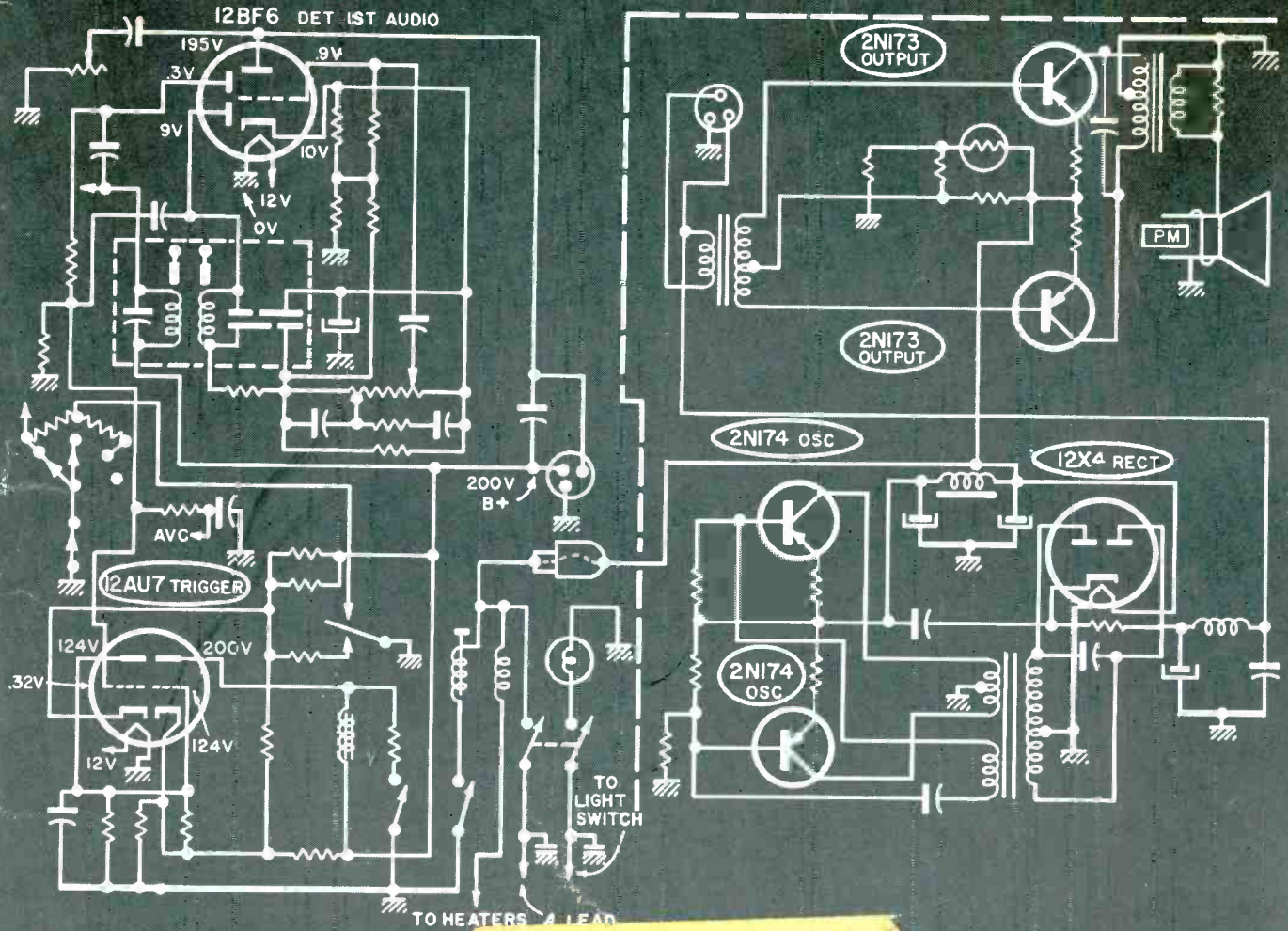
MAY, 1956

SERVICE

THE TECHNICAL JOURNAL OF THE TELEVISION-RADIO TRADE



Transistorized auto radio with transistors in push-pull audio stage and blocking-oscillator B- power supply.
See circuit analysis, this issue

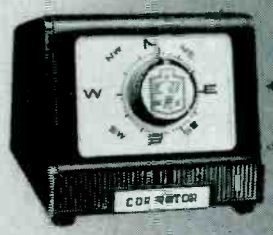
setting new selling records everywhere

C·D·R TV antenna ROTORS

the COMPLETE line
A Model for Every Need

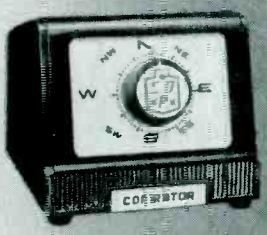
AR-1

The completely AUTOMATIC rotor, powerful and dependable, with a modern design cabinet. Uses 4 wire cable.



AR-2

Completely AUTOMATIC rotor with thrust bearing. Handsome cabinet, uses 4 wire cable.

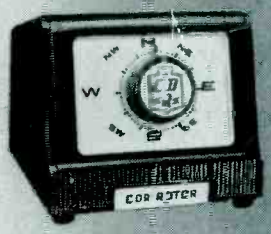


TR-4

The heavy-duty rotor complete with modern cabinet with METER control dial. Uses 4 wire cable.

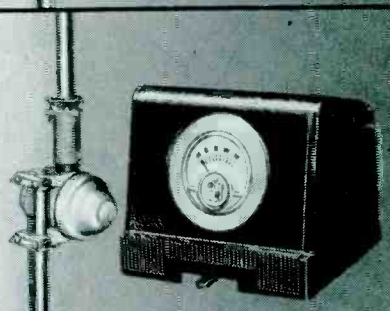
AR-22

Here is the completely AUTOMATIC version of the famous TR-2 with all the powerful features that made it so famous.



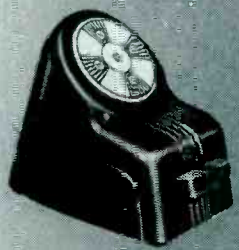
TR-11

The ideal budget all-purpose rotor with new, modern cabinet featuring meter control dial. Uses 4 wire cable.



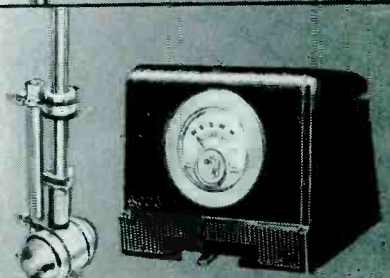
TR-2

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 with thrust bearing. Handsome modern cabinet with meter control dial, uses 4 wire cable.

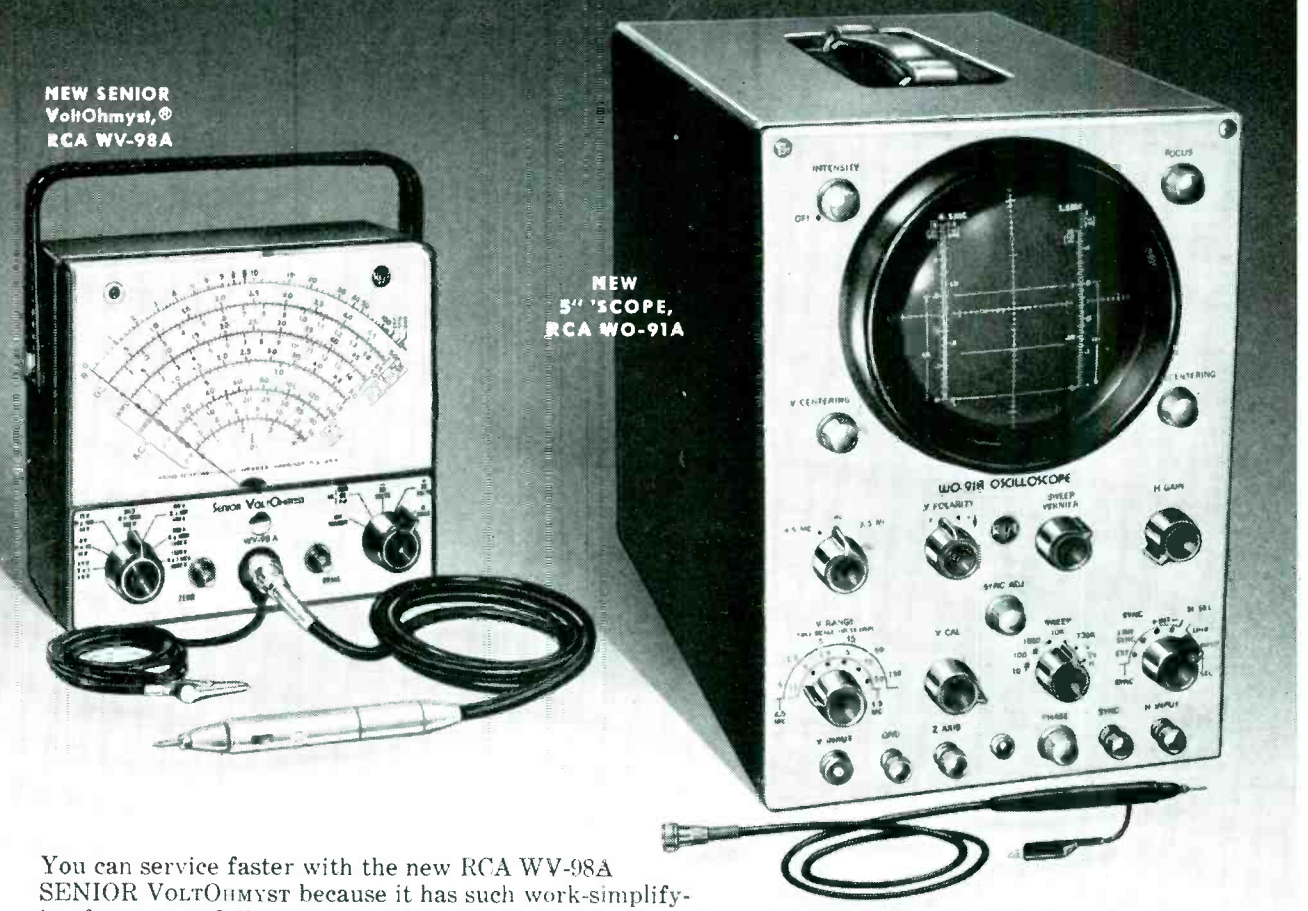


CORNELL-DUBILIER
SOUTH PLAINFIELD, N. J.

THE RADIART CORP.
CLEVELAND 13, OHIO

You can service faster...better with these new

RCA TEST INSTRUMENTS



You can service faster with the new RCA WV-98A SENIOR VOLTOHMYST because it has such work-simplifying features as full-vision, expanded, easy-to-read meter scales, and a new, streamlined single-unit probe with built-in dc/ac-ohms selector-switch which facilitates trouble-shooting in compact sets. *The new RCA 5" 'SCOPE*, WO-91A, too, is packed with labor-saving time-saving features usually found in more expensive instruments. It has preset "V" and "H" sweep positions, and there's a built-in semi-automatic voltage-calibrating circuit that automatically disconnects the input circuits during calibration. Improved circuit designs result in exceptional stability, contributing to faster—better service jobs!

NEW SENIOR VoltOhmyst®, RCA WV-98A—has *separate*, color-coded peak-to-peak and rms-voltage scales—*factory calibrated with the finest laboratory instruments* • 14 ac ranges • 7 dc ranges • 7 resistance ranges • 11 megohms input resistance on dc • ±3% accuracy full-scale on both ac- and dc-voltage measurements • tracking error 1% or better. RCA WV-98A is supplied with the new slim, single-unit WG-299A DC/AC-Ohms switch-probe and shielded cable, ground cable, alligator clip, and instruction booklet—*complete price* **$75.00***

NEW 5" 'SCOPE, RCA WO-91A—a dual-bandwidth 'scope • can be used to observe and measure color-burst signals, for signal tracing, and for aligning wide-band video amplifiers and chrominance circuits • multi-scale graph screen, scaled directly in peak-to-peak volts, makes direct reading of voltages as simple as with a VTVM • *response* within ±1 db from 10 cps to 4.5 Mc in wide-band position • *sensitivity* 0.05 volt peak-to-peak (0.018 volt rms) in narrow-band position • polarity-reversal switch • facilities for "Z"-axis modulation. RCA WO-91A, including WG-300A two-way direct/low-capacitance probe and cable, alligator clip, ground cable, green-graph screen, and instruction booklet—*complete price* **$229.50***

*User Price (optional)

Speed-up your service jobs...keep-up your quality...with "serviceman priced" RCA TEST EQUIPMENT—now—at your RCA Distributor! For data, write RCA, Commercial Engineering, Section E44W, Harrison, N.J.

RCA®

TEST EQUIPMENT
RADIO CORPORATION OF AMERICA
Harrison, N. J.

Vol. 25 No. 5

SERVICE

MAY, 1956

The Technical Journal of the Television-Radio Trade

Including SERVICE—*A Monthly Digest of Radio and Allied Maintenance:* RADIO MERCHANDISING and TELEVISION MERCHANDISING. Registered U. S. Patent Office.

COVER CIRCUIT

FEATURES

CIRCUIT DIAGRAMS

DEPARTMENTS

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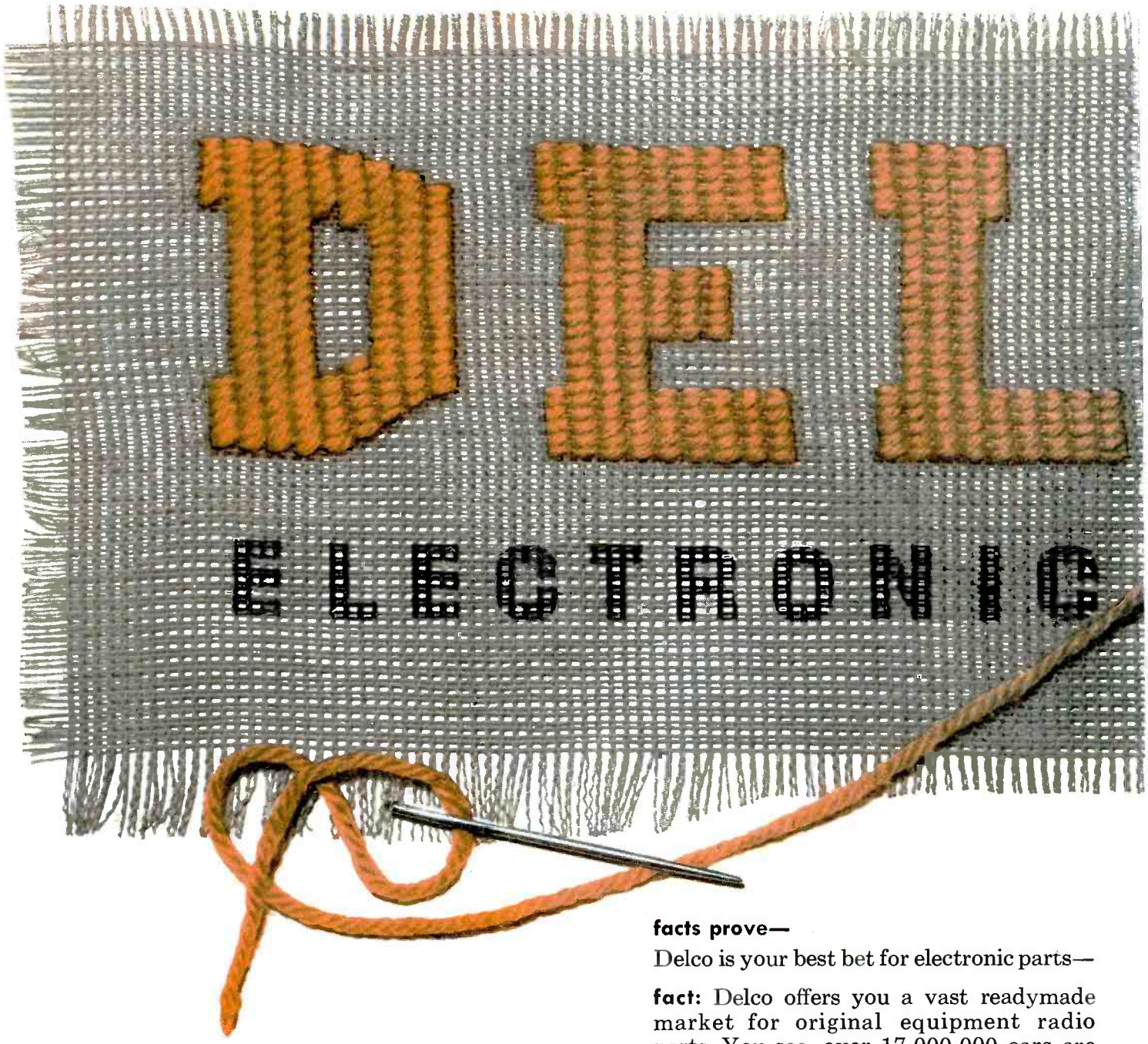

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fact: Delco offers you the 14 most important groups of fast-moving universal parts, ALL from one source—your Delco Electronic Parts Distributor.

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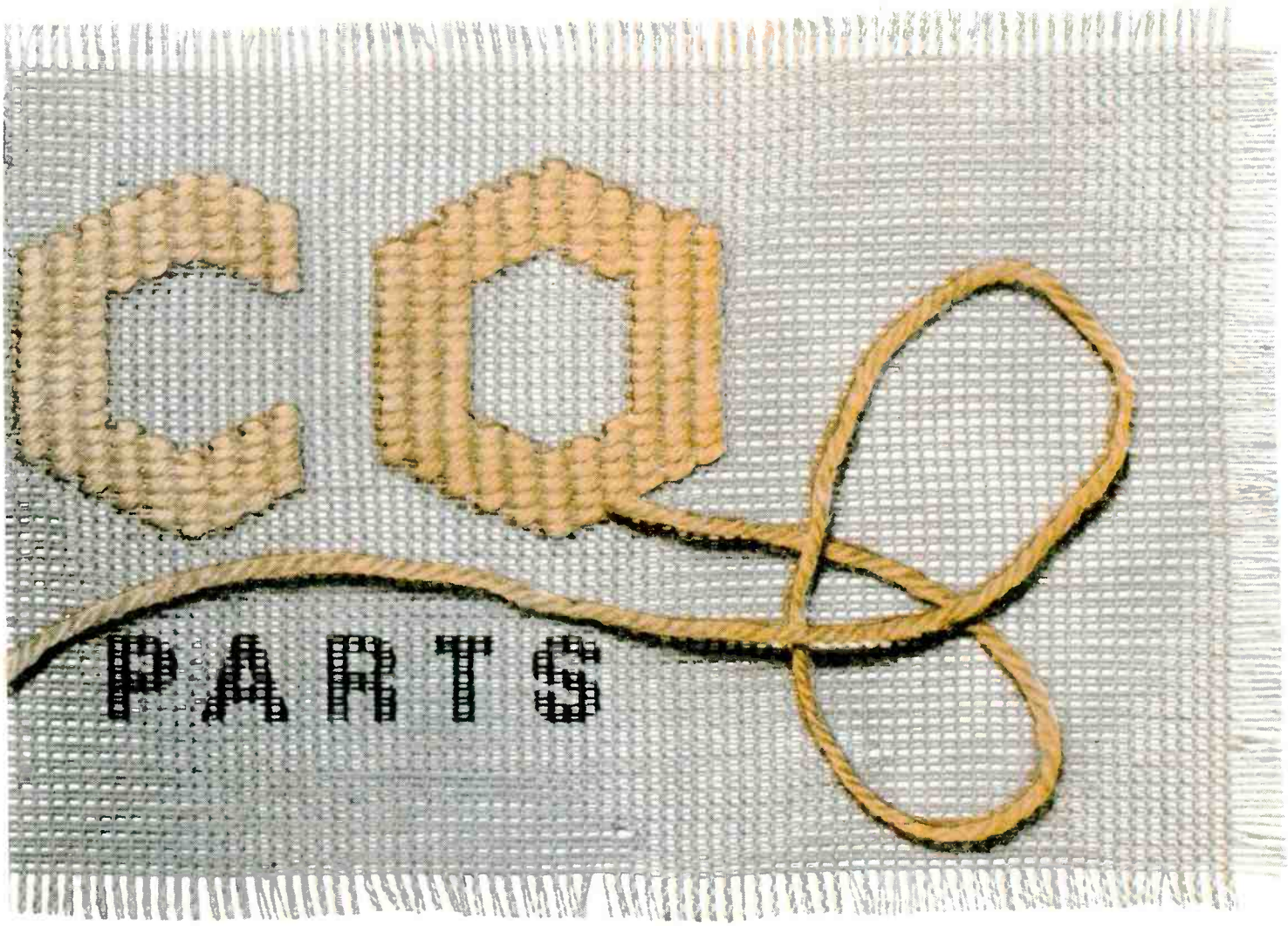

fact: Delco adds the prestige of two fine names to your business—Delco Radio and General Motors. Yes, *quality* names, *value* names, that command instant customer acceptance.

