUENCY VISUAL ANALYSIS.

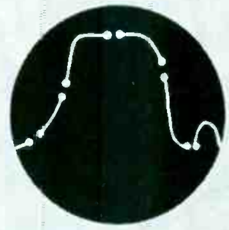
The 'scope contains identical vertical and horizontal push-pull amplifiers with a choice of AC or DC coupling without affecting either sensitivity or band width. Both amplifiers have compensated step attenuators and cathode follower input. *It has excellent square wave reproduction with overshoot of only 2 to 5%, with a rise time of 0.1 microsecond. The 'scope response is essentially flat throughout the specified range of 4.5 mc and is usable to 6 mc.*

The unit has provisions for internal calibration, internal phased sine wave, and Z-axis intensity modulation. Reversal of polarity of both horizontal and vertical signals is easily accomplished by means of toggle switching. *Tube replacements are non critical, and etched circuitry facilitates quick and rapid maintenance.*

The Model 983 Oscilloscope is now available through local distributors. For complete literature write WESTON Electrical Instrument Corporation, 614 Frelinghuysen Avenue, Newark 5, New Jersey.

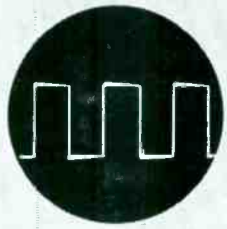
**WESTON** *Instruments*

## WAVEFORM ANALYSIS



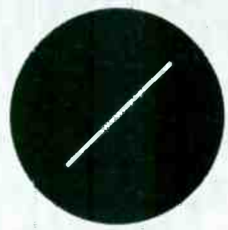
Response curves accurately displayed. Ideal for use with Weston intensity marker display. A fast, retrace sweep circuit with cathode follower output prevents pattern distortion.

## SQUARE WAVE RESPONSE



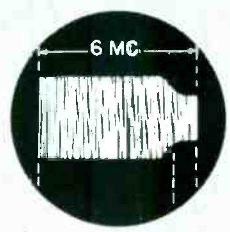
Overshoot is only 2 to 5%. Rise Time is 0.1 Microsecond. Square wave depicted 250 kc.

## PHASE MEASUREMENTS

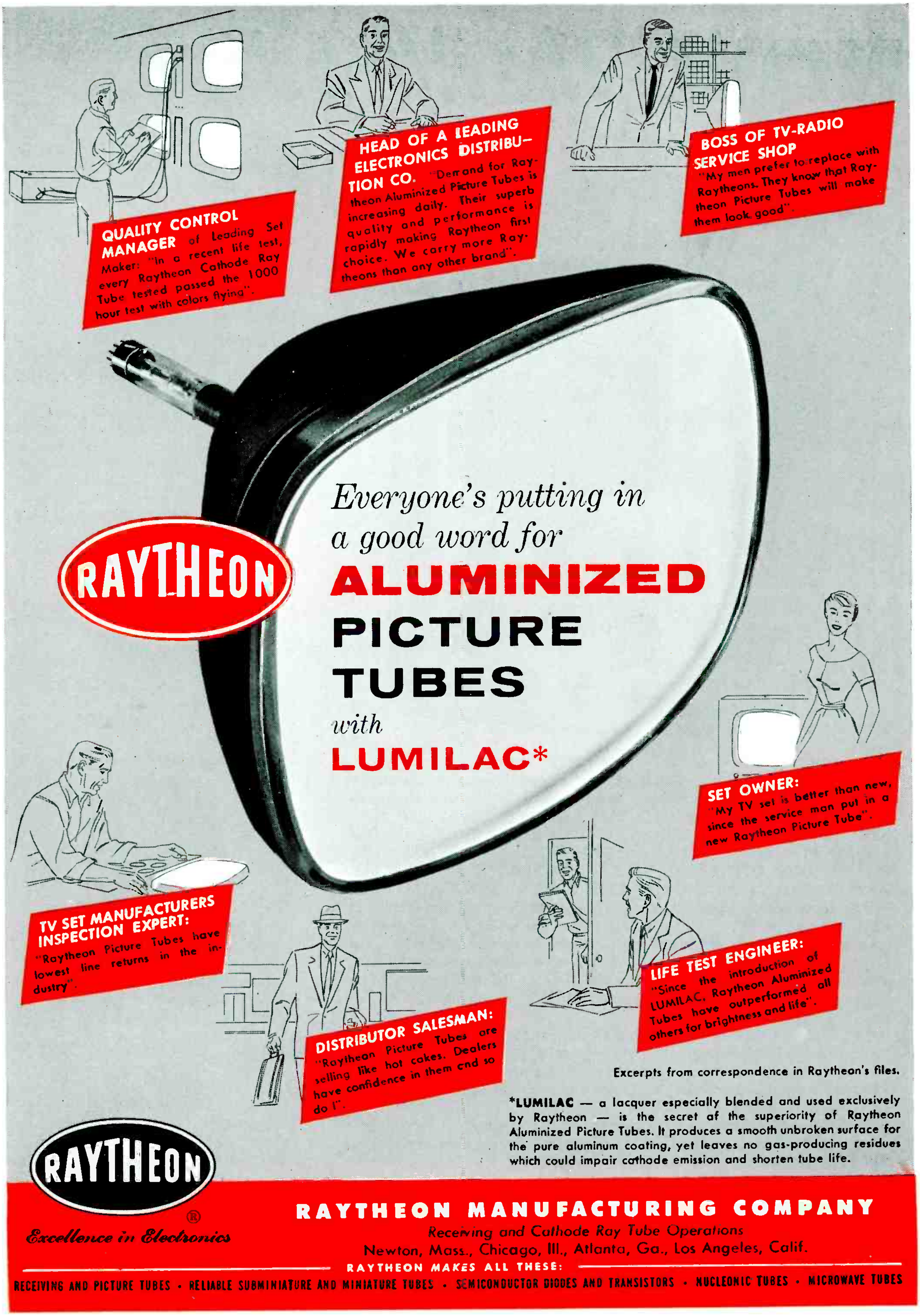


Phase shift between horizontal-vertical amplifiers, 0-500 kc-0°, to 1 mc within 2°; by internal adjustment with gain controls at max 0° phase shift possible on any specific frequency to 6 mc.

## RESPONSE CHARACTERISTIC




Note flatness throughout specified range; to 3.6 mc down 1.5 db, at 4.5 mc down 3 db, at 6 mc down 6 db.


QUALITY CONTROL MANAGER of Leading Set Maker: "In a recent life test, every Raytheon Cathode Ray Tube tested passed the 1000 hour test with colors flying".
HEAD OF A LEADING ELECTRONICS DISTRIBUTION CO. "Demand for Raytheon Aluminized Picture Tubes is increasing daily. Their superb quality and performance is rapidly making Raytheon first choice. We carry more Raytheons than any other brand".
BOSS OF TV-RADIO SERVICE SHOP "My men prefer to replace with Raytheons. They know that Raytheon Picture Tubes will make them look good".
RAYTHEON
Everyone's putting in a good word for
ALUMINIZED PICTURE TUBES
with
LUMILAC*
SET OWNER: "My TV set is better than new, since the service man put in a new Raytheon Picture Tube".
TV SET MANUFACTURERS INSPECTION EXPERT: "Raytheon Picture Tubes have lowest line returns in the industry".
DISTRIBUTOR SALESMAN: "Raytheon Picture Tubes are selling like hot cakes. Dealers have confidence in them and so do I".
LIFE TEST ENGINEER: "Since the introduction of LUMILAC, Raytheon Aluminized Tubes have outperformed all others for brightness and life".
Excerpts from correspondence in Raytheon's files.
*LUMILAC — a lacquer especially blended and used exclusively by Raytheon — is the secret of the superiority of Raytheon Aluminized Picture Tubes. It produces a smooth unbroken surface for the pure aluminum coating, yet leaves no gas-producing residues which could impair cathode emission and shorten tube life.
RAYTHEON®
Excellence in Electronics
RAYTHEON MANUFACTURING COMPANY
Receiving and Cathode Ray Tube Operations
Newton, Mass., Chicago, Ill., Atlanta, Ga., Los Angeles, Calif.
RAYTHEON MAKES ALL THESE:
RECEIVING AND PICTURE TUBES • RELIABLE SUBMINIATURE AND MINIATURE TUBES • SEMICONDUCTOR DIODES AND TRANSISTORS • NUCLEONIC TUBES • MICROWAVE TUBES

SERVICE
The Technical Journal of the Television-Radio Trade

## *Color TV Breaks Through*

WITH A 500 per cent increase in color programming on tap for this fall and winter, providing nearly fifteen hours of day and nighttime shows every week, and large-screen simplified receivers available for viewing, color TV no longer has to fret about acceptance. The barrier has been broken and from now on color will really move.

SERVICE has already begun to record the outstanding technical progress achieved by industry, in exclusive reports on big-picture chassis and their unusual circuitry. In July, the *first* analysis and circuit of a 21-inch color job appeared. In this issue, there's another front-line color story; the *first* field report and complete schematic of a new 21-inch receiver now being made in the mid-west. And in the months to come, we'll be publishing more exclusives on the latest developments in color receiver and instrumentation design.

Watch for these color specials in SERVICE!

## *Components Take On A New Look*

THE TREND to automatic radio and TV chassis assembly, featuring the use of compact printed-circuit boards with limited spacing between leads, has brought about the design of a brand new family of components, that are not only smaller than we've ever worked with, but radically different in general design.

Service Men will now find miniaturized transformers and coils with mountings that not only mechanically support them, but also provide the necessary electrical contacts. And also on deck are capacitors with both leads coming out at one end to allow vertical mounting, thus conserving space and reducing the distance between mounting holes to facilitate plated wiring. Even tube sockets have been altered. In some instances, sockets have been mounted on pins and inserted into holes similar to the other components; this has been done to allow placement of the tubes on the same side of the board. In one TV chassis, sockets with spring-type tabs for mounting have appeared. Here we'll find sockets pushed into large-mounting holes in the printed board to make contact with wiring surfaces plated at the edges of the holes, thus allowing mounting of the tubes from the soldered side of the board.

Variable controls with a number of mounting and physical variations have also been devised. Wiring holes are no longer necessary in the lugs of the component; all lugs have been grouped together to extend to the same plane, so that wiring can be kept flat.

These changes, which represent quite a departure from the conventional, have, of course, affected standard repair practices. In view of the small distances between wiring and component leads, soldering has become a particularly delicate operation. Heating now must be confined mainly to the component itself, with as little soldering as possible directly to the plated surfaces. And low-temperature-melting solder of the 60-tin 40-lead type must be used.

Field reports have disclosed that the best way to replace defective plated-board components is to simply cut them out, and then solder in new units using a low-heat small-tip area iron.

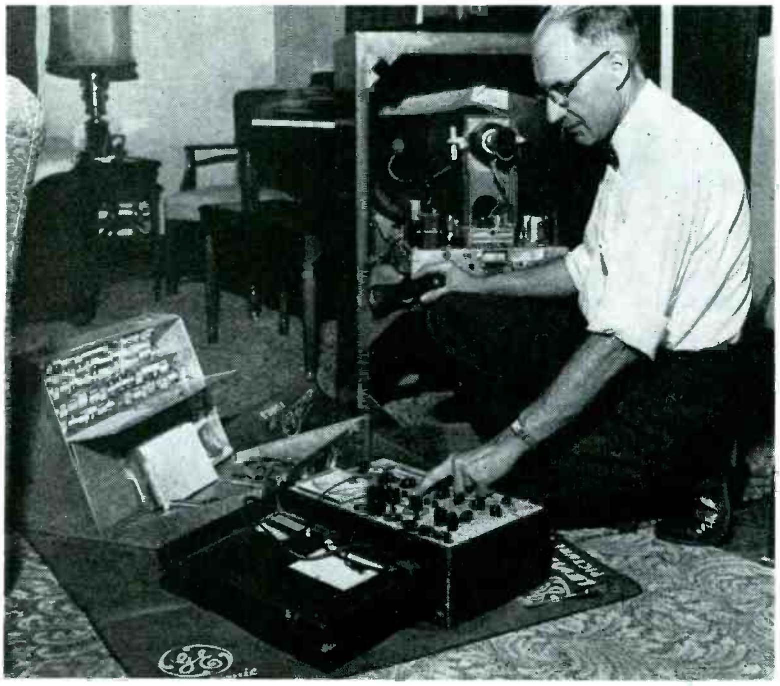
A number of other precautions must also be observed in servicing small-component plated chassis. Isolation transformers are a must here to protect against shocks. And one must be careful to avoid repairing when chassis are on a metal bench or surface. It's also necessary to watch out for arm-to-arm shocks, since usually both hands holding test prods must be used to check contacts; clips cannot be used because they are difficult to attach to the *pc* leads or components.

A number of special tools have been found handy in repairing *pc* sets; such as hollow-shaft nut drivers. They are available in sizes to fit volume control and variable capacitor shaft mounting nuts; pliers or wrenches can't be used here, because the nuts are next to the plated boards and a number of small components will also be found in the way.

There are about two-million tiny-part plated sets already in circulation. And another million are scheduled to hit the field before the year is out. Thus, what was, not too long ago, just a small market affair, has boomed and become a major factor in industry.

To the Service Man, the plated-board receivers, with the new-look components, now represent a sound, expanding activity that will mean more servicing business.—L.W.

*In this issue you'll find the **first** circuit report on new TV portables using plated chassis and a number of the new-look components described in this editorial.*



# The Independent Jamestown,

## *A Field Report*

(Left)

**Norm Smith checking tubes in the home, the only operation performed in the field by his shop.**

In our city[1] there are forty-two recognized full-time independent service organizations. Most of these, like our own, are two-man shops. A few, who deal exclusively in television service, are one-man operations, whereas only three employ over three Service Men.

Many of the service shops deal exclusively in repair, leaving receiver sales entirely up to the department and appliance stores. By the same token, department and appliance stores have found that it is not profitable to maintain their own service departments, and accordingly farm out their service work to the independents; every large store in our city has adopted this policy. Department stores have split views on how far they should go in advertising this fact. Most say they have a service department for warranty work; actually they use the independents or factory depots. Beyond that the stores explain that extra service is contracted. Due to the large volume of transient business handled by the department stores, the independent shops engaged in dealer servicing are kept extremely busy. Store customers are usually told that an independent is handling the store's service and requested to follow through directly with the shop. All payments for such service are made to the independent.

In the larger cities distance, traffic congestion, and a host of other reasons usually make it more desirable to service as much as possible in the home. We do not have these problems and since complex chassis repair in the home often becomes a chore, involves disruption of the room and irritates the customer, we relegate all work, beyond tube testing and chassis cleaning, to the shop. This has become an accepted policy by all the Service Men in this area.

The local association's efforts have made service rates almost a standard in Jamestown. Several trial and error systems have been discarded in favor of a flat rate charge for both house calls and bench work. The hourly rate was not found to be a practical base for charges; most set owners objected to the costs built up this way. Extensive field studies revealed that the problem could be solved by adopting a series of flat-rate charges. Bench work centers on a $15.00 labor charge. House calls have been leveled at $5.00, with a $3.50 minimum on the rapid and very minor repairs.

Individual service shops are to be found in all parts of the city, including both the business and residential areas. Most of them are about the size of the neighborhood corner grocery store, with a larger service area than their store front.

Our shop is rather unique in its deviation from the usual service set-

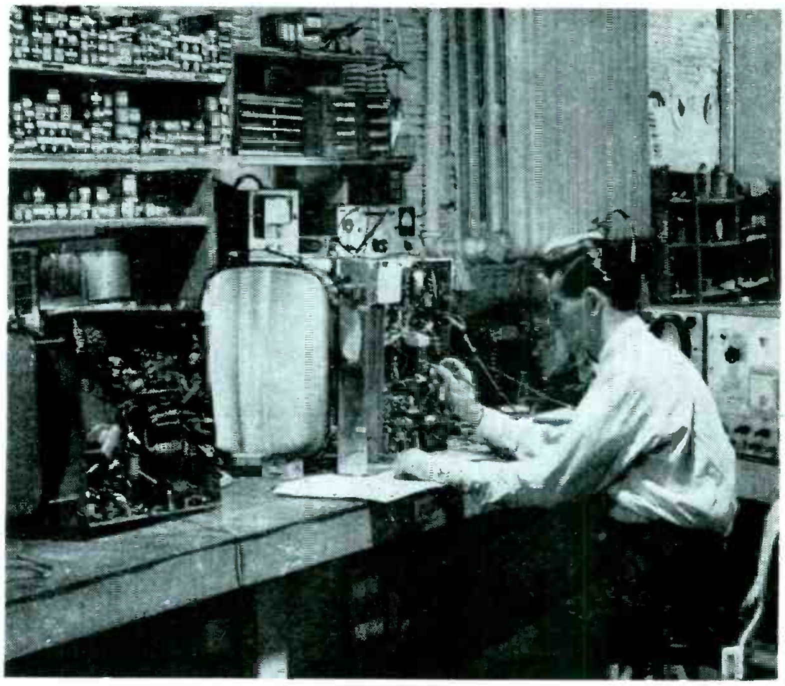
[1] *Jamestown, N. Y.; population, 45,000; trading area over 100,000.*


(Left)

**Removing chassis from truck inside garage of service shop entrance.**

# Service Man In New York

*by George Carlson*



(Right)

George Carlson at the portable test bench. At right is the radio test bench.

up. We are associated with an appliance store, in a downtown parking garage, and the shop is located inside the garage, providing easy accessibility for loading and unloading. The arrangement also permits inside parking for our customers.

Although we are basically a service operation, we do carry a line of TV sets. But since we do not have our own store front, the receivers are displayed in the window of the appliance store we share, and sold on their floor. The appliance store does not have a TV line, and thus the display-sales arrangement works out very well.

Quite often we are both outside on calls; then our telephone traffic is cared for on an extension in the appliance store.

### *Service Versatility*

Norm Smith, who has been in the service business for 29 years, has not limited his scope of business to TV and radio. Record players, hi-fi installations, public-address and intercom systems, electronic door openers, and permanent public building sound systems are serviced in our shop.

We also maintain the sound installations for a number of public schools of Chautauqua County.

Our shop also services all of the radios, record players and motion picture projectors in the city's schools.

Our's is a progressive industrial city and its many factories are dependent on service shops for the maintenance of their sound equipment. Although most of the plants employ their own maintenance crews, their sound servicing goes no further than tube testing and minor repairs. Accordingly this offers us another source of business.

### *Assembly Line Setup*

Our immediate service area is set up to handle repairs in an assembly-line fashion. In a typical assignment the truck is backed right up to the service door, just a few feet from the receiving bench, which is ten feet long. Immediately adjoining it is a TV work bench, extending a distance of fifteen feet. On this section we can service as many as four sets at one time. To provide us with maximum bench freedom, we have mounted our instruments on a separate and movable test bench.

This technique enables us to transfer any piece of equipment to whatever service area we desire, without having to carry any heavy gear around.

Tube and parts are stocked over the test bench and are readily accessible. Manuals and other service data are shelved to the left of the bench within easy reach.

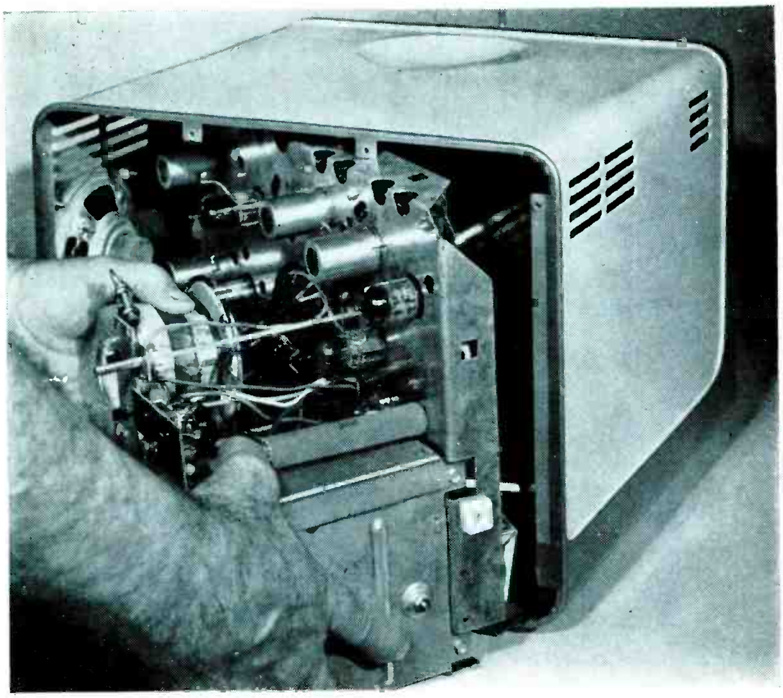
Notwithstanding some of the special features we've incorporated into

(*Continued on page 77*)

(Right)

View of shop, showing TV service bench at right and tube and component stock over bench. Larger parts and TV antennas are located under bench.

# TV



(Left)

**Removing portable TV vertical chassis from its housing for checking of the small components which face the front of the cabinet.**

(Right)

**Portable TV chassis set up for bench service, with a 5AXP4 installed in picture tube socket to facilitate access to components. Tools in foreground include scribe or soldering aid, long-nose pliers, diagonal cutters with long jaws, and low-heat small-tip soldering iron.**

The Development of a portable TV set has always intrigued electronic design engineers. Unfortunately, because of tube and component limitations, circuit complications, and cabinetry restrictions, the evolution of carry-type receivers always bogged down.

Recently, however, the balky problem was whipped by adopting new concepts in tube and component design, vertical-chassis construction using plated boards, and streamlined circuitry tailored for the job, with such features as retrace blanking, area attenuator switch and 41-mc *if* amplifiers. These advancements have been included in a new line of TV portables.[1]

### *Basic Chassis*

The circuit of the basic chassis developed for these models is shown in Fig. 1 (p. 23). A two-tube pentode type *rf tuner* was designed for the input circuit, with a 3BC5 as the *rf* amplifier. This tube has *agc* bias control fed to it from a clipper circuit maintaining its level of operation. The amplified signal is passed to a converter, one-half of a 5X8, where it is mixed with the signal produced by the local oscillator, the other half of the 5X8. A resultant 40-mc beat signal becomes the *if* signal for the set. This signal is fed through a link of the *if* amplifier system consisting of two stagger-tuned stages of amplification, bifilar coupled. The first of these two stages is also controlled by the *agc* voltage derived from the clipper.

The output of the *if* system is capacity coupled to a video detector, a 1N64 diode, and the detected signal fed directly to the video amplifier, one-half of a 6AU8.

From the plate of the video amplifier, three separate signals are picked off; one feeds the audio system, one to the sync system and one passes through suitable compensation and a 4.5-mc fixed trap to become the driving signal for the picture tube.

The audio system consists of conventional FM circuitry. The 4.5-mc is trapped out of the amplified composite signal of the video amplifier. This passes on to an audio limiter and amplifier stage, one-half of a 5AN8, and then a ratio-detector stage, one-half of a 5T8. The detected audio is first amplified by half of a 5T8 triode, and then by the audio output tube, 12CA5, which drives the loudspeaker.

The *positive going* composite signal, fed to the sync clipper, is stripped of video information, to supply negative sync information to the vertical and horizontal sync systems. The clipper is also used to provide negative bias for *agc*, supplied to the *rf* and *if* amplifiers.

For the vertical sync system the stripped sync from the plate of the clipper is first integrated to form the vertical pulse. This controls the frequency of the combination 12BH7A vertical oscillator-output stage. Output from this stage is fed to the yoke to drive the vertical-deflection coils. A pulse from the vertical output is fed to the grid of the picture tube to act as blanking for removing undesirable retrace lines at high levels of brightness setting.

### *Horizontal System*

The horizontal system compares the phase of the pulse from the clipper, with a pulse from the horizontal output transformer in a 5AN8 phase-detector circuit. The resultant differential voltage is used to correct the frequency of the horizontal multivibrator. The output of this multivibrator fires the horizontal output amplifier, which, in turn feeds the horizontal output transformer energy, to be supplied to the horizontal windings of the yoke. The output transformer also supplies energy to the *hv* rectifier, supplying high *dc* to the picture tube, and a damper from which a boosted B+ is obtained.

### *VHF and UHF Tuners*

The *vhf* tuner has provision for *uhf* reception. By switching to the *uhf* position on the selector, the *vhf* tuner becomes an *if* amplifier for the out-

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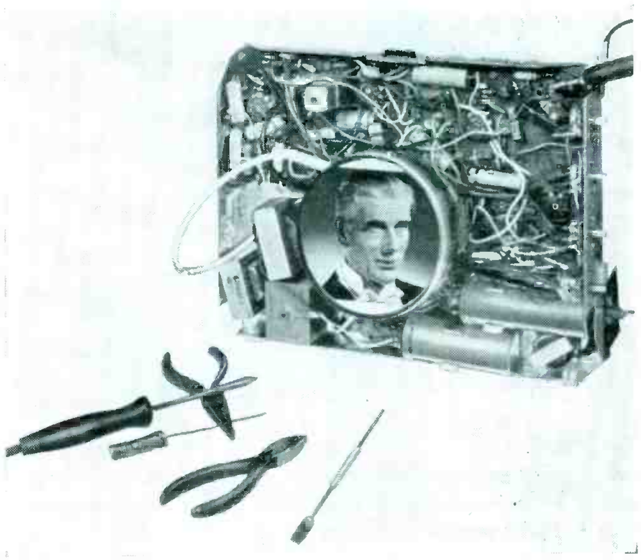
[1]*G.E. M series; models 14T007, 14T008, 14T009 and 14T009, a clock portable.*

‡*Based on information prepared by the Technical Publication Group, Radio and Television Department, **General Electric Company.***

# Portables

by WYN MARTIN

## *Complete Analysis of G.E. 13-Tube 14-Inch Models Featuring Vertical Chassis and Plated-Circuit Board Construction‡ . . . See page 23 for the Schematic of the Receiver's Main Chassis*



put signals of the *uhf* tuner. The local oscillator of the *vhf* tuner is cut off and voltages switched to the *uhf* tuner to place it into operation.

Signals received at the antenna are transferred from the transmission line by a balanced antenna-matching transformer which also contains a Faraday shield. The balanced primary and Faraday shield act to cancel undesirable signals, such as *rf* interference or noise picked up by the transmission line. The secondary of this transformer has been designed with two taps; one for channels 2-6 and one for channels 7-13.

Connected to the low band tap is a 43-mc *if* trap ($L_{101}$). This trap has been designed to attenuate further *if* frequency interfering signals which mostly affect low-channel operation.

The secondary of the transformer is tied to the grid of the 3CB5 *rf* amplifier tube, through a set of coils selected by tuner switching. As the frequency of channel number decreases, additional inductance is added by the *rf*-coil switch. This change of inductance, along with the distributed circuit capacity and the capacity of the tube, form a resonant input circuit. The *rf* amplifier grid is also fed negative voltage from the *agc* circuit of the receiver to control its output.

The output of the *rf* amplifier is coupled to the input of the converter, through instage coupling circuits, made up of the *rf* amplifier plate coils, converter grid coils and the 2.7-mmfd, 150-mmfd and .91-mfd capacitors ($C_{108}$, $C_{109}$ and $C_{112}$). Essentially the energy is capacity coupled, thus improving the bandwidth response of the lower channels over previous inductive methods. A high-band coupling strap, combined with a capacitor, achieve the necessary high-band coupling.

Coupling is not controlled by mutual inductance of the interstage coils. Therefore, coupling may be changed only by a small gimmick capacitor, 12 mmfd ($C_{111}$), between the interstage coils.

### *Pentode Tuner*

At the forward section of the tuner is the oscillator section; a modified Colpitts circuit with its plate coils at the front of the tuner to facilitate centering of the fine tuning range by individual channel adjustment. While only channels *4*, *6*, *8*, *11* and *13* are adjustable, a compromise overall can affectively be accomplished. Fine tuning is achieved by varying the capacity of the fine tuning capacitor in the regular two-plate tuning capacitor method. The oscillator signal is capacity coupled to the grid of the converter tube.

The signals coupled to the grid of the converter are mixed, and the difference in frequency becomes the *if* frequency pass-band of the receiver. The output of the converter is coupled to the *if* amplifier through a low-impedance cable; therefore the plate circuit contains a *pi* network which provides the impedance step down. A plate tank coil ($L_{135}$) becomes the input adjustment for centering the *if* frequency response to the *if* system.

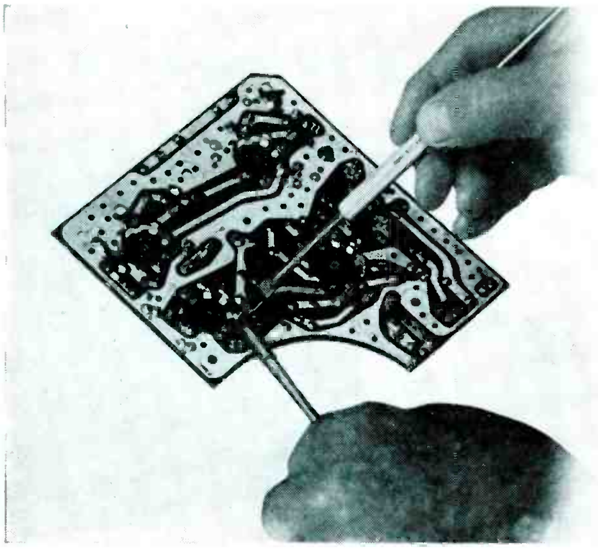
The *if* output coil ($L_{133}$) in the screen of the converter acts as a regeneration control and is adjusted on channel *13* to shape the bandwidth of the output response curve.

### *The IF and Detector System*

The output of the tuner is coupled into a link secondary or grid tuning coil ($L_{150}$). This chassis has no traps at the input of the *if*. Two pentode (3CB6) tube circuits comprise the *if* system amplifiers and are bifilar coupled by the first *if* plate transformer. The detector is capacity coupled to the plate of the last *if*, which is tuned by a shunt plate-load coil ($L_{151}$). The output of the detector is negative-polarity composite information and is loaded by approximately 3300 ohms. Reference voltage for the *agc* system is taken at the top of the diode load. Tuning of the *if* response may be made while the chassis is mounted in the cabinet with the use of a hexagon alignment tool.