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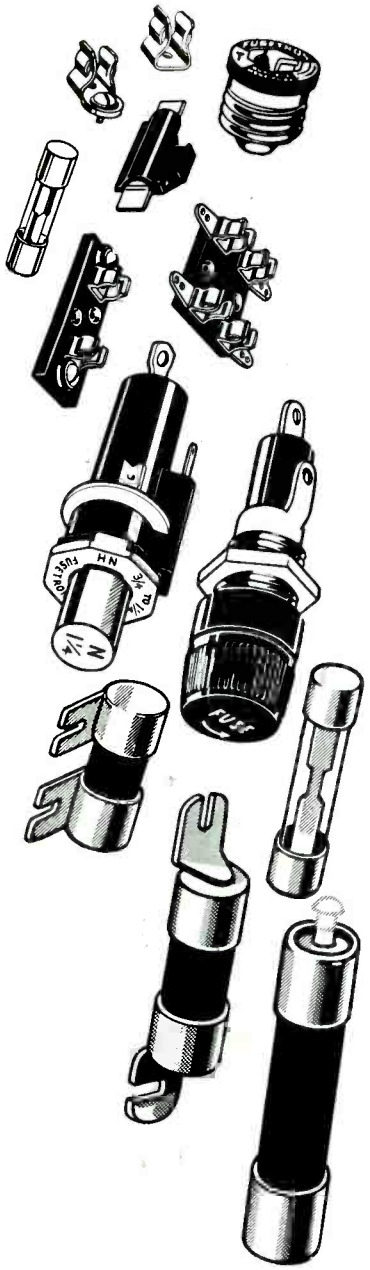
BUSS FUSES

A complete line to meet all your fuse requirements . . .



You'll find the type and size fuse you need, quickly and easily, by turning to BUSS. The complete BUSS fuse line includes: standard, dual-element (slow blowing), renewable and one-time types — in sizes from 1/500 amp. up . . . plus a companion line of fuse clips, blocks and holders.

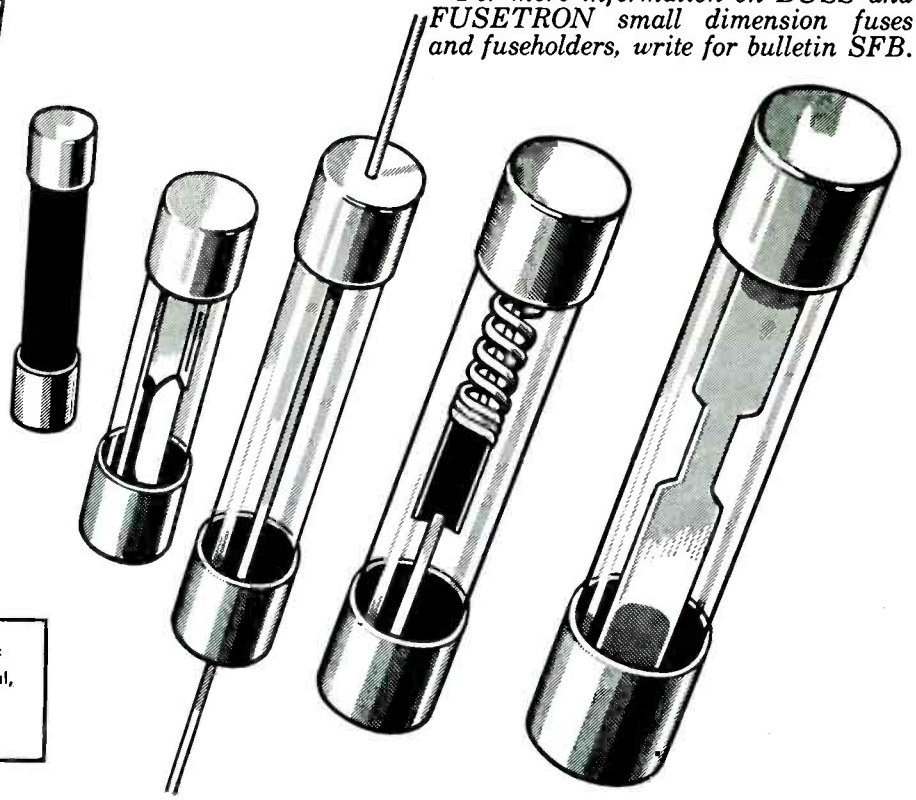
BUSS fuses are dependable and "trouble-free"

To assure you of top quality and proper operation under all service conditions — BUSS fuses are electronically tested. A sensitive device automatically rejects any fuse not correctly calibrated, properly constructed and right in all physical dimensions.

That's why BUSS fuses give you protection against costly trouble. They help reduce unnecessary repairs and replacements by safe-guarding users' equipment when there is trouble on the circuit. And BUSS fuses help you avoid costly and time wasting callbacks by eliminating needless blows.

But most important, by helping you avoid "kicks" and complaints — BUSS fuses are helping guard you against loss of your most valuable business asset — customer good will.

For more information on BUSS and FUSETRON small dimension fuses and fuseholders, write for bulletin SFB.



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CUT INVENTORY COSTS
Power-Point Replaces over 90% of All Popular Phono Cartridges

REPLACE CARTRIDGE AND NEEDLE IN SECONDS
(Just Slip Out—Slip In)

E-V Power-Point actually gives you more working capital by cutting, drastically, the number of different cartridges and different needles you need in stock to do an adequate replacement business. Power-Point *alone* replaces over 90% of all popular phono cartridges. You save valuable time, troublesome service calls . . . you can replace Power-Point in less time than it takes to read this sentence! Remember too, almost a million Power-Points are now in use, and the number is growing fast. Additional millions will be demanded by the replacement market!

Four Power-Point Types, each $3.95 list

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Model 52-2 (Green): two 2-mil sapphire tips.

Model 53-3 (Black): two 3-mil sapphire tips.

Model 56 (Blue): turnover mounted 1-mil and 3-mil sapphire tips.

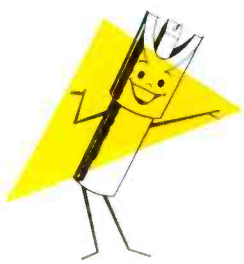
Three Mounting Mechanisms

Model PFT-1 Power-Point Fixed Mount, 50c list.

Model PT-1 Power-Point Turnover Mount, $1.00 list.

Model PT-2 Power-Point Turnunder Mount, $1.00 list.

What is Power-Point?



A nylon-encased unit combining ceramic cartridge and two jeweled* playing tips. A Power-Point cartridge can be changed in seconds, replaces virtually all popular phono cartridges, costs less than two needles alone. It has low inertia, superior tracking ability, wide range, low distortion, minimum needle noise and record wear. It is non-inductive, hum-free, unaffected by moisture or temperature. It actuates all changer mechanisms.

*Superior synthetic sapphire or natural diamond.

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Send me complete information about Electro-Voice Power-Point cartridges, sales-aids and display.

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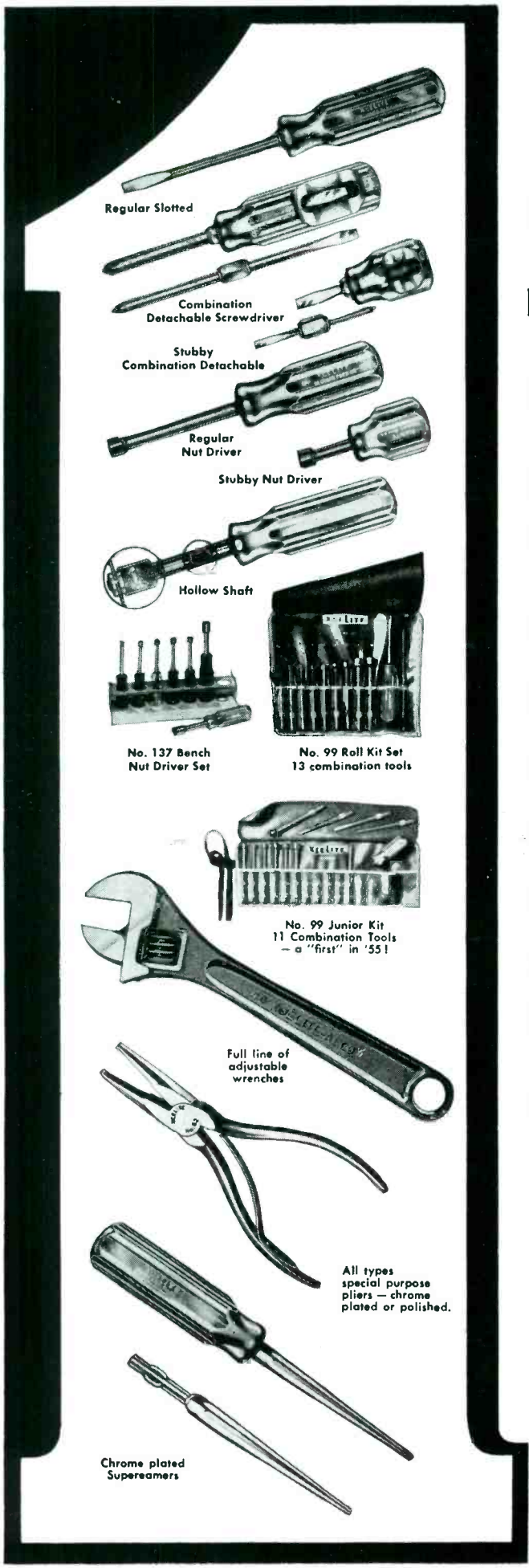
Address _____

City _____ State _____

Signed _____



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FIRST with plastic handle screwdrivers. First to use amber color. First with man-size handles!

FIRST with square bladed screwdrivers.

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FIRST to introduce nut drivers with plastic handles.

FIRST to draw-form nut driver sockets instead of broaching.

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FIRST with small pocket clip screwdrivers.

FIRST with reversible combination Phillips and regular screwdrivers.

FIRST with detachable reamers.

FIRST with complete screwdriver — nut driver — reamer kits — new and better ones every year.

FIRST with . . .

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"Originators — not imitators"

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DEPT. V, ORCHARD PARK, NEW YORK

In Canada — Charles W. Pointon Ltd., 6 Alcina Avenue, Toronto, Ontario

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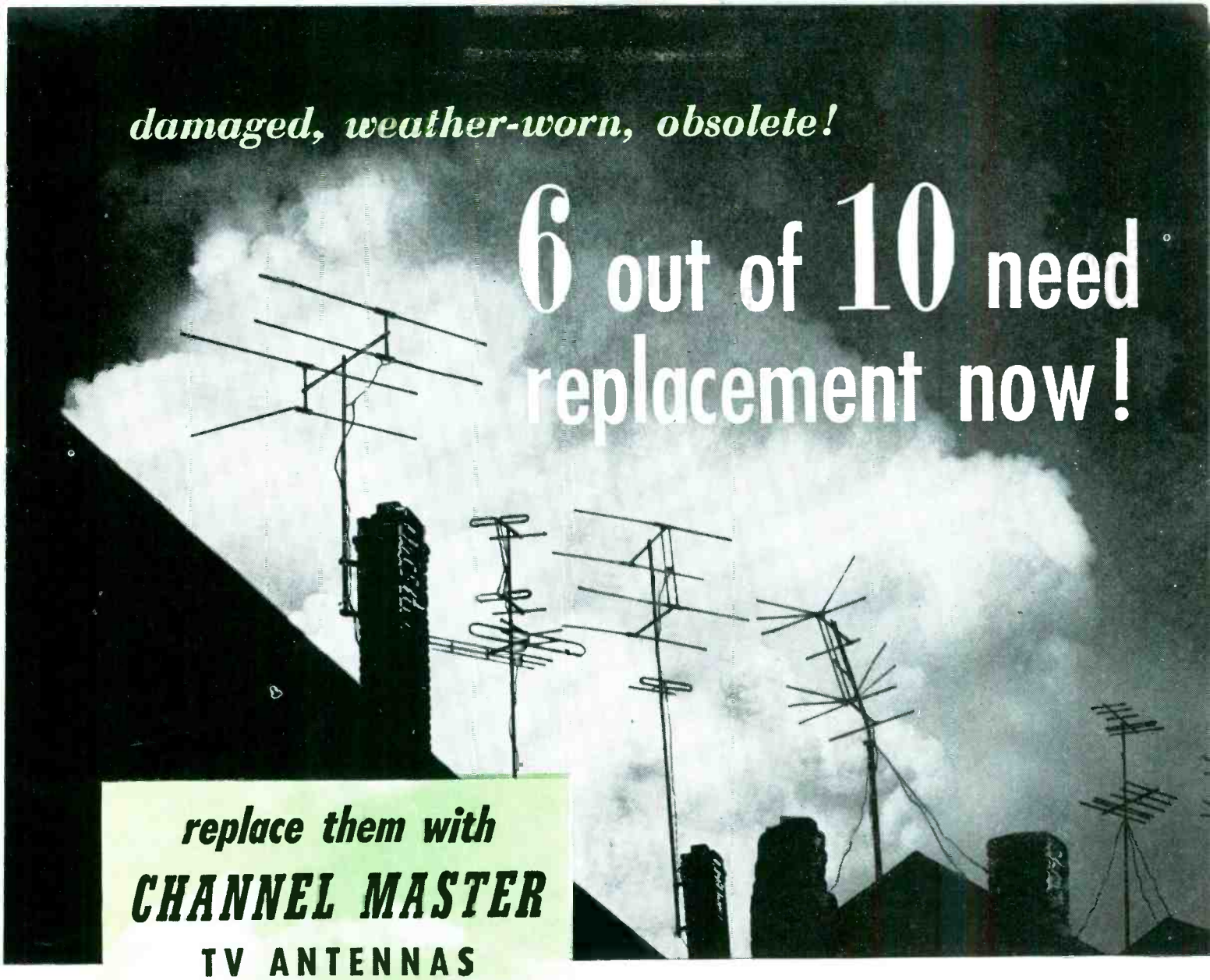
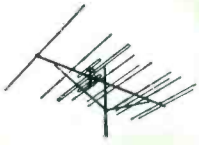
6 out of 10 need replacement now!



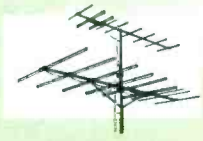
replace them with CHANNEL MASTER TV ANTENNAS

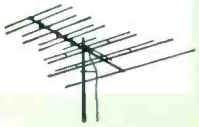
FIVE ALL-CHANNEL FAVORITES — TOPS FOR REPLACEMENT!



SUPER RAINBOW *model no. 331*
Still the most sensitive all-channel antenna made! Other popular Rainbow models also available.

"K.O." *model no. 1023*
(broad band)
Knocks out "venetian blinds" with the highest front-to-back ratios ever recorded!





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Extra elements provide extra performance at no extra cost!

New SKYLARK *model no. 337*
Popular fringe-area installation — new rugged powerful design. Also available: Super Skylark, and economy "Challenger" model.

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The finest of Fan-antennas — superior both electrically and mechanically!

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The "Golden Age" of antenna replacement is here! Time has finally caught up with millions of older TV antennas that no longer provide good reception.

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YOUR BEST REPLACEMENT BUY is Channel Master, America's most widely advertised and merchandised antenna line. Channel Master provides you with the most advanced electrical designs, the soundest construction, the easiest, fastest installation.

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WORLD'S LARGEST MANUFACTURER OF TV ANTENNAS AND ACCESSORIES

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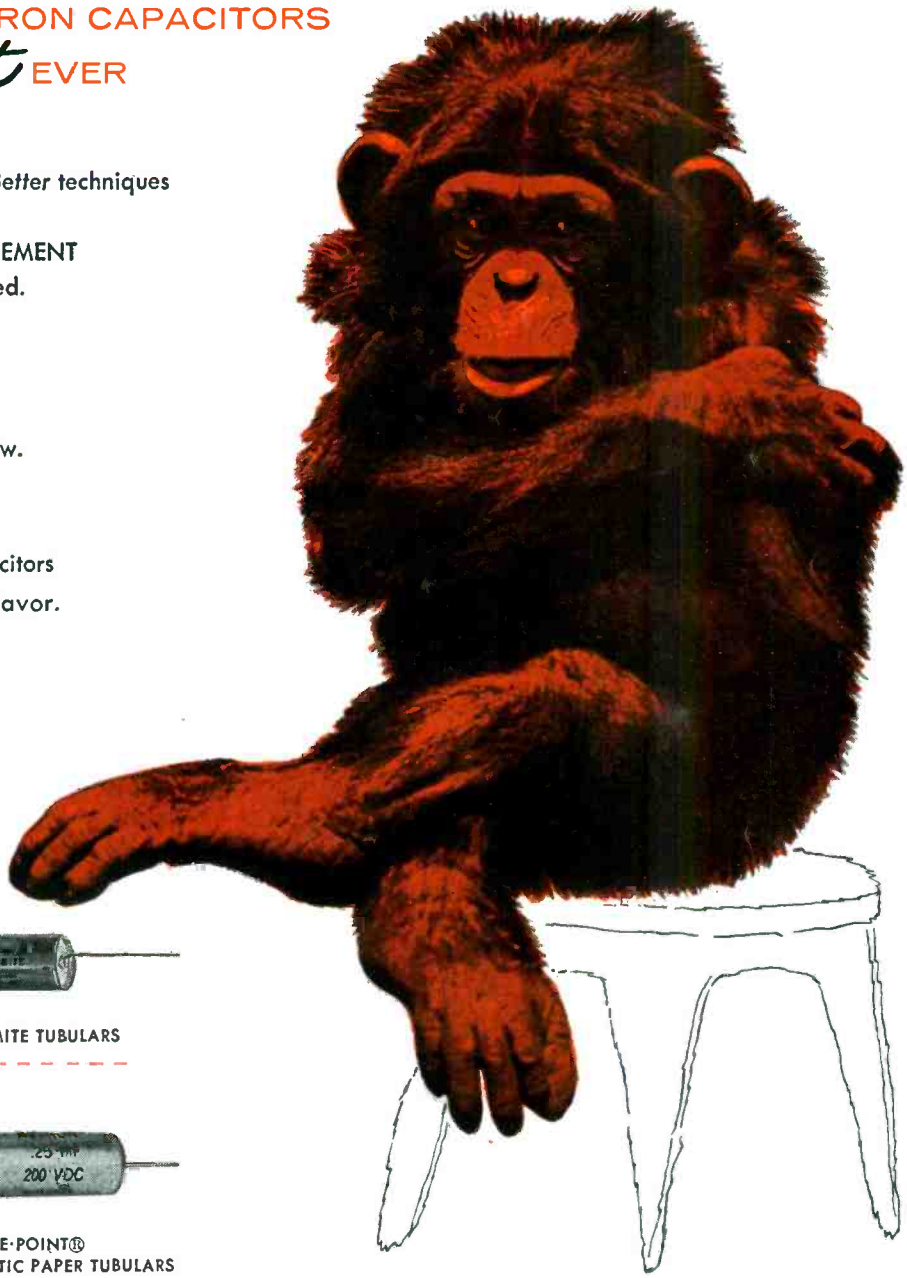

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Here is the first *complete* "testing package" for all paper, mica, and ceramic capacitors. With this *one* instrument—the Simpson Capacohmeter—you can: (1) detect most borderline capacitors *in-circuit* by means of the exclusive Simpson *Pulse Test;* (2) measure leakage of defective capacitors, including coupling capacitors, in ohms; (3) determine the capacitance directly, of good capacitors, from 10.0 uuf to 10.0 uf.

With *this* instrument, most tests can be made *in-circuit. All* tests are made under load conditions. There is no fussing with bridge circuits and balancing controls. Readings are indicated on a large 4½" meter with better than 10% accuracy. But that's not all. You can use the Simpson Capacohmeter to test for leaky wiring, sockets, and transformers . . . to measure distributed capacitance of wiring to ground . . . to "high-pot" good components . . . and many other tests which you will discover.

Model 383A with leads and Operator's Manual . . **$89.95**

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INFINITE REJECTION INTERFERENCE SYSTEM

the world's first fundamental and complete answer to the interference problem...

* The Sensational I.R.I.S.

gives infinite rejection of the interfering signal regardless of direction or channel or whether the interference is co-channel, adjacent channel or ghosts.

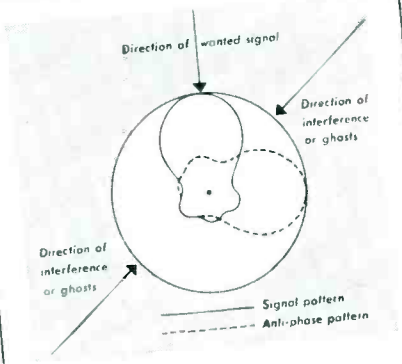
The rejection of the interfering signal is accomplished by opposing the interfering signal with a signal of equal amplitude but of opposite phase, thus producing complete cancellation. Simply rotate the upper section of the antenna to a position where the interference disappears.

Can be used either in a fixed installation or with rotor. All accessories and harness furnished for quick, easy installation.

The Famous EXPO Antenna

is used in I.R.I.S. with its fundamental unlimited bandwidth characteristic, thus insuring excellent performance throughout the 82 channels.

No more Venetian blinds, or ghosts or distortion from an interfering co-channel signal or "splatter" from a strong local station.



The combination of the principle of the exponential curve and the proved performance of I.R.I.S. offers an exceptional sales potential, both in antennas and TV sets. Now is the time to cash in on this exclusive opportunity.

EXPO-I.R.I.S. comes in the following models:

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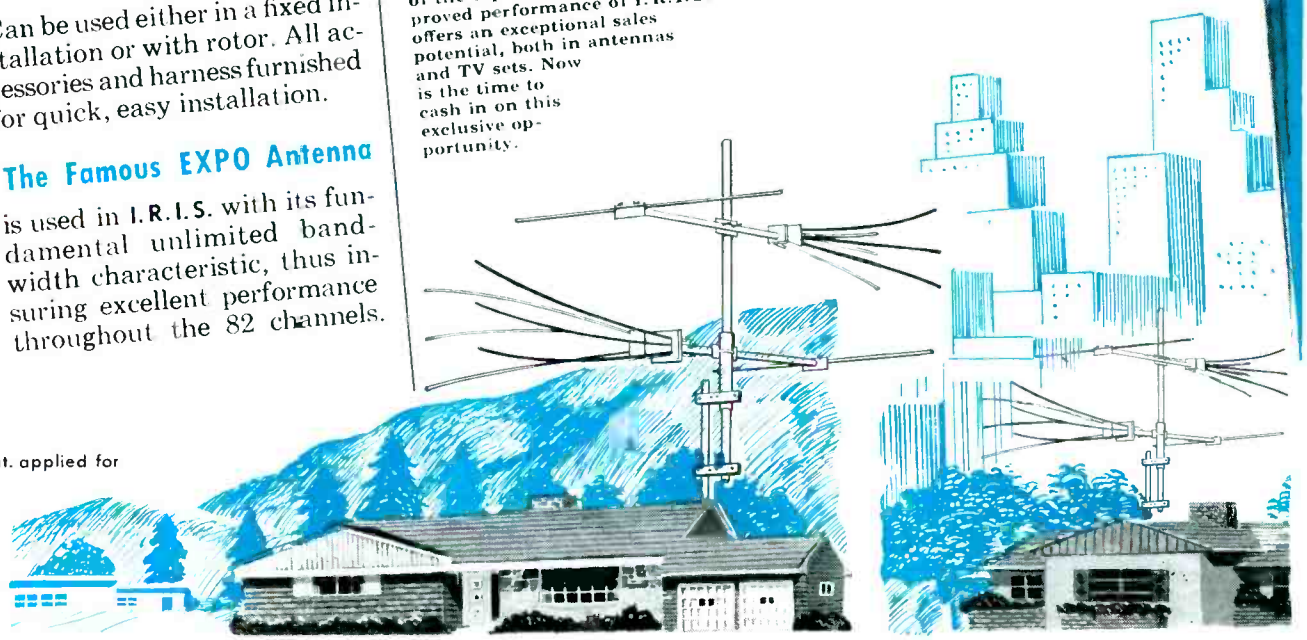
XO2R8	2-bay, 8 element EXPO-I.R.I.S.	List $25.50
XO4CR6	4-bay, 6 element colinear EXPO-I.R.I.S.	List $53.25
XO4CR8	4-bay, 8 element colinear EXPO-I.R.I.S.	List $61.75

ORDER TODAY FROM YOUR DISTRIBUTOR

whom we will supply until official distributors are designated in your locality.

EXPO

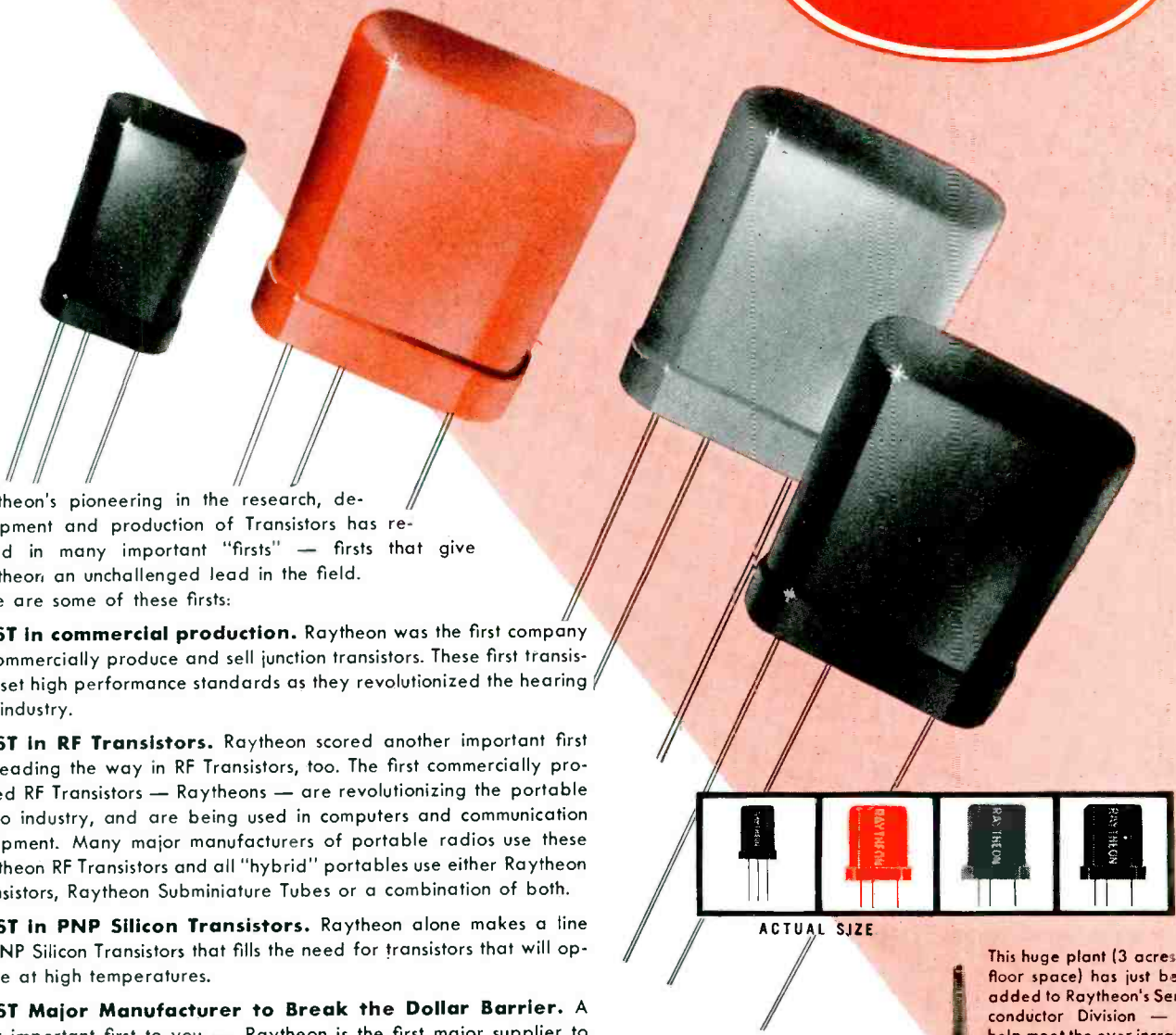
HOLLOWAY ELECTRONICS CORP.
Fort Lauderdale, Florida



*Pat. applied for

your source of finest TV and Radio Tubes is

first in transistors... RAYTHEON



Raytheon's pioneering in the research, development and production of Transistors has resulted in many important "firsts" — firsts that give Raytheon an unchallenged lead in the field. Here are some of these firsts:

FIRST in commercial production. Raytheon was the first company to commercially produce and sell junction transistors. These first transistors set high performance standards as they revolutionized the hearing aid industry.

FIRST in RF Transistors. Raytheon scored another important first by leading the way in RF Transistors, too. The first commercially produced RF Transistors — Raytheons — are revolutionizing the portable radio industry, and are being used in computers and communication equipment. Many major manufacturers of portable radios use these Raytheon RF Transistors and all "hybrid" portables use either Raytheon Transistors, Raytheon Subminiature Tubes or a combination of both.

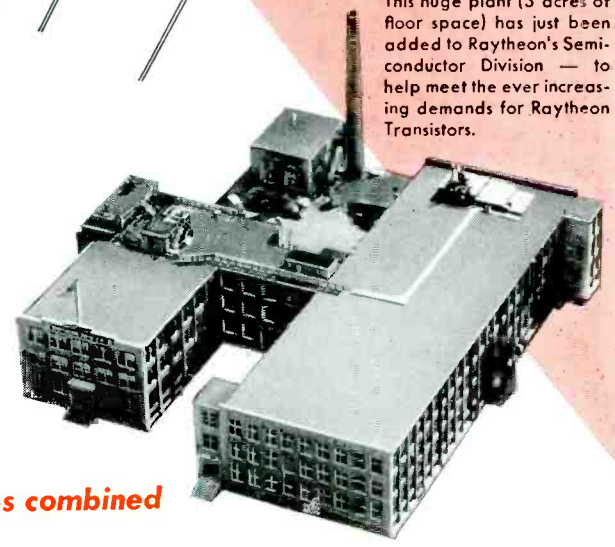
FIRST in PNP Silicon Transistors. Raytheon alone makes a line of PNP Silicon Transistors that fills the need for transistors that will operate at high temperatures.

FIRST Major Manufacturer to Break the Dollar Barrier. A most important first to you — Raytheon is the first major supplier to achieve such high production and product acceptance of their transistors that one of the line could be priced at less than a dollar — Raytheon quality transistors range in price from 99¢.

At Raytheon more than 100 engineers and scientists, plus nearly 1400 other employees are devoted to a single task — the design, development and production of the finest and best in transistors and diodes. To help them work more efficiently, and to meet increasing production schedules Raytheon recently added facilities totaling three acres of engineering and manufacturing space to its Semiconductor Division.

Raytheon Tube Distributors from coast to coast stock and recommend Raytheon Transistors.

ACTUAL SIZE



This huge plant (3 acres of floor space) has just been added to Raytheon's Semiconductor Division — to help meet the ever increasing demands for Raytheon Transistors.

RAYTHEON TRANSISTORS

more in use than all other makes combined

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

A Salute to Mr. Jobber

A Number of Factors have contributed to the rapid growth of our industry, but one of the most notable elements has been the immensely successful wholesale operation.

Under the able direction of seasoned jobbing management, it has become possible to provide effective nationwide distribution of vast quantities of replacement parts and accessories, antennas and hardware, tools and instruments, which this year will reach a record-breaking sales volume of nearly 1-billion dollars.

To the Service Man, the long list of helpful services offered by the jobber has been a blessing. One of the favorite features has been the volume warehousing of a tremendous variety of items in key depots, with distribution to branch stores, that has served to insure prompt deliveries of urgently-needed installation and repair equipment. This valuable facility, coupled with the important fact that shops can obtain such excellent cooperation on an open-account billing basis, has proved to be a boon to the progressive operator.

Another jobber service that has found wide favor has been the supply of only standard-brand packaged goods that carry the stamp of quality. The dependable delivery of such recognized and approved merchandise has brightened the days of the Service Man, making it possible for him to *know* that he'll be able to do a better job, because he has a reliable product on hand.

The Use of Capable Sales Crews, making frequent calls on shops has been another heralded jobber activity. Service Men have welcomed these field men because they can function as business administrators, ad and promotion managers, display experts, inventory specialists and credit advisors.

Aware of the Complexity of the technical products that Service Men require, many jobbers have developed competent technical staffs to study product design and pore over technical literature and journals. In some instances, jobbers have installed labs where new gear can be checked thoroughly and complete reports prepared on performance and applications. Certainly, there would be no support from these ethical sources for any of the miracle gimmicks, such as the do-it-yourself TV and radio tube testers now being advertised to check automatically all TV, radio, portable and picture tubes and *indicate the tube condition instantly with a neon light.* There would be but one comment; a worthless toy.

Jobbers Are Also on the Alert to bring new business suggestions to their shop customers. Witness one distributor who urged Service Men to get out now and begin a TV checkup program. Said the jobber in a bulletin: "Few would think of driving their cars more than a thousand miles without a lubrication and inspection check; yet too many will allow their TV sets to go for years without any attention, unless they lose the picture entirely or results are so bad that immediate repairs are needed. . . ." Preventive maintenance would prevent such incidents, the Service Men were told. Explaining this important check routine, the bulletin said: "The majority of set owners can be sold on the actual economy that results when a preventive-maintenance program is followed. . . . Inexpensive periodical checks can frequently reveal future trouble. It might be in weak tubes affecting component operation, or in the antenna. Corrosion and oxidation of the elements and the leads always affect picture results; even if the set itself is in perfect condition. . . . Now that the mild days are with us, you have a perfect opportunity to get up on those rooftops and perform a real service for your customers. . . ."

To Keep Pace with industry trends, jobbers attend countless clinics and conventions, particularly the annual parts distributors show in Chicago. This event, run historically in May every year, is a market place of ideas, where the latest products designed for installation, maintenance and repair are displayed. Jobbers always return from the Chicago conclave with advance information that serves to translate the developments exhibited into better service for their customers . . . the Service Men.

Seldom honored, the jobber certainly oils the wheels of trade; he merits a rousing salute.—L. W.

*Our thanks to NEDA prexy *Joseph DeMambro;* May parts show general manager *Ken Prince;* CBS-Hytron distributor sales manager *John Hauser,* and Raytheon ad-sales promotion manager *E. I. Montague,* for their valued help in compiling facts for this editorial.

A Field Report

Service Shop with

Top: **Bench in Boulevard-TV shop equipped with test instruments for TV service; vtvm, 'scope, signal generator, sweep and marker generators for alignment, capacitor and yoke - flyback checkers and cross-bar generator.**

Below: **Two-way communications test bench with lab-type signal generator, rf wattmeter, frequency meter and FM deviation meter. Also used for field and bench work are 6-volt power supplies, shown underneath bench top.**

Right: **Compartments for repaired radios, phonos, record changers, auto radios, and audio, rotator and antenna accessory stock.**

SIX YEARS ago, we opened our shop* in a small building (20 by 20) and several years later, thanks to community acceptance, it became necessary to expand, adding another 20 by 20 section.

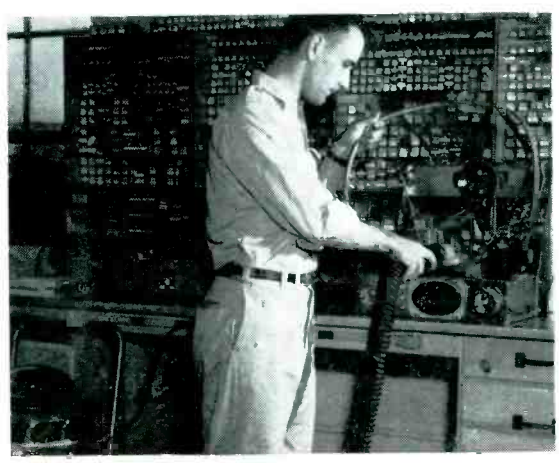
Our original investment was $2000; this has grown to $11,000 for test equipment, component - accessory - equipment inventory, manuals, text books and technical journals, and three pickup-delivery installation-repair cars.

The name of our shop, *Boulevard TV*†, is misleading. Although we are specialists in TV service, we also install and repair antennas, service auto and home radios, sell and service hi-fi, sell and service intercom and music systems, and install and service two-way mobile radio.

We have made ten miles the limit that we will travel on calls; we do not encourage service calls further than five miles.

Staying within the ten-mile limit has been found to not only cut our cost on each call, but our cost on free

†Boulevard TV was recently awarded first prize in a new-look contest conducted by Almo Radio, Philadelphia distributor.



Above: **Vacuum-cleaning chassis, a standard shop procedure, before set is hooked up for tube, circuit and component checks. Tube tests are also made on this bench. Portion of tube inventory is stocked here.**

by HARRY R. CALDABAUGH

Versatile Installation-Repair Facilities

recalls. It has also enabled us to step up our service calls to about fifty per week.

No major repairs are made in the home; usually only tube replacements or minor service work are involved.

Two separate benches have been equipped for TV service. Both contain a complete complement of vacuum-tube voltmeters, 'scopes and signal generators.

One bench is additionally equipped with a sweep and marker generator for alignment purposes. Also on the bench are capacitor and a yoke-flyback checkers, a cross-bar generator, and two portable tube testers. These instruments, being small, can be moved from one bench to the other as required.

The first step in our service procedure is to remove the chassis, vacuum clean it thoroughly, and also vacuum the cabinet. Vacuum cleaning has been found to keep the shop clean, make it easier to check circuitry and components, and return a dust-free clean-looking chassis to the customer.

Another cleaning aid that has been found very effective is windshield cleaning tissue and windex-type liquid cleaner to remove dirt from the face of the picture tube and protecting glass.

After the vacuuming operation, all tubes are checked. Then the chassis is placed on the troubleshooting bench. After all repairs have been made, the receiver is moved to one side of the room for reassembly and a final check. Before it is delivered, the cabinet is checked for scratches and mars, and touched up with an appropriate oil stain and polish.

The service bench is 36" high, a comfortable height for one standing or sitting on an adjustable stool. The width of the top is 36", which provides enough space to accommodate 21-inch chassis in any position. Bench length is 8'; this affords enough room for a chassis and service manual or technical magazine, plus instruments,

(*Continued on page* 64)

Above: **View of the shop operated by Harry R. Caldabaugh in Salisbury, Maryland. Building contains two 20x20 sections. Parking area for auto-radio repair is at rear of shop.**

Located in Salisbury, Maryland, near the middle of the peninsula formed by the Chesapeake Bay. Population of the city is approximately 20,000.

Above: **Interior of truck used primarily for antenna-installation work, which carries supply of plastic roofing cement, antennas and extension poles, safety belts, climbers' hooks, leadin, rotators and assorted hardware.**

Above: **Caldabaugh (right) and his fleet of installation-repair cars. At left is TV-antenna-installation truck. House wagon and second truck are used for service call work.**

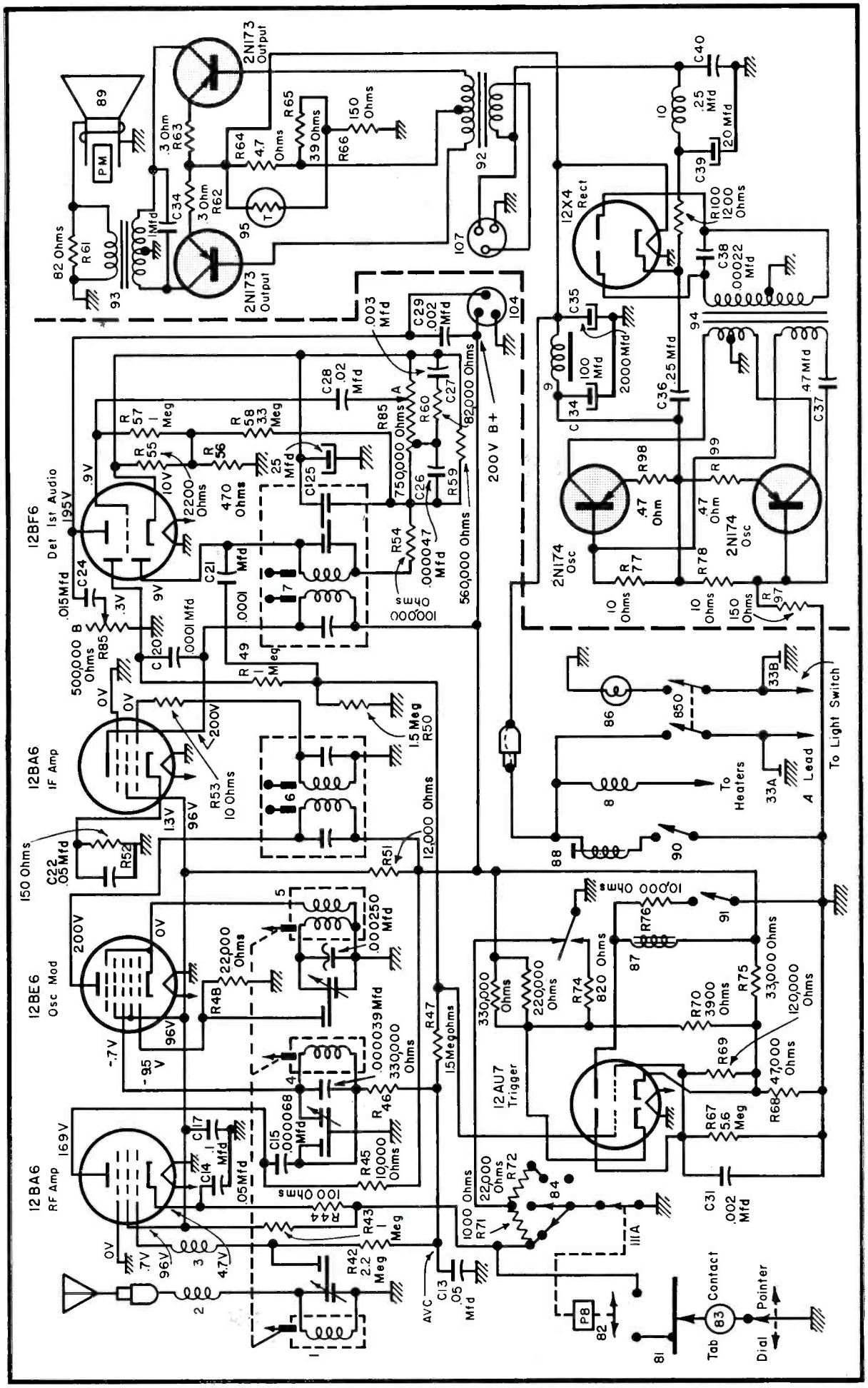


Fig. 1. Complete circuit of the Chevrolet Corvette transistorized radio with pnp hi-power transistors serving as output audio amplifiers and B-power supply.

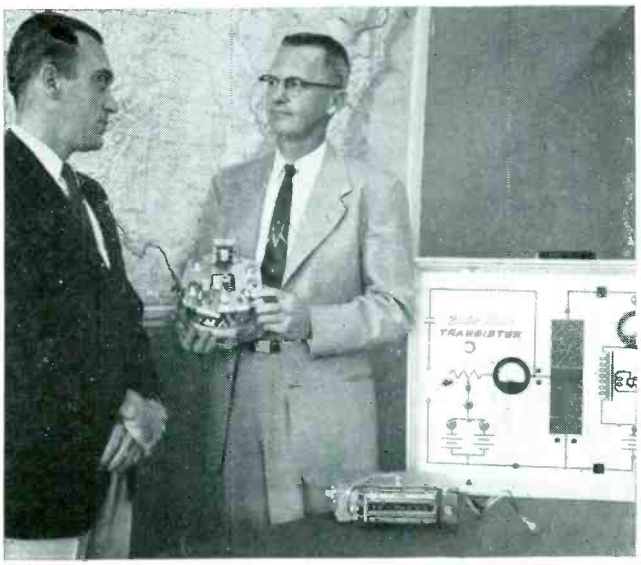
The Chevrolet Corvette Transistorized Car Radio

With Transistor Push-Pull Audio and Blocking-Oscillator B Supply

by FRANK HUGHES

Director of Field Service, Delco Radio Div., General Motors Corp.