### *Video Amp and Picture Tube*

The output of the diode detector is coupled through peaking circuits and a .047-mfd capacitor ($C_{180}$) directly to the grid of a 6AU8 video amplifier. This amplifier is a pentode with the contrast control in the cathode. Grid bias is increased by connecting the grid resistor back to a



(Left)
**Brushing off solder on a printed-circuit board with a stiff wire brush after joint has been heated. One must be careful not to brush solder on to other components or between plated leads which would short.**

voltage-divider network in the grid of the horizontal output tube.

Amplified positive polarity composite video will be found at the plate of the video amplifier, where the signal is divided up into three loads; the audio, the sync and the video signal to the picture tube. A series-peaking choke and load resistor form the plate load circuit.

A series choke, bypassed with an 8-mmfd capacitor ($C_{161}$) and then coupled through a .1 mfd coupling capacitor ($C_{162}$) feeds the cathode of the picture tube with the positive video driving signal. A 120-*uh* series choke ($L_{156}$) and its parallel 8-mmfd capacitor act as a fixed 4.5-mc trap. The catode bias of the picture tube is also controlled by 200,000-ohm brightness control.

An electrostatic-focus picture tube is used, with pin *6* connected to the focus electrode. This allows the use of a focus jumper which can be rearranged to connect pin *6* to *2* or to *10*, either to the grid (pin *2*) at approximate ground potential, or the screen (pin *10*) at boost potential. Both connections should be tried to determine which connection effectively gives best focus. Vertical blanking is introduced by feeding a pulse to the grid of the picture tube from the vertical output transformer.

### *The Audio System*

The audio signal is capacity coupled from the plate of the video amplifier and a trap ($L_{301}$) to the grid circuit of the audio *if* amplifier and limiter. The output of this tube is coupled to the ratio-detector transformer primary. The ratio-detector is a common unbalanced circuit using dual diodes of a 5T8. The output of this detector is passed through a suitable compensating network and a 500,000-ohm volume control ($R_{305}$) to a conventional triode audio amplifier. The output of this amplifier is used to drive the audio output amplifier, 12CA5, which in turn, supplies the energy to the output transformer and loudspeaker.

The system has been designed for maximum rejection of 4.5-mc buzz by the use of properly balanced audio detector transformer windings. Buzz should be at a minimum on normally received signals; however, an excessively strong station may overload the receiver and cause considerable buzz. An attenuator on the antenna is provided, so that by changing the area switch to the local position these strong signals can be reduced to the level of normal strength signals.

Composite video from the plate of the video amplifier is fed to a sync clipper. This positive-going sync is capacity coupled through a double-time constant network to the grid, which has no direct return to the ground. This causes grid current to flow, which causes a negative voltage to be developed on the grid. This negative voltage tends to cut off the tube operation, except at the most positive portions of the signal, i.e., the sync tips.

Therefore only these sync pulses are amplified and found at the plate of the clipper. This amplified sync is coupled through capacitors to the horizontal and vertical sync systems. A 180-mmfd capacitor ($C_{251}$) couples the horizontal and vertical sync systems. This same capacitor couples the horizontal short time pulses and a .15-mfd capacitor ($C_{202}$) feeds the longer vertical pulses to the integrator network. This integrator filters the composite sync and forms a vertical sync pulse which is used to control the timing of the vertical oscillator.

The negative voltage developed at the grid of the clipper is used as *agc* to set a bias level for the *rf* and first *if* amplifier. This voltage is combined with a reference voltage established at the diode load and is then filtered of all video information. A .2-mfd long-time constant capacitor ($C_{152}$) maintains constant voltage under varying signal conditions, such as those created by airplane flutter, outside interference, etc.

An area switch is incorporated as a signal attenuator at the antenna terminals. This attenuator acts to surpress extremely strong signals which would otherwise cause overload of the set circuits.

The vertical multivibrator and output system is basically a conventional circuit used as a power delivering source for driving the vertical deflection coils.

The circuitry is simple and easy to service, once understood. No bias resistor or large electroylitic capacitor appears in the cathode of the vertical output stage. Bias for this section is obtained by tapping off negative voltage developed in the grid of the first triode section. This is done with a 2-megohm *height* control ($R_{209}$). Since this voltage contains sweep information, it is filtered with the network formed by a 470,000-ohm resistor ($R_{213}$) and a .047-mfd capacitor ($C_{208}$).

The $R \times C$ time constant network formed by a 3900-mmfd capacitor ($C_{205}$) and the total of the grid resistance is adjustable by a 1.5-megohm hold control ($R_{207}$). This allows adjustment of the vertical oscillator operating frequency.

### *Horizontal Phase Detector*

The purpose of the horizontal phase detector is to compare the phase or frequency difference between the received sync pulse and the output of the horizontal sweep system.

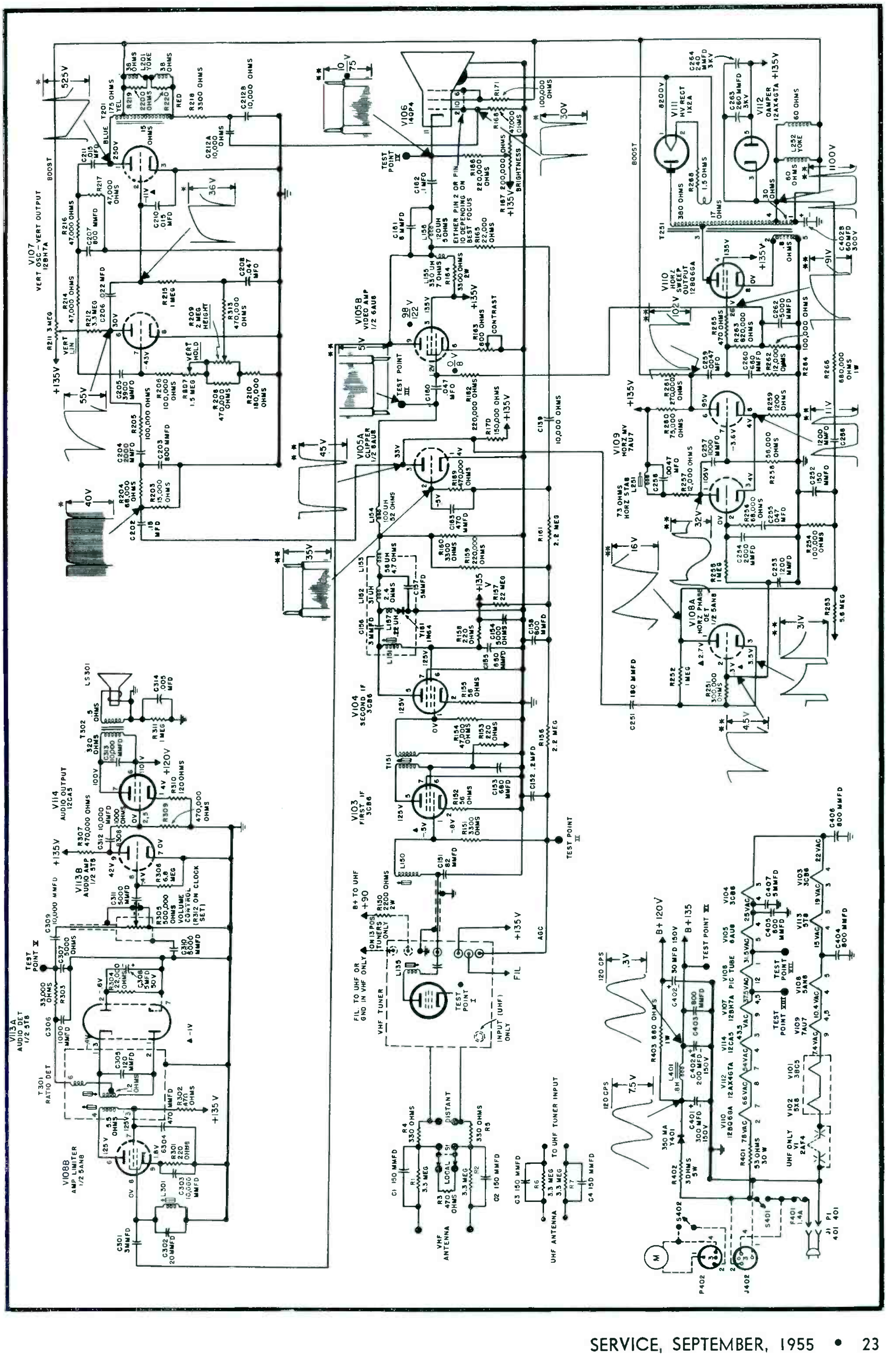
Any difference between these two signals causes the phase detector to form a voltage which is used to control the firing of the horizontal multivibrator. This *dc* voltage may be positive or negative, depending on the differential condition.

A triode tube is employed. The sync pulse from the clipper circuit is fed to the cathode and the feedback pulse from the horizontal output transformer is coupled to the plate.

Basically if any small positive identical voltage is fed to both the grid and the plate of the tube, or a common negative pulse is fed to the cathode, identical currents will flow in

(*Continued on page* 30)

**Fig. 1. Schematic of main chassis of G.E. portable TV-set M line; models 14T007/14T008/14T009/14T010. Triangles indicate points measured with a vtvm. Single-starred points represent measurement by 'scope synced at half vertical frequency; double stars indicate points where 'scope was used with sync at half horizontal frequency.**

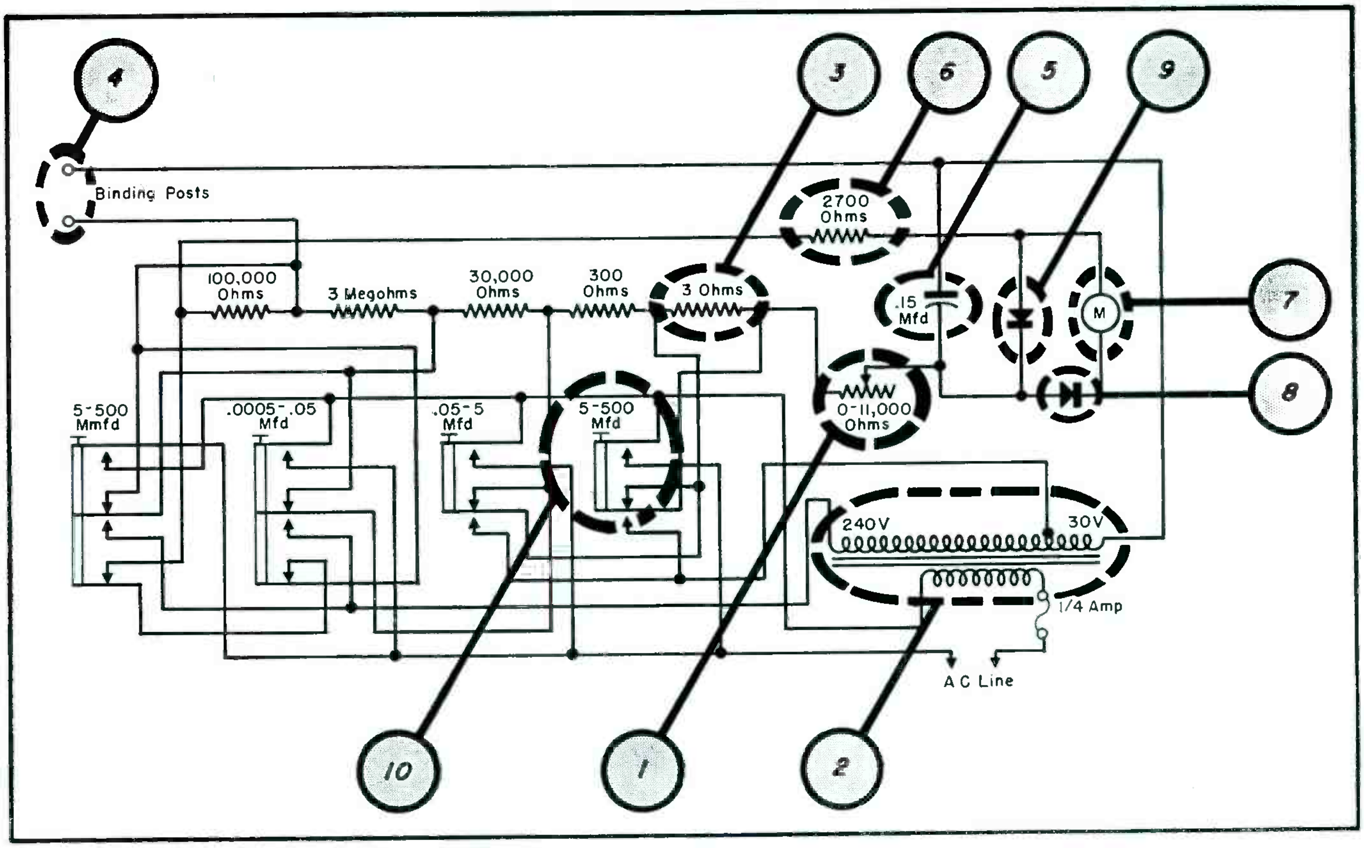


## *Analysis of Bridge Circuitry and Relation to Instrument Adjustments and Components Being Checked* **Behind the**

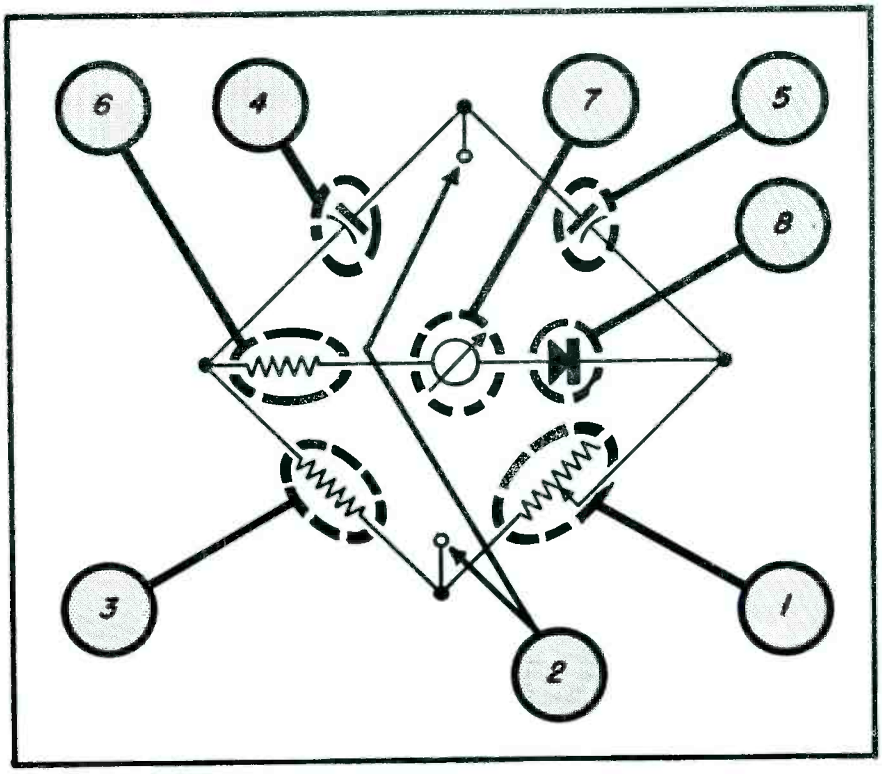
| Design Features | Purpose in Instrument | Performance Factors |
|---|---|---|
| The bridge network. **(1)** | A bridge network permits more accurate measurement of capacitance values than is possible by *ac* ohmmeter arrangements, and accommodates a wide range of capacitance values with simple circuit means. | One arm of the bridge is a potentiometer, which is utilized to obtain a balance or null-indication. This potentiometer is provided with a scale which is calibrated in capacitance values. **See circuits at right (Figs. 1 and 2); circle (1).** |
| Driving voltage; like an *ac* or *dc* ohmmeter, a capacitance bridge requires a driving voltage source. This is obtained from a simple transformer. **(2)** | Voltage from the transformer is applied to the upper and lower ends of the bridge (see Fig. 2); this voltage flows through the meter circuit in proportion to the bridge unbalance. | When the bridge is unbalanced, the driving voltage appears at the ends of the bridge with unequal potentials; but when the bridge is balanced, no potential difference is present at the left and right hand ends of the bridge, and no current flows through the meter. **See circuits at right (Figs. 1 and 2); circle (2).** |
| Potentiometer arm of the bridge *(1)*; this is balanced with respect to the resistor *(3)* in the fixed arm of the bridge. **(3)** | The fixed resistor provides an appropriate ratio of current flow in the two sides of the bridge, so that a null point can be found at some point on the potentiometer. | If the potentiometer had a very large range, the fixed resistive arm would not require range switching *(10)*, but the potentiometer adjustment would then become critical, and the accuracy of indication would be impaired. **See circuits at right (Figs. 1 and 2); circles (1), (3), (10).** |
| Capacitor under test *(4)*; comprises the third arm of the bridge. **(4)** | The displacement current flowing through the capacitor under test is inversely proportional to its reactance; the phase shift which is imposed upon the current can be neglected for practical purposes. | Since the displacement current in the capacitor under test obeys Ohm's law for *ac*, the scale of potentiometer *(1)* can be calibrated in terms of microfarads, or mmfd. **See circuits at right (Figs. 1 and 2); circles (4), (1).** |
| Fourth arm of the bridge; comprised of a standard capacitor *(5)*. **(5)** | The standard capacitor *(5)*, in combination with fixed resistor *(3)*, provides an accurate reference against which to balance *(1)* with respect to *(4)*. | One standard capacitor suffices for measurement of capacitance values over a range of from 5 mmfd to 500 mfd, since *(3)* can be switched in steps from 100,000 to 3 ohms. **See circuits at right (Figs. 1 and 2); circles (5), (3), (1), (4).** |
| Null - indicating circuit; this draws an unbalance current which is limited by resistor *(6)*. **(6)** | The passage of excess current through the indicating circuit could cause damage to the instrument, if the bridge were being operated in a seriously unbalanced condition. | The value of the limiting resistance must be sufficient to afford meter protection, while not substantially impairing the accuracy of indication. **See circuit at right (Fig. 2); circle (6).** |
| The null-indicator; a *dc* milliammeter *(7)*, which indicates zero when the potentiometer *(1)* is suitably adjusted. **(7)** | The null-indication of the meter signifies the condition: $Z_A/Z_B = Z_C/Z_D$, and the scale provided for potentiometer *(1)* indicates the value of capacitor *(4)*. | The meter is provided in the bridge because it is more convenient to use than a pair of headphones, for example; the meter also provides simplicity and compactness as compared with an amplifier and speaker. **See circuits at right (Figs. 1 and 2); circles (7), (1), (4).** |
| Contact rectifier *(8)*; provided in series with *dc* milliammeter. **(8)** | Since the bridge is necessarily energized by *ac*, to produce a displacement current through the capacitor under test, the unbalance current must be rectified before it can be utilized by the meter. | A simple contact rectifier serves satisfactorily, in spite of its non-linearity at low current values, since the meter does not indicate current values, but only the null point. **See circuits at right (Figs. 1 and 2); circle (8).** |
| Second contact rectifier *(9)*; serves to reduce the peak inverse voltage which must be withstood by rectifier *(8)*. **(9)** | In case of substantial bridge unbalance, the peak inverse voltage rating of rectifier *(8)* might otherwise be exceeded, and the unit damaged. | When the current flow swings through the non-conductive half-cycle with respect to rectifier *(8)*, the full peak voltage present would be dropped across *(8)*; however, *(9)* effectively bypasses the non-conductive half-cycle around *(7)* and *(8)*. **See circuit at right (Fig. 1); circle (9).** |

# Capacitance-Bridge Controls‡

by G. S. RYANT




**Figs. 1 and 2 (above and below): The general schematic of a capacity bridge is shown in Fig. 1. In Fig. 2 we have a simplified drawing of a capacity bridge. Both diagrams show such bridge design features as driving voltage, standard capacitor, null-indicating circuit and null-indicator, contact rectifiers, and push-button switches.**



### *The Push-Button Switches*

The push-button switch *(10)* serves not only to provide suitable values of resistance *(3)* in the fixed resistance arm of the bridge, but also remove power when the bridge is not in operation.

The bridge is energized by 30 volts for capacitance values from .05 to 500 mfd, and by 240 volts for capacitance values from 5 mmfd to .05 mfd.

Since the displacement current flowing through the capacitor under test is inversely proportional to its reactance, higher values of driving voltage must be utilized for small capacitance values, to obtain suitable indication of bridge unbalance.

**See circuit above (Fig. 1); circle (10).**

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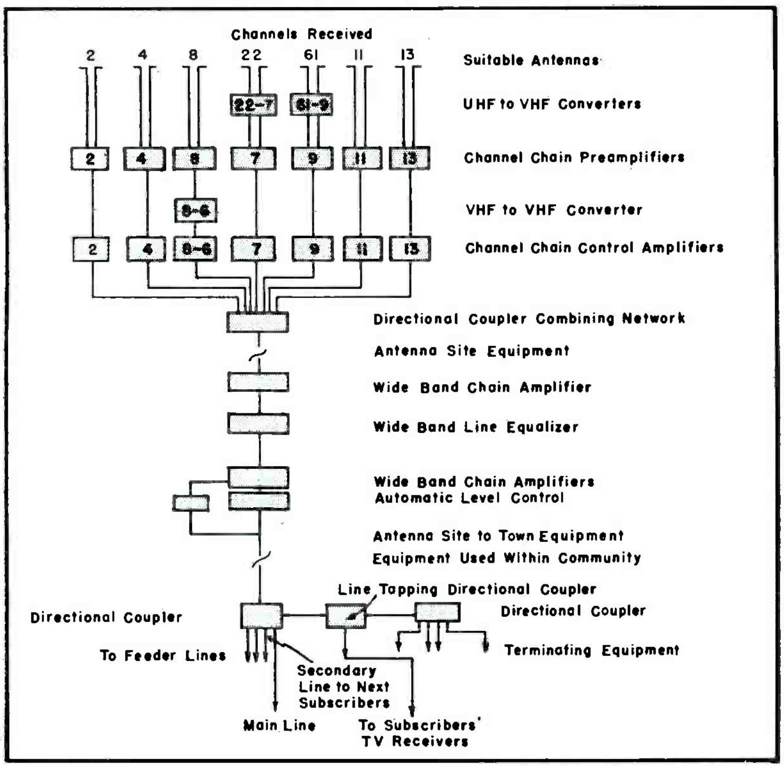
‡*From a field report submitted by* ***Robert G. Middleton,*** *Simpson Electric Company.*




# Community-TV Preventive Maintenance‡

by CAYWOOD C. COOLEY, JR.

*Jerrold Electronics Corp.*

**Left: Block drawing of a typical community-TV distribution system, including points of pickup, amplification, equalization, automatic control, tapping and feed.** (Spencer-Kennedy.)

To INSURE SERVICE RELIABILITY in community-TV systems, a comprehensive preventive maintenance program must be employed.

At present, many systems utilize a *removal and replacement* program to maintain system quality. While there is nothing radically wrong with such a program, an *r and r* program alone does not appear to be the best answer to the problem. For instance, if we depend entirely upon such a program to eliminate sources of troubles, it will be necessary to incorporate a replacement program frequency so that we could be spending a great deal of time replacing amplifiers unnecessarily. This is easy to see if we assume that one-tenth of CTA equipment requires service on a 10-week basis, whereas nine-tenths of the equipment can operate perhaps on a basis of 20 weeks. To eliminate equipment that might fail on a 10-week basis, it is necessary to remove and replace all of the amplifiers, even though nine-tenths of the total could have operated satisfactorily over twice that period. From this, it would seem that other measures are necessary in addition to a simple *r and r* program. The measure that would best fit this problem would be a system featuring routine measurements (resolution, amplitude distortion, and signal-to-noise ratio) at the *extremities* of the system. It would be possible, by observing the signal characteristics at the extremities, to determine whether or not the equipment between the antenna site and the extremities is, or is not, in good operational order.

### *Combined System Maintenance Plan*

A combined program of system maintenance that incorporates both the *r and r* program, and additionally incorporates the system of measuring the signal characteristics at the extremities, can take advantage of the fact that the few amplifiers which might fail could be located and isolated without the burden of establishing an *r and r* program to find these few.

An *r and r* program can be justified if it is based upon a history of operation, whereby the program would provide for the removal and replacement of amplifiers or associated equipment, based upon locating the majority. In other words, the extremity measurements can be used to locate the few that may fail in the meantime, while the *r and r* program would serve to locate and remedy the majority on a routine basis.

### *Required Instrumentation*

A field strength meter and a 'scope, preferably a *dc*-coupled type, can be used to establish the percentage modulation condition of each composite video signal, and observations can be made directly at the antenna to identify any peculiar and unusual characterisics of the station signals.

A *dc*-connected 'scope or a chopper is necessary to establish a base line so that the percentage of sync, video, and minimum white levels, can be determined.

The field-strength meter must be tuned to the video carrier, and the *dc*-coupled 'scope connected to the video test jack. The presentation offered by this test provides such indications as sync compression, hum, sound modulation, etc. A much more sensitive test to determine very small degrees of sync compression (amplitude distortion) can be made by tuning to the sound carrier instead of the video carrier. The 'scope presentation should indicate a smooth, straight line. The interesting point about this test is that the sound carrier displays evidence of considerable video amplitude modulation, long before noticeable sync compression is visible. Therefore, a measurement of the per cent video modulation on the sound carrier (as indicated on a 'scope) provides a very sensitive indication of the very earliest stages of sync compression. An antenna site test is necessary to determine what percentage of video modulation, if any, is directly caused by station peculiarities.

An efficient field-strength meter can be utilized to determine signal-to-

(*Continued on page* 78)

‡*From a paper presented at the fourth annual convention of the National Community TV Association in New York City.*

# FIELD REPORT NO. 5

Jack Livesay
Livesay's Music Co.
Roanoke Rapids, N. C.

*We have an eighty-five foot test tower located at our Store for the purpose of comparing the different types of antennas on the market today. The reason we have selected the JFD Star-Helix all channel antenna above all others is that it has the best frequency response and highest gain on channels 2 through 13. Since the birth of the JFD Star-Helix we have installed over 600 Star-Helix and have never had a call back due to the fault of the antenna.*

Paul Morrore
Morrore TV
Creston, Ia.

*Most of my customers are out in the fringe area. We need a lot of gain to pull in the signal, most of all on channel 13. I used every new antenna that came out that was a fringe antenna, but nothing worked until I used the Super-Star Helix made by JFD. The Super-Star Helix is for me now. It's made me a lot of new customers.*

Oliver Ewbank
Plaza Television
Topeka, Kan.

*When the Star-Helix came out, we checked its performance as we do with all new antennas. The exceptional results of those tests have since been verified many times by users who are getting the sharpest, cleanest pictures possible. We know of numerous instances where the Star-Helix delivered excellent pictures at locations where three or four other antennas had failed.*

Sam M. Patrick
Patrick TV & Radio Inc.
Orlando, Fla.

*The JFD Star-Helix is the best antenna I've tried—and I've tried them all—that pulls in clear pictures on channels 8 and 13 from Tampa over 100 miles away. Also channel 4 from Jacksonville which is over 150 miles away. I also know that my Star-Helix customers are ready for Top-notch color reception when it comes their way.*

Harry H. Rogers
Rogers Radio & TV
Lenox, Ia.

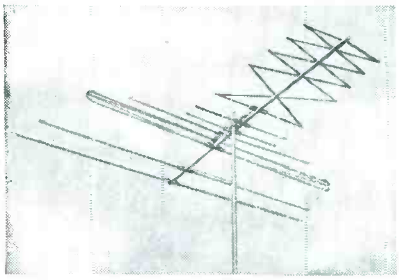
*Channel 13 from Des Moines has been a big problem out my way. The other channels came in good but 13 was nothing but ghosts and interference. JFD made the Super-Star Helix and I tried it and now 13 comes in as bright as all the other channels. Now I'm using it in all of my installations.*

John D. Sorrentino
East New York Appliance
Brooklyn, N. Y.

*It sure surprised me. It's the first time I ever got compliments on the looks of my antenna installation. That trim inline build of the JFD Fire-Ball sure looks as good as it works. I don't have to worry about break-down from high winds or ice-loading either. It's got my vote.*

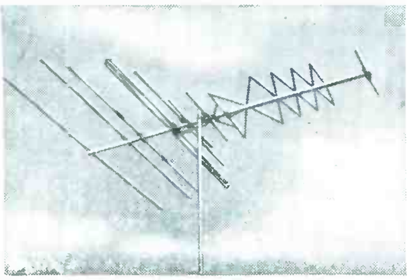
# Across the U. S. A. TV Dealers Acclaim these JFD Antennas...

Whether you buy the ultra-sensitive Star-Helix or the new Super-Star Helix or the remarkable Fire-Ball, you know the JFD antenna you install protects your reputation.



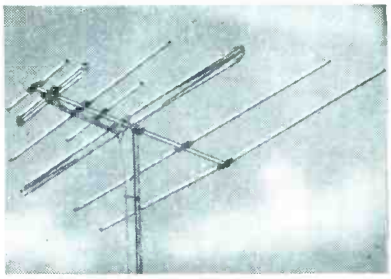
**JFD STAR-HELIX**

| | | |
|---|---|---|
| SX711 | single | $25.50 |
| SX711S | stacked | $52.50 |
| SX711S-96* | 96" stacked | $55.00 |



**JFD SUPER-STAR HELIX**

| | | |
|---|---|---|
| SX13 | single | $35.00 |
| SX13S | stacked | $72.50 |



**JFD FIRE-BALL**

| | | |
|---|---|---|
| FB500 | single | $17.35 |
| FB500S | stacked | $36.65 |
| FB500S-68† | 68" wide stacked | $36.65 |
| FB500S-96* | 96" wide stacked | $38.60 |

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†for areas with co-channel and cross-channel interference
*for added channel 2-6 gain

# B-W and COLOR-TV Oscillators

## *Characteristics of Basic and Typical Vertical Blocking, Horizontal and Relaxation Oscillators*

**by JESSE DINES,** *Ram Electronics, Inc.*

WITH VERY FEW exceptions, the vertical oscillator used in TV sets is either a blocking oscillator or a multivibrator (plate- or cathode-coupled). Incidentally, most horizontal oscillators also employ these circuits. These oscillators serve to generate a 60-cps signal, which is triggered by vertical sync pulses of the composite video signal; the oscillator is used ultimately to provide vertical deflection.

A typical vertical blocking oscillator circuit is shown in Fig. 1; it consists of a blocking oscillator transformer $T_1$, a bias network ($C$-$R_1$-$R_2$), and a sawtooth-forming capacitor, $C_2$. Sawtooth sync pulses are fed from the integrator circuit to the input of the tube. Feedback occurs from plate to grid of the oscillator through $T_1$.

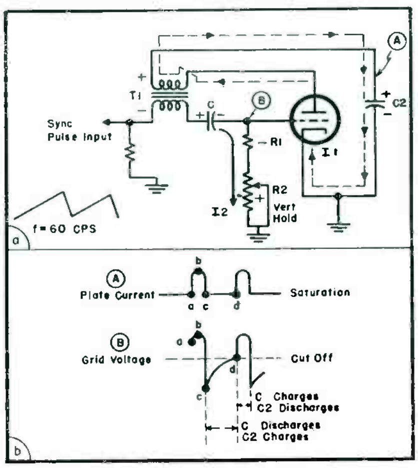
When B+ is applied to the tube, current $I_1$ flows from cathode to plate (point *a* of waveform *A*; Fig. 1), through the $T_1$ primary (with the indicated polarity), and the B+ supply. The voltage drop across $T_1$ causes an induced voltage across the $T_1$ secondary, with the polarity shown. This makes the grid more positive and still more plate current flows (from *a* to *b* of waveform *A*), and the grid, thus, becomes even more positive. This process continues, with the induced voltage developed at the grid being dependent upon the rate of current change in the primary. As the grid gets more and more positive, the increase in plate current becomes less and less (from *b* to *c* of waveform *A*) and tube saturation is approached. During the time that the grid becomes more and more positive, grid current is drawn, thereby charging up *C* (waveform *B*) with the indicated porality. When the charge on *C* becomes great enough (about the time that saturation is approached), the tube is cut off or *blocked;* hence the name *blocking* oscillator.

After the tube is cut off, the charge across *C* leaks off ($I_2$) through the relatively large time constant combination of $R_1$-$R_2$-$C$; the grid is thus held negative for a fairly long time and the tube is, therefore, held cut off for a long time. Finally, *C* discharges sufficiently to make the grid positive enough, so that the tube may conduct (point *d* of waveform *A*) and plate current flows. The foregoing process repeats itself.

The sync input signal is an integrated vertical sync pulse (sawtooth), fed from the integrator circuit to the blocking oscillator primary. The peak-portion of the sawtooth occurs at about the time that the grid is recovering from its cut-off position. The sawtooth is positive enough in magnitude to drive the grid into conduction, before the normal recovery time occurs. In this way, the oscillator is synced, together with the composite video signal, by virtue of the vertical sync pulse. To keep the oscillator *in time* with the sawtooth pulse, the normal recovery time of the oscillator is made somewhat longer than the 60-*cps* sync pulse repetition rate.

Since the discharge of *C* determines the recover time, the $C$-$R_1$-$R_2$ time constant determines the natural resonant frequency of the oscillator. Varying $R_2$ (vertical hold control) only slightly, results in a range of oscillator frequency, which is quite small; $C_2$ is a sawtooth-forming capacitor.

**Fig. 1. Typical vertical blocking oscillator and performance waveforms.**




Most of the actual blocking oscillator circuits are the same as the basic one shown in Fig. 1.

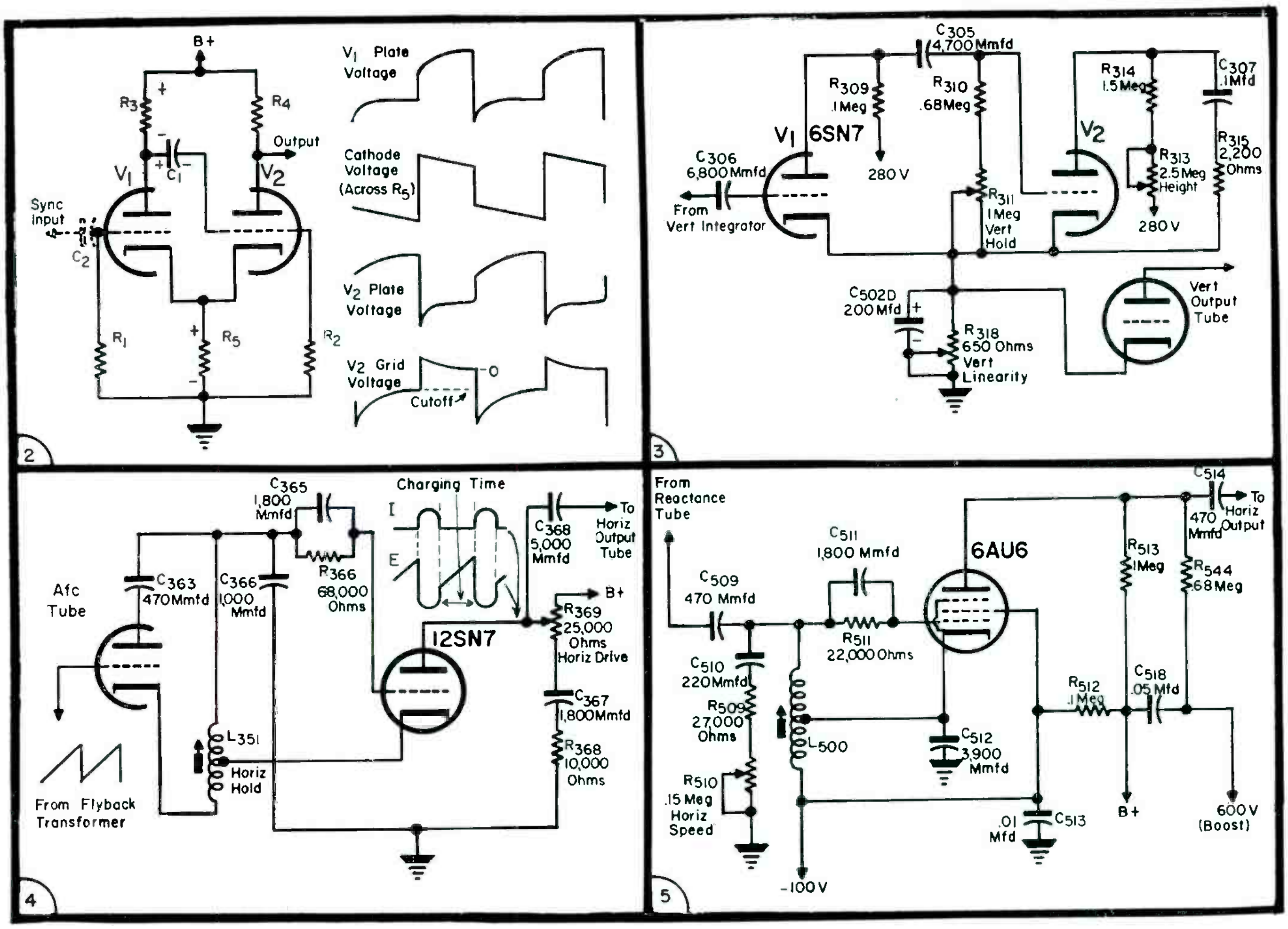
There are many different types of *mv* circuits. The most commonly used for the vertical oscillator, is the cathode-coupled type shown in Fig. 2. Incidentally, *mv*'s generally are known as *relaxation* oscillators, since they generate non-sinusoidal waves by storing up energy gradually and releasing it quickly.

In Fig. 2, $V_1$ and $V_2$ are, in essence, two resistance-coupled amplifiers which have a common B+ supply and cathode resistor ($R_5$). In this way, voltage variations existing in $V_2$ are fed back to $V_1$, so that they may be in phase with the $V_1$ voltage variations; this permits the oscillations to be sustained. $C_1$ is the coupling capacitor between $V_1$ and $V_2$. $R_1$-$R_2$ and $R_3$-$R_4$ are the grid-leak and plate resistors, respectively.

### *Operation of Circuit*

It is assumed that, because no two tubes have identical characteristics, $V_1$ or $V_2$ will conduct slightly more when B+ is applied to the *mv*. Let us assume that $V_1$ conducts slightly more. With *I* flowing from cathode-to-plate of $V_1$, $R_3$, B+ and ground, $C_1$ charges (with the shown polarity) from ground, $R_2$, $C_1$, $R_3$, and B+. The charge across $C_1$ makes the plate of $V_1$ more positive and the grid of $V_2$ more negative. $V_1$ thus conducts even more heavily, and $V_2$ (whatever current does flow through it) conducts even less. Finally, when the charge across $C_1$ reaches a maximum, $V_1$ is conducting at maximum (until saturation is reached) and $V_2$ is cut off. The plate voltages at $V_1$ and $V_2$ are thus, minimum and maximum, respectively.

With $V_2$ cut off, $C_1$ is now permitted to discharge from the $V_2$ grid, through $R_2$ and $R_5$ (there is very little current flow through $R_1$, because of its very high resistance, as compared to $R_5$), and $V_1$. The discharge current




**Figs. 2 to 5. The schematic of a cathode-coupled mv used for a vertical oscillator, with resultant plate voltage waveforms at right, is shown in Fig. 2. A typical vertical oscillator cathode-coupled mv circuit used in Magnavox 105L appears in Fig. 3. The Hartley oscillator used in G.E. model 17C113 is diagrammed in Fig. 4, and in Fig. 5 we have another form of oscillator, the electron-coupled type, used as a horizontal oscillator in G.E. model 24C101.**

through $R_5$ results in the designated polarity across it. This, in effect, increases the bias on the $V_1$ stage, which is in the process of conducting heavily. The bias gets greater and greater as $C_1$ discharges more and more. Accordingly, $V_1$ conducts less and less, thereby raising its plate voltage; see $V_1$ plate voltage waveform. This increase in plate voltage is transferred to the $V_2$ grid via $C_1$. (In addition, with $V_1$ conducting less, the voltage across $R_5$ is less, and there is less bias prevailing.) When this voltage becomes positive enough, (coupled with the fact that there is very little bias present), $V_2$ begins to conduct.

When $V_2$ conducts, $C_1$ charges again through the B+ supply, with the indicated polarity; the result is a voltage drop across $R_3$ (with the polarity shown), making the plate of $C_1$ more negative, and causing $V_2$ to conduct less. As $C_1$ charges more and more, the $V_1$ plate gets more and more negative, until the tube is cut off; $V_2$ now conducts heavily.

This entire process repeats itself, with $V_1$ and $V_2$ conducting and being cut off alternately. The result is a square wave at the $V_2$ plate, as disclosed on the waveform; actually this waveform is not completely *square*, but rather exponential, because of the manner in which $C_1$ charges and discharges.

The *mv* described is *free-running;* that is, it oscillates without the aid of external sync pulses. However, sync pulses may be fed to the input of $V_1$ (through $C_2$, as shown in Fig. 2), so that the oscillator can be synchronized with the 60-cps (or 15,750-cps for the horizontal oscillator) sync pulses of the composite video signal. A positive sync pulse is fed to the *mv* immediately before $V_1$ goes into conduction; the positive pulse, therefore, arrives just in time to initiate the *mv* action.

A typical vertical oscillator cathode-coupled *mv* circuit, used in Magnavox chassis 105L, is shown in Fig. 3. Here $V_1$ and $V_2$ (6SN7) form the *mv*. The common cathode-bias resistor for both stages is the 650-ohm vertical linearity control which is, incidentally, the cathode-bias resistor for the vertical output tube, as well. $R_{310}$ and $R_{311}$ lie in the discharge path of $C_{305}$; since these components comprise the *R-C* network which determines the *mv* frequency, $R_{311}$ is variable and is appropriately called the vertical *hold* control. A peaking network, consisting of $C_{307}$ and $R_{315}$, shapes the voltage output of the *mv* so that it closely resembles a *trapezoid.* The 2.5-megohm height control determines the *p-p* output of the *mv* and, therefore, its picture height. The *mv* is synced by the pulses fed from the vertical integrator to the $V_1$ grid via $C_{306}$.

It will be noted that the grid-leak resistors ($R_{310}$-$R_{311}$) are returned to the $V_1$-$V_2$ cathodes, instead of to ground, unlike the case of the basic *mv* circuit shown in Fig. 2. This has been done to decrease the discharge time of $C_{305}$, which now does not have to discharge through $R_{318}$. By reducing the discharge time, the square-wave output of the *mv* becomes more asym-

(*Continued on page 77*)

## TV Portables

(*Continued from page 23*)

grid and plate. Therefore, correcting voltage can be obtained from the grid, as in this case, where the pulses to be compared are fed to the plate and cathode circuits.

The horizontal oscillator in the *M* chassis uses one-half of 5AN8 as a phase detector and a 7AU7 as a horizontal multivibrator.

The output of the phase detector is a voltage derived at the grid. This voltage is filtered to provide a *dc* control to the multivibrator. The time constant of this network, a 1200-mmfd capacitor, a 1-megohm resistor and a 2000-mmfd capacitor ($C_{253}$, $R_{255}$, $C_{254}$), is long enough to remove sync information, but fast enough to permit the rapid change created by oscillator drift or sync breaks such as channel switching.

The oscillator circuit is the common cathode-coupled multivibrator. To this circuit has been added an $L \times C$ network in the plate of the first section. This network stabilizes operation and is tuned to the resonant frequency. A shaft, from the coil-tuning slug, is extended to the back of the set and is used to control the frequency of the horizontal system.

Basically, the operation cycle is as follows: The first triode conducts throughout the operating cycle. The second triode conducts only on *trace* time. Since the cathodes are tied to ground through a common resistor, the operating bias of the second triode is effected by the cathode voltage developed by the first triode.

The grid of the first triode is bypassed to ground and is not part of the feedback loop. This leaves the grid available as the controlling element of the system.

If the correcting voltage on the grid of the first triode is forced positive, the cathode voltage will rise. This extends the cut-off time of the second triode. Since the time is lengthened before trace time occurs the oscillator speed is lowered.

Similarly any negative voltage applied to the first triode grid lowers the cathode potential and *shortens* the time of the $R \times C$ discharge of the second triode grid circuit. This likewise increases the firing rate and thus raises the frequency of the system. The output of this oscillator is capacity coupled to the horizontal sweep output tube grid. To increase the amount of drive obtained from the oscillator, the output plate is supplied with additional $B+$ boost voltage.

The output of the oscillator is fed to the horizontal output tube grid. In the grid circuit, the grid return resistor is tapped, so that a voltage may be obtained. This voltage is used to maintain grid bias level for the video amplifier; the voltage is filtered of horizontal information by a 5000-mmfd bypass capacitor ($C_{262}$).

Since the regulation of the high voltage is dependent on the retrace timing of the horizontal-sweep output, the tube must be completely cut-off during this period. This is positively accomplished by feeding a pulse to the cathode of the output tube, from the output transformer.

The plate of the output tube is tied into an auto-transformer ($T_{251}$) which enables a great degree of coupling between the various output circuit elements.

The damper, a 12AX4GTA, serves to dampen spurious oscillations which occur at the start of the trace and also is used to charge gradually a 60-mfd electrolytic ($C_{402B}$) with a voltage which, when added to the existing $B+$, becomes $B+$ boost. This boost voltage is used to supply the vertical and horizontal oscillator sections as well as the outputs of the sweep system. This voltage also supplies voltage to the picture tube screen and the focus anode, when desired.

A simple halfwave selenium rectifier and brute force filter are employed to supply regular $B+$ values. The input *ac* to the rectifier is protected with a series 3-ohm resistor ($R_{102}$).

The tube heaters are series connected through a 53-ohm dropping resistor ($R_{401}$). These tubes, the new 600-*ma* equalized current type, cause equal currents to be drawn throughout the string, protecting the tubes from excessive burn-out due to unequal voltage distribution during warm-up time. The tubes also are designed with the same thermal-time factor. This shortens the warm-up timing and the set usually is ready to go after only 30-45 seconds of warm-up time.

Two *vhf* tuners are employed in this series; there is a slight difference in heater wiring necessary to provide for the *uhf* tuner. In the *vhf* only models, the oscillator-converter (5X8) becomes the ground end of the string. In the *vhf-uhf* combination a lead from the *vhf* tuner supplies heater current to the *uhf* oscillator (2AF4) which becomes the terminating point.


**by MAXWELL ALBERTS**

## Phono Pickup Replacements: How to Screen Cartridges to Fit Phono Job . . . Meeting Matching Requirements to Achieve Maximum Gain and Best Frequency Response‡

When a new Cartridge is to be installed, the mechanical and electronic characteristics of the pickup being replaced, and the circuitry of the phono's amplifier or preamp, must be carefully reviewed.

At the mechanical end of the picture, one of the problems that must be resolved involves stylus pressure necessary to maintain tracking. Where we have a tone-arm designed to carry an old fashioned type of phono cartridge, requiring considerably more pressure on the disc than the newer ones, some adjustment has to be made to reduce the pressure, if best results are to be obtained from the new cartridge being installed.

Apart from tone-arm pressure it is necessary to note the arm's effective mass or inertia and any resonances that may be set up due to its physical construction, in combination with the mass of the phono cartridge. Such resonances will usually occur at the extreme low end of the frequency range. Usually cartridges are designed with a particular type of tone-arm in mind, and often a cartridge manufacturer also supplies a tone-arm, or a range of tone-arms, suitable for use with his cartridges.

It is not always necessary to employ the identical tone-arm supplied by the manufacturer of the cartridge, if the existing one is of similar general construction, and thus likely to give a similar performance.

The important features that must be remembered are weight of the tone-arm, how this weight is distributed, and also the rigidity of its construction.

It is, of course, important to check the construction of the cartridge and tone-arm, for both should complement each other physically.

As noted earlier tracking must be maintained; the position of the stylus relative to the tone-arm pivot point must not be changed with the new cartridge, for a variation can throw the tracking in error. Usually tone-arm suppliers prepare templates to enable mounting for correct tracking. Such a template can be used to see that correct tracking obtains.

After the mechanical problems have been solved, we can turn to the electronic details. These are concerned with the method of matching the cartridge into the input of the phono.

To analyze the problems of matching, four groups of cartridges will be considered. In order of working impedance (not to be confused with order of merit) they are ribbon, moving coil or dynamic, variable reluctance and ceramic.

With the ribbon type of phono pickup, we must use a transformer, because the impedance of the ribbon itself is so extremely low that it is impossible to obtain sufficient output to rise above the noise level at the grid of the first tube. Ribbon cartridge manufacturers usually either supply or recommend a transformer type that can be used. The transformer must be provided with suitable hum shielding, and even then it should not be assumed that such shielding takes care of any amount of hum.

Shielding only reduces hum by so many db, and best results are obtained by paying careful attention to the positioning of the transformer, so as to achieve minimum hum pickup

(*Continued on page 58*)

‡*Based on report prepared by* **Norman Crowhurst.**

**Fig. 1. Effect of different transformers on overall frequency response of ribbon or moving coil cartridges: AA, correct transformer; BB, transformer with too high a stepup ratio; CA, transformer with correct ratio, but designed for lower working impedance; AD, transformer with correct ratio, but designed for higher working impedance.**

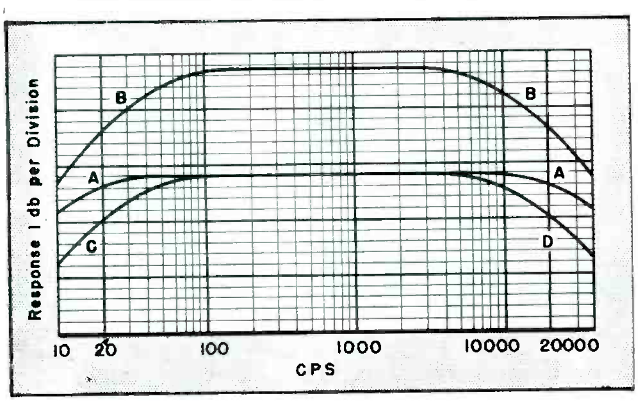
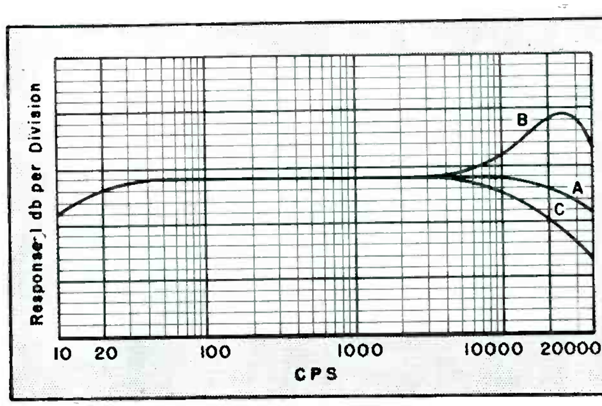



**Fig. 2. Effect of different values of loading resistance in the input of a ribbon or moving-coil cartridge; A, correct value; B, no loading resistance, or value too high; C, value too low.**



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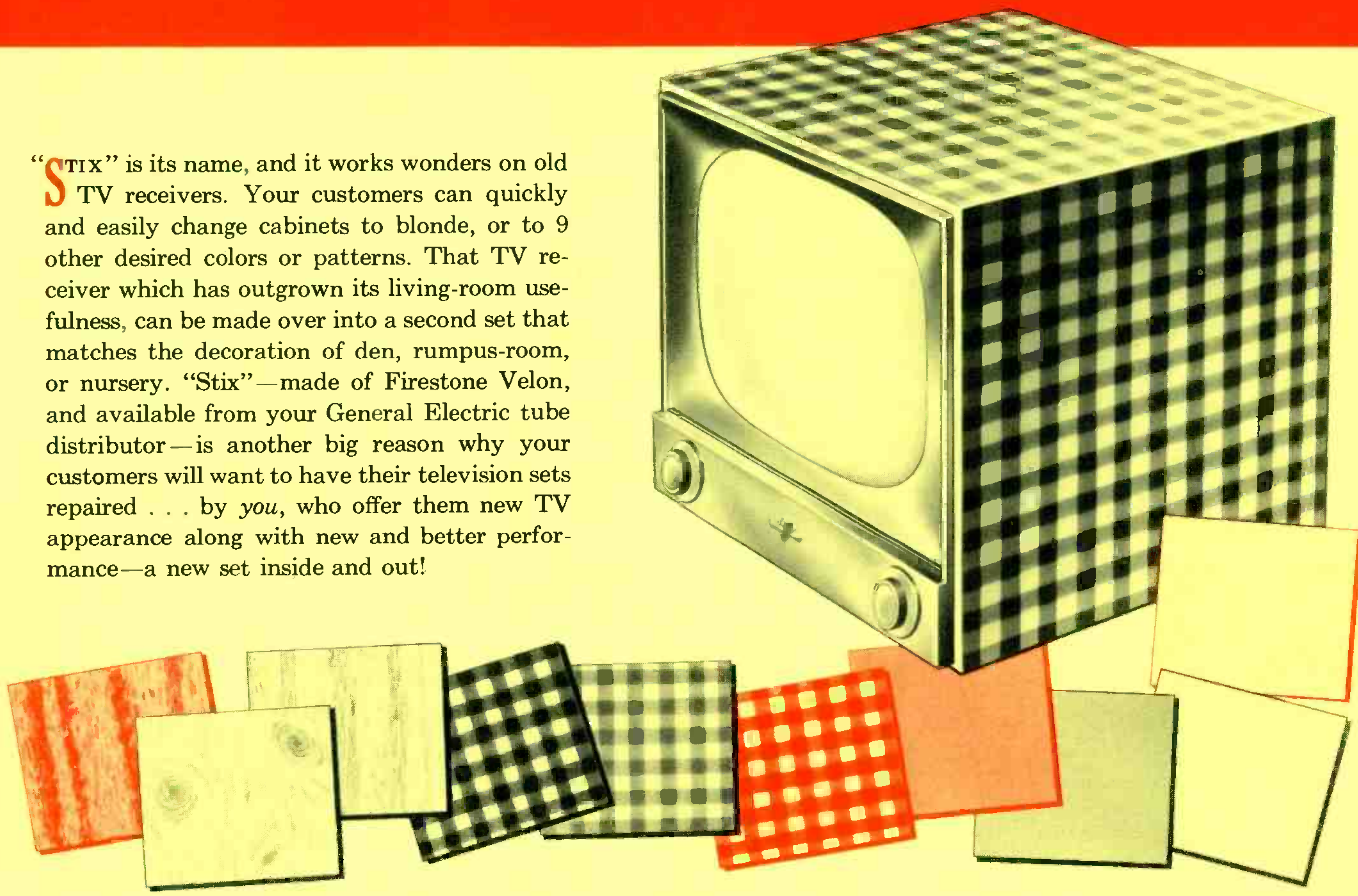

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**GENERAL ELECTRIC**

# by T. L. GILFORD


**Beam-Current Adjustments . . . Removing Intermittent Horizontal Sync . . . Troubleshooting Switch-Type VHF Tuners . . . Antenna Rod Repairs . . . AGC Adjustments**

A BEAM-CURRENT adjustment control has been incorporated in Hoffman's *Mark V* series chassis to assure maximum results from the high-voltage circuit. This control is a screwdriver adjustment located below the vertical-size control on the rear of the chassis and is accessible with the receiver backboard removed.

The beam-current control is properly adjusted at the factory and will need readjustment only if the picture tube, video amplifier, horizontal output or high-voltage rectifier tubes are replaced.

To adjust this control, the ion-trap setting must be checked and the brightness control turned to maximum. Then the beam current control should be adjusted, while observing the raster. The control should be adjusted for brightest raster with no blooming. After adjusting the beam-current control, the normal set-up adjustments can be made.

### *Removing Intermittent Horiz Sync*

USUALLY AFTER about two to three hours of normal operation, sync in the Sylvania 521 chassis will shift into horizontal bars and in severe cases left side of screen will appear black. Trouble here is due to intermittent operation of the *filter capacitor;* $C_{178A}$ or $_B$ in same can.

### *Antenna Rod Repair*

IT HAS BEEN found that the exposed location of the antenna rods on RCA 6-BX-5-6 series portables occasionally resulted in accidental breakage, when the batteries were changed or power line plug was inserted for battery operation. To minimize such breakage, a fiber shield has been added to the chassis. The shield is held in position by eight small *fingers* engaging in chassis ventilation holes. It is installed by entering the fingers of one side into ventilation holes, and squeezing and entering the fingers of the other side into ventilation holes and releasing.

### *AGC Adjustments*

THE AGC CONTROLS on the *X* and *K* Stromberg-Carlson series provide different results when adjusted.

In the *X* series, the *agc* control affects only the negative delay voltage feeding the tuner; thus the visible results on the picture are slight. However, the *K* series *agc* control is connected at the grid of the keyed *agc* tube and controls the conduction of this tube. Both negative voltages feeding the tuner and *if* change with a change in pot setting. Thus care should be taken to adjust the *agc* control on the strongest signal available in the area; otherwise clipping of the sync pulses may take place and result in unstable sync.

### *Troubleshooting VHF Tuners*[1]

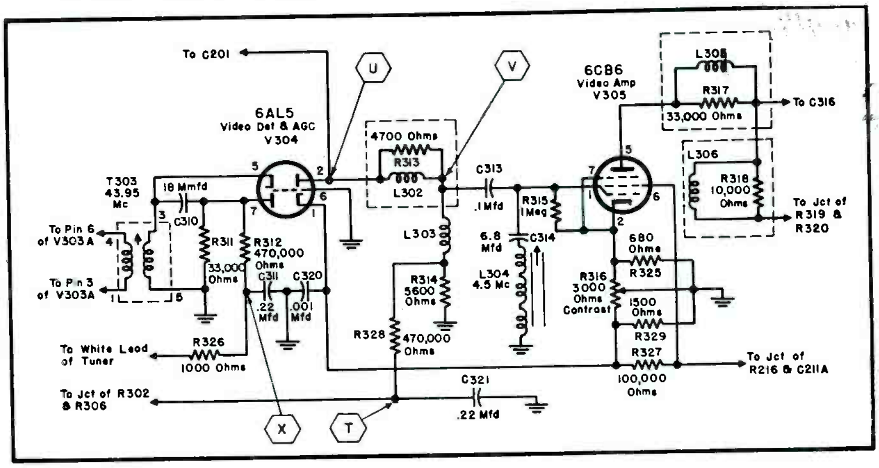
NORMALLY DEFECTS in the *vhf* tuner affect both picture and sound. Usually both will be missing, although a raster will be present. If there is a picture, it will be weak and snowy. Other tuner trouble symptoms such as hum or sound in the picture, loss of picture detail, or normal reception on certain channels and not others, are less frequent.

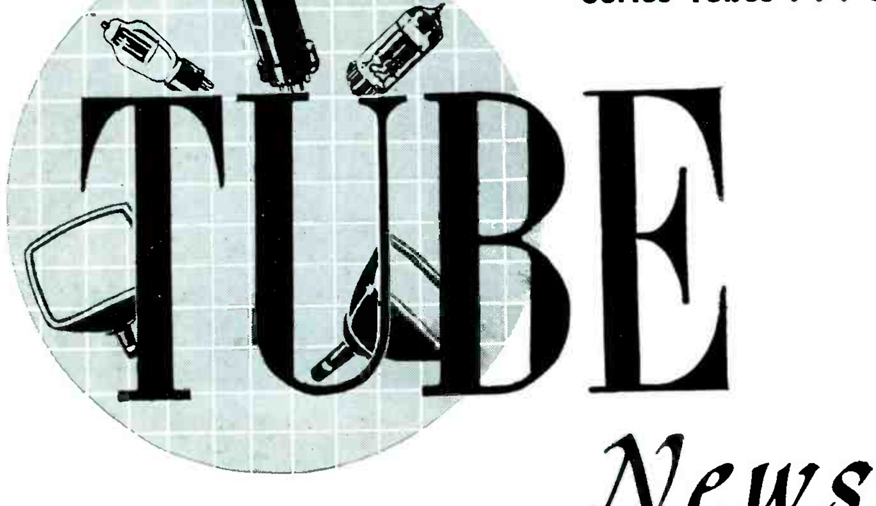
If a tuner is suspected as the source of trouble, checking should be limited to replacement of its tubes and measurement of the B+, heater and *agc* voltages. To avoid unnecessary handling, one should attempt to eliminate the possibility of defects in other sections of the receiver. Steps should also be taken to determine if the condition

(*Continued on page* 71)

[1]*From Capehart-Farnsworth service notes for models CX-38 and CX-38C chassis; 850330A-1 tuner.*

**Admiral 20AX5A/20AX5EZ** agc **system circuitry with changes made to reduce snow in fringe areas. The** agc **voltage for the** vhf rf **amplifier is now supplied by one-half of the 6AL5. In conjunction with voltage from** agc **diode, a variable source of tuner delay voltage is provided by arrangement of components in the cathode circuit of 6CB6 video amp, as shown below. The** agc **voltage for the first and second** if **amps is developed across the 5600-ohm video detector load resistor,** $R_{314}$. **The average** dc **level of this signal is applied to the first and second** if **amps as** agc **voltage.**






## Electronic Voltage Regulators Using Beam-Power Series Tubes . . . Crystal Diodes in TV Receivers

by A. M. KELWOOD

BY ADDING A SEPARATE screen supply to beam-power series tubes having low ratios of screen-to-plate current, and employing screen grid supplies using semiconductor rectifiers, it has been found possible to produce highly stabilized voltage regulators.[1] The series tubes were found to have slightly lower efficiency, but much higher amplification factors than the low-mu triodes usually used in voltage regulators.