[See Front Cover]



A. N. Jonsson (right), **Delco service mgr. and** Frank L. Hughes **discussing transistorized audio-amp/power - supply unit used in Corvette car receiver. Display at right is used to illustrate operation of a power transistor and its circuitry. Demonstration board is used in G-M center classes and one - night distributor-sponsored sales clinics.**

HIGH-POWER TRANSISTORS have now reached a stage of development where it is possible to use them not only as audio amplifiers, but as a source of *B* power in auto radio receivers.

A circuit, into which pairs of these semi-conductors (2N173 and 2N174) have been engineered, is shown in Fig. 1 (*left*) and on the *cover*.

The transistors, alloy-junction *pnp* type, designed for general use with auto-battery power supplies of 12 and 28 *v*, respectively, are characterized by high-current carrying capacity at these voltages; the 2N173 also amplifies with particularly low distortion. The large signal-current amplification is high and relatively constant for collector currents up to 7 amperes. The distortion is low, even in the common emitter configuration. To insure maximum ruggedness and reliability, they are enclosed in a hermetically sealed case.

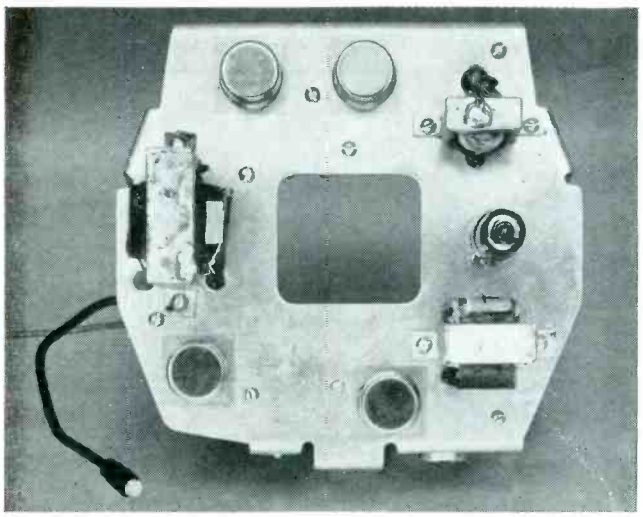
The receiver consists basically of the conventional Delco *wonder bar* circuit using a combination of tubes and transistors. The tube lineup includes a 12BA6 *rf* amp, 12BE6 oscillator modulator, 12BA6 *if* amp, 12BF6 detector first audio, 12AU7 trigger tube and a 12X4 rectifier.

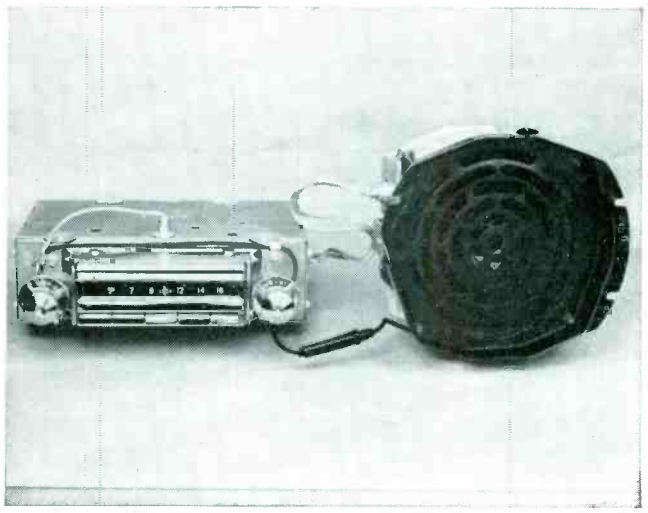
The output power amplifier stage utilizes two 2N173 transistors connected in push-pull; in common-emitter type circuits to take advantage of the tremendous power gain potential of the units.

The emitter-base circuits of each of these transistors are biased in the forward direction by the action of the positive 12-*v* from the car battery being applied directly to the two emitters. A bleeder-resistance network is present between the emitters and ground, consisting of 4.7-ohm, 39-ohm and 150-ohm resistors ($R_{64, 65, 66}$). The base of each transistor is connected back to its emitter through one-half of the input transformer secondary winding and the 4.7-ohm resistor (R_{61}). Approximately .3 of a volt is dropped across the 4.7-ohm

(*Continued on page* 62)

Closeup of transistorized power and audio supply chassis (left) **and complete tuning unit connected to speaker-power-amp chassis.**





Key Circuit Differences in B-W and COLOR-TV With Which

The Installation and Servicing of

A COLOR TELEVISION RECEIVER is different from a black-and-white chassis only in that a new type picture tube and additional circuitry is required to reproduce pictures in full color. Since the NTSC color transmitting standards are compatible with b-w, color receivers must be capable of receiving monochrome transmission and reproducing black-and-white pictures. Because of this requirement, the design of color receivers must closely parallel that of b-w sets for those circuits which will handle the b-w signal. Following this reasoning, color receivers, regardless of make, can be considered as nothing more than b-w models with different type picture tubes and additional circuitry added for the reception of color. The block diagram of Fig. 1, a basic color receiver, illustrates this point.

Approximately 50% of the circuits in a color receiver, when analyzed from a circuitry standpoint, are identical in every respect to a b-w receiver; 30% are b-w circuits with slight modifications, and 20% of the circuits are new and different. The 30% b-w circuits with slight modification differ only in application and not in function or operation. As an example, the high voltage circuit in a color receiver delivers 25 *kv* at an average current drain of approximately 800 microamperes. This, plus other requirements, necessitates heavier components, new tube types and a diagram which appears considerably different. However, upon examining this circuit, it will be found that its function and operation is similar to b-w high-voltage circuits.

When analyzing a color receiver from a service standpoint, one must thoroughly acquaint himself with the color picture tube, transmitted color signal, and color circuitry.

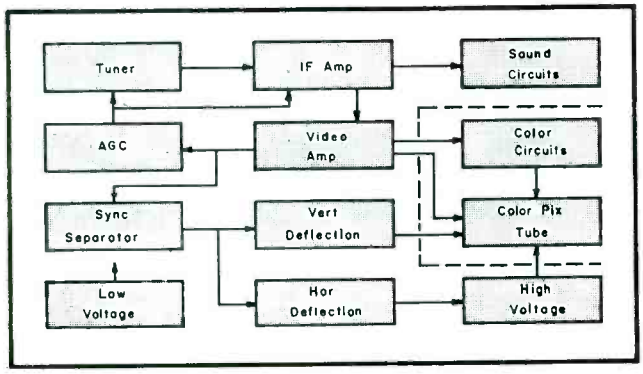
The Color Picture Tube

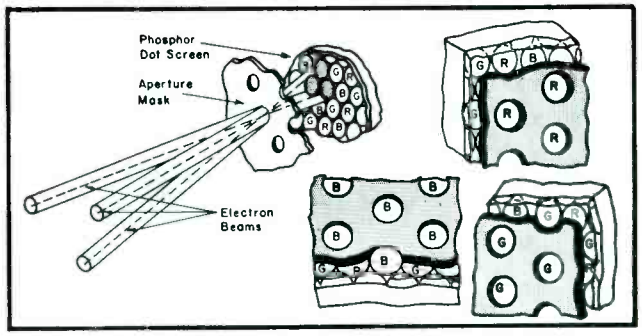
Color picture tubes presently being used are of the three-gun type; an example is illustrated in Fig. 2. This tube can be considered as three separate picture tubes in one envelope; each of the three separate picture tubes is similar to a b-w picture tube. Incorporated are three separate electron guns, as well as three separate phosphor screens. Each electron gun has a filament, cathode, control grid, screen grid and focus electrode. Each electron gun also has a corresponding phosphor dot screen and the only difference between the three picture tubes in the single envelope is the color of the phosphor dot screen. The individual colors of the phosphor screens are red, blue, and green, and they are arranged in a regular sequence.

There is only one component in a three-gun color picture tube not found in a b-w picture tube; the aperture mask. This mask is located directly behind the phosphor screen and its purpose is to insure color purity. Proper color purity results when the electron beam from a particular electron gun strikes only its respective phosphor dot screen. In other words, electrons from the red electron gun must strike only red phosphor dots, electrons from the blue electron gun must strike only blue phosphor dots, and the same for the green.

Due to production tolerances and the mechanical structure of a three-gun color picture tube, some adjustments are required when a color receiver is initially installed. These adjustments fall into three basic categories; purity, convergence, and balance. Purity adjustments involve deflection-yoke positioning and adjustment of a purity magnet located on the neck of the picture tube and field equalizing magnets, located around the face of the picture tube. These components are adjusted until each electron beam strikes only its respective color phosphor dots over the entire screen surface. Convergence adjustments are necessary due to the difference in electron beam travel from the center to the edges of the phosphor screen. The shortest distance between the phosphor screen and electron guns is at the center of the screen and the further away from the center the electron beam is deflected, the greater this distance becomes. If the electron beams do not

Fig. 1. Block diagram of basic color-TV chassis. Blocks at left of dashed line represent circuits found in b-w receiver.





(Above)

Fig. 2. Arrangement of phosphor dots on face of tube and electron action on groups of dots for each color.

Service Men Should Be Familiar to Streamline

COLOR-TV Chassis

by KEN KLEIDON

Color-TV Training Director

Raytheon Manufacturing Company,

Television and Radio Operations

converge at the same holes in the aperture mask, the proper color phosphor dot will not be illuminated at the correct time and color misregistration will result. Because of this reason, provisions are made to lengthen electrically the electron beam as it travels toward the edges of the phosphor dot screen by means of convergence coils located on the neck of the picture tube. A number of controls are used to vary the current through each convergence coil, one for each electron gun, to provide the necessary correction.

Because three electron guns are employed and due to variations between each electron gun, balance adjustments are necessary. The balance controls consist of individual electron gun screen and brightness controls which enable balancing of each electron beam to provide proper color mixing on the face of the picture tube to produce white. White is formed on the face of the picture tube by the proper excitation of the red, blue, and green phosphor dots.

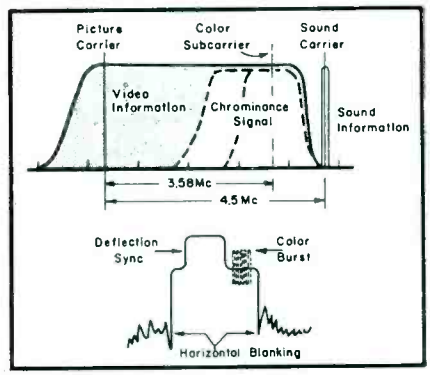
The Service Man should consider the color picture tube as three b-w pictures tubes in one envelope and service it accordingly when trouble develops.

During a color telecast, the transmitted color signal must contain information capable of being received by existing b-w receivers, even though the picture will only be reproduced in black-and-white. Because of this reason, essentially the same transmission specifications must be maintained; 6-mc bandwidth, with the sound carrier 4.5 mc above picture carrier, etc. Therefore, a b-w and color transmission are identical to a certain degree and differ only in that additional signals are transmitted to reproduce color pictures. The difference between a b-w and color signal arriving at the receiver's antenna can best be explained by referring to Fig. 3; this drawing clearly illustrates how the additional information is added to the present monochrome signal to comprise a complete color signal. For all practical purposes a color picture is constructed, on the face of the picture tube, by developing first a black-and-white picture and then adding the color. Since the same basic b-w signal is transmitted as part of the complete color signal, a black-and-white picture is produced on the face of the picture tube and then the chrominance signal (color video information), adds the color. This point can easily be illustrated by simply turning the color or chroma control of a color receiver to minimum during reception of a color broadcast. A black-and-white picture will be observed; advancing the color control will then add the color to the picture.

The chrominance signal is composed of two signals which are 90° out-of-phase, and amplitude and phase modulated onto a separate subcarrier, which is at a frequency of 3.58 mc. The modulated subcarrier is then amplitude modulated onto the picture carrier. For simplicity, however, we must keep in mind that while the dashed-line area (Fig. 5) represents the chrominance signal whose subcarrier is 3.58 mc above the picture carrier, this added information is only additional amplitude modulation on the picture carrier.

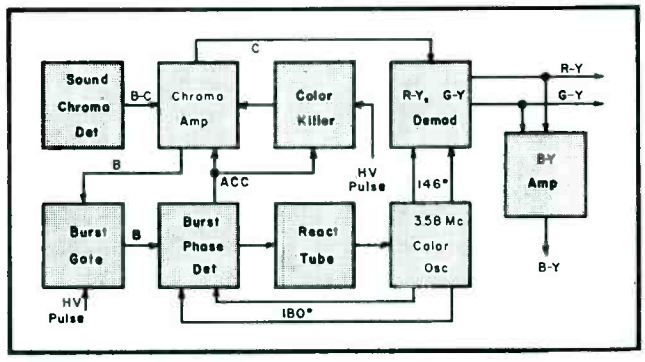
The horizontal blanking pedestal illustrated in Fig. 5 shows the position of the color burst signal here in dotted lines. The color burst signal appears on the back porch of each blanking pedestal following the horizontal sync pulse and is nothing more than a synchronizing signal provided to control the phase and frequency of the color subcarrier reference oscillator in the color circuits of the receiver. The color burst signal can be considered as an additional sync pulse, similar to

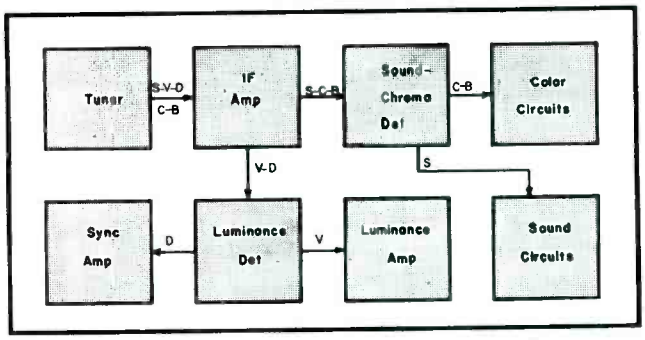
(*Continued on page* 66)



(Above, right)

Fig. 5. Development of the color signal in the picture-tube system.



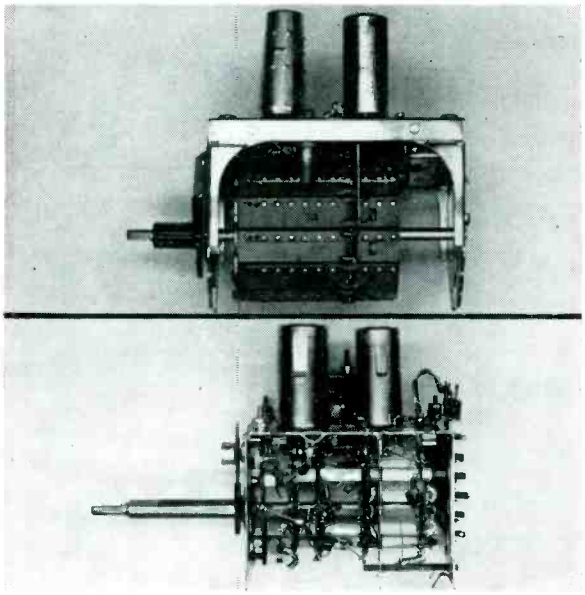


(Above)

Fig. 3. Path of color and b-w signals in color-TV receiver.

(Right)

Fig. 4. Special circuits found in color-TV chassis.



★ A Field Progress Report on TV

Tuning Arrangements, Tubes and RF Amplifier-Mixer Circuitry for

TV Tuners

THE TELEVISION TUNER, the first section of the TV receiving system which encounters the incoming signal, is usually thought of as a separate receiver unit, because it is generally constructed as an individual component, apart from the main chassis.

The main purpose of the tuner is to be able to distinguish between the various channels; to provide gain between the antenna and the receiver *if* amplifiers; and to convert the incoming radio frequency to a more usable (intermediate) frequency.

Frequency Conversion

Frequency conversion is necessary because a tremendous amount of amplification of the antenna signal is required before signal information can be applied to the receiver picture tube. The most convenient way of obtaining this amplification is by using high-gain stages operating at a single frequency.[1]

The signal from the TV transmitter impinges upon the receiving antenna and is amplified by the tuner *rf* amplifier, which may have a voltage gain of 20. Also, tuned circuits in the *rf* amplifier grid and plate circuits tune out unwanted channel frequencies and allow the desired channel frequency to pass on to the input of the mixer stage. A radio-frequency signal of constant amplitude is fed into the mixer stage at the same time. This signal, generated in the local oscillator stage, is higher in frequency than the signal frequency entering the antenna, being equal to the sum of the incoming frequency and the intermediate frequency used. Thus, a receiver with a 44-mc *if*, with the tuner set on channel 13 (about 213 mc), will have the local oscillator feeding a frequency of about 257 mc into the mixer stage. In the mixer stage, both the amplified antenna signal and the local oscillator signal are amplified in a non-linear device. The two original radio frequencies and their sum and difference frequencies appear in the plate circuit of the mixer, but since the mixer plate circuit is tuned only to the difference in frequency (44 mc), this is the only signal that will appear at the tuner output. Thus, the incoming signal frequency has been converted to the intermediate frequency.

When the tuner is switched to another channel, the *rf* amplifier and local oscillator tuned circuits are simultaneously changed to produce the desired intermediate frequency at the output of the tuner. The *rf* amplifier tuned circuits, in addition to aiding discrimination against adjacent channels, improves the tuner's noise figure; one of the tuner's most important characteristics.

The requirements for a good tuner are good spurious signal rejection; good gain; low noise figure; low local-oscillator drift; low local-oscillator radiation; good match to antenna transmission line and balance to ground; and litttle susceptibility to microphonism.

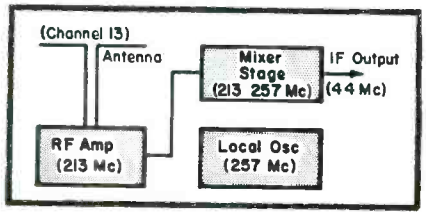
Also, an overall tuner voltage gain of at least 60 is usually desired. Noise figure is a number which compares a given tuner to an ideal noise-free tuner. Therefore, this quantity describes the ability of that tuner to amplify weak signals without introducing noise. Since mixer stages are especially inherently noisy, appreciable *rf* gain preceding the mixer stage is necessary to avoid deterioration of the overall tuner noise figure. Naturally it is desirable to have as much *rf* amplifier gain as possible, with minimum *rf* stage noise. Good tuner noise figures average about 6 to 9 db, at present.

Present tuners can be classified into several categories.

(*1*) Mechanical tuning arrangement:
- (*a*)—Turret type
- (*b*)—Coil-segment switch-deck type
- (*c*)—Continuous-coil switch-deck type

Above: **Typical turret tuner** (top) **and** (bottom) **switch-deck construction.**

Below: **Block diagram illustrating tuner operation.**



[1]This method of converting the incoming signal to a lower fixed frequency and then greatly amplifying the signal is the superhet principle, and all TV receivers at present use this principle.

‡**One of an exclusive series of technical reports, appearing in this issue, on the latest developments in *components, instruments, TV antennas, audio, auto-radios* and *shop accessories*, on display at the annual May Electronics Parts Distributors Show in Chicago. See table of contents, page 2, for complete listing of these advance industry-progress articles.**

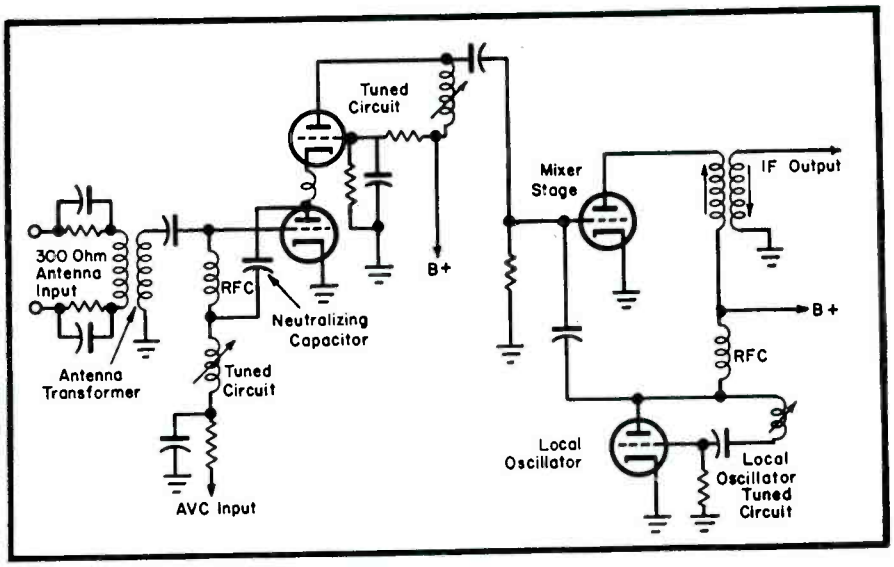
Component Developments‡

by WAYNE S. RIAL

Application Engineer,

Electronic Tube Division

Westinghouse Electric Corp.



(Right)

Schematic of simplified cascode tuner using triode mixer.