A voltage regulator usually consists of a series tube, a *dc* amplifier, and a source reference voltage. It is commonly used in conjunction with an unregulated voltage source to deliver a regulated voltage output. Acting as a *variable resistor* connected between an unregulated source and a load, the series tube is controlled by the *dc* amplifier. Signals representing the difference between a portion of a load voltage and a reference source are fed to the input of the *dc* amplifier, and the amplifier output voltage is used to control the *resistance* of the series tube. For every change in load voltage caused by a change in either line voltage or load current, a corrective voltage is applied to the control-grid of the series tube, resulting in an essentially constant voltage across the load.

Although it is desirable to have a series tube that combines high efficiency with high amplification, an increase in one of these factors can in general be achieved only at the cost of a decrease in the other. Low-mu triodes such as the type 6AS7 are very efficient because, under conditions of zero control grid bias, they can pass a large amount of current with a small plate-cathode voltage drop. On the other hand, a triode-connected (screen grid tied to cathode through a small resistance) beam-power pentode has a higher amplification factor, but requires a larger plate-cathode voltage drop for the same current and the same grid bias conditions. The addition of a separate screen voltage source was found to provide a unit that has a higher effective amplification factor than a triode-connected beam-power tube. The efficiency of the regulator approaches that of a low-mu triode.

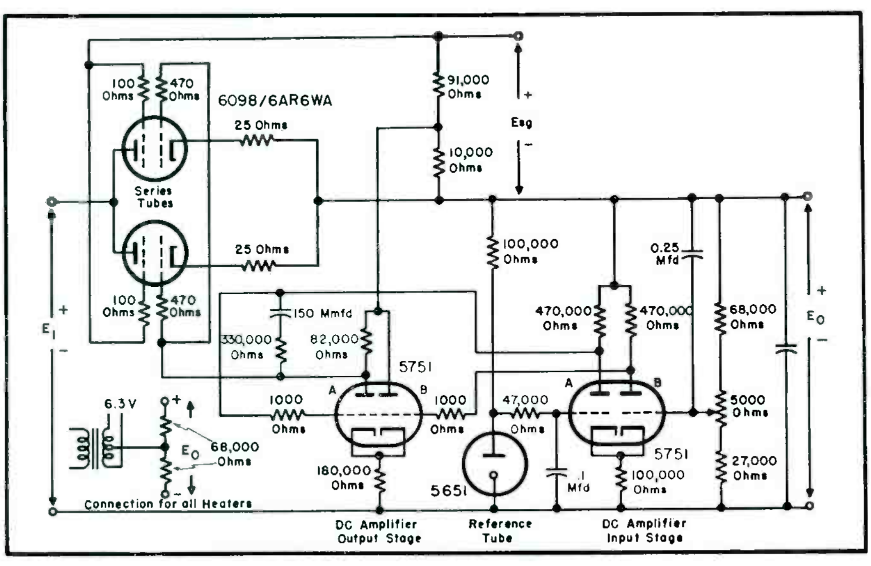
A 300-volt regulated power supply was constructed using pentode-connected 6098/6AR6 series tubes and a selenium bridge rectifier-*RC* filter type unregulated screen supply. The regulator contained a two-stage *dc* amplifier with a 5751 twin-triode differential amplifier in each stage. Lab investigations disclosed that the output voltage had a ripple of 1 *mv*, when the input-voltage ripple was 30 *v* and the screen-voltage ripple 1 *v*. With an input-voltage ripple of one volt and a screen-voltage ripple of less than .5 volt, a change in line voltage from —10% to +10% of nominal value, together with a variation in load from 25% of full load to full load, was found to result in an output voltage variation of less than .2 volt. During this study, the input voltage was 335 volts at full-load current and at minimum line voltage. The load current was 100 *ma* per tube. There was a drop of 2.5 *v* in the cathode equalizing resistors inserted between the cathode of each series tube and the regulated output.

The output impedance of a power supply using the regulator is less than 1 ohm from direct current to over 150 kc. This low impedance was achieved with a single *RC* feedback network in the *dc* amplifier and a 4-mfd capacitor across the regulated output. This high gain made it possible to reduce the number of stages in the *dc* amplifier to achieve a given magnitude of loop gain, and also to reduce the plate voltage variation

(*Continued on page* 76)

[1]*Developed at Bureau of Standards by S. Rubin.*

**Circuit diagram of the voltage regulator designed for either positive or negative 300-volt output. The screen grid voltage, $E_{sg}$, should have a minimum value of 150 v. Tubes of the 6CU6/6BQ6 type may be substituted for the 6098/6AR6WA shown. For such operation, the minimum screen voltage is 90.**



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## Alprodco's POP-UP TOWER with "MAGIC ELBOW" ACTION


**ONE-PACKAGE TOWER**

A single compact unit includes all necessary parts.

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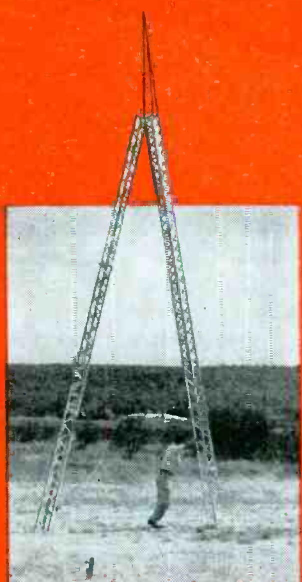

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Pick up the assembled tower at the "elbow" and work back on top half as tower swings up.

**THEN THE POP-UP**

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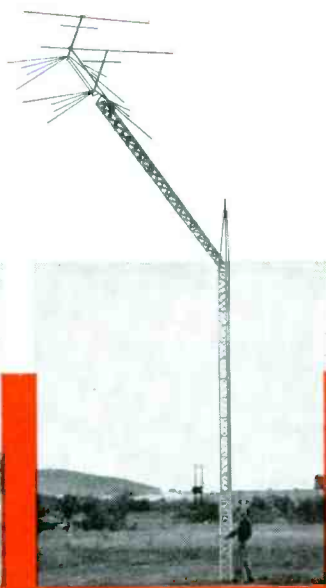

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"Magic elbow" does the rest. Easiest possible assembly and erection. Just as simple to lower, when necessary.

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# ASSOCIATIONS

### ESC

An umbrella type of national association to coordinate all existing groups on a national level, which would be known as the *Electronic Service Council,* was proposed at an exploratory meeting of eastern, east-central, mid-western and western associations in Pittsburgh, recently.

To provide such unity, *Max Leibowitz,* ARTSNY prexy, suggested the formation of a United Nations type of *super body* featuring a *security council* formed by the three national bodies, NATESA, NARDA and NETSDA. Delegates from these groups would hold permanent seats with representatives of state and local organizations elected on an alternating basis; rotating chairmen would be named.

There would also be, it was noted, a *general assembly* whose members would be representatives of all service organizations with power to overrule any decisions taken by the former group, even if a veto were exercised. This would enable local organizations to have an equal voice in promulgating national policy, and maintain their sovereignty as well.

*Gordon M. Vrooman,* secretary of the Syracuse Television Technicians Association, also proposed a national plan, featuring state assemblies for the highly populated sections, like New York, Pennsylvania, Illinois, Missouri, or other New England states, where there is a direct need for such a body to establish close liaison and solving of problems not of a national nature. In more scarcely populated areas such as the southwest part of the country, local representation would suffice, it was said; or perhaps state meetings at a regional conference with a representative of the group attending a national conclave.

The national group, Vrooman said, would be obliged to send out information releases that would bring about the upgrading of the profession, review products that are used in service, and provide for liaison between Service Men and manufacturers to promote the good of service and products used.

These suggestions and others offered at the unity session will be reviewed at a second meeting in the Lincoln-Sheraton Hotel, in Indianapolis, Indiana, on October 9.

*Bert A. Bregenzer,* president of the Federation of Radio Servicemen's Associations of Pennsylvania, will serve as chairman pro tem at the Indiana conclave.

About 28 delegates, representing five groups of associations, who in turn represented ninety-four associations, were at the Pittsburgh session.

**Association delegates reviewing the suggestions offered on association unity at the recent Pittsburgh meeting, and the proposed agenda for the second meeting in Indianapolis on October 9:** Max Leibowitz, Jonathan Boyer, Vincent Lutz, Orville Shanteau, John W. Heimak, and Bob Nist.

Groups represented included the National Alliance of Television and Electronics Service Associations, National Electronic Technicians and Service Dealers Association, Federation of Radio Servicemen's Associations of Pennsylvania, Empire State Federation of Electronic Technician's Association, Inc., Minnesota Television Service Engineers, Inc., of Minneapolis, ETA of Toledo, Ohio, Lehigh Valley RSA and RSA of Evansville, Indiana.

Delegates included *J. H. Boyer,* Ephrata, Pa., *Richard W. Filghman,* Allentown, Pa., *Joseph Knot,* Catassaqua, Pa., *Vincent J. Lutz,* St. Louis, Mo., *Orville G. Shanteau,* Toledo, Ohio, *Herman Seehausen,* Frewsberg, N. Y., *George Carlson,* Jamestown, N. Y., *Marty Boxer,* Brooklyn, N. Y., *Francis P. Skolnick,* Pittsburgh, Pa., *John Gonsowski,* Pittsburgh, Pa., *J. Paul Wertz,* Evansville, Ind., *John A. Wheaton,* Mineola, N. Y., *Daniel Hurley,* Syracuse, N. Y., *John Cochran,* Pittsburgh, Pa., *Gordon Vrooman,* Syracuse, N. Y. and *John Hemack,* Minneapolis, Minn.

Invitations have been mailed to local, state and national associations asking them to submit ideas and suggestions as to how the unity program might be set up.

### NATESA

Over 1500 registered at the recent NATESA convention which was held in Chicago.

Delegates from 38 affiliates were at the show. Submitted was a new plan, featuring the creation of new districts, governors for the districts, state chairmen, and an advisory council to complete the job of organization all the way down to the town level.

A TV-Radio Service Week or Month was proposed and suggested to RETMA.

*Frank J. Moch* was reelected president. Others named included *R. Hester,* Mission, Kansas, secretary-general; *Bertram Lewis,* Rochester, N. Y., treasurer; *Harold Eskin,* Rochester, N. Y., Eastern vice prexy; *Russ Harmon,* Cincinnati, East Central v-p; *Vince Lutz,* St. Louis, West Central v-p; *Jim Failing,* Greeley, Colo., Western v-p; *P. P. Pratt,* Buffalo, N. Y., Eastern secretary; *L. C. Stallcup,* Nashville, Tenn., East Central secretary; *Joe Driscoll,* St. Paul, Minn., West Central secretary, and *Al Saunders,* educational director.

### TEN YEARS AGO IN SERVICE

A stream of unknown brand sets, with no diagrams and makeshift circuit modifications, rushed out because of nationally-known chassis production difficulties, due in part to shortages of standard-brand components, created a rash of servicing problems. . . . Associations pooled the talents of their members to provide solutions and set up maintenance-repair programs to keep older sets in operation. Many associations also created field teams, expert in certain phases of repair, to lend a hand and expedite bench and home servicing. . . . The Los Angeles Council of the West Coast Electronic Manufacturer's Association and the Southern California chapter of NEDA held a joint meeting in Los Angeles, under the chairmanship of *Lew Howard* of Peerless Electrical Products. Speakers included *R. V. Weatherford,* Radio Specialties Co.; *T. A. Lynch,* Radio Product Sales, and *James L. Fouch,* Universal Microphone Co.


# How to hand yourself more business

Whenever you replace a tube, it's smart to hand the lady the CBS carton . . . and yourself more business.

It's smart because CBS tubes are advertised to *women* in Life, Good Housekeeping and on Arthur Godfrey's Talent Scouts.

And it's good business for you because *women* have greater confidence in CBS tubes . . . the tubes with the Good Housekeeping Guaranty Seal.

*There are no better tubes made than CBS tubes.*

Guaranteed by Good Housekeeping

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# telrex THUNDERBIRDS

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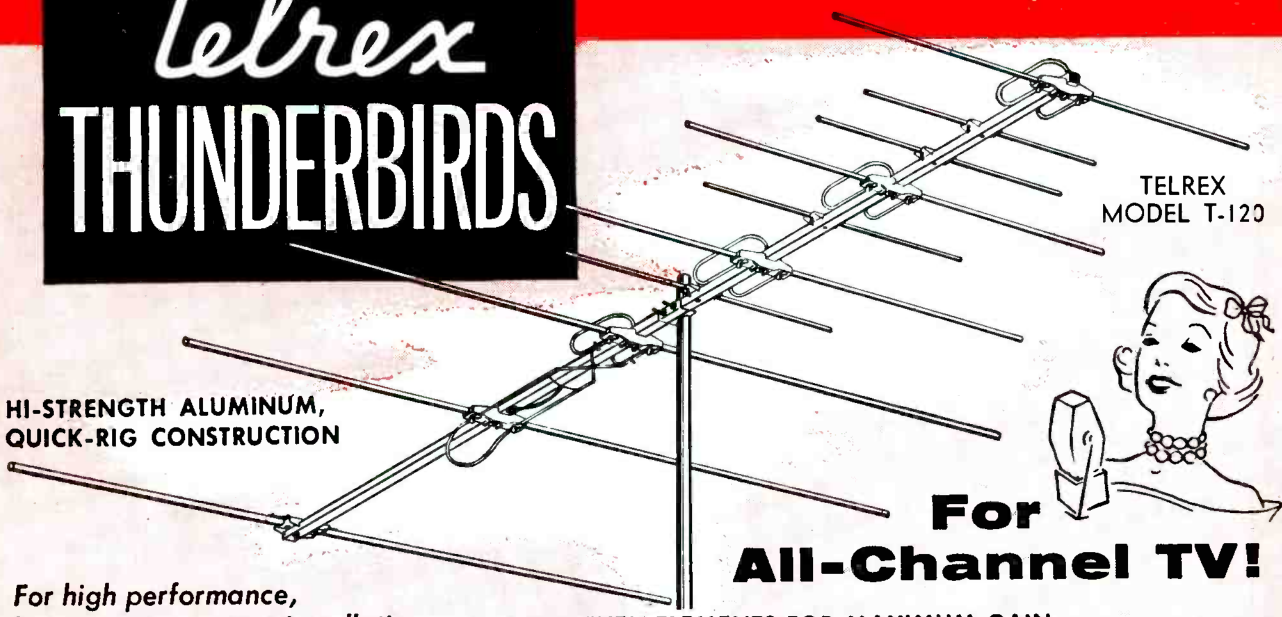


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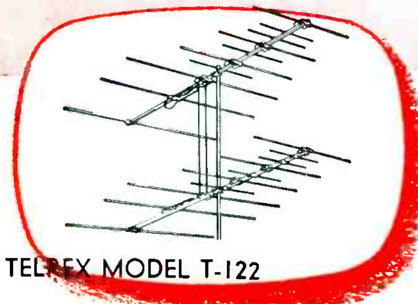
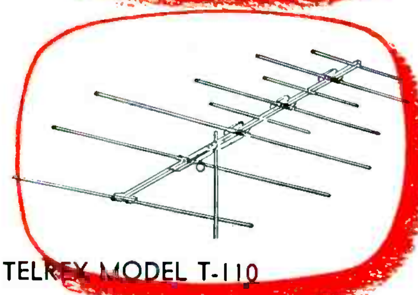


• TELREX MODEL T-122



• TELREX MODEL T-110

• TELREX MODEL T-130

**The new Telrex "THUNDERBIRD" multi-element wide-band Beamed Power arrays are engineered for fringe and "sub-fringe" area reception, and for all receiving conditions requiring exceptionally good directivity and high sensitivity.**

**Super Thunderbird Model T-120** is the finest wide-band, multi-element array ever developed. A system of variable impedance phasing loops permit precision tuning and the duplexing of element functions to provide the equivalent of 6 operating elements on the LO chanels; 13 elements on the HI channels. Element for element, they develop greater gain and directivity than many single channel arrays. **Model T-120** is accurately matched to 200-300 ohm transmission line for both HI and LO channels with compensated "trombone" section to yield exceptionally high gain and optimum signal transfer efficiency. LO band gain averages better than 5.5 db; HI band gains exceed 12 db, while front-to-back ratios range to 25 db.

For brilliant, interference-free signals under toughest reception conditions, choose the Telrex **Super Thunderbird T-120!** Available also in 2 bay units — **Model T-122,** ¼-wave stacked for gain increases averaging 3 db on all channels: and **Model T-122S,** ½-wave stacked to provide gain increases up to 4.5 db on LO channels, over single bay units.

**Thunderbird Model T-110** incorporates all the high-performance features of the **Super Thunderbird T-120,** including variable impedance loop phasing, compensated "trombone" matching sections and in-line, low wind resistance configuration plus high strength, all aluminum, quick-rig construction for dependable, high performance, low cost, long lasting installations. Duplexed elements are equivalent to 5 effective elements on LO channels for average gains exceeding 5 db; and 11 operating elements on the HI channels for gains exceeding 10 db. Front-to-back and front-to-side ratios of better than 22 db minimize interference. Available stacked ¼-wave, **Model T-112,** for all channel gain increases of 3 db; and ½-wave stacked, **Model T-112S,** for increased gains to 4.5 db on LO channels.

**Thunderbird T-130** employs Conical Dipole and "V" Beam quadrature phased driven elements to achieve virtually flat, stepless gain characteristics on all VHF channels with minimum number of elements. **Model T-130** also employs variable impedance phasing loops, duplexed elements and Telrex compensated "trombone" matching sections. Four effective LO channel elements; 9 operating elements on HI channels, produce gains to 5 db on 2-6, and up to 11 db on channels 7-13. Special trap circuitry used in all Thunderbirds, attenuates interference arising outside the assigned TV bands to assure crisp, smear-free picture quality and full sound response.

**Model T-132,** stacked ¼-wave gives average gain increase of 3 db on all channels; ½-wave stacked **Model T-132S** provides up to 4.5 db gain on LO channels over single bay.

Producers of famous "BEAMED POWER" Communication Rotaries. Call or write for new catalogs on TV Antennas, Commercial Arrays or Amateur Rotaries.

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**"Conical-V-Beams" are produced under U. S. Patent No. 23.346, Canadian Patent No. 500,436 and British Patent No. 691,485 — other patents pending. Sold only through authorized distributors.*

# Service Engineering — field and shop notes

by GEORGE W. VASS
*Supervisor, Communication Field Engineering
General Electric Company*

THE RAPID EXPANSION of the two-way radio industry calling for the use of a wide variety of equipment has boomed interest in the field among radio and TV Service Men. Although base station packages are fundamentally the same in that they consist of a receiver, transmitter, power supply and control unit, we do have considerable variation in the receiver and transmitter designs to consider.

In one case we may find a transmitter with a 60-watt output, and in the next a transmitter with a 250-watt output. And on closer examination we might find that one of the transmitters is a narrow-band affair, while the other features wide-band design. In either case, though, we would find that the transmitter is crystal controlled and the carrier produced is frequency modulated.

A glance at a pair of 25-50 mc receivers would show that they too are crystal controlled, capable of receiving a frequency-modulated signal of a half microvolt or less. But, in one case we might find that the receiver is a narrow-band unit, while the other has wide-band features. The obvious question is why the difference and how are they used?

Power selection depends largely upon the desired range. The sensitivity of the receiver is fixed, and once the height and type of antennas are fixed too, then the only variable is the transmitter power. The use of narrow or wide-band operation largely depends upon channel-frequency availability.

The FCC has allocated 40-kc channels in the 25 to 50-mc band for various services and operations. If we have a concentration of one particular type of service in a limited area, such as the petroleum industry, the number of channels available soon become crowded. Channels would have to be shared and hence the use of the radio equipment reduced. To overcome limited spectrum problems assigned channels are split and two 20-kc channels are thus available in place of a single 40-kc channel.

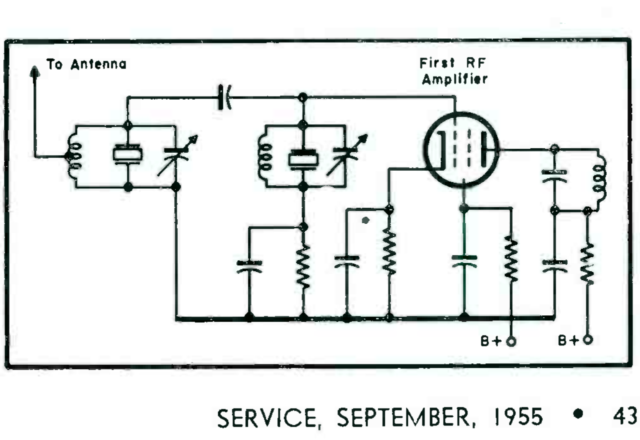
The selectivity of the receivers becomes the key factor when narrow versus wide-band operation is the question. Selectivity must take into account the inherent selectivities of all of the tuned circuits and the fact that these tuned circuits are linked together with non-linear vacuum tubes. The sensitivity of a two-way chassis is also very important and hence a balance must obtain. For example, if we built selectivity into the grid circuit of the first *rf* amplifier tube, it would be at the sacrifice of sensitivity. Balance is accomplished in three sections of a communication receiver; the *rf* section with high selectivity, narrow selective high *if* amplifier and very narrow low *if* frequency amplifiers.

A service engineer examining the philosophy and design with which he must live can readily forecast some of the common problems with which he will have to contend. For example, since the receiver is a narrow-selective, crystal-controlled device, the center or assigned frequency is therefore very important. (An instrument capable of measuring the transmitter frequency to an accuracy of .01% or one part in ten thousand must be available.) If the transmitter is not set on frequency, the sensitivity of the receiver is effectively reduced. The signal no longer rides down on the nose of the selective circuits, resulting in less gain and audio distortion. Preparations must be made to set the modulation of the transmitters accurately. If the modulation is set too low, weak audio results, and if it is set too high, the signal is clipped by the selective circuits in the receiver. The result is distorted audio and possible interference to adjacent channels. A method of measuring power must be available; i.e., the actual power which is being fed to the antenna.[1]

Power, frequency and modulation considerations are of the utmost importance in servicing a base station transmitter; these are functions that the transmitter performs, and the way they are made to perform these functions represents a service factor.

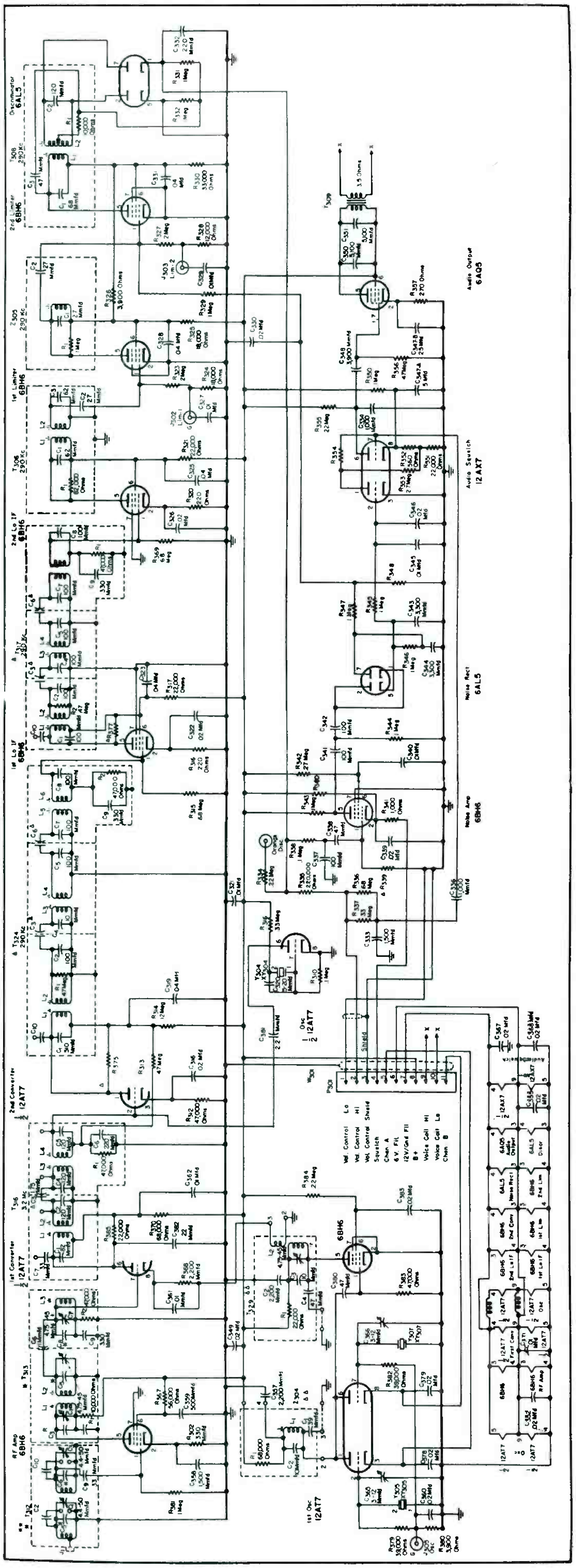
Two-way radio service of 25-50 mc band gear follows the same basic principle as any other type of service. The problem first must be isolated; is the difficulty in the transmitter or receiver or associated equipment? If all the units in a fleet cannot receive, the indication is that the base transmitter is at fault. Power output is probably the easiest function of the transmitter to check. Should power be low or zero, a quick check on B+ and filaments will eliminate the possibility of a blown fuse or a defect in the power supply. Low grid drive would indicate that either there is a defect in the grid circuit or in some preceding stage. A further check down

[1]*Instruments commonly used to perform these functions today are the Lampkin frequency and modulation monitors, and Bird wattmeters.*




(Right)

**Antenna input circuit to receiver showing use of crystals instead of cavities to minimize intermodulation.**



**Schematic of two-frequency 25-54 mc receiver; G.E. 4ER24A/B11/B12. Components with asterisk change value with frequency range. For 25-30 mc the following capacity values hold: In T312, $C_5$ and $C_8$ should be 62 mmfd; $C_{10}$, 39 mmfd; and $C_2$ 15 mmfd. In T313, $C_3$ should be 33 mmfd; $C_5$, 47 mmfd; $C_8$, 39 mmfd; and $C_6$, 1 mmfd. For 30-54 mc: In T314, $C_4$ should be 10 mmfd; $C_7$, 15 mmfd; $C_8$, 30 mmfd; and $C_2$, 15 mmfd. In T315, $C_{10}$ should be 15 mmfd; $C_{11}$, 24 mmfd; $C_{12}$, 20 mmfd; and $C_{16}$, .75 mmfd. Double asterisk indicates range of 25 to 30 mc tuned by clipping the links grounding $C_2$ and $C_{10}$ for frequencies above approximately 27 mc. Range of 30 to 54 mc is tuned by clipping links grounding $C_2$ and $C_8$ for frequencies above approximately 37 mc. Components identified by a triangle vary in narrow and wide-band sets. For wide-band operation, in the T324 section, $C_3$ should be 7.25 mmfd; $C_6$, 6 mmfd; $R_{375}$, 10,000 ohms and $R_{339}$, 100,000 ohms; in the T317 section, $C_3$ should be 7.25 mmfd; $C_6$, 6 mmfd; $R_{377}$, 47,000 ohms, and $R_{348}$, 560,000 ohms. For narrow-band operation, in the T318 section, $C_{12}$ should be 5.5 mmfd; $C_{18}$, 2.2 mmfd; $R_{376}$, 62,000 ohms, and $R_{388}$, 180,000 ohms. In the T319 section, $C_{12}$ should be 5.5 mmfd; $C_{13}$, 2.2 mmfd; $R_{378}$ and $R_{387}$, 200,000 ohms. Double triangle notation: For operating frequencies above approximately 30 mc, the links which ground $C_4$ in T329 should be grounded. For operating frequencies above approximately 35 mc, the links which ground $C_1$ in T304 should be clipped.**

the line will isolate which stage is at fault. If grid drive is normal up to the final, then trouble is in the *pa* stage. Perhaps the *pa* fails to tune to a minimum plate current; this would indicate a defective *pa* tube or defective *pa* component. The *pa* tube is the easiest to eliminate on the basis of isolation.

If power was found to be normal, a check on modulation would be the next step in isolation. A modulation problem may start with the microphone. Once it has been established that audio is reaching the grid of the audio amplifier, the circuit of the audio amplifier, modulation limiter, or modulator can be isolated. Wherever there is a control to set a level, such as the modulation-level control, it should be eliminated as a source of trouble as soon as possible.

Frequency problems are usually noted by a gradual degradation of the system, more so than an off-the-air problem. The quickest way to observe a frequency problem in a transmitter is to note the discriminator action of the associated receivers. Wrong multiplication is seldom experienced in routine maintenance; this would show up on the frequency monitor and action of tuning in the preceding stages. The most useful tool in servicing a transmitter, and one which is quite frequently left behind, is the manufacturer's instruction book which applies to the transmitter. By the way, no service to a transmitter should be attempted unless one has the proper *FCC* licenses, and all test equipment is capable of measuring results to comply with the *FCC* rules and regulations.

The most interesting problems in low-band stations are usually associated with the receiver. Noise signals are much more prevalent in the 25-50 mc band, than the other frequency bands now used in two-way radio. The growing number of licensed equipment and frequency assignments has accented the problem of intermodulation and adjacent channel interference.

Ambient noise level at a station location is a difficult problem with which to deal. The source of the noise is usually difficult to pin point, and in many instances, it is impossible to eliminate. Cases have been observed where mounting the antenna higher has increased the noise and in other cases lowering the antenna served to increase noise. No service engineer enjoys the thought of a noise-elimination problem at a base station loca-

(*Continued on page* 47)

# PERSONNEL

SAMUEL W. ARCHER, formerly service manager, has become assistant general merchandising manager of United Motors Service Division of G.M.


S. W. Archer


Louis Martin


M. P. Fumarola

LOUIS MARTIN, formerly general sales manager of Standard Coil Products Co., Inc., has been named general sales manager of Westinghouse Electronic Tube Division, Elmira, N. Y.

* * *

MICHAEL P. FUMAROLA has been named publicity director of the JFD Manufacturing Co., Inc., 6101 16th Avenue, Brooklyn 4, N. Y.

* * *

GORDON L. JOLLY has been promoted to the position of manager of product information in the TV-radio division of Westinghouse Electric Corp.

* * *

W. HAYES CLARK has been appointed national accounts sales manager of the General Electric tube department, Schenectady, N. Y. . . . F. H. O'KELLEY, JR. is the new eastern regional sales manager, headquartering at Clifton, N. J.

* * *

P. NEWTON COOK has been promoted to general sales manager of Chicago Standard Transformer Corp., Addison and Elston Sts., Chicago 18, Ill. . . . R. J. RIEGEL has succeeded Cook as sales manager of the Chicago and Stancor catalog divisions.

* * *

MARTY WOLF has joined B & K Manufacturing Co., 3726 N. Southport Ave., Chicago 13, Ill., as ad and sales promotion manager.

* * *

JEROME E. RESPESS, formerly vice president of La Pointe Electronics, Inc., has become president and treasurer of Johns-Hartford Tool Co., Hartford, Conn.

* * *

ROY G. TRUE is now executive vice president of I. D. E. A., Inc., 7900 Pendleton Pike, Indianapolis 26, Ind. . . . RICHARD C. KOCH has been promoted to the chief engineer post.

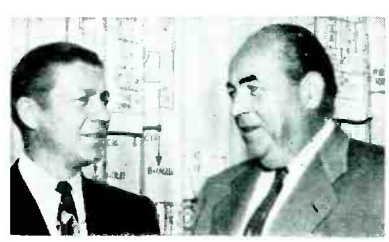
* * *

W. P. READY, JR., has joined Wallace's Telaides, Inc., 134-136 Day St., Jamaica Plain 30, Mass., as general sales manager.

* * *

C. A. SWANSON, former sales manager of the west coast division of Standard Coil Products Co., has been named general sales manager, and ODEN F. JESTER, former jobber sales manager, has been appointed assistant general sales manager.

C. A. Swanson (left) and O. F. Jester



## Service Engineering

(Continued from page 44)

tion. The best solution to this problem is *elimination of the problem before it occurs.* And that means one should select the site for an installation carefully and then make a noise survey. If possible, one should use a mobile receiver with the same sensitivity and selectivity that the proposed station receiver will have and of course tuned to the same frequency. Observation of the limiter current will give an indication of the noise level in the area. One check will not be of too much value; several should be made at various times during the night and day. For example, observations made at night may indicate that the location is quiet, while during some of the daylight hours heavy automobile traffic may prove to be a disturbing source of noise. While running such a test with a mobile installation, it is important that the normal ignition noise should not be confused with ambient noise. Observations should be made with the car motor stopped. If the auto or vehicle used has been routined for noise suppression, it's quite logical to use the car for locating possible sites. An ammeter located on the dash or in a convenient location for observation can serve to monitor limiter current as the car is driven around possible locations.

As mentioned earlier, the problems of adjacent channel interference and intermodulation are the major problems facing the Service Man today. It has been found that standard piezoelectric quartz crystals can be used instead of the alternative method of using large expensive cavities to minimize intermodulation.[2]

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[2]*Recommended by* ***Arthur G. Manke,*** *communications engineering,* ***G.E.***

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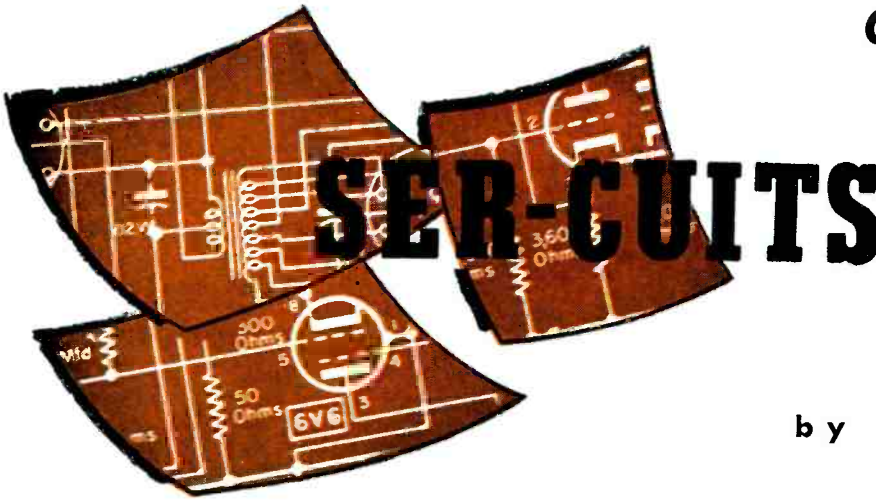
**SCHOLARSHIP AWARDS**

**Tore Lundahl,** Technical Appliance Corp. **vice-prexy and director of sales, awarding four Taco scholarships, each valued at $2,500, to Central New York students selected for outstanding high school work.**

# Circuitry Report on



# SER-CUITS

See Front Cover and Pages 49-50 for the Complete Schematic

by RAY S. GUICHARD

*Capehart-Farnsworth Company*

THE DATE, December 17, 1953, can be considered *D* day for commercial color telecasting, for it was then that the FCC gave final approval to the NTSC compatible color-TV system. Tremendous strides have been made since that day, although to some it may seem that the development has not been fast enough. We have heard it said, on many occasions during the past two years, that the growth of color television was dependent upon three important *Ps;* the three factors which must be satisfied before color TV can gain national acceptance: *picture, price* and *programming.*

The major television networks have indicated there will be a marked increase in color telecasting this fall. These announcements, plus the news that a number of TV stations have been modified for transmission of color, seem to indicate definitely that the factor of *programming* will be satisfied this fall.

The evolution of the 21-inch color tube, providing 260 square inches of picture area, and advanced circuitry for that tube, as illustrated on the cover and in the schematics on pages 50 and 51, will, it is felt, go a long way towards providing an answer to the remaining factors, or picture and price.

These receivers[1] incorporate a specially designed *uhf/vhf* tuner, 29 tubes, two selenium rectifiers and three germanium diodes. The entire chassis and picture-tube assembly is installed in the cabinet as one unit and designed so that no electrical disconnections need be made, to facilitate its removal from the cabinet. Other chassis features include a 4-stage wideband (4.1 mc) *if* strip, separate luminance and chrominance detector circuits, two stages of chroma amplification, cathode-coupled high-level color demodulator, automatic color sync, keyed *agc* with special noise immunity circuits, sync separator, and a noise cancellation stage with a fringe lock control to maximize sync stability.

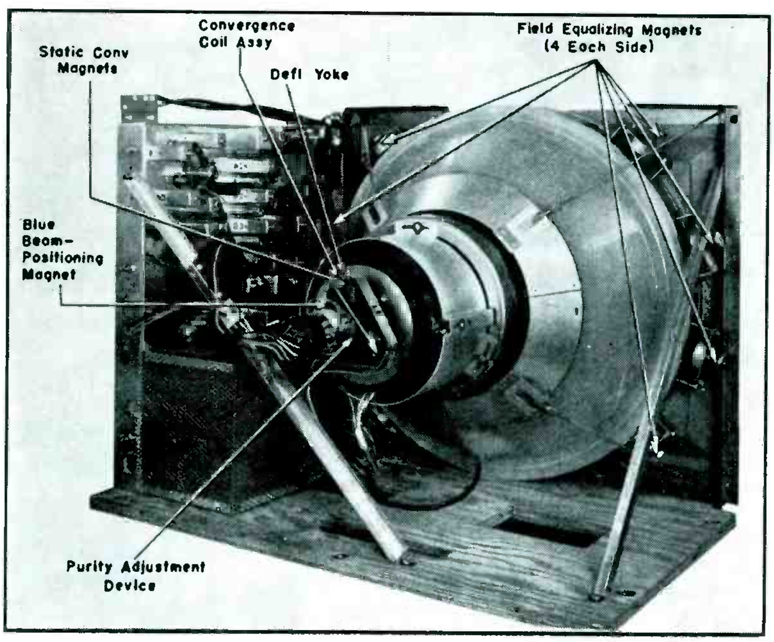
[1] *Capehart CXC-13 series; models 31T216M and 36C216M.*

The *vhf* tuner is the *switch-type* employing a 6BZ7 cascode *rf* amplifier and 6U8 pentode mixer-triode oscillator. Special precautions have been taken to maintain a wide, flat-topped *rf* passband on all channels. This is essential if picture and sound carriers, as well as the color information, are to be amplified equally without attenuation, distortion or phase displacement. The bandwidth specifications state that the 4.5-mc markers must be located at not less than 80% maximum on all channels. Tilt is held to not more than 15% on all channels. Variation of tilt with changes in *agc* bias have been given special consideration. The amount of tilt permissible between the 4.5-mc bandwidth markers is not more than 15% when *agc* bias is varied from −1 to −4 volts.

The *uhf* tuner has been designed as an integral, but, mechanically separate part of the *vhf* unit. It is completely self-contained with continuous tuning from channel 14 through 83. The unit employs a 6AF4 as a *uhf* oscillator and a 1N82 as a diode mixer. This circuit provides a flat response with a *uhf* signal-to-noise ratio of 11 to 12 db.

The *if* output from the mixer stage is coupled to the first *if* grid through an overcoupled tuned circuit; this circuit is tuned so that it has a passband 4.1-mc wide, relatively flat between extremes. Four stages of *if* amplification using three 6DC6s and one

**Rear view of Capehart color chassis showing position of several key components.**



# *Capehart's 21-Inch COLOR-TV Receiver*

6CB6 follow this. Coupling to the second, third and fourth stages is accomplished with bifilar transformers in what comprises a triple stagger-tuned circuit.

The output of the fourth *if* stage is fed into two separate circuits one of which is a tuned bandpass circuit which includes a 41.25-mc trap. This circuit feeds a 1N60 diode which is used for detection of the luminance signal only. Since this detector is used for luminance information only, the 41.25-mc trap can be tuned for maximum attenuation, thus eliminating the appearance of the 920-kc beat pattern in the picture. Another 1N64 diode is capacitively coupled to the fourth *if* stage and is employed as a sound and chrominance detector.

In general the *if* circuits are of conventional design, but, with particular attention paid to the passband and slope of the curve; 41.25-mc and 47.25-mc traps are located in the overcoupled *if* stage. The bandwidth of the *if* channel is considerably broader than in the average monochrome receiver, having approximately 41-bc width at 6 db down.

The composite video signal, which results from the detection process in the luminance detector, is coupled through a Y delay line and 3.58-mc tuned trap to the grid of a 12BY7 video amplifier. The amplified video signal is fed to the cathodes of the tricolor picture tube. A contrast control in the plate circuit of the 12BY7 provides for variation of the amount of video signal applied to the cathodes.

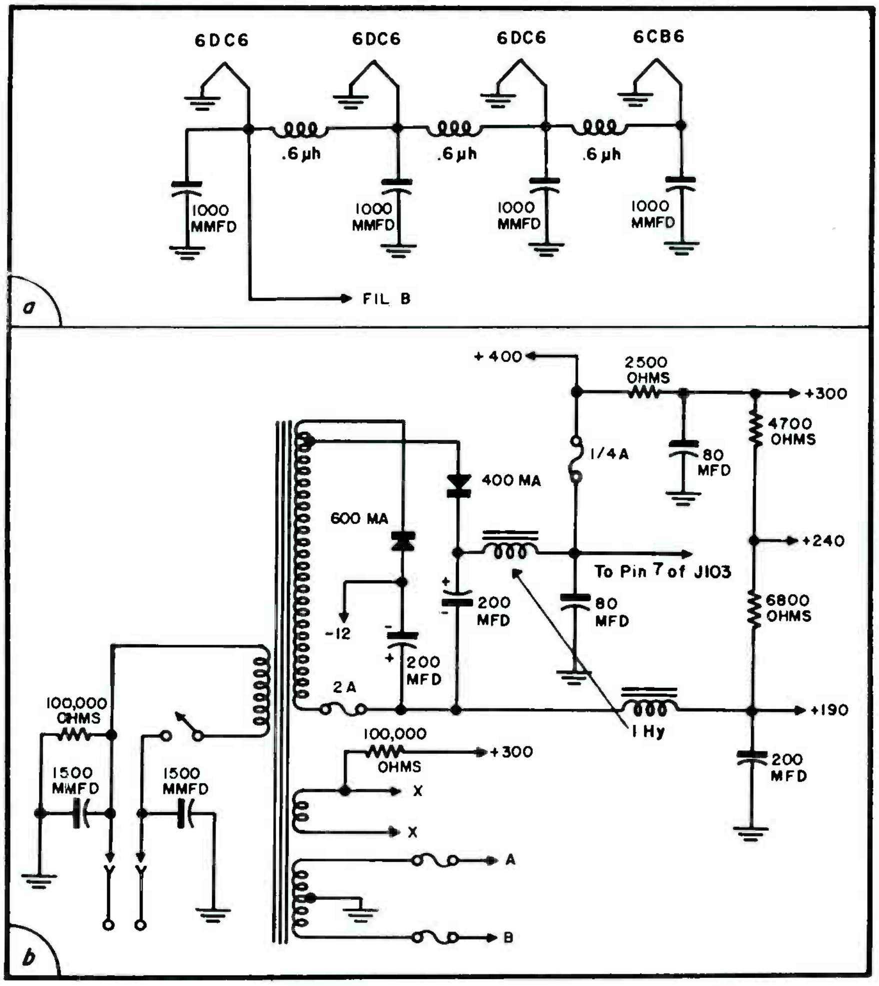
Two 6AU6s are used in a two-stage 4.5-mc sound *if* strip. Sound detection is accomplished in a ratio-detector circuit using a 6T8. A 6AQ5 audio-output stage provides two watts undistorted output.

The amplification and shaping of the horizontal and vertical sync pulses, plus the removal of noise bursts that would interfere with scanning stability, is accomplished by a 6CS6 sync separator and noise cancellation stage. The ouput of this stage, which is essentially sync pulses with all video and noise removed, is fed to a phase splitter and then into the vertical and horizontal-scan circuits. A 6AL5 is used as a phase comparitor for horizontal *afc* of a 12BH7 cathode-coupled multivibrator. The horizontal output stage employs a 6CB5. The vertical scan circuit uses one half of a 12AU7 as a blocking oscillator and a 6BL7 for vertical output.

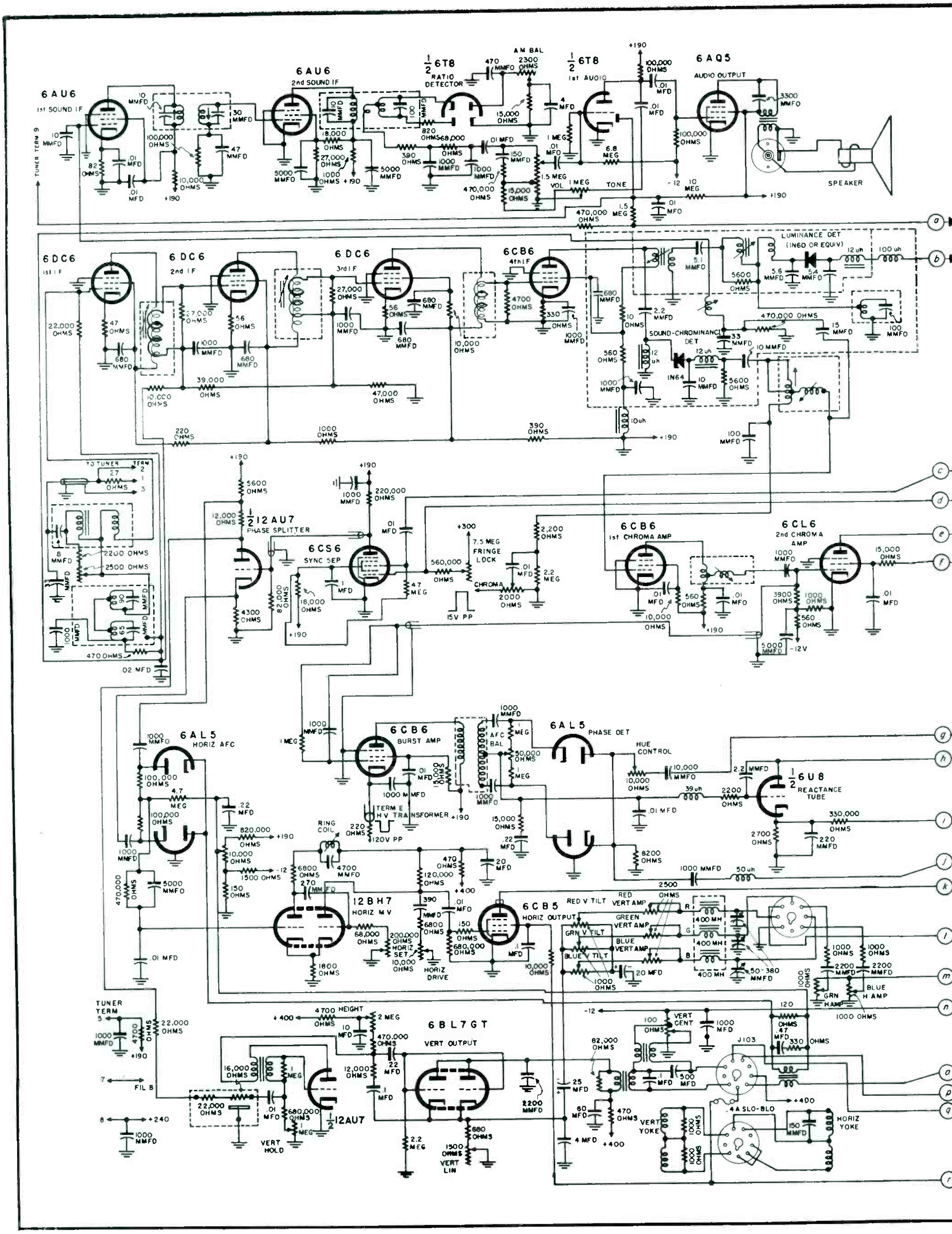
### *The Chrominance Circuits*

The output of the chrominance detector is coupled through a tuned circuit to the first chroma amplifier, a 6CB6. The bandpass of this circuit is relatively flat between 3.1 and 4.1 mc. The 4.5-mc sound takeoff coil, also in this circuit, provides a fast drop-off at 4.5 mc. The chroma-control circuitry is unique in that it provides variation of the amplitude of the chrominance information, but, maintains the amplitude of the burst signal constant, regardless of chroma setting. A horizontal-flyback pulse of positive polarity (15 *v* peak-to-peak) is coupled from a tap on the horizontal output transformer to the chroma control. The center arm of this control is then capacitively coupled to the grid of the first chroma amplifier. At minimum chroma setting the positive-going pulse is applied to the grid at maximum amplitude. This positive pulse causes the tube to draw grid current and as a result develop a self-bias across the grid-return resistor. The time constant chosen for this circuit is such that this bias will be maintained for the duration of the trace-time interval. As the chroma control is advanced, the pulse is decreased in amplitude and the self-bias decreases (as a result of less grid current) allowing the tube to draw more plate current and provide amplification of the chrominance signal. Since the burst signal falls within the time interval of the horizontal flyback pulse, it appears at the chroma-amplifier grid at the period of maximum conduction, and as a result receives maximum amplification. A constant-amplitude burst signal is desirable to obtain maximum efficiency from the 3.58-mc phase-detector circuit. Since the burst amplitude does not change

(*Continued on page* 50)



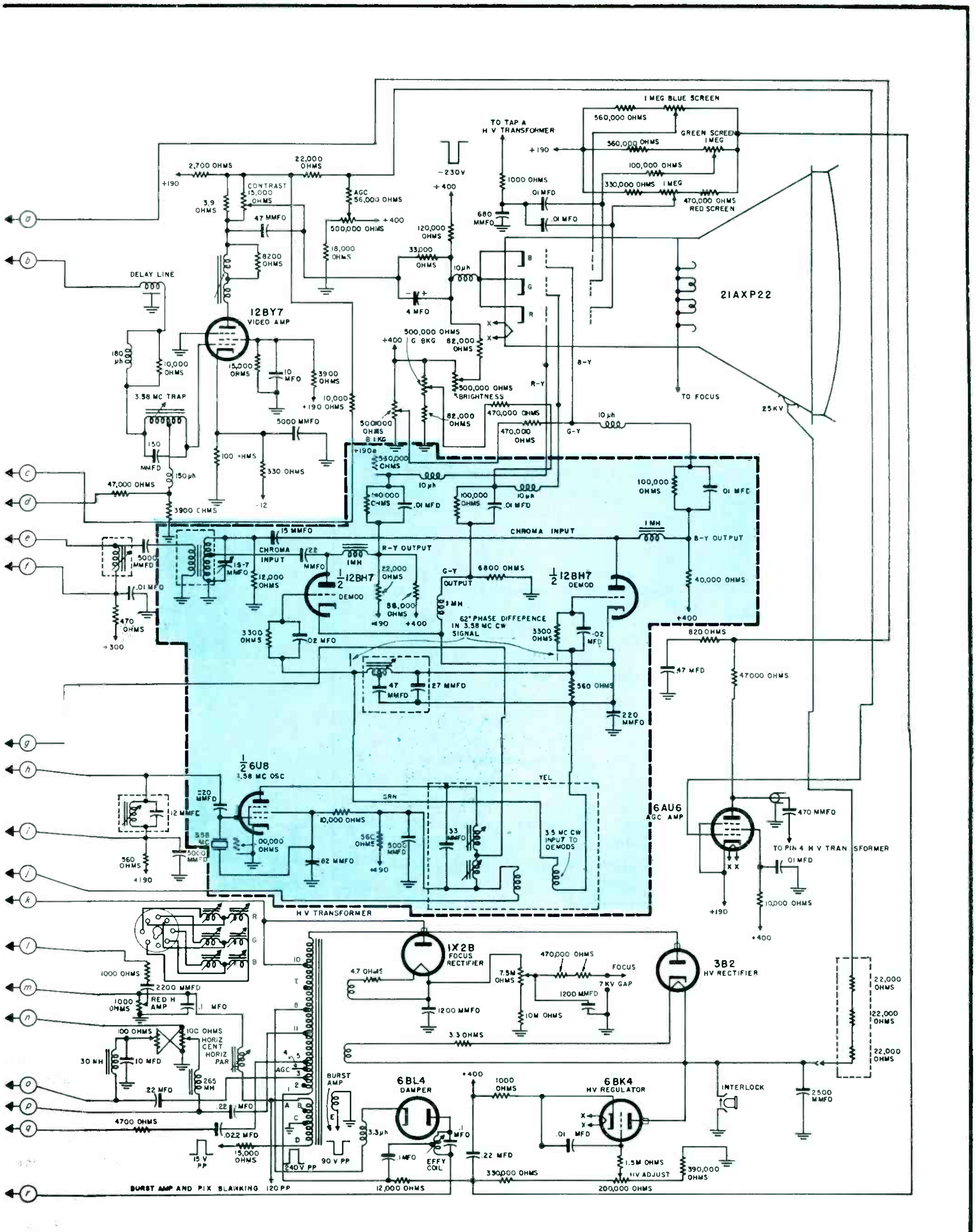

**Right: At top (a) is filament string of if chain in Capehart color set. In (b) is selenium B voltage supply for chassis. See pages 50 and 51 for complete circuit of color receiver.**




**Complete circuit of the Capehart CXC-13 series color chassis. The cathode-coupled color demodulators in the chrominance-**

with variation of the chroma control, excellent color stability can be obtained even at low chroma settings.

The amplified chrominance and burst signals are then fed through a second bandpass-tuned circuit to the grid of the second chroma amplifier. At this point the burst signal is taken off and fed to the burst amplifier. The




**channel circuitry, diagrammed on the cover, are in the dashed-line area in the schematic above.**

chrominance signal, however, is further amplified and then fed to the chrominance-input transformer.

The color demodulator is a dual-triode 12BH7, connected as a cathode-coupled, high-level demodulator. One triode is used to demodulate *R-Y* and the other *B-Y*. The *G-Y* sig-

(*Continued on page* 52)

(*Continued from page 51*)

nal is made up of $-.51$ *R-Y* and $-.19$ *B-Y;* therefore, by selecting the proper plate-load resistors for the two triodes the proper amount of *R-Y* and *B-Y* current can be made to flow through a common-cathode resistor to develop the *G-Y* signal. The high-level demodulator allows for a considerable amount of simplification in the chrominance circuits. With this system the demodulated signals are at such high amplitudes that no further amplification is necessary before application to the grids of the picture tube. Furthermore, the matrixing circuits and color gain controls which were required with low-level demodulation can also be eliminated. This not only reduces the receiver cost, but, also simplifies the adjustment and service procedures for these circuits.

In this circuit a 3.58-mc *cw* signal (obtained from the 3.58-mc oscillator) is applied to the control grid of each triode, while the chrominance signal is applied to the plates through the chrominance-input transformer. The secondary windings of this transformer have a turns ratio of 1:1.41, chosen to compensate for the unequal amplitudes of the chrominance signals in the original transmission process.

The chrominance signal applied to the plates of these tubes will be as high as 200 volts peak-to-peak. The demodulated output from these tubes is approximately equal to the peak-to-peak input; therefore, the grids of the picture tube receive up to 200 *v* peak-to-peak video drive. In the operation of this circuit, when there is no chrominance signal applied to the plate, the plate voltage of that tube remains at a fixed value, which is a result of the 3.58-mc *cw* signal applied to its grid. The chrominance applied to the plate causes the tube either to increase or decrease conduction. When the phase of the chrominance signal is the same as the *cw* signal, the tube draws maximum current and therefore the plate voltage drops to a minimum. The video output at this instant would be maximum negative. As the phase difference increases, the tube draws less current, plate voltage rises, and as a result the video output decreases from its maximum negative amplitude. When the chrominance signal is 90° out of phase with the 3.58-mc *cw* signal, the plate voltage has again reached the point equivalent to the steady-state value with no chrominance input. This condition would then result in no video output. When the chrominance signal has a phase angle greater than 90°, the tube conducts correspondingly less, until at the 180° angle tube conduction has decreased to the point where plate voltage reaches its maximum positive value above the no-signal value. This point then corresponds to maximum positive video output. Up to this point we have considered only the effect of the chrominance signal as it varies in phase relationship to the 3.58-mc *cw* signal. Simply stated, a change in chrominance signal phase causes the chrominance to either add to or subtract from the *cw* signal applied to the control grid. It was stated previously that the output of the demodulator is approximately equal to the peak-to-peak value of its input. In other words, the instantaneous value of the video output will depend on two factors; the phase difference between the chrominance and *cw* signals at that time and also the amplitude value of the chrominance signal at that instant. These two factors, of course, correspond to the saturation value and hue of the color as seen by the color camera at that same instant.

The color-difference demodulators, with which most of us have become familiar, have been operated with the 3.58-mc *cw* signal in quadrature phase relationship. To obtain the operating convenience and simplicity of the cathode-coupled demodulator it is necessary that this phase relationship be changed. The reason for this can be made clear if we would, for the moment, consider that the circuit we are discussing is being operated in quadrature. Because of the common cathode connection between the two triodes a certain amount of *R-Y* current would flow through the *B-Y* circuit and likewise some *B-Y* current will flow through the *R-Y* circuit. This would mean that the output of each demodulator would not be a true representation of either the *R-Y* or *B-Y* signal, but, instead the output of each tube would be a mixture of both. The quadrature components must be eliminated to provide true *R-Y* and *B-Y* video outputs. This is accomplished by operating the two demodulators with a 3.58-mc signal having a phase displacement of less than 90°. The two tubes are actually operated 62° apart instead of in quadrature. In this manner of operation, the *R-Y* demodulator would develop a *B-Y* component (in addition to *R-Y*), which would be of opposite polarity to the *B-Y* component introduced through the common cathode connection. The *B-Y* component is thus cancelled and the output of the *R-Y*

(*Continued on page 54*)

(*Continued from page* 53)

demodulator is then a pure *R-Y* video signal. The *R-Y* component in the *B-Y* demodulator is similarly cancelled so that the output of that stage is *B-Y* video only. The demodulated *R-Y, B-Y* and *G-Y* video signals are then *dc* coupled to the control grids of the red, blue and green guns, respectively. The action of the *Y* signal, applied to the cathode, and the color difference signal applied to the control grid, is combined in each of the three electron guns providing modulation of the three beams in accordance with the original red, blue and green signals, as developed by the color camera.