(*d*)—Continuous-tuning lecher-line type

(2) Tube heater operation:
- (*a*)—6.3-volt tubes (parallel-connected)
- (*b*)—600-ma tubes (series-connected)

(3) RF-amplifier circuit:
- (*a*)—Cascode amplifier
- (*b*)—Pentode amplifier

(4) Mixer-circuit arrangement:
- (*a*)—Triode mixer
- (*b*)—Pentode mixer

(5) Tuner output frequency:
- (*a*)—21 mc *if*
- (*b*)—44 mc *if*

In tuner-switching arrangements, probably the turret type is preferred to all other types because it is rugged in construction, foolproof, easy to service, and causes little operational difficulty. This is so, because a separate tuned circuit segment is employed for each channel and all channel segments are mounted on a drum which rotates, engaging each segment with contacts mounted to the tuner frame. In this type, channel segments can be easily replaced; also *uhf* segments or *strips* are available for replacing unused *vhf* channel strips.[2]

The coil-segment switch-deck and the continuous switch-deck tuners are very similar in that they both employ wafer switch decks and wound coils. In the coil-segment type, a complete set of individual coils is required for each channel; all of the unused coils are either grounded or shorted out. Where any of these coils are above *rf* ground, two wafer switch decks are needed to switch channels for that particular circuit. This type has the advantage over the continuous-coil type, in that individual coils may be adjusted for each channel without affecting the alignment of any other coil segment. In the continuous coil switch-deck type only one wafer switch section is required for each tuned circuit; i.e., *rf* amplifier grid tank, mixer grid tank, oscillator tank, etc. This system uses one long coil for all channels which is tapped at the proper intervals, so that from one end of the coil to the proper tap, there is the required inductance. This type is much more difficult to adjust after it has been factory aligned than the other switch deck type. The latter type gives good gain, is sometimes difficult to service, is not very foolproof, but is less expensive.

The last mechanical arrangement, the lecher-line system, is the least popular *vhf* tuning method. It employs tuned lines for the *rf* amplifier plate and oscillator tanks. It is very unstable, noisy, has fair gain, but is less expensive than the other types mentioned.

Again tuners can be classed as to the type of *rf* amplifier circuit employed. At present, two *rf*-amplifier circuit arrangements are most popular; the cascode and pentode circuits.[3] In the past, several other circuits have been used successfully, like the grounded-grid, push-pull, grounded-cathode, and cascade-connected triodes.

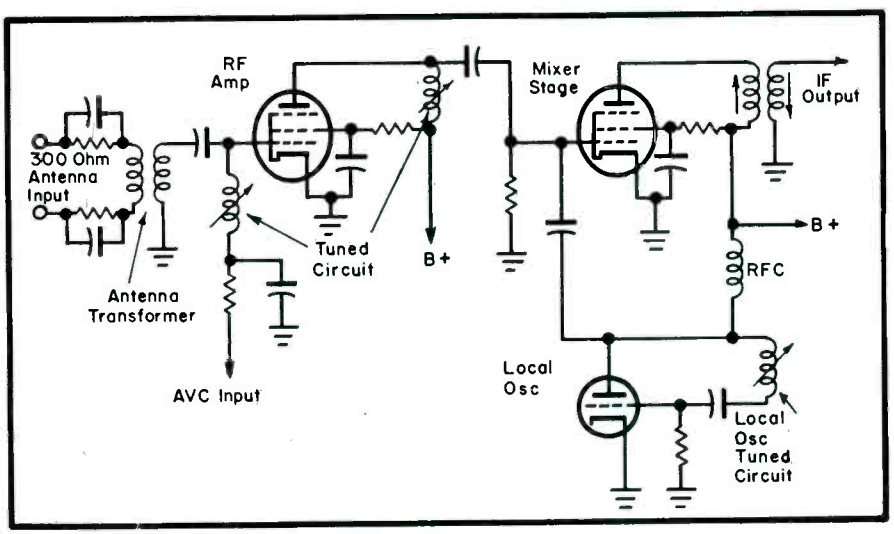
No matter how tuners are classified, all must accomplish the same task.

The tuner input circuit alone must provide proper transformation of the

(*Continued on page 68*)

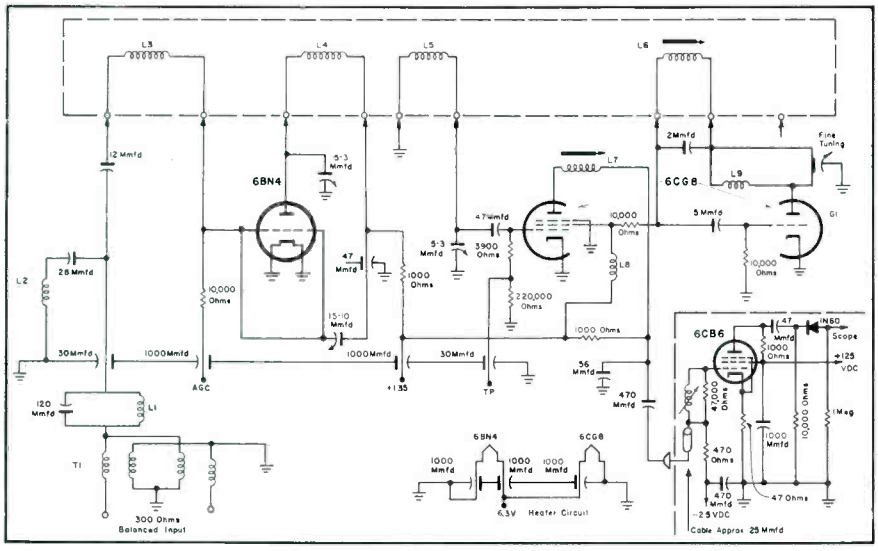
[2]This design is typical of present Standard Coil *vhf* tuners.

[3]See page 24, this issue, for report on another type tuner using *neutrode* system.

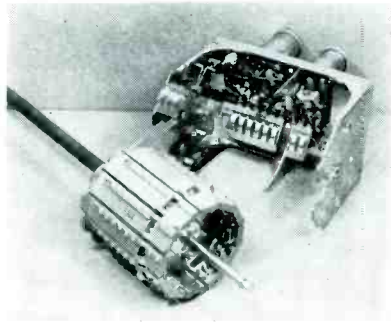


(Right)

Simplified circuit of pentode tuner using pentode mixer.



Left: Schematic of the Standard Coil neutrode tuner. Unit employs neutralizing feedback in single rf triode, special tubes featuring low cathode-to-ground and grid-to-ground inductive impedance, and book-type printed-circuit fine tuner plate. G1 is half of 6CG8. As a first if (lower right) a 6CB6 can be used.



Above: **Bottom view of tuner chassis with components and separate drum-assembly.**

Analysis of UHF-VHF Front End Featuring Neutralized Triode Circuit

THE TREND TO SMALLER B-W TV chassis with simplified circuitry, fewer and less bulky parts, yet higher gain and good signal-to-noise ratio results, has instituted the design of a number of special tubes and components.

One such development is a *uhf-vhf* tuner* which features a single triode neutralized *rf* circuit and incorporates feedthrough capacitors, two new tube types, and a printed-wiring circuit board.

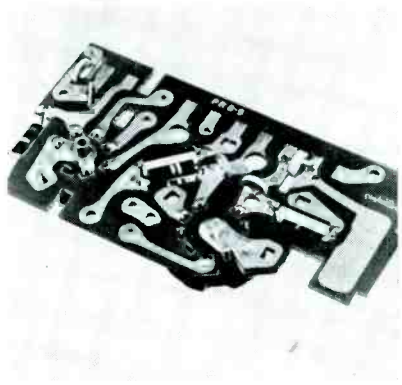
Because, it has been found, the input signal is attenuated by plate-to-grid capacitance, particularly on high-frequency channels, compensation for the loss can be achieved by an aiding voltage fed back from plate to grid. To provide in-phase feedback, a 180° phase shift was introduced in this tuner through 47 and 1.5 to 10-mmfd capacitors. This neutralization was found to provide good signal-to-noise ratio over the entire *uhf* band.

The unit employs a 6BN4 for the *rf* stage (or a 2BN4 for series-string application) and a 6CG8 mixer-oscillator tube (or a 5CG8 for series heaters), each of which has been especially designed to minimize inductive impedance to ground. The two cathode leads of each tube and the two grid leads of the 6BN4 have been incorporated for this purpose.

Five feedthrough capacitors with values of 30, 1000, 47 and 30 mmfd are used. Capacitance exists between the inner conductor and each plate. The plates of the 1000-mmfd capacitor, for example, provide coupling between the inner lead and ground, while the lead itself connects the tube plate to $B+$. Similarly, the 47-mmfd unit acts as a plate signal phase-shifting capacitor.

The local oscillator is a conventional Colpitts, but printed circuitry is used to provide *book*-type tuning. The fine tuning stator in the plate circuit of the 6CG8 triode section is a rectangular area on a printed board. A hinged, silver-plated phosphor bronze plate (separated from the stator by insulating tape) is brought closer to the stator or further away as the fine tuner cam is turned.

Below: **Printed-wiring board in tuner with components mounted for final assembly.**



For *uhf*, a strip is inserted in an unused channel and a bracket containing a high-pass filter and a pre-selector is also inserted.

The *uhf* signal is introduced through the high-pass filter to a germanium diode on the *uhf* strip. The regular *vhf* local oscillator is used in conjunction with the oscillator coil on the *uhf* strip. The coil is so designed that the oscillator frequency is a submultiple of the desired frequency. In other words, mixing is accomplished by operating the oscillator at a *low* frequency and working off the higher harmonics. The proper harmonic for mixing is chosen by the harmonic selector. This system has been found to be simpler than double conversion techniques, whereby the input signal is beat down through successive oscillators to obtain the desired *if*, and is said to provide a better *if* signal.

For *vhf*, the input from the antenna is matched to the tuner by a ferrite core matching transformer. The signal feeds into a pair of *if* traps

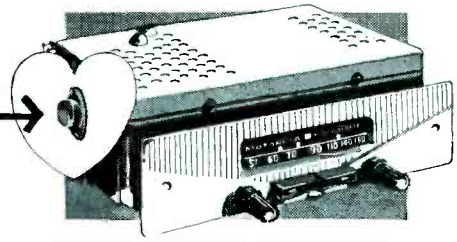
(*Continued on page 67*)

*Standard Coil neutrode tuner.

New Motorola® Transistor POWERED Car Radio

Tiny transistor replaces 15 vital car radio parts

WITH A "GOLDEN HEART THAT WON'T WEAR OUT"



Motorola Transistor-Powered Car Radio. (Model 6TAS-8, 12 volt) $99.95. Other new models from $39.95

PLUS—NEW TWIN BAR STATION FINDER Most automatic tuning of all! Electronically picks and pinpoints any station. Twin Search Bars move station selector either right or left from any point on the dial.

Most trouble-free car radio ever built—The amazing transistor heart won't ever wear out. And it replaces 15 parts that do wear out in conventional sets. (Including the vibrator and vacuum tubes.)

Cuts battery drain 50%—Transistors use hardly any power. Even with the engine off, this radio can play for hours without running down the battery.

Fits most cars—Custom fits instrument panels of most cars. Takes just a few minutes to put in. (Or, Motorola's Installation Depot can do it for you, in most cities.)

Here's how you fit in—Every fourth car lacks a radio. Car radio sales are up 30% . . . and still growing. And now, Motorola has produced the hottest car radio ever. Advertised in *Reader's Digest* (to reach every third American). Now's the time to get into the plus-profit car radio business. Send this coupon today. No obligation.

MOTOROLA
World's Largest Exclusive Electronics Manufacturer

Motorola, Inc., Dept. S-5
4545 W. Augusta Blvd.
Chicago 51, Illinois
Attn.: Car Radio Department
Please give me all facts about the Motorola Car Radio business. Thank you.

Name_____

Firm_____

Street_____ City_____ State_____

THIS MONTH IN SERVICE

COLOR TV BOOM IN FALL PREDICTED BY GOVERNMENT EXPERT--The new and augmented color set lines that will be introduced in June-July will start a real boom in color TV. So said Donald Parris, acting director of the electronics division in the Business and Defense Services Administration of the Department of Commerce, at a recent Atlantic City meeting of distributors. . . . The pleasant effect of all this on the future replacement business is certainly very real, the government specialist added, since typical color receivers have more than 2000 components. There will also be a terrific need for replacement tubes, the distributors were told, because color chassis have at least ten more tubes than b-w models and this spread will hold for at least two more years; then the difference might go down to about eight or nine tubes. . . . This optimism was shared by a number of set makers. One prexy said that there is increasing evidence that heavy volume sales of color will get under way this fall; to meet this demand a number of new improved models will be announced this summer. . . . The drive, it was said, has been sparked by the cost drop in tricolor tubes tumbling the price of sets, and the increased schedule of color shows on a nationwide basis. . . . Even those who have been most pessimistic about color have changed their tune and announced plans to set up production lines for polychrome chassis.

ANTICIPATING THE COLOR PUSH instrument makers have begun to speed production of wideband 'scopes, and dot and bar generators. Clinic depots with color sets in operation have been set up so that Service Men can familiarize themselves with set performance and test techniques. A number of Service Men have disclosed that they are setting up their own study benches and arranging to install one of the new color models. . . . These moves have been received enthusiastically by distributors, who have announced their willingness to supply chassis, either on lend-lease or outright purchase at attractive prices.

21 AND 17-INCH PICTURE TUBES FOUND MOST POPULAR--21 and 17-inch picture tubes have been found to make up 61% of the picture tube replacement market. A survey by one of the nation's largest tube manufacturers has revealed that the 21-inch, the most popular size, now constitutes 38% of all picture tube replacement sales; the 17-inch accounts for 23% of the replacement business. . . . It was also found that more than 40% of all replacements in these two sizes are aluminized types, and that over 50% of the 21-inch models and 20% of the 17-inch replacements feature aluminized envelopes.

NOW IT'S A 10.375-INCH TUBE FOR PORTABLES--A 90° tube, measuring 10.375-inches overall diagonally, providing 53½ square inches of picture area has been developed and is now being included in a new series of TV portables that features printed wiring throughout. . . . Cabinets for these chassis are 8-7/16" high, 10-11/16" wide and only 13-13/16" deep.

STRONG MOVE ON TO POPULARIZE UHF--The official announcement by the Office of Defense Mobilization that the government will not only need all of its vhf channels, but perhaps press for several more, has generated new hope for the ultrahighs in industry and government. . . . Strong support for ultrahighs has appeared in Washington, with the FCC preparing an assortment of proposals to bring the high bands up front. Commenting on these programs, the Commission's head man said recently that not only do government engineers, but industry experts too, believe that uhf may still prove to be the answer to the allocation problem, since it is impossible to obtain a sufficient number of channels in the veryhigh spectrum. . . . One bold plan under consideration by the Commission, involving a ten-year transition period, would divide the nation and bring the ultrahighs to the complete eastern seaboard and spread the veryhighs across the western portion of the nation.

NEW YORK STATE ASSOCIATION ELECTS NEW OFFICERS--At the eighth annual meeting of the Empire State Federation of Electronic Technicians' Associations held in Binghamton, N. Y., Gordon Vrooman was elected president. Others named included Harold Hazzard, vice prexy; John A. Wheaton, secretary; and Herman Seehausen, sergeant-at-arms. Pat Pratt was reelected treasurer.

We CHALLENGE any other antenna to outperform our new

Seldom has an antenna aroused as much enthusiasm as our wonderful new Power-Helix. Its performance in Black and White and Color has been so remarkable, so outstanding, that we challenge any other antenna to surpass it.

A single bay of the new JFD Power Helix will:

OUTPERFORM a 10-element cut-to-channel Yagi on each high band channel from 7 to 13.

MATCH a 10-element cut-to-channel Yagi on channels 4, 5 and 6.

MATCH a 5-element wide-spaced cut-to-channel Yagi on channels 2 and 3.

We do not make nor should you take this challenge lightly.

It is backed by astonishing on-the-job performance under all operating conditions. You can extend to all your customers this same iron-clad guarantee of performance ... whether it is a new set sale ... a replacement antenna installation ... or a color TV installation.

You be the judge. Try the Power-Helix. If it doesn't perform as we say... you name the forfeit.

EDWARD FINKEL, Sales Manager

POWER HELIX

NCB* COLORTENNA®

MODEL		LIST
PX911	*1-Bay Power-Helix*	**$35.00**
PX911S	*"Wide Stacked" Power-Helix*	**72.50**

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JFD MANUFACTURING CO., INC., BROOKLYN 4, NEW YORK

Go Forward with JFD Engineering!

2-Way High-Band Mobile Installation—Service Tips

by A. R. SINCLAIR, *Communications Engineer, General Electric Company*

WHAT WOULD YOU consider important when installing a high-band mobile? Would you consider the location of the units or the microphone important to the convenience of your customer?

The *service engineer* should locate the transmitter and receiver cabinet in such a manner that it will not interfere with the customer's normal operations. For example, in taxi service the units should be mounted to one side or in the rear of the trunk space to preserve maximum luggage space. In making an installation one must be selfish and remember that it is necessary to service the equipment; thus the units must be mounted where they are accessible.

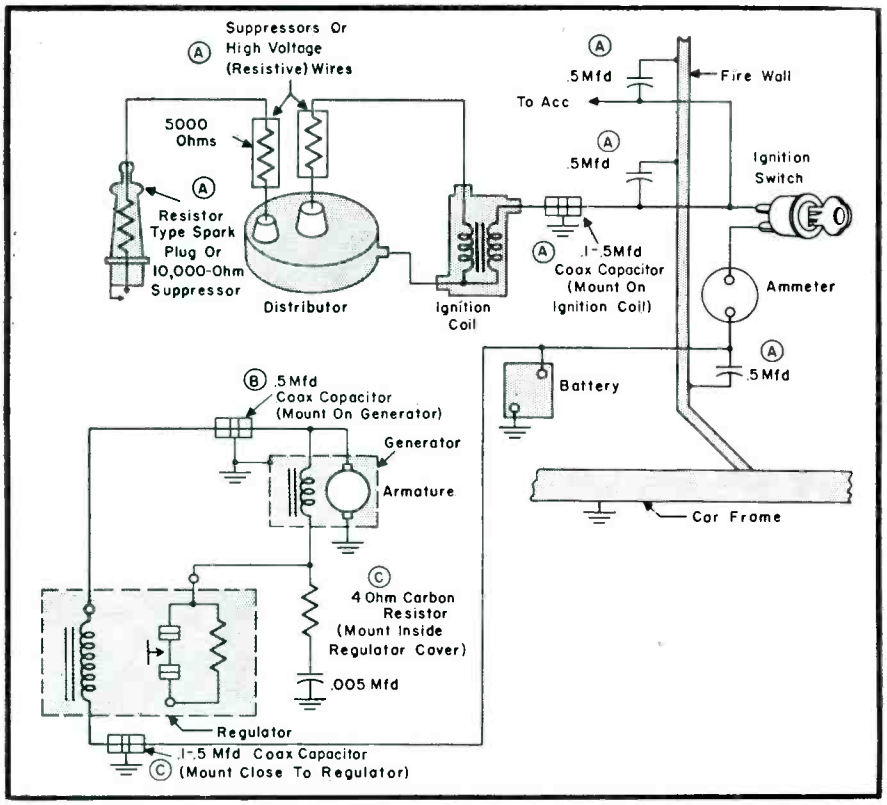
Another operation, control-cable routing, if followed through correctly at first, will save many a service call. These cables must be routed so that they will not be subject to chafing on sharp objects and receive abnormal wear. After having run the cables comes the task of connecting the *A* leads. Most manufacturers supply cables that are longer than necessary. The first impulse is to cut these cables and make them as short as possible. This shouldn't be done, for the cables have been with an *IR* drop to provide *design-center* operation of the mobile units under average battery conditions. This is the reason why one should not cut the cables, for accidently cable might be left out or some of the copper strands might be cut, changing the input voltage which might result in adverse operation. When making any connections to the car chassis or to the battery, one must remember to clean the connection with sandpaper or its equivalent. Such precaution will mean more watts to the antenna and less noise in the receiver.

How else can a little more effort be beneficial? By securely fastening the equipment to the car body efficiency can be upped, because this move will provide better grounding of the equipment, and reduce vibration in the unit, thereby providing longer trouble-free operation. Also there'll be less tendency to create electrical and mechanical noise through movement of the equipment.

While on the subject of grounding, a 17′ ground strap is supplied with our two-way gear°; this should be connected to the battery ground. It is usually located on the motor or the chassis; a full ground return strap will give consistent grounding, resulting in improved performance.