The color synchronization circuits consist of the burst amplifier (6CB6), 3.58-mc phase detector (6AL5) and a 6U8, the triode section of which is used as a reactance tube and the pentode section as the 3.58-mc subcarrier oscillator. The burst amplifier receives as its input, the color-sync burst signal, which is coupled from the grid circuit of the second chroma amplifier. The cathode of this stage receives a negative *keying* pulse, that is derived from a separate winding on the horizontal-output transformer. This *keying* pulse serves as an automatic conduction control for the burst amplifier. The grid of this tube is biased so that it is normally cut-off. The keying pulse drives the cathode negative sufficiently to overcome the grid bias and allow the tube to conduct during the burst interval. In this manner the burst amplifier is permitted to amplify and pass on to the 3.58-mc phase detector, only the burst signal. The amplified burst signal is coupled to the 6AL5 phase-detector circuit by means of the phase-detector transformer. This transformer has a balanced secondary which feeds the cathode of one half of the 6AL5 with a burst signal, that is 180° out of phase with the burst signal that it feeds to the plate of the other half of this tube. In other words, the signal from the *burst amplifier* is applied to the phase detector in *push-pull*. In addition to the burst signal, the phase detector receives a comparison signal which is derived from the local 3.58-mc subcarrier oscillator. This signal is applied through a phasing network to the plate and cathode of the two sections of the 6AL5 connected in parallel. The *hue* control is connected as a variable portion of the phasing network and permits manual adjustment of the subcarrier oscillator phase. Under normal operation this circuit is adjusted so that the 3.58-mc signal supplied from the subcarrier oscillator maintains a 90° phase relationship to the burst signal. When this condition exists there will be equal conduction through the two diodes of the phase detector. This will result in zero voltage at the center of the balanced resistor network between cathode and plate of the two diodes. The center tap of this network is connected to the grid of the reactance tube and the *dc* potential developed there is used to vary the effective capacitive reactance which this tube will present across the tank circuit of the subcarrier oscillator. Zero correction voltage at this point corresponds to proper adjustment. Should the subcarrier oscillator drift slightly, the control voltage developed in the *phase-detector* circuit would change (becoming either positive or negative depending on the direction of the drift) causing the *reactance* tube to change the operation of the subcarrier oscillator, until proper phasing is again obtained. A portion of the balanced network in the *phase-detector* circuit is made variable to allow for compensation of any inherent unbalance between the two diodes or between the load resistors used. This variable pot is identified as the *afc balance* control.

The 3.58-mc oscillator is very closely controlled, so that the effects of temperature changes and line voltage fluctuations are negligible.

### *The Convergence Circuits*

Convergence of the three beams in the picture tube is accomplished by means of an electromagnetic convergence-yoke assembly. The yoke consists of three pairs of horizontal and vertical coils, and three ferrite magnets. Each pair of coils is located so that they produce a magnetic field, which acts upon the individual electron beams to provide for proper convergence of the three beams, as they traverse the shadow mask of the three-gun tube. Each of the three coil pairs is wound on a ferrite core which is also equipped with an adjustable rod magnet. Center screen (or static) convergence can be obtained by rotating these three magnets. To facilitate static adjustment an additional device, referred to as the *blue-beam* positioning magnet, is provided to permit lateral variation of the blue beam. Dynamic convergence of the three beams is accomplished without the use of any circuit tubes for amplification or shaping of the required waveforms. Each of the three sets of coils in the convergence-yoke assembly requires a parabolic current waveform of both horizontal and vertical scanning frequency to develop the necessary magnetic fields for dynamic correction. These needed waveforms are derived from the existing waveshapes which are the natural products of the vertical and horizontal-scanning circuits.

As noted earlier, for ease of servicing and accessibility, the chassis and picture tube in these models have been mounted as an assembly separate from the cabinet. In addition, all convergence controls have been located on the front apron of the chassis and are accessible through a removable wood panel on the front of the cabinet.

At the start of this article we listed the three major factors which it is felt control the growth of color TV. The one main factor which is absolutely necessary if this growth is to continue was not mentioned; however, it was not overlooked. We are speaking of *service* and more specifically *good, efficient* service; the type of service that has been rendered by the many well-organized service shops throughout our country and which has contributed so greatly to the expansion of TV up to the present time.

# SERVICE... The National Scene

SERVICE BUSINESS AT RECORD HIGH AND STILL GOING UP TEXAS GROUP TOLD--In a hard-hitting message extolling the power of the Service Man, the jobber veep of one of New England's largest component manufacturers told Service Men at the recent convention in San Antonio, Texas, that they're in one of the best grooves today, where the sky is the limit and individual enterprise can keep that cash register ringing. . . . To reap this harvest, the Service Men were told to build up set owners' confidence through right approaches, right repair and the right charges. It isn't necessary to do a job at a loss, the veep said, but neither should one take advantage of the customer. It's also important to look ahead--never stand still--and constantly improve the shop's equipment, working library, and knowledge of new developments, those at the clinic were also told. Continuing, the industry secialist, offered seven points which all Service Men would do well to follow: Avoid talking too much. Remember, this is the grand era of do-it-yourself. There is no money in free diagnosis. . . . Justify charges. Give itemized bills. Return defective and replaced parts; and state what has been done to avoid comebacks on subsequent breakdowns. . . . Observe the best ethics of the profession and business. . . . Don't worry about competition; there's more than enough to go around and at the right prices. . . . Avoid bargains for replacements; one cannot afford callbacks, early breakdowns or hard feelings. . . . Everyone should consider the building of a real organization for the future. . . . Like your business and your business will like you.

PHONO, TAPE, PICKUPS AND SPEAKERS TO RECEIVE KEY ATTENTION AT AUDIO FAIR--The four-day annual audio meeting, that once again will be held in the Hotel New Yorker, New York, (October 12-15) will headline the current big-four of audio--phonos, tape, pickup and speakers--in the session hall and display rooms, too. . . . Tape papers will cover such topics as bias characteristics and playback. . . . Speaker and pickup reports will describe mechanical-crossover characteristics in dual systems, tweeter design considerations, radial tone arms and lightweight pickups. . . . Transistors in audio will also get a big play at the conclave. There'll be talks on applications of junction transistors in af gear, high-quality audio amplifiers using transistors, power-output stages using transistors, and a transistor amplifier with 40 db of negative feedback.

2-WAY CITIZENS-RADIO BAND USES GROWING--The 460-470 mc band, reserved for low-powered two-way gear, that can be operated without a license, continues to attract many in varied fields. . . . Recently a tractor dealer in California installed a number of talk-listen handsets to serve as interstore contact between employees of all departments and expedite the location of parts that are not on hand in the store where the customer is asking for them. Until now it was necessary to hang on the phone and call all of the stores in a search for the missing components. . . . Signals are fed to a console desk-type set in each of the branches, a main transmitter in the main store and to a repeater transmitter for signal strengthening; these transmitters are operated by licensed personnel.

SYRACUSE TV OPERATOR APPLIES FOR SATELLITE PERMIT--FCC now has a request from the first telecaster in the east, WSYR-TV Syracause, N. Y., to install a satellite which would provide additional coverage. The station said it would like to put the slave on a hill, three miles from Elmira, and transmit on ultrahigh channel 18, using a power of 15.1 kilowatts.

SELENIUM SALVAGE PLAN ANNOUNCED--The recent copper strike, which has aggravated an already acute selenium shortage, has prompted a mid-western manufacturer to set up a drive asking for old rectifiers, so that they can be salvaged. The government is lending its support to the campaign, which we're sure will also win the support of Service Men.--L. W.

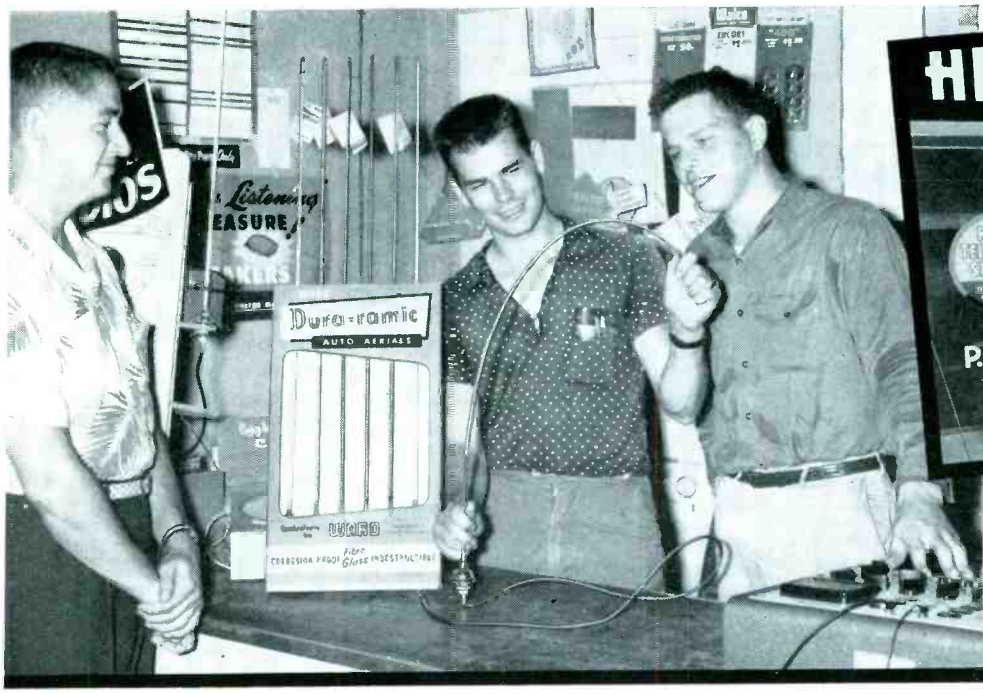
# THEY'RE HOT!

## WARD Dura-ramic

TRADE MARK

## REINFORCED *FIBERGLAS*

# CAR AERIALS in SIX COLORS





Kent and Bob Adams, co-owners of Adams Radio Service, are shown, left and right, behind counter, discussing Dura-ramic advantages with John Rose, salesman for jobber Pat Young. Their Dura-ramic window display is pictured above.

## ADAMS RADIO SERVICE FINDS ALMOST EVERY CAR OWNER A PROSPECT FOR DURA-RAMIC

Are you, too, cashing in like Adams Radio Service, on the big sales appeal of the new, noncorroding Ward Dura-ramic car aerial?

Dealers all over the country are finding that Dura-ramic car aerials, in six popular colors, are one of their hottest items today. If you are not now taking advantage of the big trend to color and the flexible, durable reinforced Fiberglas construction of the Dura-ramic, you are missing one of the biggest profit opportunities in your business at the present time.

Adams Radio Service, Cleveland, is only one of many Dura-ramic dealers who are making important *added* profits from the sale of this sensational, new car aerial.

It will pay you, too, in big, new profits to talk, push and sell Dura-ramics. Ride the wave of color popularity in cars! Sell Dura-ramics!

Write today for name of your nearest electronics wholesaler.

**WARD PRODUCTS CORPORATION**

DIVISION OF GABRIEL CO.

1148 EUCLID AVENUE • CLEVELAND, OHIO

## Audio

(*Continued from page* 32)

under all operating conditions of the equipment.

The moving-coil pickups have a somewhat higher impedance than the ribbon, but they are still lower in impedance than most other cartridges. Both the ribbon and moving-coil pickups have an impedance principally resistance; thus changing the matching condition affects the gain, but does not have any drastic affect upon frequency response.

Increasing impedance with a transformer, using too high a step-up results in both low and high frequency roll-off; this factor is not determined by the characteristic of the pickup, but instead by that of the transformer used, plus the terminating impedances, the pickup as an input resistance, and the grid circuit as an output load. But the important fact to realize here is, that when we do not get the response we expected, the transformer is more likely to be the cause than the pickup.

Thus it is best to use the pickup transformer recommended by the manufacturer, or one whose ratings are as close as possible to those specified. The transformer should not only have the same step-up ratio, but the ratio should be as near as possible to the same nominal impedances.

As an example, let us suppose we were to use a moving-coil type cartridge with a specified coil impedance, and *dc* resistance of 170 ohms. If a transformer, used to improve cartridge sensitivity, had a step-up ratio of 4.5:1, then the specified primary impedance of the transformer should be, say, 150 or 200 ohms.

If a transformer of lower specified primary impedance were used, the result would show up in deteriorated low-frequency response. If the transformer had a specified primary impedance that was higher, the defect would show up in the high-frequency response.

Frequently this type of transformer, operated open circuit into grid, will show a considerable peak, at or beyond the high-frequency roll-off point of the cartridge. This should be pulled down by secondary loading. The frequency response can be checked by one of the variety of frequency check records now available, and the value of the shunt resistance adjusted until a suitable overall response is found.

When this matching transformer is used, hum must be watched. Not only should the transformer be provided with good hum shielding, but care should be exercised in selecting a suitable mounting position.

Variable-reluctance cartridges, featuring a moving iron armature that varies the course of the flux through a fixed coil, have a much higher impedance than either the ribbon or the moving coil type of cartridge, but also a considerable proportion of their impedance is inductive. This means that one must pay particular attention to circuit loading.

The higher impedance of these cartridges indicates that a transformer is invariably unnecessary. But manufacturers of these cartridges usually specify a suitable loading circuit to obtain the response given in the specifications.

If the preamp uses a load-resistance value in the grid circuit higher than specified, the cartridge will produce a slightly improved high-frequency response. The improvement may not be appreciable because the value of resistance specified may introduce an almost effective open circuit from the cartridge viewpoint. What is certain, however, is that use of a lower loading resistance will result in a high-frequency roll-off, due to the inductance of the cartridge.

Often this approach is used as a method of adjusting the frequency characteristic of the cartridge if, for example, the preamp should have an undesirable high-frequency lift. However, this means of control is not recommended, for it is always best to get every stage of equipment right, rather than have one section compensate for another.

With the foregoing cartridge types, it is usually possible to obtain a convenient output from the cartridge to drive the preamp, since most of these pickups have the same order of output, or about 10 to 20 millivolts at the grid of the first tube. It may be difficult to check these values since, in some cases, the specified output is referred to a calibrated test tone on the record, while some preamps give a specified gain to provide a maximum output.

With ceramic cartridges, we have quite a different story, not that there is likely to be insufficient gain, but that there may be too much. A ceramic cartridge can provide an output of .5 volt or more, which will most probably overload some stage in the preamp before the volume control takes effect. If the preamp is provided with a high-impedance, high-level input, this may be a satisfactory point to connect the ceramic cartridge.

The impedance that the ceramic looks into represents another aspect to consider. With the inductive type of cartridge, loading by a resistance affects the high-frequency response. With ceramic cartridges, which are basically a capacitance-source impedance, loading by lower grid input resistance values attenuates the low-frequency response. To achieve a satisfactory low-frequency response, a ceramic cartridge should be terminated on the input to the amplifier with a resistance of at least a megohm, and preferably higher.

If the input resistance in the grid circuit is, say 100,000 ohms, it may be satisfactory to connect 2 megohms in series with the input to the grid; in this case we'll have an attenuation of approximately 26 db. Thus, if the cartridge provides an output of .7 volt, the input to the grid would be attenuated to 35 millivolts, which is probably a satisfactory input voltage for most preamps. If this method is employed, one must pay careful attention to electrostatic shielding of the 2-megohm resistor and the entire input circuit, because an input impedance of the order of 2 megohms is extremely susceptible to electrical hum field pickup.

# AUDIO Amplifier Measurements

**by NORMAN CROWHURST**

**Practical Setups for Audio Signal Generators to Check Gain and Response . . . Testing for Frequency Response in Phono Equalization Systems . . . Checking for Distortion and Transient Response.**

THE GROWING interest in better sound has created a demand for critical measurements during installation and repair. Today, one can't rely on the usual routine tests; it's necessary to check carefully such factors as frequency response and distortion, and see to it that performance matches new-equipment results.

*Basic Instrumentation*

A basic requirement in the audio-bench program is a signal generator with a low harmonic content in the output; such gear can be used to make distortion measurements, and check square wave and sine wave output.

Additionally, one might employ a gain set and one or two voltmeters, associated with the gain set. Gain set results could be obtained through the use of half-watt resistors, arranged to attenuate the oscillator output down from a level that can easily be measured, to the level required by the input to the amplifier.

To illustrate, let us suppose that an amplifier requires 10 millivolts input. Then a thousand-to-one attenuation will enable a reading of volts at the input, providing a direct indication of millivolts at the input to the amplifier. If the amplifier were intended to operate from an input of 600 ohms, then the Fig. 1 circuit would serve quite well, using 620,000 and 620-ohm resistors in series. A reading of 5 volts measured across the output of the signal generator would mean that 5 millivolts had been applied to the input of amplifier.

*Value of Single Instrument*

The switch from input to output enbales the same instrument to be used for measuring the input and output voltage from the amplifier. This is an advantage for one can thus obtain accurate results in measuring frequency response. It's true that using two instruments would eliminate the need for switching over to take each reading, but this would require a check of two voltmeters, one against the other, to be sure that both had identical frequency response.

On many occasions individual meters have been found to deviate from another in frequency response, particularly in the high frequencies. By using the same instrument for both input and output, the measurement becomes independent of the accuracy of the instrument as related to frequency.

If the resistors used in making the measurements can be calculated so that the input and output voltages measured are approximately the same, so much the better, from the viewpoint of measuring accuracy. For example, if 5 millivolts in, results in 5 or 6 volts out across the dummy-load resistor, then the thousand-to-one attenuation, enabling 5 volts in to give 5 or 6 volts out from the whole arrangement, would prove ideal in making good measurements. This would avoid, any inaccuracy that might be involved, if the instrument used did not have a consistent frequency response between different ranges, or between different parts of the meter scale on the same range.

*Use of Db-Scale Meter*

In plotting the response curve, it is helpful to use a meter which has a *db* scale, in addition to the regular voltage scale. This enables one to plot the response directly in *db*. If we didn't use equalization, response could be measured by setting the input voltage at each frequency to have the same reading, say 5 volts, representing 5 millivolts; then the output voltage could be measured by using an arbitrary point on the *db* scale as zero or, if you want to be technically correct, taking the reading obtained at a thousand cycles as a reference zero.

To do this, one should initially measure the response at 1000 cycles. It will make the job easier, if an adjustable resistance is placed somewhere in the arrangement, as shown in Fig. 2, to enable adjustment of the reading at 1000 cps to some exact point on the scale, that can be used

**Fig. 1. An arrangement that can be used to check the frequency response of an amplifier.**

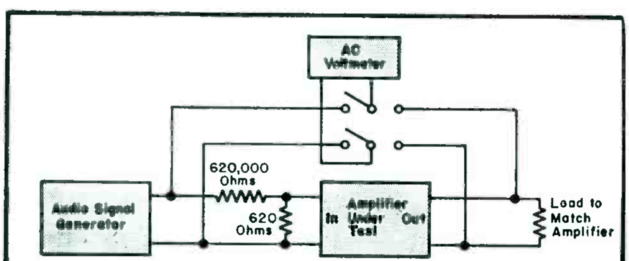
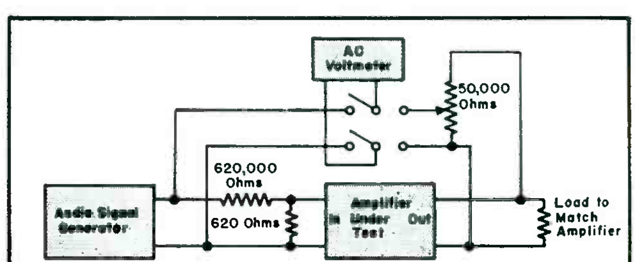



**Fig. 2. Addition of a fine adjustment for setting up reference level aids to make the finer readings required on modern amplifiers; 50,000 ohms, a typical value for the potentiometer, is not critical.**



as a zero reference. Having set this adjustable resistance, the whole response can then be plotted and cited in reference to 1000 cps.

The foregoing method has been found very effective, because it will afford a more accurate plot of the response, since failure to have a definite reference point can result in some confusion in interpreting the exact reading. If the reading at 1000 cycles comes somewhere between two *db* markings on the scale, and the readings at different frequencies are at times a little nearer the lower division and often a little nearer the higher division, the method of estimating the fraction between scale divisions will vary; it will therefore be difficult to get a smooth and accurate curve, by this method. But, by taking an accurate reference point, coincident with a scale division, at 1000 cycles, the whole curve can be plotted much more accurately and with ease.

### *Phono Equalization*

In checking frequency response, where equalization is included, as for pickup playback, one could use a phono disc with calibrated tones. This technique would serve not only to check the equipment but also the response of the phono cartridge; this should be done at some point in the complete testing of a system. However, in checking a system, it is often necessary to know whether the cartridge is performing correctly, or whether there's some fault in the preamp equalization that is not producing correct response. In this case, we must take a frequency response curve through the preamp equalization without using the cartridge, to eliminate any possible error due to the cartridge's response.

To do this, the cartridge should be simulated for input. This can usually be done by using a resistance of a value equal to the impedance of the pickup, together with other resistances to attenuate the voltage down from a convenient measuring level; an arrangement similar to the one described. It is the method of measuring that differs slightly.

To obtain accurate results the output level should be adjusted to give the same reading every time, and then the switch should be thrown to obtain a reading for the input voltage necessary to obtain this output level. Again a reference point should be set at 1000 cycles, so that reading on both output and input represent a

(*Continued on page 68*)

# AUDIO Maintenance-Service Tips

by FRED R. SAILES

**Troubleshooting Radio-Phonos . . . Installation-Repair Notes for 30-Watt PA Amplifiers . . . Servicing Changers for Record Shutoff and Drop Failures, Ejector Lever Faults and Cycle Problems**

When troubleshooting radio-phonos, one always finds two pesty problems around; boomy reproduction and microphonics.

Boominess can be due to cabinet or amplifier conditions. An improperly designed speaker enclosure, or an improperly adjusted bass-reflex enclosure will cause boom.

The use of an amplifier with a high source impedance—as for example, pentode amplifier without feedback—connected to a poorly-damped speaker system will also generate boomy results. (Reduction of source impedance by negative-voltage feedback over output stage will introduce electrical damping.)

Microphonics on all signal sources can be due to a microphonic tube, or hardening of rubber shock-mounts for low-level tubes or tuning capacitor.

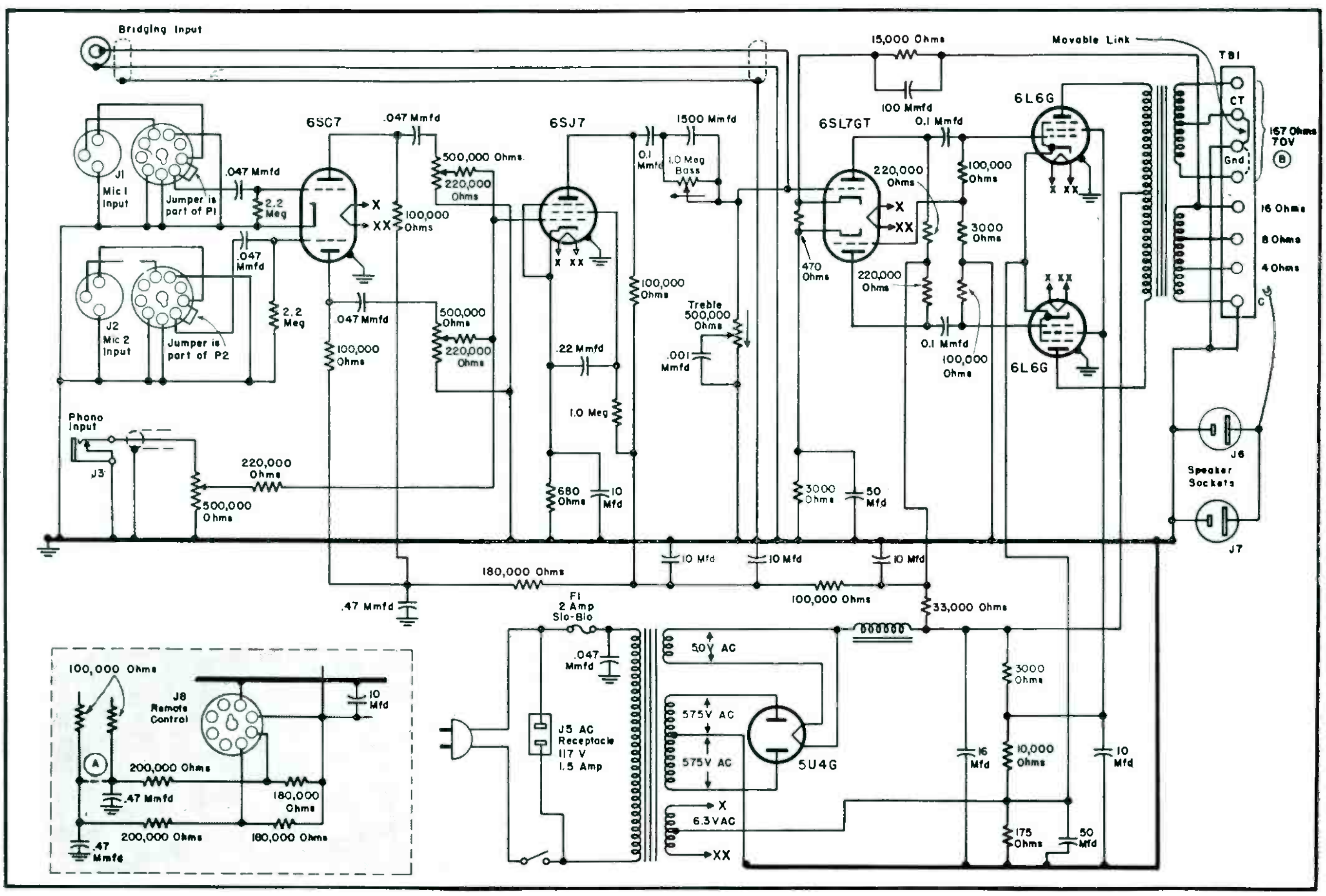
Microphonics in the phono only could be caused by cabinet vibration or phono pickup having high vertical response. One should substitute a phono pickup with a low vertical response; in general needles with high vertical compliance, such as horizontal shank type indicate low, vertical output.

### *Capacitor Leakage*

In some instances, the .05-mfd 400 v coupling capacitor from pin *1* of the 12AT7 to pin 5 of the 6V6 in Webster-Chicago model 1139, has been found to have a tendency to leak or short out, causing distortion and overheating of the first 6V6 in the output stage.

The only correction required is replacement of the capacitor with one of comparable value.

**Circuit of 30-watt amplifier featuring inputs for two microphones and one crystal or ceramic phono pickup. To permit adapting the mike inputs for high- or low-impedance microphones, two nine-pin sockets are provided on top of chassis. Connections to these sockets are made by inserting a shorting plug for high impedance, or a plug-in transformer for low impedance.** (RCA SA-32A).



### *Bridging Connections*

A NUMBER OF *pa* amplifiers feature bridging links to permit use of additional equipment. For this purpose, in the RCA SA-32A 30-watt unit, there's a jack marked *bridging input* on the rear apron of the chassis. This jack is connected between the mixer and phase inverter stages. It thus may be used either as an additional high-impedance input to the unit, or as an output to supply another amplifier having a high-impedance input connection (100,000 ohms or greater). A signal of 1.5 volts fed into the jack will produce 30 watts output. A signal fed out of the jack will have a level of 1.5 volts when the amplifier controls are set for 30 watts output.

### *Input-Output Variations*

When the bridging jacks of two of these amplifiers are connected together, all four input signals appear at the outputs of both amplifiers. If the amplifier output transformers are then connected in parallel, the two units act as one 60-watt amplifier with four microphone and two phonograph inputs.

### *Remote Volume Control Provisions*

The amplifiers can be so modified that a remote volume control for each of the two microphone channels can be connected into the circuit. Such remote controls adjust the gain of the preamplifier stages by varying the plate voltage.

Since the controls are not in the signal circuits, the frequency response of the amplifier is not affected by capacity of the inter-connecting cables and no hum or noise is picked up by the controls.

The remote volume controls and the resistors and capacitors for modifying the chassis are available as a kit.[1]

### *Amplifier Outputs*

The output transformer in these amplifiers has two secondary windings. The lower secondary winding has taps for unbalanced connections to loudspeakers having a total voice coil impedance of 4, 8, or 16 ohms. The upper winding provides a rated output of 70 volts and is designed to feed a standard RETMA 70-volt loudspeaker line. A link on the output terminal board permits grounding either the center tap of the 70-

(*Continued on page* 64)

[1] *RCA M1-14831.*

(Continued from page 63)

volt winding, for balanced output, or one end of the winding, for unbalanced output. The 70-volt winding provides 30 watts output at rated distortion to a loudspeaker load of 167 ohms.

Negative feedback from one secondary of the output transformer to the cathode at pin 6 of the 6SL7GT serves to reduce distortion and instability caused by variations in tube characteristics and fluctuations in the *ac* supply voltage.

In the power supply, the rectifier output is filtered by a choke and a 16-mfd electrolytic capacitor. Voltages for the various stages are obtained by use of dropping resistors. Additional filtering and decoupling is provided where required by the four sections of a 50-mfd electrolytic.

To reduce hum, due to heater-cathode emission, the tube filaments are kept at a fixed positive potential of about 26.5 *v* by connecting the center tap of the 6.3-*v* filament winding to a 175-ohm resistor. This resistor serves as part of the bleeder chain and as a cathode-bias resistor for the power output stage.

### *Microphone Connections*

As shipped, the amplifier is connected for use with high-impedance microphones. If a low-impedance microphone is to be used on either of the two channels, the plug from the nine-pin socket corresponding to the channel desired must be removed and as a cathode-bias resistor for the quired impedance must be inserted in the socket.

In general, it has been found a high-impedance microphone will be satisfactory whenever the microphone cable is short. When the cable is long a low-impedance microphone will provide better high-frequency response.

When a single-conductor shielded cable is used with a microphone for this amp, the center conductor should be soldered to terminal number 2 of the plug, and the shield lead to terminal number one. When the microphone is connected for *high-impedance* and two conductor shielded cable is used, one of the audio leads must be soldered to terminal 2 of the plug, and the other audio lead and shield to terminal one. When the microphone is connected for *low-impedance*, the microphone audio leads should be soldered to terminals 2 and 3, and the ground lead to terminal number one.

To prevent hum in the loudspeakers, the *ac* power line must be kept



## *Coming Event*

**Annual Audio Fair**
**October 12 to 15**
**Hotel New Yorker, N. Y.**

away from all of the microphone cables.

Whenever two or more microphones are to be used at the same time they must be connected in phase with each other.

The phono input circuit on these *pa* models has been designed for a crystal or ceramic pickup. To connect a phono to the amplifier a single conductor shielded cable should be used. The center conductor should be connected to the tip of the telephone plug supplied and the shield to the sleeve of the plug.

### *Loudspeaker Connections*

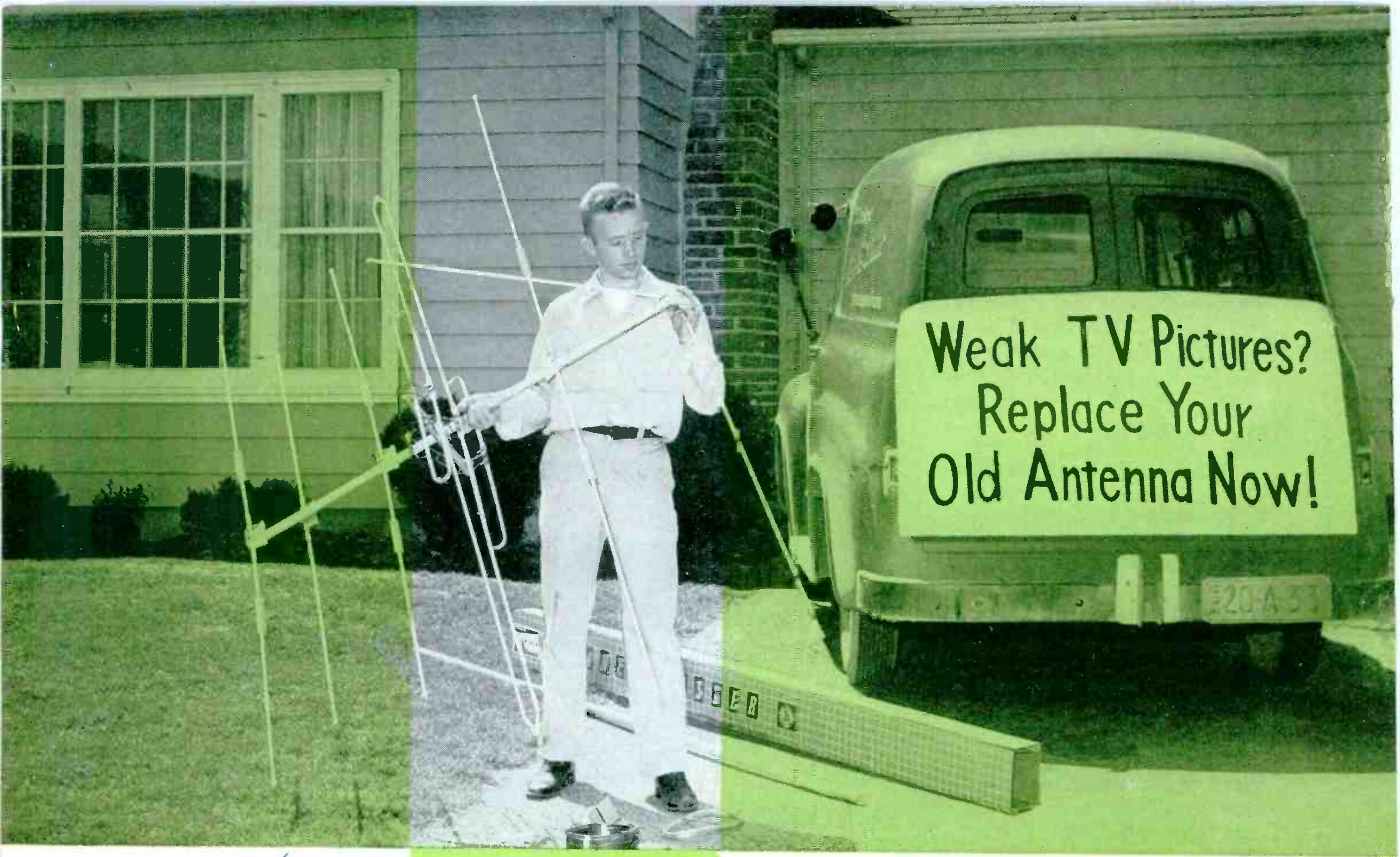
In connecting loudspeakers to the amplifier, one must make certain that the impedance of the group of speakers is equal to or slightly greater (never less) than the amplifier output impedance that is used. To determine the impedance of a group of identical speakers, the impedance of one speaker should be divided by the number of speakers connected in parallel.

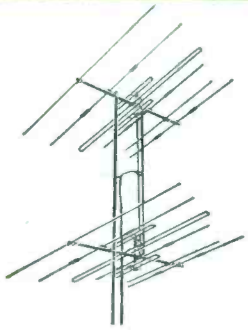
When connecting two or more loudspeakers in the same vicinity, one should observe the correct polarity in connections, as noted in earlier discussions in these columns, so that the speakers will operate in phase with each other. The cones of the various speakers must move simultaneously in the same direction. If they are not in phase, the sound output will be materially reduced, because the sound from one unit will cancel that of the other. A simple method of checking the phase of speakers is to connect a 1½-v dry cell across the voice coil to determine polarity of winding. The cone will jump forward or backward, according to the battery polarity. Selecting the positive battery pole as a reference, all the voice-coil leads which were connected to this pole for the same direction of cone deflection, should be connected together. This will place the loudspeakers in parallel.

### *3-Speed Changer Repair Notes*‡

WHEN A CHANGER fails to shut off after the last record is played the trouble is probably due to binding in the pressure arm assembly. To cure this the pressure arm assembly must be removed and cleaned thoroughly, and any burrs removed. It should be lubricated with light mineral oil before reinstallation. The pressure arm housing should be cleaned with solvent and the key slot checked to make sure it is clean and free from burrs.

‡*From Webster-Chicago service notes.*



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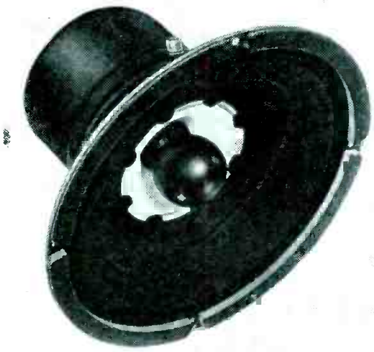
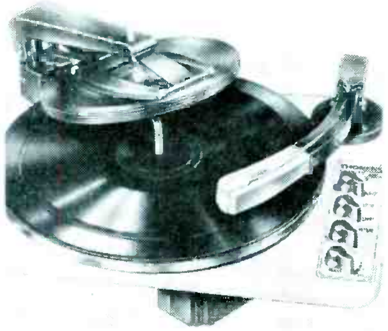
# Latest in Audio



**Eight-inch speaker featuring a phase-equalizing globe, and elliptical corrugation of cone. Has separate tweeter and woofer cones, coaxially mounted with a mechanical crossover. Spider is of coaxially-corrugated thin fiber. Voice coil is of aluminum.** (Matsushita Electric Panasonic; R. I. Mendels, Inc., 41 E. 42d St., N.Y. 17, N.Y.)

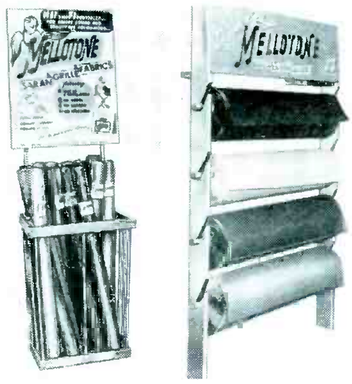


**Record changer powered by a direct-drive motor utilizing a separate gear for each standard speed. Has dial-action control knob for selecting three standard speeds. Concentric with dial, is a fine-tuning knob, said to permit pitch adjustments within a 5% latitude above and below each of standard speeds during audition.** (Model CD-43; Thorens Company, New Hyde Park, L. I., New York.)

**Tape recorder microphone, also said to be suitable for paging systems and general purpose work. Available with either shielded crystal or ceramic elements. Crystal type has a response of 100 to 7000 cps and an output of —55 db; ceramic type has a response of 100 to 6,000 cps and an output of —62 db. Impedance is high in both types; they are omnidirectional. Size: 3¼" x 2⅛" x 15/16".** (American Microphone Co., 370 S. Fair Oaks Ave., Pasadena, Calif.)

**Counter display featuring chemically treated cloth designed to remove record static and clean grit from record grooves. Moving hand is operated by flashlight battery.** (Electro Wipe; Duotone Co., Keyport, N. J.)


**Displays of plastic grille fabrics; material is available in 22 patterns.** (Mellotone Grille Fabric; Wendell Plastic Fabrics Corp., 17 W 17 St., N. Y. 11, N. Y.)




**Disc cleaner developed to prevent static build-up; also claimed to stop pops and ticks in microgroove records.** (Quiet; Beyland Engineering Co., Box 53, Yalesville, Conn.)

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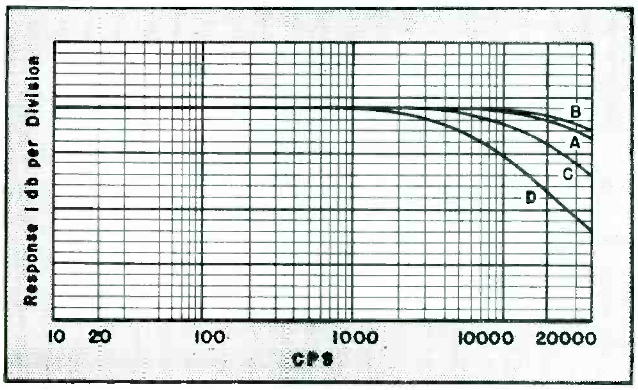
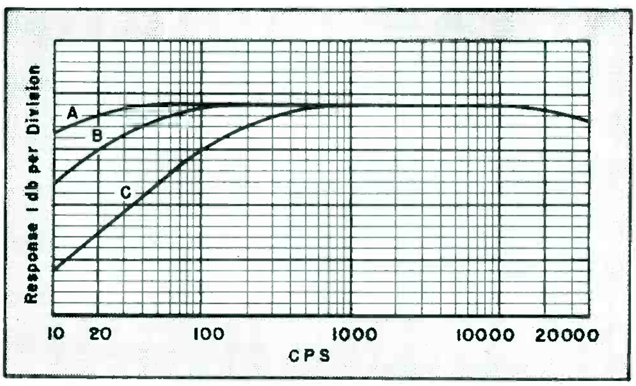
**Below: Effect of different loading-resistor values on response of variable reluctance cartridge;** A, **correct value;** B, **value too high;** C **and** D, **values too low. Right, below: Frequency response of ceramic cartridges with various loading-resistor values;** A, **2 megohms;** B, **680,000 ohms;** C, **150,000 ohms: See pages 32, 58 and 59 for report on cartridge replacement practices.**



## Audio Measurements

(*Continued from page* 61)

convenient exact reading on the *db* scale.

Of course, the readings on the input will be inverted to obtain the equalization response. For example, let us suppose that at 5000 cycles an input of 3 *db more* than that required at 1000 cycles, gives the correct output reading; this would mean that the equalization curve is 3 *db down* at 5000 cps, compared to the 1000-cycle reference point.

One must keep the output voltage constant to avoid spurious reading due to noise pickup or similar troubles. This problem occurs when we use a lash-up arrangement with odd resistors, instead of a proper gain set.

When one becomes doubtful of a reading, it is best to turn down the audio signal generator level, and see if the output reading goes down at the same time. If the output reading does not drop away considerably below the reading obtained, with the signal level turned up to its working position, then you are not reading the signal you think you are; instead you are picking up something spurious along the way, probably hum. This can, of course, be checked by putting a 'scope across the output and studying the waveform.

If it is not possible to take your measurements at a level that will rise sufficiently above the hum, to be sure of getting accurate reading, then one must take some steps to reduce the hum, by looking at the manner the input is connected. It may be that there is some inconsistency in the ground arrangement between the signal generator and the input to the amplifier. Perhaps, both are solidly grounded back to the power line at different points along the supply line. This can be a cause for hum injection. If each is grounded internally to some ground point and ultimately gets to a different ground connection, then one of the grounds will have to be disconnected and the two unit grounds tied together.

There are some simple output checks available for amplifiers which will tell whether the distortion is



down to 1%; this level will be found effective for most practical purposes.

A 'scope waveform may or may not show distortion as low as 5%, dependent on the kind of distortion. If the distortion is in the form of clipping, it will definitely show up long before 5% is reached, but if the wave is somewhat rounded (which occurs before clipping) then it becomes difficult to analyze the wave and detect if the distortion is much less than 5%. The simplest approach to the problem is the straight-line method.

In this test the 'scope is connected up, as shown at Fig. 3, so as to compare the output waveform against the input waveform. With this setup, if the amplifier is performing correctly, a straight line, at an angle of approximately 45°, will appear on the 'scope screen. If there is any phase shift in the amplifier, the line will open out

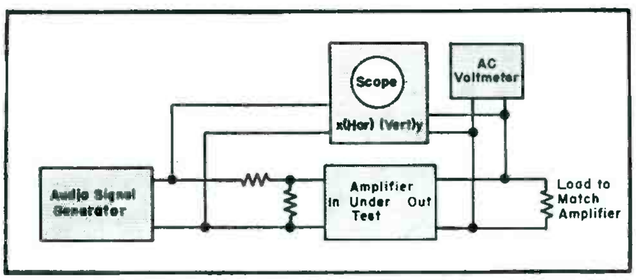



**Fig. 3. Method of connecting 'scope to give input-output comparisons.**

to form an ellipse. In this case it will be best to introduce some kind of phase-shift arrangement, as shown at Fig. 5, to bring the sides of the ellipse together to form a single straight line.

If the line is not perfectly straight, then we know there is some distortion in the amplifier. If the line shows just a slight curvature in one direction, there's some second harmonic distortion in the amplifier; if there's a double curvature, the presence of some third harmonic is indicated. If just the ends of the line bend over, clipping is indicated.

Having set the 'scope up for measuring distortion, it is a simple matter to turn the input level up until clipping begins to show, back off until the clipping disappears and measure the voltage across the output dummy load.. Then, from the power formula, $V^2/R$, we can calculate the power output from the amplifier and see whether it measures up to specifications. Detection of the presence of distortion less than 1%, by any visual method of this nature, is not possible. In fact it is not possible to *measure* the distortion this way; only to estimate it by experience from visual indication.

Checking the frequency response, to see that it is flat over the audio range, and checking the output to see that it's reasonably near its rated undistorted power at different frequencies over the audio range, are not the only criteria of good performance in an amplifier. We are still left with the possibility that the amplifier may not give good transient response.

The commonly accepted way of checking transient response is through the use of the square wave. The amplifier should be able to reproduce square waves without any sign of overshoot or ringing. Thus we see why we should have a signal generator with square-wave and simple sinusoidal outputs.

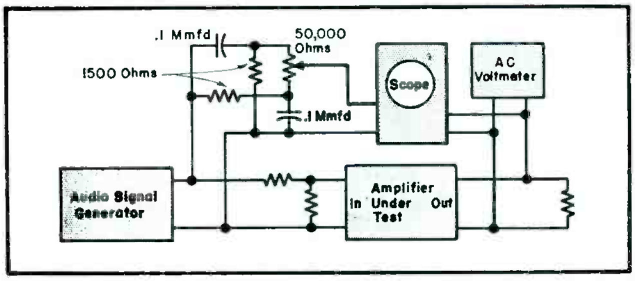
What should be done if the amplifier does not produce a satisfactory square wave? It can deviate from the square form in two fashions: Rounded corners, due to inadequate reproduction of the higher frequency components in the square wave, or an overshoot, or ringing effect, can appear on the corners of the square wave due to overemphasis of *hf* present at this point.

How can the latter occur, when the

(*Continued on page 70*)



**Fig. 4. (right): Traces obtained with the setup of Fig. 5 showing:** (a) **no distortion;** (b) **second harmonic;** (c) **third harmonic;** (d) **clipping.**



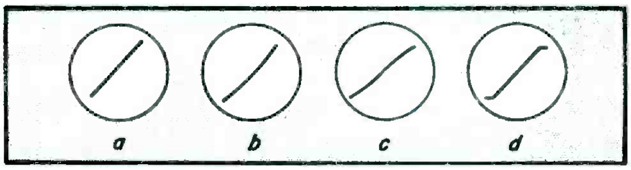




**Fig. 5 (left): Addition of an adjustable phase-shift network which serves to compensate phase shifts in the amplifier, so that a simple trace is obtained. The values shown are suitable for 1000 cps. For other frequencies the capacitors should be changed; higher frequencies require proportionately smaller values, and vice versa.**

## Audio Measurements

(*Continued from page* 69)

frequency response looks perfectly flat, right out to the ends of the audio band? Transient response is dependent, not only on the response being level throughout the band, but also on what happens when the response rolls off beyond the band. The effect of the difference in response in this region, is to make the amplifier perform differently for short pulses of different component frequencies, from the way it does when a continuous tone of single frequency is applied, and this is what square waves help to resolve.

The usual cause of either defect is incorrect adjustment of the feedback circuit. Most feedback circuits have a compensating capacitor somewhere; a small value capacitor connected in parallel with a resistor. Usually the value of this capacitor is pretty critical, and adjustment of it by a fraction of its value will often correct ringing or rounding of the square wave.

The check should be made with a dummy load resistor, working into a loudspeaker of the correct impedance for the output tapping used. It will be found that the waveform differs depending on whether a resistance or the loudspeaker is connected, and the feedback should be adjusted so as to give the best compromise on both arrangements.

There is another kind of transient distortion that shows up on a different kind of test. If a sinusoidal wave is pulsed into the amplifier, the wave may not follow steadily the input shape. Fluctuation of this nature is due usually to the changing in the potentials in the amplifier at different signal levels, and the fact that these changes in potential have time constants which take time to adjust to the new level.

This can generally be detected by applying a *dc* voltmeter to various points in the amplifier and watching the reading of the voltmeter as the audio input is switched on and off. A convenient way of switching the audio input to make such checks is to short circuit the output from the resistance network used at the input to the amplifier. This provides a rapid change from full signal to no signal at the input to the amplifier, and prevents interference with the output circuit of the signal generator, which can sometimes cause a similar transient fluctuation with some types of signal generators.



## Coming Events

**Northern California Audio Show**
**September 30, October 1 and 2**
**Sheraton-Palace Hotel, San Francisco**

**Institute of Hi-Fi Manufacturers Show**
**November 4, 5 and 6**
**Benjamin Franklin Hotel, Philadelphia**

## Servicing Helps

(*Continued from page 37*)

present on only one station or on all available channels. In either case the antenna should be checked as a possible source of trouble. An antenna test can be made by examining the antenna itself, or by substituting another antenna or receiver known to be in good operating condition.

If there is no picture or sound, and snow is present in the raster when the contrast control is turned up, one can be certain that the video and *if* stages are functioning properly. As an added precaution, however, the first *if* stage should be checked. If sound is present and there is no evidence of snow in the raster, the trouble is probably *not* in the tuner.

After faulty operation has definitely been isolated to the tuner a systematic check can be made to locate any defective component.

### *Visual-Instrument Checks*

When the tuner is partly disassembled, a visual check can be made to locate any obvious defects such as burned or overheated components, shorts caused by components or lead wires touching, and mechanical defects or poor solder connections. Often a static discharge from lightning can cause an antenna coil to open. If the current flow from such a discharge is sufficiently great the coil will be obviously burned. A resistance check from the *vhf* antenna terminals to the tuner chassis will show whether or not the coil is open. One terminal should show approximately 1 ohm to ground; the other about .5 ohm. There are two ground connections on this tuner, and both must be tested to make sure that good contact is made. Resistance measurements can also be made to check for other open coils in the tuner.

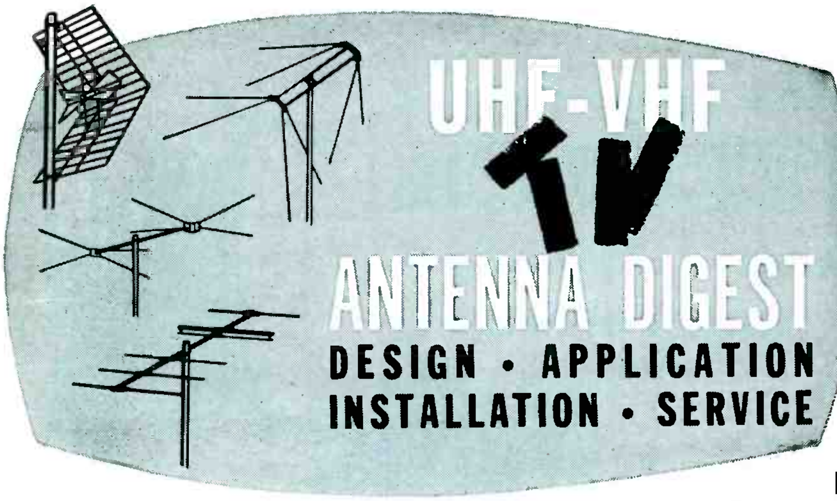
### *Antenna Coil Inspection*

Open antenna coils are sometimes caused by carelessness during receiver installation when the back cover is being replaced. If the line cord is plugged into a wall socket, the interlock is at 110 *v* and accidental contact with any projecting metal on the chassis will result in an *ac* short. In most cases the antenna mast or tower is grounded; thus, if the antenna leadin is connected, current will flow from the ungrounded side of the line through the antenna coil (which is connected to the chassis), leadin and back to ground through the mast.

Frequently tuners appear to have intermittent troubles. For example, a tuner may operate perfectly when removed from the main chassis, but show trouble when replaced. This can be caused by twisting or bending of the tuner frame when it is mounted, which can cause a component or lead wire to short against another. If an intermittent condition exists, the tuner should be given a dynamic test by bending or twisting it while it is operating. Normally a visual check will locate the trouble. If a tuner has been dropped, a twisted frame is almost a certainty.

If visual checks fail to locate the trouble the tuner should be given a series of operating checks.

The first step in an operational check is to find out if the plate and screen voltages on the tuner tubes are normal. A *vtvm* should be used, with the tuner set to an operating channel. If the voltages are normal, the plate and screen-load resistors and bypass capacitors can be eliminated as the causes of trouble. In most




## Highlights of Antenna-Installation Rules Now Being Considered by the Insurance Companies to Curb Damage Due to Storms

by RALPH G. PETERS

THE WAVES of gales and hurricanes that have been hammering the Atlantic coast and other areas throughout the south and west, dooming many thousands of antenna setups to the scrap heap, have alerted TV set owners to the import of periodic antenna inspection and ruggedized installations that might forestall such destruction.

Service Men are being called in by home owners and apartment dwellers to look over poles, guys, towers, leads, brackets and antennas, and repair and replace where necessary.

Insurance agencies have become so alarmed at the damages that result when the antennas are blown down that they have begun to study sets of rules that could be adopted, and which it would be mandatory to meet, before storm coverage was issued.

Some of the regulations under consideration are now included in state and city ordinances. Covering antenna mounts, one such provision requires that no mast or antenna can be fastened to, or in any manner braced or supported by a chimney, vent or other structure that extends vertically from a roof. And if it is necessary to use anchor screws for antenna guys, the measure continues, the screws must be securely fastened to rafters, beams or substantial framing members of the building.

Where good construction requires guy wires, the codes add, at least four equally-spaced guys should be used for the first twenty feet of mast height; where the roof design makes the use of three guys a better type of construction, that many may be used, provided they are not less than 115° apart. Where the pole or tower is over twenty feet high, the official rules say, additional sets of guys must be installed for each additional ten feet, and separate roof anchors must be installed, too. It is also necessary, according to this installation edict, to see to it that all guys are attached to anchors, masts, turnbuckles or other fastenings with adequate guy thimbles or equivalent.

To prevent electrical hazards when antennas fall across live wires, the following regulation, from a western state ordinance, is being considered by some insurance companies. Leadins must be kept at least twelve inches clear of existing telephone or electric power wires and be properly supported to prevent swinging into the conductors, in case of a lead break.

During one inspection tour, insurance men found that thousands of antennas were in danger of damage or destruction because their supporting guys were too weak, with a break strength of 200 to 300 pounds, instead of 500. Thus, this requirement is also being surveyed for coverage rules. Some have suggested that aluminum cable be used to avoid pitting damage.

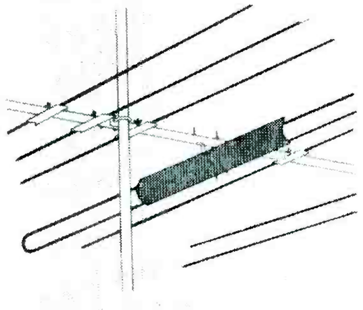
Also in the planning stage is a coordinated insurance company-Service Man educational program urging viewers to call on their local shops for checkups so that adequate insurance coverage can be obtained and roof and other property damage avoided when a storm strikes.

**Checking heights of antennas that will provide best signal in co-channel country; Burlington, Vermont. Photo at left shows truck equipped with crank-up tower and antenna ready for test. At right is a view of rear of truck, with extensions being inserted into pole before tower is raised for testing. Note TV set used to study pix quality.** (Courtesy Channel Master, Ross Radio Shop and Radio Service Lab.)

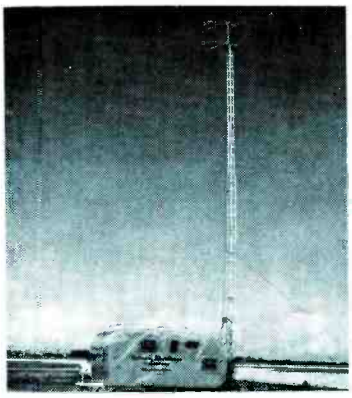
# Rep Talk

Wally Shulan and Co., 136 Liberty St., New York 6, N. Y., have announced the opening of an additional office at 880 Bergen Ave., Jersey City 6, N. J. . . . *Farber-Jacobson*, Buffalo, N. Y., have been appointed to rep for Insuline Corp. of America in upper New York state. . . . Clear Beam Antenna Corp. has named *Norman A. Chezak*, 18 Ferncliff St., Clifton, N. J., to rep in upstate New York. . . . *J. W. Lehner Co.*, 367 Brynhild Rd., Columbus, O., has been chosen to rep for Perma Power Co. in Ohio, western Pennsylvania and West Virginia. . . . Perlmuth-Colman and Associates, 2419 S. Grand Ave., Los Angeles 7, Cal., have announced two additions to their distributor sales division staff: *Travis Weber* and *Hal Baker, Jr.* . . . *William Linz* will rep for the Electronics Division of Thompson Products, Inc., in southern Wisconsin and Illinois. . . . Marshank Sales Co., 722 Melrose Ave., Los Angeles, Cal., has announced the addition of *Reg Thatcher* to its industrial sales engineering staff. . . . Magnetic Shield Division, Perfection Mica Co., has named *Trionic Engineering Associates*, 11 S. Austin Blvd., Chicago, Ill., and *Rex Electronics*, 1351 E. De Loss St., Indianapolis, Ind., as reps. . . . *Kenneth Reinhardt*, Box 3196, R. R. 10, Indianapolis, Ind. (Indiana and Kentucky) and *Tri-onic Sales Co.*, 10116 Puritan St., Detroit, Mich. (Michigan) have been appointed jobber reps for Pyramid Electric Co. . . . Astron Corp. has named Peyser and Co., 1501 W. Weber St., Colorado Springs, Col., as rep for Nevada, New Mexico, Colorado, Utah, Wyoming, Idaho and Montana. . . . *W. R. Hays*, Dallas, Tex. (Texas and Oklahoma); *Engleman-Jesse Co.*, Memphis, Tenn. (Arkansas and Louisiana); *Gene T. Clears*, Chicago, Ill. (Indiana) and *Arthur Davis Co.* (western Pennsylvania, Ohio and West Virginia) will rep for Tescon TV Products Co., Inc. . . . *Myers, Young and Forristal, Inc.*, Kansas City and St. Louis, Mo., have been appointed reps for David Bogen Co. in southern Illinois, Kansas and Missouri. . . . Clear Beam Antenna Corp. has announced that *Jack Geartner Co.*, 823 86th St., Miami Beach, Fla., will be their factory rep for Florida; *Francisco Fernandez Fernandez*, P.O. Box 3508, Havana, Cuba, will rep for the company in Cuba. . . . *Art Cerf and Co.*, 744 Broad St., Newark, N. J., will rep for Merit Coil and Transformer Corp. in upper New York state. . . . The *William Engelbretson Co.*, 906 Ottawa Ave., St. Paul 7, Minn., (Minnesota, North and South Dakota, western Idaho and western Wisconsin) and *Dale G. Weber Co.*, 234 Sherlock Bldg., Portland 4, Ore. (Washington, Oregon, western Idaho and western Montana) have been named reps by Perma-Power Co.

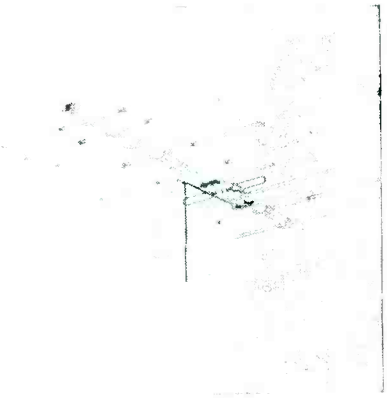
# TV Antenna—Accessory Developments



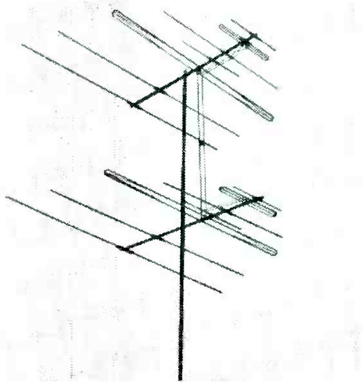
**Fringe antenna featuring a** phase reverser, **a specially shaped, metallic** shield **mounted in front of the receiving element. Design, it is said, permits antenna to function as three separate antennas in one for coverage on high and low channels. The use of the phase reverser, it is claimed, permits elimination of harnesses, phasing stubs, and extra dipoles.** (Wizardette, Wizard, and Wizard Imperial; Walsco Electronics Corp., 3602 Crenshaw Boulevard, Los Angeles 16, Calif.)



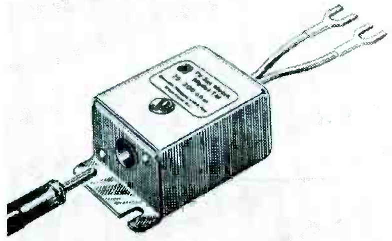
**Exponential type antenna said to feature elements that are curved in the form of an exponential curve according to, and within the limits of a mathematical formula for such curve. With these curved elements properly positioned with respect to each other, it is claimed, the antennas' upper frequency range is unlimited. Pictured is the mobile lab used to test antenna.** (Holloway Electronics Corp., Broward County International Airport, Fort Lauderdale, Florida.)