Our mobile line° has been designed to work through the ignition switch of an automobile. Most of the current cars are equipped with accessories that are disconnected from the battery while the engine is being started; this feature makes it very desirable to connect the *off-on* control to the ignition switch. In the case of mobile equipment this arrangement prevents vibrators from stocking and blowing fuses when the battery voltage drops below a safe value during cranking. However, the voltage drop through this switch is not a constant, and if

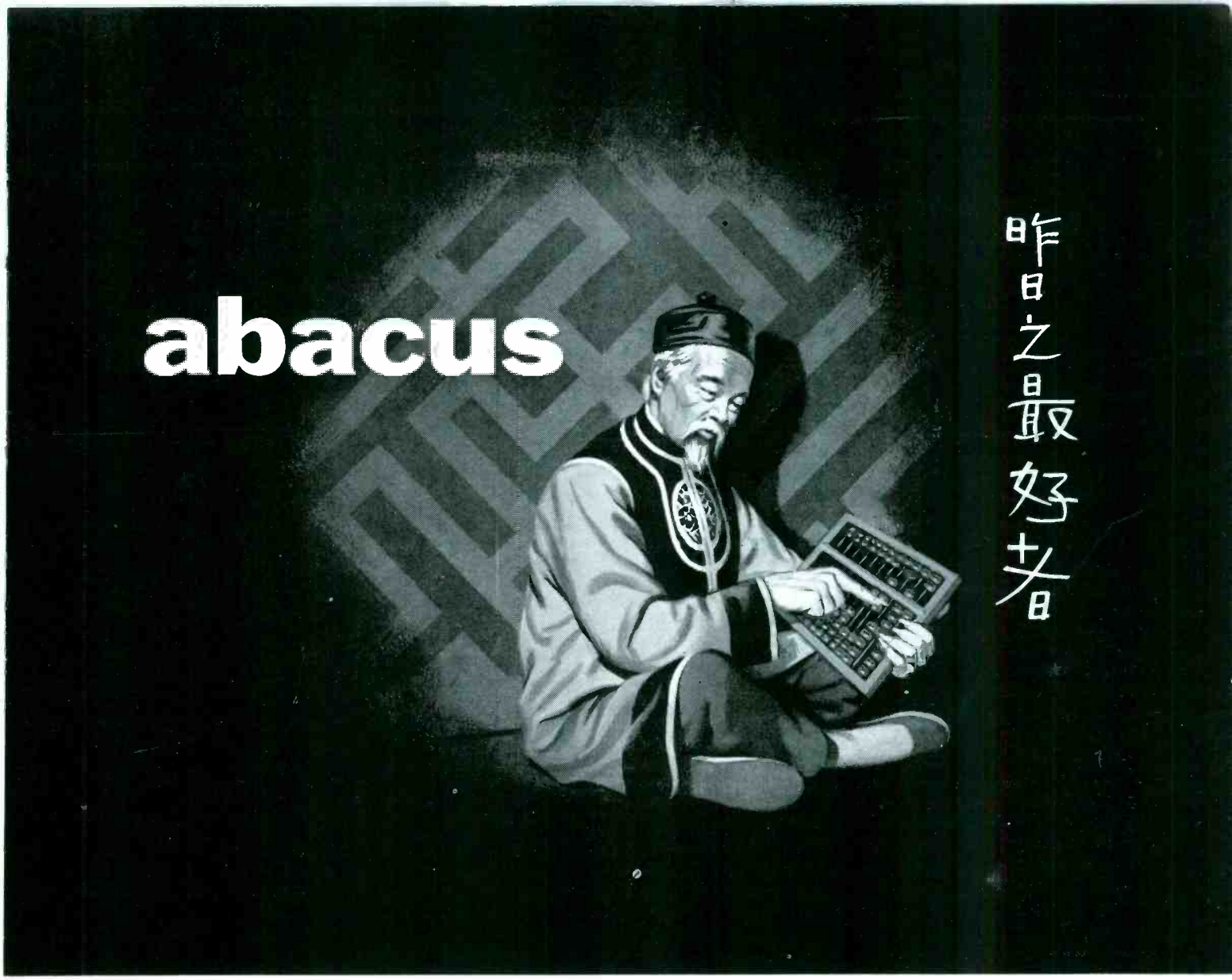
(*Continued on page 68*)



(Left)

A typical ignition system illustrating position of assorted noise-suppression components. Suppressors of ignition noise are shown at A; generator noise suppressor appears at B; and C indicates regulator-noise suppressor location.

° *Progress line.*



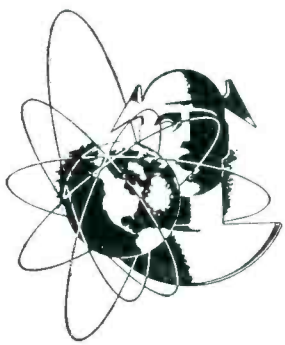
honorable ancestor of the UNIVAC

In theory many centuries have gone into the development of the Univac® Only recently, at Remington Rand Univac, has it achieved product perfection. The tremendous strides forward in the past few years are due to the imagination and creative genius of the scientists and engineers of Univac. Recognized leaders in the field of electronic computer systems, they are the men *who set the standards for others to follow.* You can become a member of this team . . . where ambition and professional skill find their reward in limitless opportunities in an expanding organization.

Immediate openings for:

FIELD LOCATION ENGINEERS with a college degree in a scientific or engineering field and experience in electronics. Extensive electronic background may substitute for some college. Many opportunities for rapid advancement.

FIELD LOCATION TECHNICIANS with technical school background and preferably some experience in electronics. These positions can lead to full engineering responsibility.



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CATALOGS — BULLETINS — BOOKS

R-Columbia Products Co., Inc., Highwood, Ill., has issued bulletin 22, explaining operation of *TrolMaster* cleaning and lubricating tools for radio and TV controls. Includes information on *Kleentrol* solvent developed for use with the tools.

* * *

Johns-Manville Dutch Brand Div., 7800 S. Woodlawn Ave., Chicago 19, Ill., has published a 12-page catalog with specifications on plastic, friction, rubber and colored vinyl tapes.

* * *

National Electronic Manufacturing Co., 186 Granite St., Manchester, N. H., has released a 4-page brochure describing auto antennas, mounting bases, contour fender adapters, antenna boosters and communication antennas.

* * *

Ray-O-Vac Co., 212 E. Washington Ave., Madison, Wisc., has published a radio-battery replacement guide and comparative slide chart with new Neda and old Ray-O-Vac numbers, and numbering systems of other major radio battery manufacturers.

* * *

United Catalog Publishers, Inc., 106-110 Lafayette St., New York 13, N. Y., has released a brochure describing *The Radio Electronic Master* industry parts buying guide. Included is an insert listing parts distributors handling the guide.

* * *

CBS-Hytron, Danvers, Mass., has published a new edition of its *Reference Guide for Miniature Electron Tubes* (*PA-1*), listing data for 416 tubes, including 88 new types. Also contains 168 basing diagrams, of which 33 are new.

* * *

Howard W. Sams and Co., Inc., 2201 E. 46th St., Indianapolis 5, Ind., has published a 132-page book on *Servicing AGC Systems,* by *Henry A. Carter* and *Thomas A. Lesh.* Three sections cover theory of *agc* circuits, commercial *agc* circuits and troubleshooting. Contains schematics and photographs of faulty pictures resulting from *agc* defects. Copies are available at $1.75 each.

* * *

Elgin National Watch Co., Electronics Division, 370 S. Fair Oaks Ave., Pasadena 1, Calif., has issued a 20-page catalog, *47,* describing broadcast, *pa,* general purpose, crystal, tape recorder and mobile microphones; handsets; mobile and microphone accessories and replacement parts; phono cartridges and pickup arms.

* * *

RCA Service Co., Inc., Cherry Hill, Camden 8, N. J., has published a 92-page illustrated book on *Servicing Color Television Receivers,* covering the 21CT66OU color chassis. Book is available from the company's commercial service section at $1 per copy.

TEN YEARS AGO IN SERVICE

An annual replacement parts business of $150-million for '46 was forecast by *H. W. Clough,* president of the Radio Parts Show, during the annual convention in Chicago. . . . Television, it was said, would play a leading role in building this tremendous market. . . . Service Men began preparing for this TV boom by organizing training units to familiarize themselves with TV chassis construction. . . . Associations joined in the drive to acquaint their members with the latest developments in receiver design and test techniques, through local, state and national clinics and conventions. . . . Service continued to publish exclusive basic TV technical reports which served as training-program copy for local and state associations. . . . *Sidney L. Chertok* was appointed ad manager of Solar Manufacturing Corp. and Solar Capacitor Sales Corp. . . . A 12-page booklet describing antennas for FM and TV store demonstrations and noise reducing systems was issued by Technical Appliance Corp.

Associations

NATESA, Chicago

AT THE OMAHA, NEBRASKA, board of directors meeting of the National Alliance of Television and Electronic Service Associations, *Frank Moch*, president, was named chief executive director and voted a salary plus expenses, to cover the last half of the fiscal year ending August 31, 1956. A committee was established to work out ways and means, including organizational changes, to free *Moch* of some of his duties, to enable him to devote more time to top level executive problems.

As steps in this direction, three governors were named. *Albert C. W. Saunders* will serve in dual offices, as educational director and as New England zone governor; *Gordon Vrooman*, Central Atlantic Zone; and *Robert L. Kidd*, South Atlantic Zone.

Fred Colton announced his resignation at the meeting. His post as Great Lakes governor was assigned to his former business partner, *John Graham*.

An expanded public relations program was described and plans were approved unanimously. Plans for the 1956 convention, September 14 through 16 in Chicago, were described by convention chairman *Russ Harmon*.

The meeting was closed with a banquet at which *Friends* awards were presented to several tube and component manufacturers. *Dan Creato* of RCA Service Co., received a personal citation for the part he has played in handling industry problems.

° ° °

CSEA, California

JACK WEBB received from the California State Electronics Association, the FRSAP achievement award for his work in "exposing the practices of *some* TV Service Men who victimize the public."

At the award ceremonies, Webb also installed officers for '56-'57.

Present officers of CSEA are *Keith Kirsten*, president; *Rex Yeager*, vice president; *James F. Wakefield*, secretary; and *H. Lawrence Schmitt*, treasurer.

° ° °

TSA, Detroit, Mich.

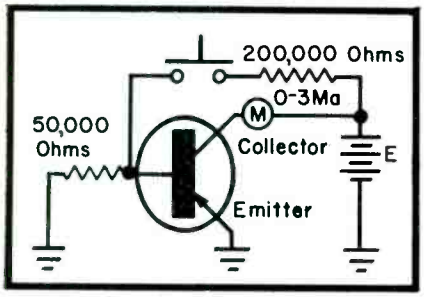
AT THE SPRING election meeting of the Television Service Association of Michigan, *Carl Heinzman*, was named president.

Others voted into office include *Charles Judd* as first vice president; *John Keppinger*, second vice president; *Fred Canning*, treasurer and *Sam Mooney*, secretary.

Retiring president *Alexander Weiss* was elected chairman of the board of directors. Others on the board are: *Harold Chase*, *Jack Barton*, *Al Longton*, *Troy Hunt*, and *Michael Dallen*.

Booth of Electronic Technicians Association of Jamestown, N. Y. at the Midwinter Fair held in Jamestown. At far left, adjusting 'scope, George Carlson, **association secretary. At right,** Herman Seehausen, **prexy of association and** Anthony Miano, **ETA member, looking over one of the literature sheets distributed from booth.**

[*For complete report on exhibit, see National Scene,* SERVICE; *April, 1956.*]



Portable Transistor and Tube-Transistor Testers

THE STEPPED-UP production of transistorized portables and table models, car radios, amplifiers and instruments, and the forecasts that transistors will soon be found in portions of TV chassis, has firmly placed these pea-sized semi-conductors up front as a vital component that will be of concern to every Service Man.

The trend has prompted the design of unique testers, either as instruments that check transistors only, or tubes and transistors.

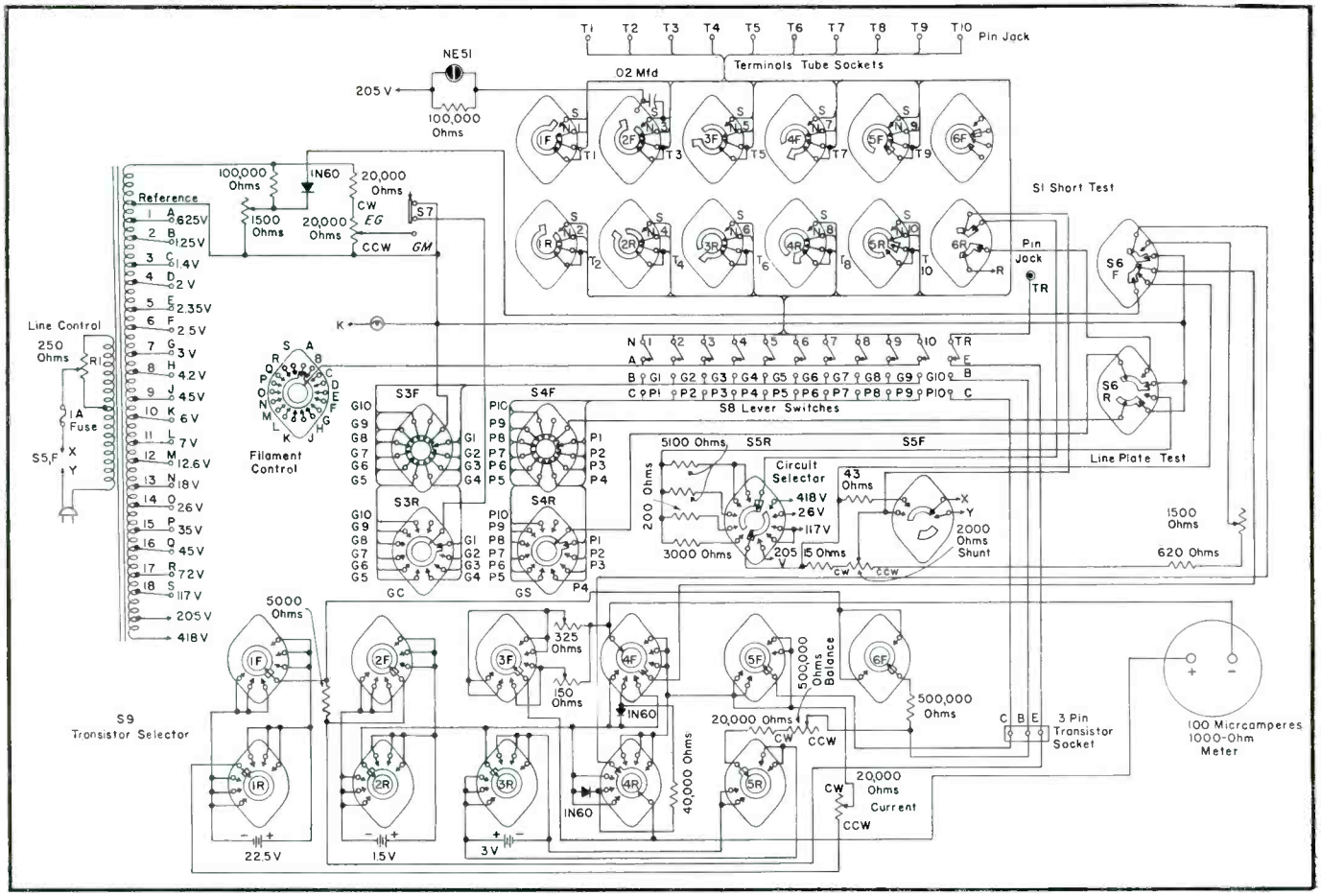
In developing these instruments, the designers found that such standard means of checking as ohmmeters could give trouble. Many ohmmeters are so designed that, on the *Rx1* scale, 1000 milliamperes flows through the unit. A heavy current of this amplitude can permanently change the transistor characteristics, if the meter is used to check the emitter resistance. Some ohmmeters use a high-voltage battery on the high *R* scale. Many of the transistors used in radio receivers break down with more than 20 volts at the collector. Transistors checked with this type of ohmmeter for back resistance could therefore be seriously damaged.

The selection of a unit for quick-checking transistors should be based on an understanding of both transistor and tester operation. The testers, as presently designed, check for opens, shorts and gain. Such units usually incorporate a chart with replacement data and an internal battery supply. Because of the type of testing done, the batteries normally have long life, but they should be checked periodically and replaced to insure consistently accurate indications.

One of the most revealing characteristics of a transistor is the collector current that flows when the emitter is grounded and no bias is supplied

(*Continued on page* 58)

Figs. 1 (above, left) and 2 (below). Fig. 1 shows circuit of portable G. E. transistor tester. Unit incorporates ammeter, battery, and switch; checks for open, short, and current gain. E = +6 for npn and −6 for pnp. In Fig. 2 is the schematic of RCP 325 tube-transistor tester, with separate test circuit for transistors.



★ A Field Progress Report on Component Developments

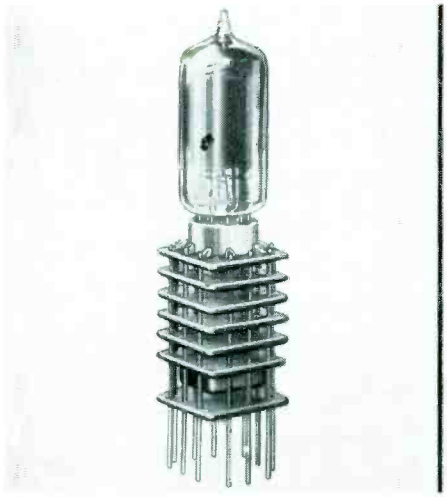
1943: One hundred components required 100 insertions and 200 individual soldering operations.
1954: One hundred components required 100 insertion operations, and one soldering operation.
1956-57: One hundred components now call for only 8 insertion operations and one soldering operation.

The evolution of chassis production techniques.

The Stacked Modules Now Being Built Into AC-DC Portables and TV Chassis

by FRED ISRAEL

Module Division
Aerovox Corporation



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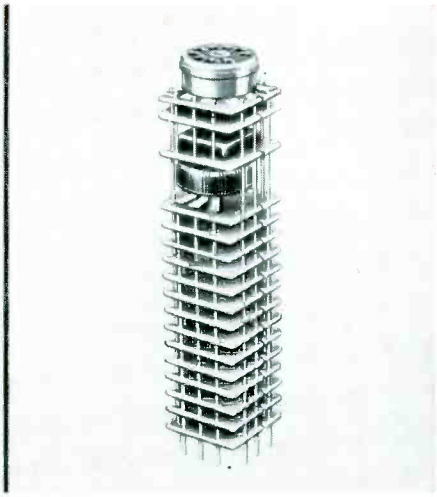

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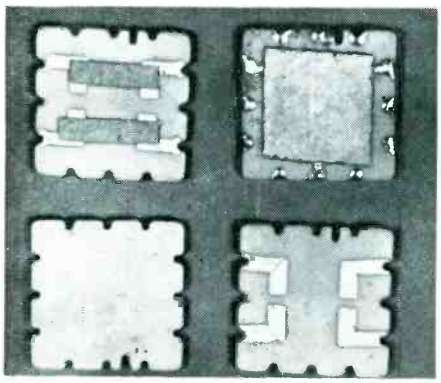

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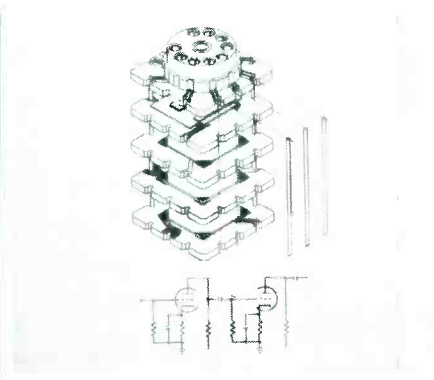

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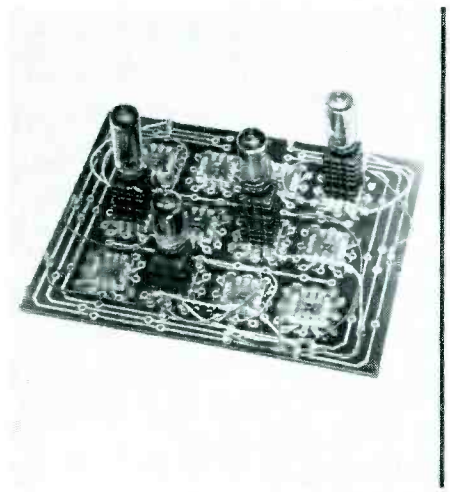


Figs. 1 to 6. A typical module is illustrated in Fig. 1; a voltage-regulator type is shown in Fig. 2. Fig. 3 shows a module resistor wafer in four stages of preparation; blank, painted terminals, resistors attached to painted connections and resistors with protective coating. An exploded view of a module and its circuitry appears in Fig. 4. Module units interconnected on a prototype board and a standard circuit prototype board are illustrated in Figs. 5 and 6.

THE DEVELOPMENT of the printed wiring board has made possible the multiple interconnection assembly of numbers of components in a single soldering operation. The recent design of complex component assemblies containing a variety of sub-components (resistors, capacitors, tube sockets, and coils) has further reduced production time and the number of individual components that must be handled by an electronics fabricator. These new complex components, supplied to meet a specific functional specification, are known as *modules*.

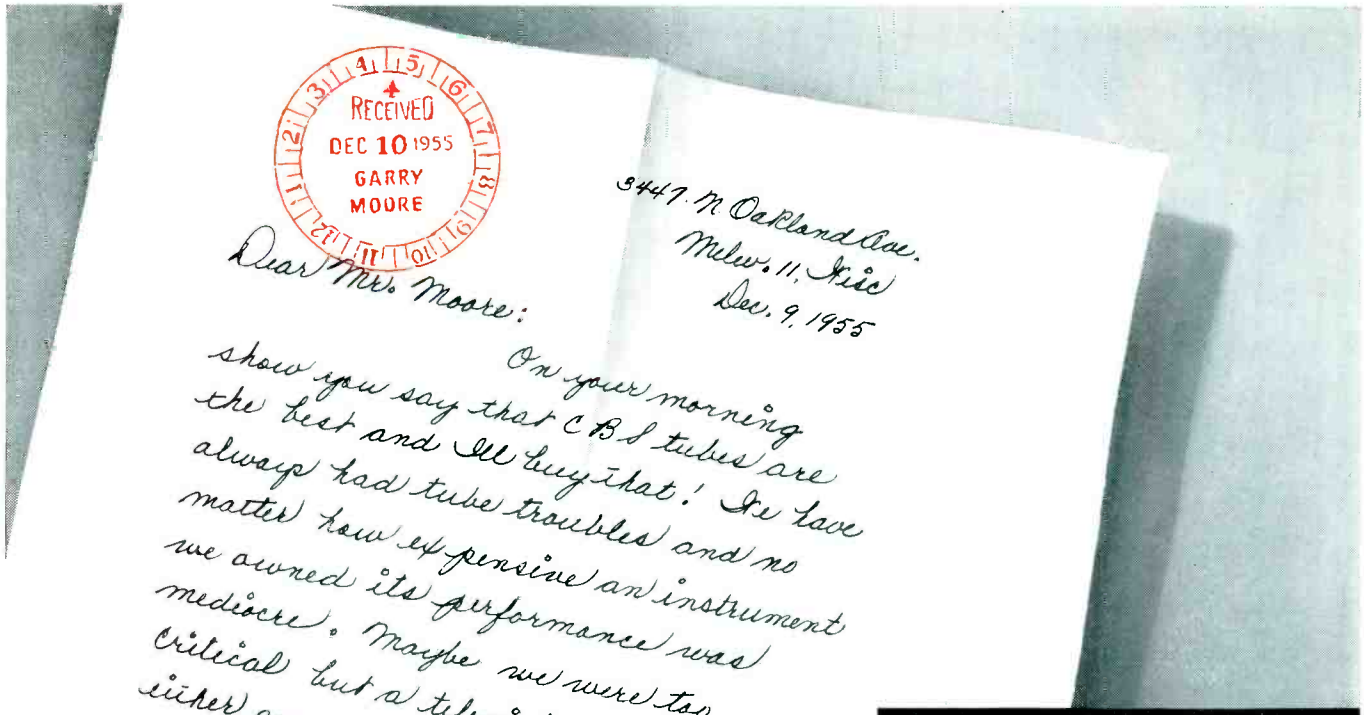
The production requirements of the Korean War accentuated the shortcomings of electronic production techniques, as they existed in this country in 1950. Production lead times were excessive both in terms of equipment assembly and component availability. An answer to the component assembly problem was provided by the introduction of printed wiring which permitted the mass assembly of a number of components. The problem of component availability still remained; accordingly, the Navy Department's Bureau of Aeronautics instituted a development program which had as its goals the following:

(1) Development of new components which could be fabricated to as great an extent as possible from raw materials in non-critical supply.

(2) Development of a mechanized system for the manufacture of these components.

(3) Development of production techniques for the mechanical inter-

(*Continued on page* 51)



CBS-HYTRON

Danvers, Massachusetts

A DIVISION OF COLUMBIA BROADCASTING SYSTEM, INC.

HERE'S PROOF

your customers want CBS tubes

Since Garry Moore has been selling CBS tubes over the CBS Television Network, most service technicians have had women customers ask them for CBS tubes. And not just once in awhile.

Every day more and more women are requesting CBS tubes. We hear stories like Mrs. Svensson's often.

It all adds up to these important facts. You build good will . . . cut call-backs . . . and profit more when you install CBS tubes . . . the tubes with the Good Housekeeping Guaranty Seal.

Is your caddy well stocked with CBS tubes?

Guaranteed by Good Housekeeping

Show her the CBS carton with the Good Housekeeping Guaranty Seal.

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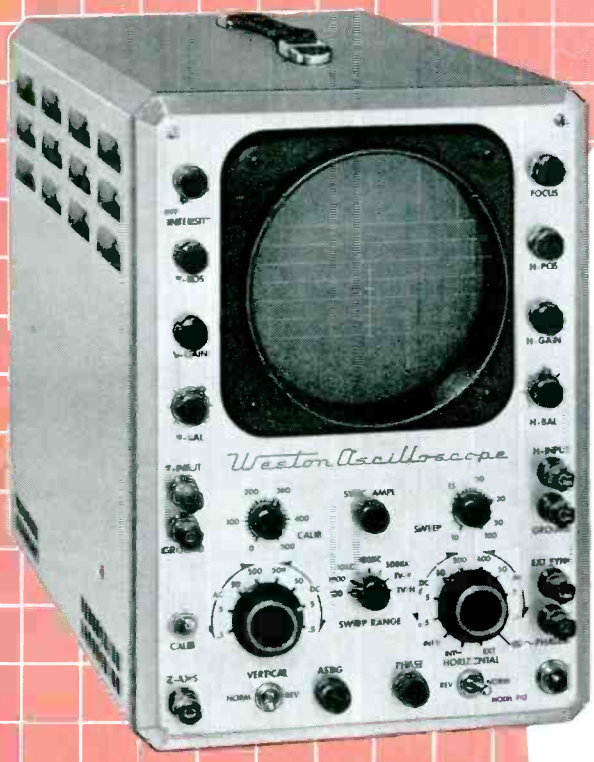

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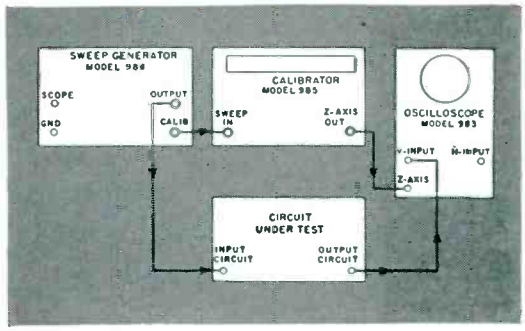
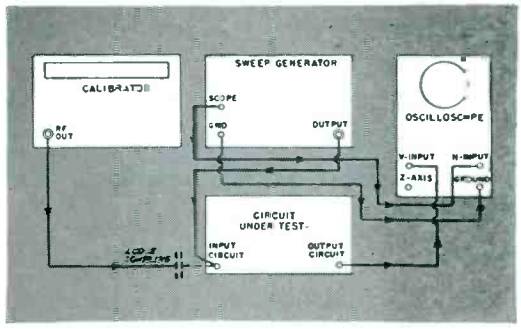


Conventional Method of Alignment



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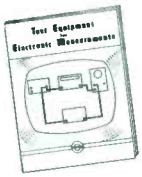

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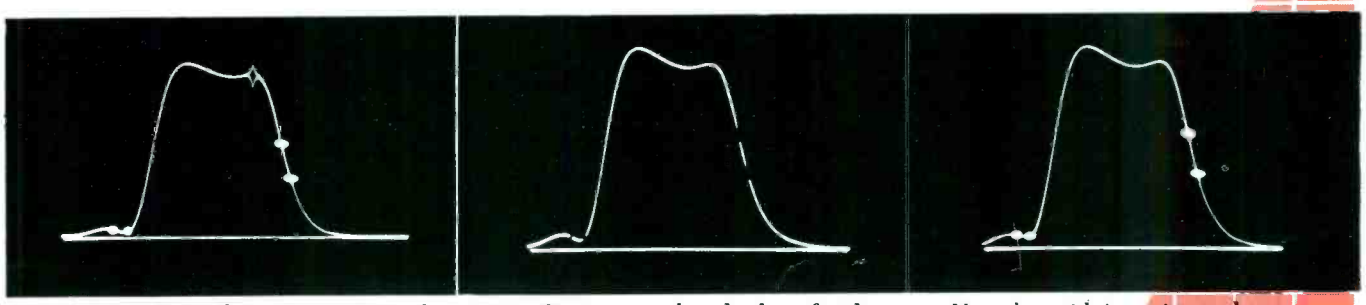

Simultaneous marker presentation of video and sound carrier frequencies (positive intensity markers).

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Note that with intensity markers there is no possible misinterpretation with spurious responses.

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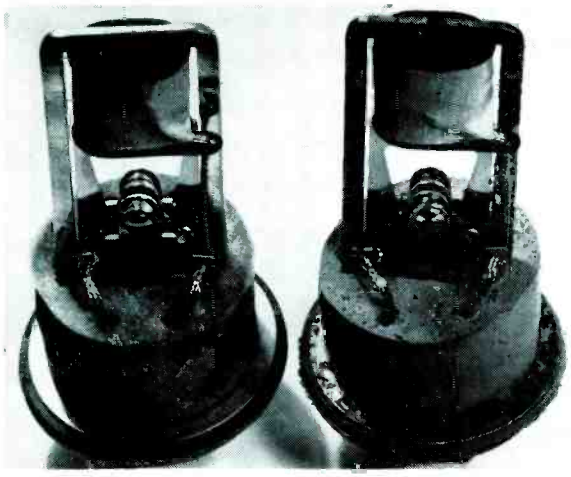

★ A Field Progress Report on

Component Developments

Highlights of An Auto-Radio Vibrator Evaluation Test-Study to Determine Breakdown Causes and Cures

THE RAPID evolution of improved and new components for radio and TV has been highlighted by extensive engineering research and experimentation that have served not only to provide better performance, but eliminate common sources of trouble. Studies of the problems under investigation by industry and their findings have always proved revealing, providing a valuable insight into the causes of breakdown, anticipated future difficulties and the test and production techniques developed to resolve these problems.

In one such study,* concerning the cause of vibrator breakdown, it was found that *no-starts* have been a major difficulty; often, the records revealed this can be traced to oxidation of the tungsten contact points. A second important vibrator problem has been the reduction of noise level.

The extent of contact-point surface oxidation is determined by the amount of time the points are exposed to air, particularly during storage, and by exposure to moisture. Accordingly, in this study the possibility of applying a substance to the points, which would inhibit corrosion by protecting the surface from exposure to air, was surveyed. Such a substance would have to be sufficiently conductive electrically to allow operation of the vibrator. Any oily material containing hydrocarbons would be unsatisfactory, as it would immediately carbonize the spark gap, ruining the vibrator. A special silicone compound with a rust inhibitor was found effective.

To test the effectiveness of the preparation two groups of vibrators were stored for a number of months and then checked. One group, which initially had its points polished by means of a cloth impregnated with the silicone compound, showed no average increase in starting voltage of any consequence. The second group, cleaned in the normal manner, showed an increase of over 1 volt for starting.

(Above, left)

Vibrators subjected to moisture test. Protected contacts of left vibrator still have shine; those of right-hand vibrator, exposed to moisture, show marked oxidation. This test illustrates the type of industry research being conducted to improve components by determining causes for breakdown and their cures.

(Courtesy Vokar)

It was subsequently found that the silicone compound, besides inhibiting oxidation to reduce the occurrence of no-starts, lowered the ionization potential of the air between the points, thus reducing the sparking effect. This sparking causes much of the heat which is produced during vibrator operation, followed by failure of the unit.

In another series of humidity tests (using the same group of vibrators checked for point efficiency) under varying conditions, at temperatures below 68° to 78° *F*, the difference in average starting voltage between the first group and the second one was even greater, amounting to over 5 volts. Also, time of exposure alone did not appear to be the only factor determining corrosion, as some units showed the effects of oxidation sooner than others within groups that had been treated and tested in the same manner. The effect of moisture, therefore, on the oxidation of points, was next investigated.

It was determined through tests that, once a vibrator had been canned, the ambient condition of the air within the unit remained substantially unchanged. The assumption was then made that the condition of the air during the canning process may occasionally prove to be responsible for enough trapped moisture to cause some degree of oxidation. Accordingly, this characteristic was checked in a series of tests.

Two groups of vibrators were canned at 75° *F*, 60% relative humidity, and then were stored for three days at an ambient temperature of 40°-55° *F*. One group, which contained silica gel** within each unit, showed no appreciable rise in starting voltage, while the second group, containing no dehydrating compound, showed an increase of over 1 volt.

Another test was conducted with vibrators canned in moist air (65% relative humidity) and then stored for three days at 40° *F* (approximating occasional temperature conditions during winter trucking). These showed an average increase of 1.8 volts starting. This is just sufficient to have the vibrators operate as they are installed in the auto radios by the radio manufacturer, and to then have them fail to start for the customer,

(*Continued on page* 41)

*Conducted by Vokar

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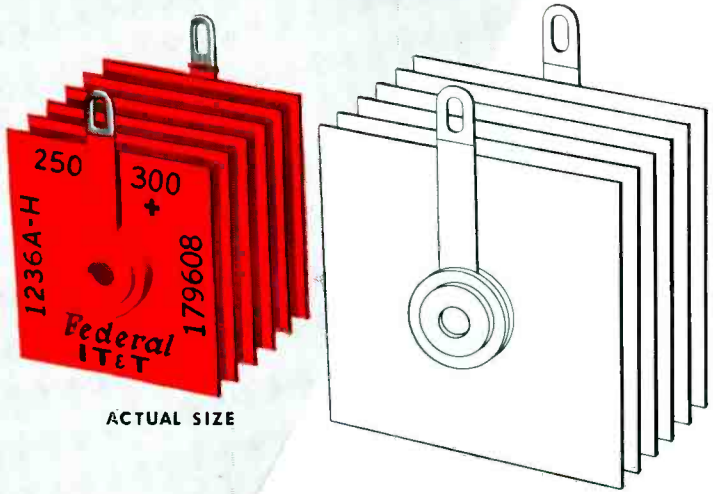

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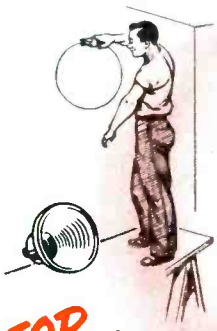

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			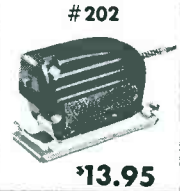			
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Auto-Radio Vibrators

(*Continued from page 38*)

because of additional oxidation during the time between shipment of the set and its initial use within the automobile.

As a result of this study, a dry, air-conditioned room has been set up for the canning process, having a constant temperature of 70° *F* and a maximum relative humidity of 30%. All units are pushed into the room through a flap arrangement, to prevent the introduction of moisture, and are left there for a minimum of 12 hours prior to canning.

An extensive study was also made on the failure of vibrators to start because of microscopic particles of dust in the atmosphere. Often, slipping a piece of paper between the points, or merely striking the case, causes a *no-start* vibrator to become operative. Investigation showed that dust particles which have settled on the contacts are dislodged at least temporarily in this manner.

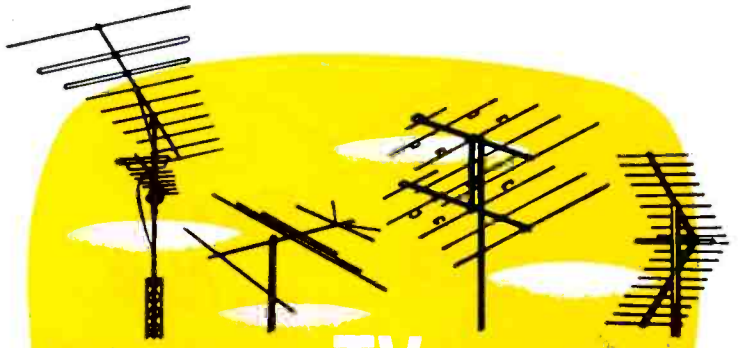
It was determined through tests that, once canned, no outside dust enters the unit. Steps were therefore taken to remove dust from the air during the canning process, and to have all parts free of dust before and during assembly.

The second problem of importance, that of noise level, was investigated as a function of the vibrating reed shaking the entire unit. The axis of movement of the vibrator (during operation) was located, and the unit was supported so that it rested against the rubber lining at the point of zero movement. In this manner, it was found, there was no effective connection between the vibrator base and the stack assembly.

75th Birthday Celebration

Frank C. Engelhart **(second from left), prexy of Kester Solder Co., receiving scroll signed by every Kester employee as a diamond birthday gift. Making presentation were (l. to r):** J. A. T. Butler, **manager of Kester's Canadian plant;** Joseph H. Humble, **general sales manager; and** Edynfed Williams, **vice president and general counsel.**

Weather Protecting Outdoor Antennas . . . . . by Matthew Mandl



UHF-VHF TV ANTENNA DIGEST

DESIGN • APPLICATION • INSTALLATION • SERVICE

DESPITE THE use of non-rusting elements for TV antennas, outdoor antennas deteriorate rapidly under exposure to the whims of weather. Aluminum or brass bolts and nuts have not been broadly accepted, because they are not as strong as galvanized steel hardware. However, even galvanized hardware eventually succumbs to the corrosive effects of weather.

At the seashore, salt attacks every member of the antenna and efficiency declines rapidly after installation. Even in areas free from the defects of salt water, antenna installations show a marked decline in efficiency after two or three years, because weather affects such areas as the transmission-line insulator connections where contacts become pitted. Often, too, the insulators absorb moisture and during winter months freezing of the moisture within the insulator causes cracks. Insulators so affected absorb additional moisture and dust, and contribute materially to signal losses.

The life of an outdoor antenna can be extended materially by use of clear plastic sprays.* The spray has been found to provide a plastic protective coating over insulators, bolts and nuts, and other important terminals of the antenna system. The plastic hardens almost immediately to form a weather-resistant film.

Applying plastic spray to antenna insulator to prevent moisture absorption by the insulator and also prolong the life of the bolts, nuts, and turnbuckle lugs.

The best time to coat antenna elements is after the antenna has been assembled and is ready to mount on the mast. At this time, the spray can be utilized to coat all the critical points of the antenna. Since the spray dries within a few minutes, the antenna can be handled for mounting on the mast, without danger of disturbing the insulating and protective characteristics of the hardened plastic film.

In applying the spray to the insulator section of the antenna, the can containing the spray should be first shaken, then held about twelve inches from the part to be sprayed. A pressure on the top button of the can releases a fine spray. The insulator should be sprayed thoroughly, both back and front, paying particular attention to the bolts and nuts.

The reflector portion of an antenna should also be sprayed. Even though no insulator is utilized here, the plas-

(*Continued on page* 60)

*Such as **Krylon.***

Left: **Applying plastic spray to reflector-crossarm point.** Center: **Another plastic spray application; to standoff insulator and to leadin section between the antenna insulator and the first standoff insulator. Spray protects standoff and also adds rigidity to the section of twin lead right below the antenna. This minimizes flexing during high winds.** Right: **Applying protective spray to the antenna crossarm mast-section to prevent rust formation and loosening of the U-bolt section.**

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Selecting Components For Indoor-Outdoor

IN SETTING UP a sound system operation one must determine the type of installations or rentals that would be initial shop specialties. For small assignments, outdoor or indoor, one must establish whether the expected jobs will entail a single microphone, amplifier and one or two loudspeakers; and also whether the installations will be permanent or temporary, involving portable equipment. Degree of penetration and quality of sound required also must be considered very carefully.

Kinds of Loudspeakers

There are three types of horn loudspeakers that have been found very effective in *pa* work.

One is the reentrant horn, a modification of the older long straight horn which uses a high-pressure screw-on type unit to achieve a high efficiency. These are illustrated in Fig. 1. For outdoor work, where one has to *stretch* the available power output, as far as possible, to cover a large area and overcome considerable background noise, due to crowd cheers or other problems, this design is recommended.

The older straight type of horn was rather cumbersome to handle and posed mounting problems. The reentrant type is much more compact and facilitates mounting. It is somewhat more directional than the older long straight horn, because the sound emerging from its mouth is rather like a ring source; thus the sound tends to project with the localized properties of an ejected smoke-ring.

For outdoor applications this characteristic will usually prove to be an advantage rather than a disadvantage. One must keep the sound in the area where it is wanted and avoid wasting it in directions where it is not wanted. So, by suitable placement, the reentrant type of horn can be very useful.

The reentrant is sometimes also used for indoor installations, particularly in indoor sporting event buildings; these buildings are usually more reverberant than might be desired and the directional properties of the reentrant horn, judiciously used, enable the sound to be kept where it is wanted, avoiding bouncing all round the roof.

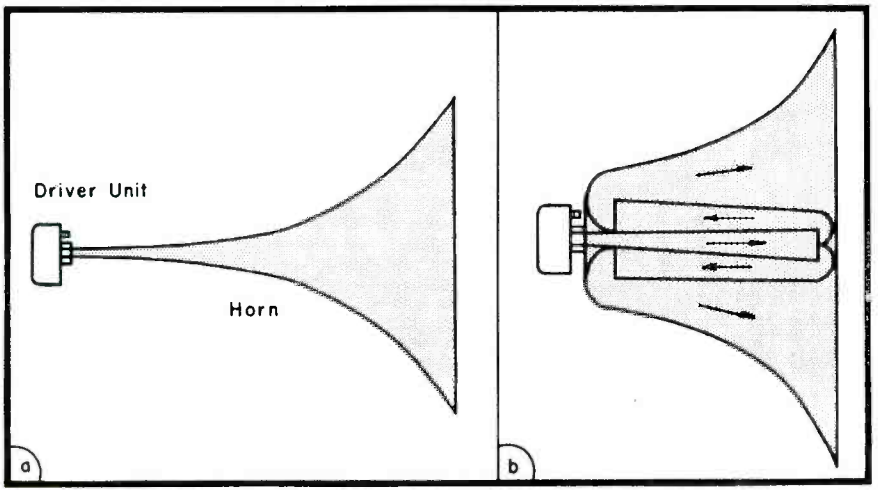
However, to get the desired effect, it is important to use enough speakers so that the entire audience area is adequately covered. It is also important to see that the level supplied to every unit is sufficient to avoid any undesirable echo effects. In this type of installation echo effects become noticeable in a particular section of the audience, when sound comes from a unit further away than the one they should be listening to, reaching them at greater intensity, perhaps via some wall reflection. Every section of the audience should only be able to hear the unit nearest them. In this way echo effects and reverberation are minimized.

Flare Horns

The flare horn differs from the original long straight horn by being shorter, and using an ordinary cone or diaphragm-type loudspeaker instead of a high pressure drive unit. A sectionalized view of this type is shown in Fig. 2.

These units are less directional than the reentrants and are usually less efficient, but they are more efficient and more directional than most of the cabinet-type loudspeakers. Usually the flare-type loudspeaker has a frequency response extending about

Fig. 1. Types of low frequency horn, which provide a response down to a cutoff frequency of 400 or 800 cycles. The older, almost obsolete straight type horn is shown in (a); at (b) is the more compact reentrant type, which is much easier to handle, and in some respects gives better performance than the straight type. Both use high-pressure, screw-on drive units.