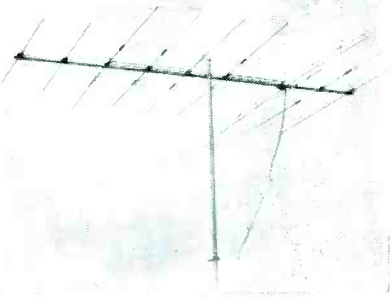
**Broad-band vhf antenna of boom-type construction, with a** fidelity phasing stub, **which it is said eliminates the need for a phase-reversing matching harness. Boom is constructed of aluminum and features a no-tilt saddle bracket for horizontal mounting. Model shown includes multiple low-band reflectors and directors, and high-band colinear reflectors and directors.** (Model B-5 Finco Geomatic; The Finney Co., Cleveland, O.)



**Inline broad-band 2-bay antenna, incorporating reverse-phase multiplex dipole system, and said to be custom tailored for areas with cochannel and cross-channel interference. Unit is wide stacked at a spacing of 68", and coupled with 68" hi-band rejection stacking transformers; recommended for channels 7 to 13.** (Model FB500S-68; JFD Manufacturing Co., Inc., 6101 16th Ave., Brooklyn 4, N. Y.)



**Impedance matching transformer that mounts on back of TV set to match 75-ohm input cable to 300 ohm-receiver terminals. Cable can be connected or disconnected through a built-in plug and jack. Heavy duty leads attach to receiver input.** (Model TM; Blonder-Tongue Labs, Inc., 526-536 North Ave., Westfield, N. J.)



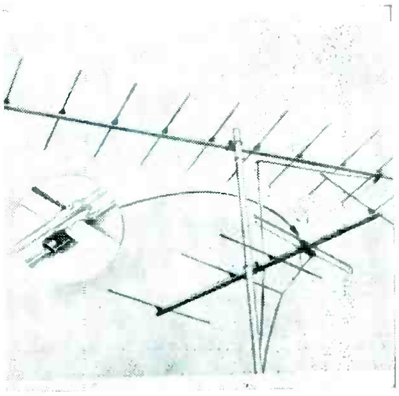
**All-channel vhf antenna with four additional parasitic elements; one extra low-band director and three extra high-band reflectors. Stacked versions are furnished with 60" stacking rods. For those who prefer conventional wide-spaced stacking, 90" rods are available.** (Super Lancer Models 334 and 334-2; Channel Master, Ellenville, New York.)


(Left)

**Antenna rotator control unit, said to be completely electronic. Has an automatically illuminated dial. Device is claimed to provide perfect synchronization between control and rotor units.** (Automatic Superotor; Electronics Division, Thompson Products, Inc., Cleveland, O.)

(Right)

**High band five- and ten-element single channel all-aluminum yagis featuring** monolock **brackets. Antennas are wide spaced and said to offer a sharp forward pattern. Stacking lines for two-bay arrays are available for the five- and ten-element series.** (Highlander; Technical Appliance Corp., Sherburne, N. Y.)



## Tube News

(*Continued from page* 38)

(plate swing) requirements of the output stage of the *dc* amplifier.

If a piece of electronic equipment requiring more than one voltage incorporates several regulators with pentode-connected beam-power series tubes, the output of one supply may be used to feed the screen grid of a lower-voltage regulator series-tube and thus eliminate all but one of the separate screen supplies.

### *Semiconductor Diodes*‡

General purpose diodes for use as clippers, clampers, rectifiers, etc., are specified in terms of their static characteristics only. The current is normally given for a single value of voltage in the forward direction and at several values of reverse voltage.

Video detector diodes are normally specified in terms of rectification efficiency at approximately 40 *mc* with certain limits also imposed on some portion of the static characteristic.

*Uhf* mixer diodes are specified in terms of the overall receiver noise factor.

The first consideration in determining the best diode for any application should be the maximum voltage that the diode will be called upon to withstand.

The general purpose diodes with their continuous reverse working voltage ratings appear in *Table 1*. Having determined those diodes which will meet the reverse voltage requirements, consideration can then be given to the back resistance and forward conduction requirements of the circuit application. For example, if the circuit application requires that the diode withstand 60 *v* continuous reverse working voltage, it would be possible to use the *1N34* or *1N34A* or any diode above them shown in the table. The final choice of diode will be determined by the back resistance and forward conduction requirements.

| | |
|---|---|
| 1N39A | 200 v |
| 1N55A | 150 v |
| 1N38A | 100 v |
| 1N58A | 100 v |
| 1N34A | 60 v |
| 1N54A | 50 v |
| 1N56A | 40 v |

**Table I: List of general-purpose diodes and continuous reverse working voltage ratings.**

‡*From a report prepared by Sylvania Electric Products, Inc.*

## Independent Service Man

(*Continued from page* 19)

our operations, our shop is typical of the size and type that we have in our city. We feel that we are also typical of the small service town, located many miles from the nearest television station. Where, because of distance, our problems entail getting a strong enough signal into our area, the bigger city installations often require padding of signals to prevent overloading. Where larger cities find it more desirable to service in the home, we find it to our advantage to service in the shop.

•

## TV Oscillators

(*Continued from page* 29)

metrical and resembles a retangular wave more closely.

Some multivibrators are plate-coupled (instead of cathode-coupled), where the $V_1$ and $V_2$ cathodes are grounded and $R_6$ (Fig. 2) does not exist. Also, a coupling capacitor from the $V_2$ plate to the $V_1$ grid is used to provide coupling from $V_2$ to $V_1$; this was previously accomplished through $R_5$. The operation of the plate-coupled *mv* is essentially the same as that of the cathode-coupled *mv* with $V_1$ cutoff and $V_2$ conducting at first, and then $V_2$ cutoff and $V_1$ conducting, alternately.

### *The Horizontal Oscillator*

The horizontal oscillator generates a 15,750-cps signal (triggered by the horizontal sync pulses of the composite video signal) which is used ultimately to provide horizontal deflection. Like the vertical oscillator, *most* horizontal oscillators are either blocking or multivibrators. The circuit operation of these is similar to the vertical oscillator, with one exception; the synchro-guide (or synchro-lock) oscillator circuit is used very often instead of the conventional blocking oscillator. The synchro-guide circuit consists of a blocking oscillator, control tube, and stabilization circuit. Hartley and electron-coupled oscillators are also used as the horizontal oscillator. Sometimes, Colpitt oscillators are used.

### *Typical Hartley Oscillator*

A typical Hartley oscillator circuit, used in G.E. model 17C113, is shown in Fig. 4 (p. 29). This oscillator is a sine-wave generator which operates class C and which, therefore, has positive current pulses appearing in its plate, as noted.

## Community TV

(*Continued from page 26*)

noise by measuring the video-carrier level, and comparing this level with the snow or grass level read at a frequency nearer to the sound carrier. A 'scope can be used to assure that the measurement of the snow level is not effected by either the sound carrier or the upper video side bands.

This measurement can be made while normal service continues as indicated; however, it is simpler to make during off-the-air hours. Many systems now provide for *automatic carrier replacement*. This provides a locally generated video carrier free of all propagational variations, so that measurements made are accurate and a true indiction of system performance.

The ideal method to check on picture resolution would be to utilize a test pattern monoscope. This would serve to eliminate variations due to propagational disturbances.

However, without such a unit, it is still possible to observe picture quality and compare, at least mentally, the pictures that are observed at any point in the system with those that are available at the antenna site.

The frequency response of a system is a direct indication of its resolution possibilities. The summation sweep technique can be made at intervals, if the resolution capabilities of the system are in question.

A simpler, but not always foolproof method, is to measure the relative video and sound carrier levels. A flat system will maintain a constant video-to-sound ratio; assuming constant video sound ratios from the antenna or the application of sound *agc*. This is not completely foolproof because cable reflections from other sources can introduce discontinuities within the system that are not linear across the channel.

•

### DON'T DO IT YOURSELF PROGRAM

**Betty Furness, who will spearhead Westinghouse program, stressing the slogan, "Don't do it yourself!" advising TV set owners in 99 cities across the nation to rely on Service Men for set repairs. Manufacturers will also provide "Don't do it yourself!" booklets pointing out hazards of amateur tinkering.**

# TV Parts . . . Accessories

### *RAM HORIZONTAL-OUTPUT REPLACEMENTS*

Horizontal output replacement transformers for RCA chassis, *X124* and *X125*, have been announced by Ram Electronics Sales Co., Irvington, N. Y.

Units, direct-drive type, are designed to operate in 66-70° horizontal-deflection angle systems and are capable of delivering 12 *kv* and 16.4 *kv*, respectively.

° ° °

### *VIDAIRE TV DIAL LIGHT*

A dial accessory, *DL-10 ChanneLite*, for illuminating Standard Coil tuners, has been designed by Vidaire Electronics Manufacturing, 576 W. Merrick Rd., Lynbrook, N. Y.

Unit consists of a lucite dial and pilot light assembly. Lead clips onto filament pin of any octal tube for light operation.

° ° °

### *MOSLEY AC/TV WALL OUTLETS*

Combination *ac* and TV line-rotator cable outlets, providing a dual *ac* outlet and plug-in connections for one to three 300-ohm TV lines or one or two 300-ohm line outlets plus a four, five or eight-wire rotator cable outlet, have been announced by Mosley Electronics, Inc., 8622 St. Charles Rock Rd., St. Louis 14, Mo.

Matching plugs are polarized to prevent accidental plugging into *ac* outlets and a barrier plate is furnished to isolate the two halves of the box. Units are available in ivory or brown.

## Schematics In This Issue



**WHEN YOU CHANGE YOUR ADDRESS**

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# Bench-Field Tools . . .

### G-C RACK-TRUCK

A chassis and tube service rack and truck, *Picto-Vue*, for moving chassis and tilting them into position for servicing, has been announced by General Cement Manufacturing Co., 919 Taylor Ave., Rockford, Ill. An adjustable glass mirror at bottom of unit permits observation of tube picture while servicing.

° ° °

### ARROW STAPLE GUN

A staple gun, *T-25*, for fastening low-voltage wire, has been introduced by Arrow Fastener Co., Inc., 1 Junius St., Brooklyn 12, N. Y.

Unit features a tapered striking edge just slightly wider than the wire itself, said to allow fastening of wire in tight corners. Uses either 7/16" or 9/16" leg size round top staples.

### IRC TENSION-GRIP NUT DRIVERS

A tension-grip nut-holding nut driver, for close work in starting or removing nuts on TV and radio chassis, has been announced by International Resistance Co., 401 N. Broad St., Philadelphia 8, Pa.

Driver has spring-action tempered steel band that grips nut or hexagon head screw automatically as it enters the socket. Shaft is set in a shock-proof plastic handle. Tool is available in 1/4", 5/16", 11/32", 3/8", 7/16" and 1/2" sizes.

### TV ACCESSORIES MINIATURE SOLDERING TOOL

A miniature soldering tool, *Oryx Model 11*, weighing less than ½ ounce, has been announced by Television Accessories Co., 1412 Great Northern Bldg., Chicago 4, Ill.

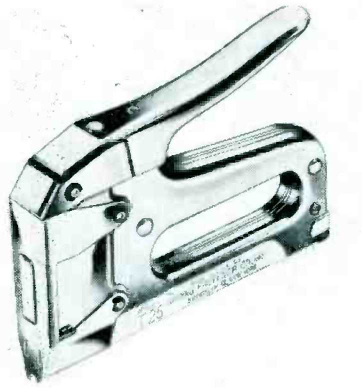
Unit is 6" long and equipped with a 5/32" nickel tip.

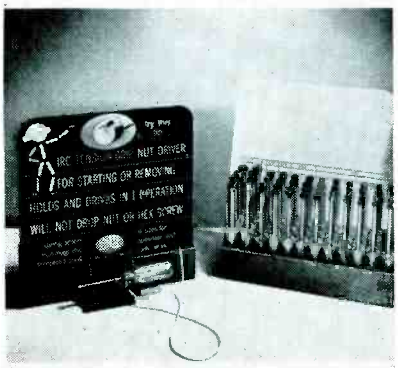
° ° °

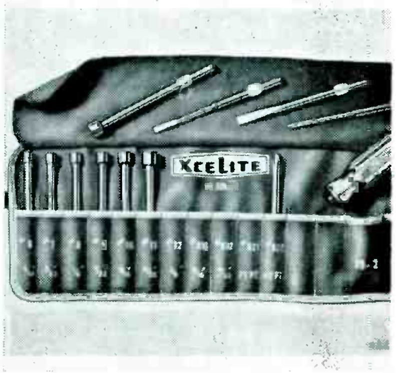
### XCELITE POCKET ROLL TOOL KIT

A pocket-size plastic-roll tool kit, *99 Junior*, containing 11 tool bits and a combination handle, has been made available by Xcelite, Inc., Orchard Park, N. Y.

Kit consists of seven nut driver shafts (3/16"-3/8"), two slotted screwdriver bits (3/16" and 1/4") and Nos. 1 and 2 Phillips.





# Components

### OHMITE AXIAL-LEAD, VITREOUS-ENAMELED RESISTORS

Miniature power-type vitreous-enameled resistors with axial leads have been made available by Ohmite Manufacturing Co., 3678 Howard St., Skokie, Ill.

Units are wire-wound with steatite cores and feature resistance wire and terminal lead welded to end cap. All parts are said to be thermally balanced, allowing expansion and contraction as a unit. Two sizes, rated at 5 and 10 watts, available for assortment of resistance values. Further information in bulletin *147*.

* * *

### CLAROSTAT POWER-SWITCH TERMINAL-SHIELD COVER

A positive locking, snap-on type terminal-shielding cover for series *AE* power switches has been announced by Clarostat Manufacturing Co., Inc., Dover, N. H.

Insulated by a fiber liner, unit is designed to meet UL approval on sets using above-chassis mounted controls with switches. Also said to shield inductive fields.

* * *

### G-C FUSE RESISTOR

A 7.5-ohm TV fuse resistor, *9207*, for replacement on series-wired TV sets, has been introduced by General Cement Manufacturing Co., 919 Taylor Ave., Rockford, Ill.

Tinned wire leads and male plug-in terminals, for use with a mounting strip, are supplied.

* * *

### ERIE MINIATURE HIGH-CAP CERAMICS

Miniature high-cap ceramics, *Ceramicons*, for use in transistor and other miniaturized circuitry, have been made available by Erie Resistor Corp., 644 W. 12 St., Erie, Pa.

Units feature rectangular shape, phenolic dipped coating, wax impregnated hot-tinned copper leads. Supplied in three sizes: .34" x .34", .58" x .43" and .75" x .56". Capacity ranges are from .0022 to .1 mfd; 200 volts.

* * *

### ARGOS TUBE CADDY

A tube caddy, *Junior TC-2A*, for carrying up to 144 tubes, with space for tools and meter, has been introduced by Argos Products Co., Genoa, Ill.

Caddy opens at top in a break-away making all compartments accessible. Made of plywood covered with plastic-coated tweed-gray fabric.

* * *

### AS TWIN AUTO ANTENNAS

Twin auto antennas, consisting of two 26½" telescopic antennas with leads, have been announced by The Antenna Specialists Co., 12435 Euclid Ave., Cleveland, O.

Available in chrome or red, blue, green, yellow, white and brown.

# Instruments

### TRIPLETT DOT GENERATOR

A dot generator *(model 3438)* for checking video, *rf*, *if*, sync and color circuits, providing modulated *rf* (channels 2-6) and *if* (20-55 mc) outputs, is now being made by Triplett Electrical Instrument Co., Bluffton, O.

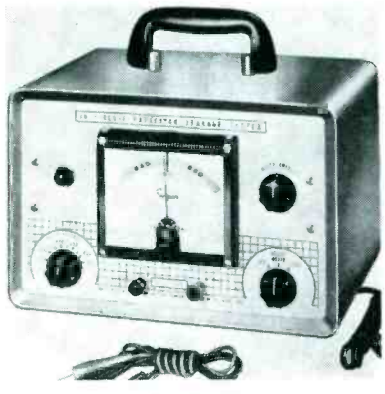
Horizontal (15,750 cps) and vertical (60 cps) sync pulses are available for checking sync circuits. Unit produces horizontal and vertical bar, and square-block cross-hatch patterns for checking linearity, and red, blue and green color spectrum, and colors corresponding to phases of *R-Y*, *B-Y*, *I* and *Q* axis. Can also be used for signal tracing.

° ° °

### SIMPSON CAPACITOR LEAKAGE TESTER

An in-circuit capacitor leakage tester *(model 383)* which, it is said, shows the presence or absence of leakage in paper, mica or ceramic capacitors while connected in the circuit, has been developed by the Simpson Electric Co., 5200 W. Kinzie St., Chicago 44, Ill. Tester checks capacitors ranging from 1 mmfd to .25 mfd for leakage from a few ohms to hundreds of megohms, and also detects breakdowns, shorts, and intermittents. Checking is done at full rated working voltage.

Model operates on principle that leakage resistance of fixed capacitors, which are deteriorating in service, is inherently non-linear, unstable and changeable. Leakage resistance can be made to change value when subjected to shock pulsing, changing the effective circuit resistance, which can be indicated by an ohmmeter of the suppressed-zero type.



° ° °

### HYCON COLOR BAR-DOT GENERATOR

A color bar-dot generator *(model 616)* featuring three color sequences for adjusting, testing and troubleshooting color-TV sets has been developed by Hycon Manufacturing Co., 365 S. Arroyo Pkwy., Pasadena, Cal. Color band *A* has complete NTSC sequence; band *B*, four bars (G-Y at 90°, R-Y, B-Y and black); and band *C*, black, I, Q and black. Black vertical or horizontal bars or crosshatch patterns are available for linearity adjustments; a white dot pattern for convergence adjustments.

# Catalogs-Bulletins

Todd-Tran Corp., 156 Gramatan Ave., Mount Vernon, N. Y., has issued two catalog sheets listing deflection yoke, flyback, vertical and power transformer replacements for RCA and Motorola TV sets, detailing manufacturer's model, chassis and part numbers.

° ° °

Electro-Voice, Inc., Buchanan, Mich., has published an illustrated 14-page catalog *123*, containing basic information on broadcast, TV, *pa* and general purpose microphones, high fidelity components and systems, and phono cartridges.

° ° °

Acoustic Research, Inc., 23 Mt. Auburn St., Cambridge, Mass., has published a brochure describing its *acoustic suspension* speaker system. Included are a brief explanation of principle, performance curves, model designations and prices.

° ° °

Chicago Standard Transformer Corp., Addison and Elston Aves., Chicago 18, Ill., has published a 24-page illustrated catalog listing 543 Stancor transformers and related components. Contains electrical and physical specifications for each unit plus a classified index by types.

° ° °

Sylvania Electric Products, Inc., 1100 Main St., Buffalo 9, N. Y., has released a series of picture-tube and general receiving-tube booklets. Picture-tube guide covers characteristics of magnetic and electrostatic types, with base diagrams, and a discussion of installation and handling. Complete details on radio and TV receiving tubes are in a 34-page booklet; included is a list of base arrangements by tube types. Crystal diode data are also featured. A chart detailing by types, how aluminized tubes can be installed in place of standard picture tubes, has also been prepared.

## ADVERTISERS IN SERVICE SEPTEMBER, 1955



# NEWS

### SPEEDBOAT TRIAL TELECASTS SPONSORED BY CHANNEL MASTER

Channel Master Corp., Ellenville, N. Y., sponsored the televising of the recent speed trials of the '55 Gold Cup Race over KING-TV, Seattle. Company also sponsored three pre-trial interview and background shows. Promotional program was carried out in cooperation with Channel Master distributors in the area.

* * *

### CLETRON EXPANDS

Cletron, Inc., 1974 E. 61 St., Cleveland, O., recently moved to larger quarters, which it is said will double production capacity.

* * *

### SNYDER ANTENNA CAMPAIGN SET

An intensified sales program for its line of TV and auto radio antennas and accessories was recently announced by Snyder Manufacturing Co., Philadelphia 40, Pa., at a mid-year sales meeting.

Among those present were *Dick Morris*, national sales manager; *Milton Schindler*, administrative assistant to the president and customer liaison director; *Charles Schlegel*, east coast sales chief; *Jack Schweighauser*, assistant sales manager and *Dave Evans*, midwest sales head.

* * *

### ASTRON OPENS PACIFIC WAREHOUSE

Astron Corp., 255 Grant Ave., East Newark, N. J., has set up warehousing facilities in Los Angeles, under the supervision of the *Harry A. Lasure Co.*, 9041 W. Pico Blvd., Los Angeles 35, Calif.

* * *

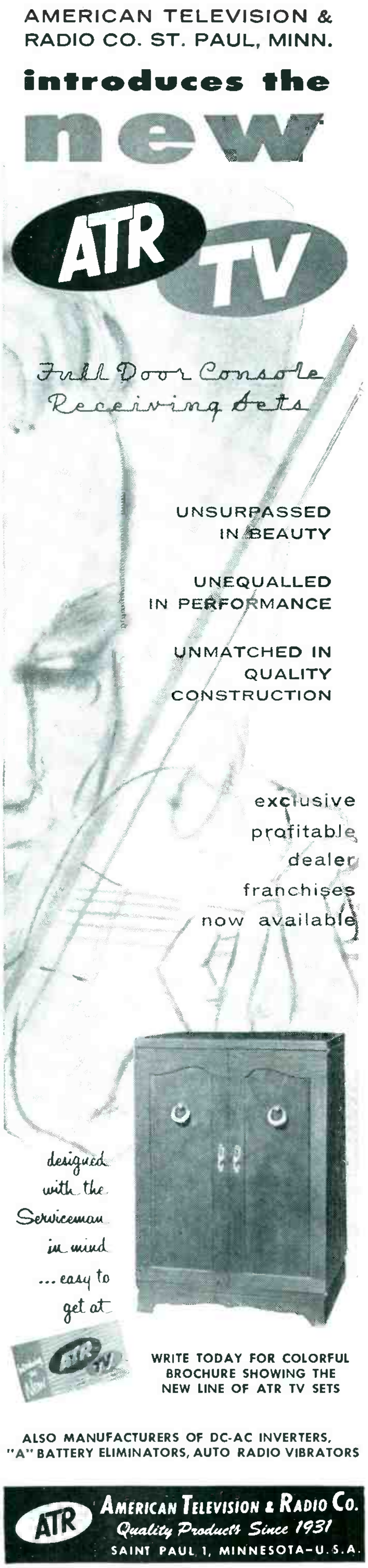
### VOKAR EXPANDING

Vokar Corp., Dexter, Mich., is constructing an addition to their plant which, it is said, will triple their engineering and research department space.

* * *

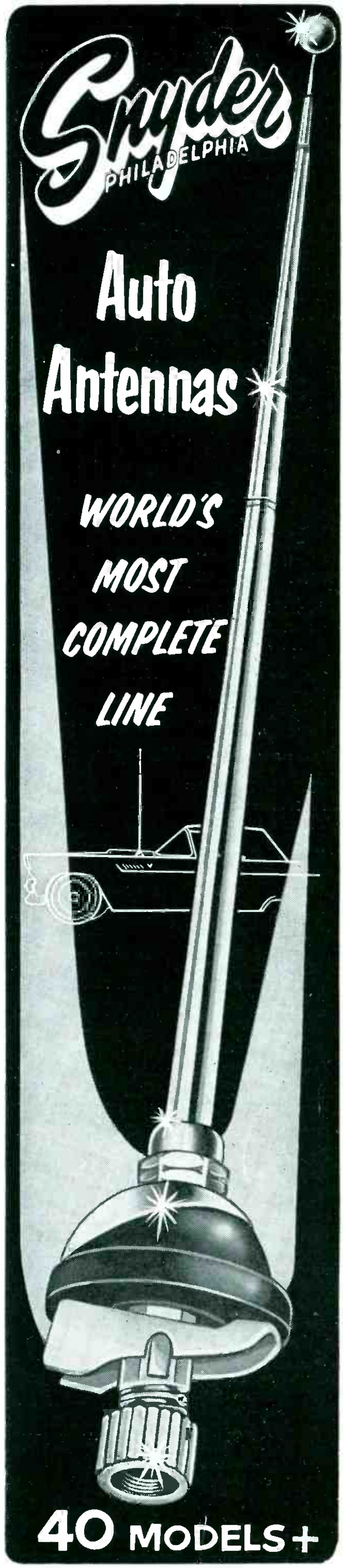
### TUBE DISTRIBUTOR APPOINTMENT CEREMONY

Leslie C. Rucker **(center foreground), president of Rucker Electronic Products Co., Inc., Washington, D. C., being welcomed as a CBS tube distributor by** Alfred E. Bourassa, **merchandising coordinator for CBS-Hytron, at sales conclave. Looking on (left to right): CBS-Hytron's** Herbert H. Friedman, **manager, Mid-Atlantic district, distributor sales;** Alton K. Marsters, **general sales manager; and** John H. Hauser, **distributor sales manager.**




## JOTS AND FLASHES

Flexible construction sound systems, which link work areas with central offices and can be expanded as the project grows floor by floor, are emerging as important construction aids for the nation's building trades, *M. J. Yahr* of RCA, disclosed recently. Noting that the construction sound system serves to speed and facilitate building operations, he said that the tie provides quick, complete, and private communication between the man with the blueprint and the man on the girders. In one system, completed a few months ago, 126 loudspeakers, a microphone, two 250-watt amplifiers, and associated preamps were installed to provide contact between construction offices and floor foremen. . . . *J. H. Craft, Jr.*, Stromberg-Carlson, has been appointed chairman of the service committee of the Radio-Electronics-Television Manufacturers Association, succeeding *H. J. Schulman*, CBS-Columbia. *W. L. Parkinson,* General Electric, has been named chairman of the vocational training subcommittee, and *J. A. Hatchwell,* Allen B. DuMont Laboratories, Inc., chairman of the advisory committee to the New York Trade School. . . . A 36-page manual, prepared as a supplement to *Practical Color Television for the Service Industry*, has been published by the RCA Service Company. Book carries schematics and other data on RCA's 21-inch color receivers and additional information on the general subject of color TV receivers. Price is 75-cents per copy. . . . Olson Radio Warehouse, Inc., has opened a new store at 711 Main Street, Buffalo, N. Y., under the management of *Cleon Billings*. . . . *Dr. Benjamin H. Alexander* is now manager of semiconductor operations at CBS-Hytron, located at Lowell, Mass. . . . *Sid Weiss* has been appointed regional sales manager of Berlant-Concertone, audio division of American Electronics, Inc., in Los Angeles, and will supervise distributor sales in eleven western states, handling all matters pertaining to orders, parts, service and advertising in the area. . . . *Wilfred L. Larson,* president of Switchcraft, Inc., Chicago, Ill., has been named chairman of the Association of Electronic Parts and Equipment Manufacturers. . . . *James P. Cody,* formerly executive vice president of Burton Browne Advertising, has announced the opening of his own agency, Cody Advertising, 30 W. Washington St., Chicago, Ill. . . . Astron Corp. has begun construction of a 20,000-square-foot addition to production facilities of the main plant in East Newark, N. J. . . . *Al D'Urso,* formerly distributor sales manager of the Sarkes Tarzian rectifier division, has established a wholesale parts distributorship: Valley Electronics, Inc., 1735 E. Joppa Rd., Towson, Md. . . . Kester Solder Co. has expanded its eastern plant facilities at 88 Ferguson St., Newark, N. J. . . . Radio Receptor Co., Inc., 251 W. 19th St., New York 11, N. Y. has released a bulletin *G50A,* giving specifications on its *RR125 transistor* and a diagram for an experimental crystal receiver with a stage of transistor audio amplification.



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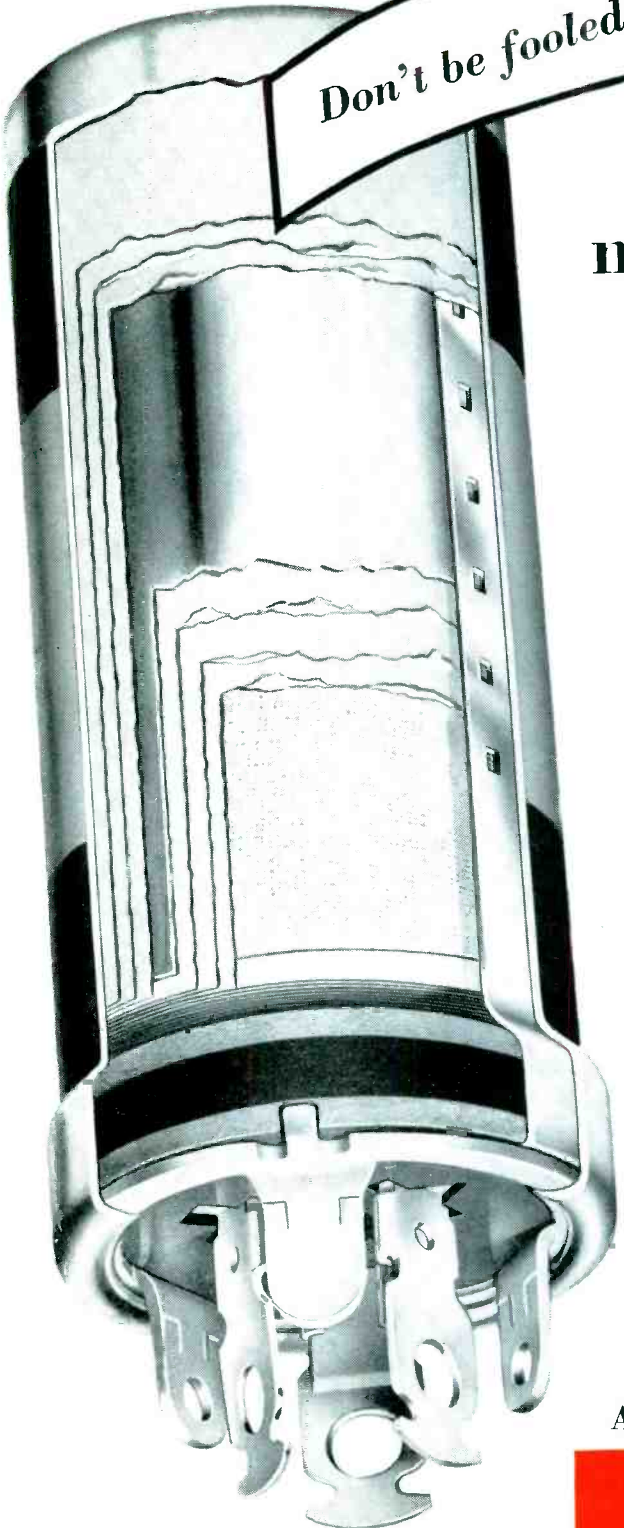

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