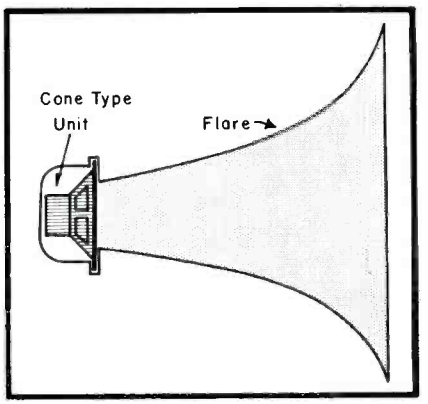


Fig. 2. Flare type of loudspeaker which uses an ordinary cone type unit with a much shorter horn than that shown in (a) of Fig. 1.

Projector horn with driver unit. (Model H-200; Jensen)

an octave lower than the reentrant horn. For this reason it will sound somewhat better when reproducing music; this makes it particularly suitable for outdoor installations where musical presentation constitutes part of the program. Use of this type of unit outdoors results in reproduction that is considerably less *horny* than reentrant delivery.

However, the flare type unit is not particularly brilliant at the high-frequency end as a rule, and should be supplemented by multi-cellular horns to carry the high frequencies. The two kinds should be mounted together in pairs or clusters to give the effect, in any part of the audience, of a common sound source for the composite sound. Flares are not particularly satisfactory for indoor work.

The multi-cellular type horn offers uniform distribution of the high frequencies. For this reason it is usually employed to supplement either flare or the cabinet type units, in outdoor

(*Continued on page* 46)

Another reentrant projector horn with a 4½" air column and 26" bell diameter. (Model DR-54; Atlas)

Audio

(*Continued from page 45*)

or indoor applications. It is particularly useful in theatres.

Slightly different construction is used for indoor and outdoor models. The outdoor units are naturally constructed of metal or some material that will be durable under all kinds of weather conditions. The indoor multi-cellular units are frequently cut from wood to provide a good solid wall for the horn that will not reverberate and produce undesirable resonances.

Cabinet Type Loudspeakers

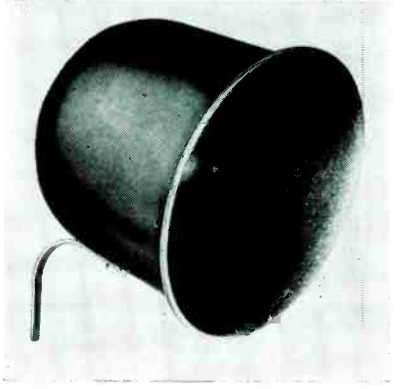
There are, broadly, two groups of cabinet speakers; small and large ones. The smaller cabinet speakers do not have a particularly wide frequency response, but are useful for installations where a large number are required, because they are inexpensive and also can be mounted in such a way as to be unobtrusive.

They are not particularly directional, but tend to radiate sound pressure uniformly in all directions from the point where they are mounted. Over the limited frequency range they cover, their quality is as good as can be provided by the enclosures in which they are mounted, which is, generally speaking, smoother than the quality of most horn units. Hence, they are better for indoor applications.

Cabinet speakers *can* be used out of doors, but they are not particularly well suited to withstand weather conditions and should only be used in temporary installations.

The larger type of cabinet loudspeaker has the best frequency range of any and is similar in construction to some types of enclosure employed for living room use. There is one principal difference; instead of being suited for a corner position, as most living room loudspeakers are, rec-

A reentrant speaker that is particularly adapted to mobile applications. (Model AR-10; Jensen)



tangular construction is employed to permit use in any position.

The larger type of cabinet loudspeaker employs some kind of woofer/tweeter arrangement, either a dual concentric unit, or else a separate woofer unit with a multi-cellular high-frequency unit mounted in the same cabinet. This kind of speaker is extremely expensive and can only be employed where relatively few are necessary.

However, because of its superior frequency response it is often possible to use, say, two of the cabinet loudspeakers, where a considerably larger number of inferior type would be needed to cover the same area. The larger cabinet speakers are particularly useful in small halls or theatres where the principal presentation comes from a stage or platform. Two of them can be placed, one on either side of the stage or platform, and the resultant sound reinforcement gives a very good impression of coming from the stage or platform.

Multiple-Speaker Applications

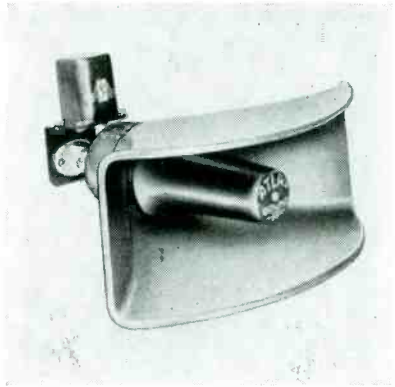
The same arrangement can often be used in larger auditoriums; smaller cabinet loudspeakers judiciously placed toward the rear, can be used to reinforce the sound when it becomes too weak from the front speakers. However, the larger proportion of the sound energy should be delivered by the larger cabinet loudspeakers, so as to give a good impression of sound source in all parts of the auditorium.

Mounting

With all types of speakers, considering the application intended, one must consider the mounting arrangements and the best impedance to use. The larger type cabinet normally sits on the floor in a convenient position, but all of the other speaker types need

(*Continued on page 48*)

A wide-angle flare projector designed for paging and talk-back intercom industrial-marine-mobile services. (Model CJ-30; Atlas)



Audio

(*Continued from page 47*)

some means of mounting to a convenient location.

Outdoors, the units can be mounted on poles or part of a stand structure. Indoors they must be mounted on any convenient brackets or wall surfaces. Some thought must be given to the kind of application for which they will be required and whether the mounting provided is adequate and suitable.

Impedance

The choice of suitable loudspeaker impedance will depend on the method of operation; example, how many speakers are to be used together in one installation. If a number of loudspeakers are to be used in the same building, it may be necessary to operate some louder or quieter than others to get complete audience coverage, while avoiding undesirable echo effects. Different techniques can be used to vary the distribution of sound energy to a number of loudspeakers in a system.

For smaller installations, an impedance of 16 ohms is the most useful. Provided not too many are used, they can be connected in parallel on to the same amplifier for equal power distribution. If some are required to receive less power, a suitable resistance can be connected in series with the loudspeakers requiring lower level.

For larger installations the foregoing method is wasteful of audio power. A large number of 16-ohm loudspeakers, connected in parallel, results in quite a low impedance, and a considerable proportion of the audio power will

Omni-directional dynamic (moving-coil) **dual-impedance indoor-outdoor microphone that can be used as a hand mike, attached to a lavalier cord or set up on a desk or floor stand. May be connected to a 50-250 ohm line, or high-impedance input (100,000 ohms or more).** (Model 535 Slendyne; Shure Brothers, Inc., 222 Hartrey Ave., Evanston, Ill.)

be lost. Also, it a number of resistances are used in series with individual loudspeakers, a considerable portion of the total audio power may be dissipated in the resistors, instead of getting to the loudspeakers; this can also be wasteful of power, and necessitate an unduly large amplifier.

Thus, for the applications requiring, say, more than four loudspeakers, it might be better to consider the use of a higher impedance loudspeaker, employing some kind of transformer to step the impedance up, so that a high impedance or constant voltage line system of distribution can be used. This enables audio to be *piped* round the installation, rather like an electrical installation; loudspeakers can be connected to the line at any point and the transformer connection adjusted to deliver the required power to that particular loudspeaker. This arrangement can be much more versatile for the larger installations.

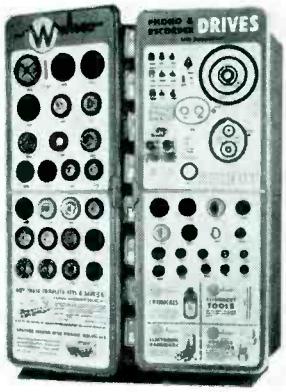
Amplifier Features

Choice of a suitable amplifier or amplifiers is the next factor one must consider, and a number of features must receive attention. Shall we have the amplifier in one piece or two? Are we going to have a single unit to work from one or more microphone inputs right through to the loudspeakers, or shall we use a separate preamp or mixer to handle the microphones, amplifying the input from them up to a suitable level and then transfer this to a separate power amplifier that feeds the loudspeakers?

One has to define carefully the kind of work the amplifiers are required for in making a decision. For many

(*Continued on page 54*)

Phono-recorder drive display said to hold entire line of belt and drive replacement parts for every major phono and tape recorder. Reference and comparison charts accompany display. (Walsco Electronics Corp., 3602 Crenshaw Boulevard, Los Angeles 16, Calif.)

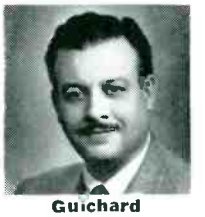


PERSONNEL

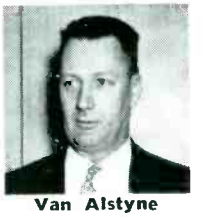
RAY S. GUICHARD, formerly director of publications and training of the Capehart-Farnsworth service department, has been named assistant service manager for Spartan division service operations by The Magnavox Co., Fort Wayne 4, Ind.

MELVIN E. KRUMREY has joined the Quam-Nichols Co., Chicago, Ill., as assistant manager of the distributor division.

FLOYD VAN ALSTYNE has joined Acme Electric Corp., Cuba, N. Y., as sales engineer for southern New York state.


Guichard


Krumrey

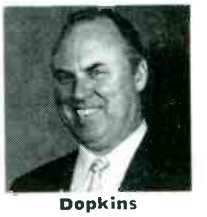

Van Alstyne

° ° °

HENRY FOGEL, president of Granco Products, Inc., has been named chairman of the board of a wholly owned subsidiary of the company, Granco Sales Corp. . . . LOYD DOPKINS has been elected president of Granco Sales and will retain his position as vice president in charge of sales of the parent company.

FRANK APPLE has been named ad manager of Centralab Division, Globe-Union, Inc., 900 E. Keefe Ave., Milwaukee 1, Wisc.


Fogel


Dopkins


Apple

° ° °

ALBERT COUMONT, formerly service coordinator of RETMA, now with Sprague Products Co., North Adams, Mass., has been named assistant to the president, in charge of Sprague's educational program in both the service and school fields.

° ° °

KENNETH H. BROWN, formerly service manager of Bendix, has been appointed service manager of the TV-Radio division of Westinghouse Electric Corp., Metuchen, N. J. . . . AL KUTTRUFF, formerly service manager, will remain as Brown's assistant.

° ° °

ARCHIE ANDERS, vice president in charge of sales of the Ie Manufacturing Co., Chicago, Ill., has taken over the duties of Sidney Gracen, recently resigned general sales manager.

° ° °

EDWARD C. FRITZ, JR., has been named vice president of Cody Advertising, Inc., 30 W. Washington Blvd., Chicago 2, Ill.

° ° °

LEO G. SANDS, president of Sands Associates, Inc., 535 Ramona St., Palo Alto, Calif., has been elected a director of Cymac Corp., Pomona, Calif.

° ° °

BURTON BROWNE, head of Burton Browne Advertising, 619 N. Michigan Ave., Chicago 11, Ill., has been named to an All-Chicago Citizens' Committee by Richard J. Daley, Mayor of Chicago.

Stacked Modules

(*Continued from page 34*)

connection and assembly of these new components into larger component packages which could be supplied to a functional specification.

The result of this program (*the Tinkertoy project*) was the development of a mechanical production system for the fabrication of functional components performing to specific dynamic specifications. Starting with ceramic insulators ⅜" square, electrodes are painted on the ceramic surface to electrical tie points (notches in the wafer), and components which have been specifically redesigned to enable them to be automatically positioned and fastened to the conducting paint surface, are assembled to these ceramic wafers. The various combinations of components on ceramic wafers are then assembled together in a vertical stack by means of wires which act as electrical interconnections and mechanical supports.

There are at present only 7 different shapes of sub-components; resistors, capacitors, etc. These components are positioned and assembled to their supporting wafer in only one manner irrespective of the circuit configuration for which they are intended. Consequently, it is possible to manufacture an endless variety of circuits on the same machines without requiring long set-up times when changing from one module type to another.

The virtues of this new production system were demonstrated in 1954 by the successful production of 7,000 Sonobuoys (comprising a total production of some 75,000 modules) for the Navy. Soon after the results of the pilot production run were announced, manufacturers started investigations to see whether modules would lend themselves to commer-

(*Continued on page 66*)

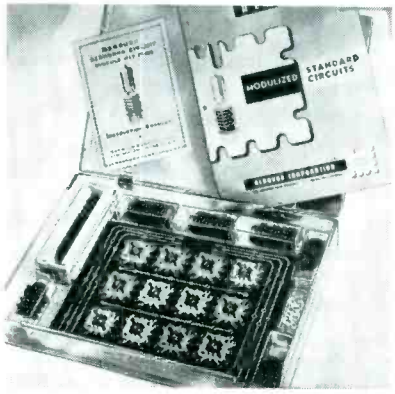


Fig. 7. A standard circuit kit containing video modules.

Servicing Helps

Video Lead Dress . . . Tube Pin Soldering Localizing HV Problems‡

CARELESS LEAD DRESS, involving the lead which carries video information to the picture tube socket (cathode in many chassis, as the Bendix), can cause considerable confusion and lost trouble shooting time. If the lead rides over the horizontal oscillator, a slight horizontal jitter takes place. Resting close to the yoke or yoke plug causes ringing; very pronounced, depending on proximity of the lead to the deflection yoke. Everything points to trouble in the sync circuits but every tube, component and voltage measurement says this is not so.

To correct, the lead should be dressed away from the yoke and horizontal oscillator tube. It may be helpful to tie the lead in a permanent desirable position with a piece of cord.

Pin Soldering

WHEN RESOLDERING picture tube pins, which are making intermittent contact, the *solder-flow* problem may be solved in the following way.

A short piece of copper wire should be inserted into the pin opening alongside the wire making faulty contact. This will allow the solder to flow readily inside the pin, resulting in a solid contact.

Localizing High-Voltage Troubles

TO TROUBLESHOOT the high-voltage section of TV receivers, best results will be obtained by localizing the defect through a process of elimination.

The development of high-voltage is the result of many circuits, any one of which can cause a partial or complete loss of the second anode voltage. Incidentally, all tubes must be carefully checked first and be free of defects. Also, since certain controls, such as horizontal drive, can also cause a loss of *hv*, if improperly adjusted, their adjustment must be checked, too.

The initial step in localizing the defect is to check for presence of high voltage. This may be done by use of a *vtvm* and a high-voltage probe. Some check for high voltage presence by shorting the second anode lead to ground and drawing an arc (*dc* arc should be bluish-white) which should be approximately one inch long. This last method may be controversial; but it shows whether or not there is high voltage present. If high voltage is present the defect is forward of this point and most likely in the picture tube.

Should little or no high voltage be available at this point the next step is to check for presence of *rf* voltage at the plate cap of the high-voltage rectifier. A bluish-purple arc (*ac*) approximately one-inch long should exist at this point. (*Caution:* This arc should not be drawn directly to ground, but merely by placing a well-insulated metal screwdriver near the cap.) If the arc is present, but there is still no high voltage, the *hv* rectifier should be checked for proper filament heating. Often the filament resistor is damaged to the point of high resistance or an open circuit. A positive check can be made of the filament supply by substituting a 1.5-*v* battery supply; however, care must be taken for proper insulation above ground, since the filament sup-

‡*Based on Bendix field notes.*

ply is at a *dc* potential, equivalent to the high voltage that is developed by the flyback.

Now the plate cap of the high-voltage rectifier tube should be removed and a check made for *rf* arc off the open cap. The appearance of the arc under these conditions would then indicate an extreme overload of the high-voltage rectifier tube. It is possible that the filter capacitor is shorted and is loading down the output stage.

Should no definite indications of deficiency be noted up to this point, the horizontal output stage should be checked. A slight *rf* arc, up to ⅛", should be produced when the plate cap of the output tube is checked with the same method which was employed on the cap of the rectifier tube. If this does not occur, it is time to resort to a *vtvm* check, testing for *B+* on cap of horizontal output tube; cap from tube should be removed first as a safety measure for the meter. If *B+* is absent, there is an open circuit between the cap and the *B+* supply. It is possible that the flyback transformer has an open winding and should be checked with an ohmmeter. If the *B+* is present, the grid of the output tube should be checked for proper bias. The drive signal applied to the grid of the output tube develops approximately 20-25 volts of bias in the average receiver. This point may also be checked with 'scope for approximate frequency of applied signal (15 *kc*) and peak-to-peak reading; approximately 90 volts.

Some horizontal oscillators are supplied by *B+* boost. If there is no flyback action, the boost will be absent and the output of the oscillator stage will be considerably lower, resulting in an accompanying smaller signal on the output tube grid.

With normal drive on the output tube and no response in the flyback network, it is time now to delve into the flyback and sweep circuits.

When no drive is present on the grid of the output tube, the trouble is isolated to the oscillator section or phase detector circuit. In Bendix receivers, these two stages can be isolated further by grounding pin *1* of the horizontal-oscillator tube. This eliminates any control the phase detector has on the oscillator. If the fault is in the phase detector, the oscillator will immediately break into oscillation and high voltage will be returned. If this action does not bring the oscillator into operation, the trouble must be located in the oscillator itself.

Once a defect has been isolated to a particular stage or section, the major portion of the service job is complete.

Audio

(*Continued from page 49*)

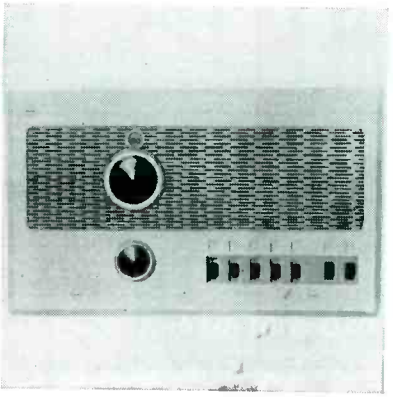
of the smaller permanent installations a single unit amplifier is the best, simply because it is less expensive and gives performance that is almost indistinguishable from a two-unit job. But, for equipment intended to be used in a variety of applications, it is often better to get separate units.

For example, if the equipment is to be used for some smaller and some larger jobs, it may be possible to use a single preamp or mixer unit to take care of the input end with one or more power amplifiers, according to the number of loudspeakers that have to be fed. In a smaller installation a single power amplifier will suffice, while for bigger ones the same preamp or mixer can be used to feed a number of power amplifiers.

On the other hand, separate units can also be helpful where it may sometimes be necessary to increase the input facilities. Suppose there is the possibility that a large number of microphones may sometimes be required. Use of a separate preamp or mixer provides a flexible arrangement; it becomes easy to add on another unit of the same type to accommodate the additional microphones feeding the same power amplifier system.

The next thing to be considered is the power output required. Here again the choice will depend upon applications for which the amplifier is to be used. There is no point in

Radio-intercom system, for use in the home, which includes a control-master, four remote speakers and all necessary installation material. The entire system mounts flush in either plaster or plasterboard walls and serves to distribute radio programs to any or all remotes for home entertainment; provide intercom between the master position and any or all remotes for convenience, and monitor any or all stations from any or all other stations for safety and protection. Built-in AM radio uses an all printed-wiring 5-tube superhet. (Model RC-5; Harman-Kardon, Inc., 520 Main St., Westbury, L. I., N. Y.)



buying a 50 or 100-watt amplifier, where maybe a 25 or 30-watt amplifier would suffice. On the other hand, if you have a number of possible jobs, some of which may require 50 watts, while some only require 25 watts, and you do not contemplate taking on more than one job at a time, the obvious solution would be to buy a 50-watt amplifier. Then you will have a little in reserve for the jobs that only require 25 watts.

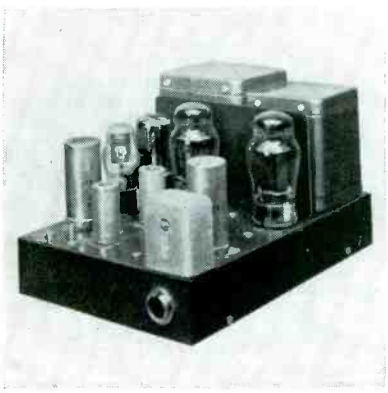
Alternatively, if you have ideas of expansion and getting someone else to work with you, so that you might be undertaking a number of small jobs at one time, while at other times you may concentrate all of your facilities on one large job, then the better solution is a larger number of small power amplifiers. For the smaller jobs, the latter will give adequate output, while for the larger jobs the inputs can be paralleled up and the outputs fed to different sections or groups of loudspeakers, so as to provide sufficient total audio power for the larger installation.

Output Impedances

Coupled with power output, one must also think about output matching arrangements. This must also be considered with the impedance of the loudspeakers selected. If all the loudspeakers are of one fixed impedance, for example 16 ohms, then different tappings should be provided on the

(*Continued on page* 56)

Public address and commercial sound system 35-watt amplifier claimed to have a total harmonic distortion of less than .5% from 25 to 20,000 cps; frequency response ±.5 db from 5 to 50,000 cps. Source impedances of 30/50, 125/150, 250/300, 500/600 with plug-in transformer; load impedances of 8, 16 ohms and 70 v line. Output impedance less than 3.5% of nominal load impedance. Noise level 85 db below full output. Continuously variable composition volume control. (Model 341A; Altec Lansing Corp., 9356 Santa Monica Blvd., Beverly Hills, Calif.)



Audio

(*Continued from page* 55)

amplifier, so that a varying number of loudspeakers can be connected according to individual requirements.

If the amplifier is to be used permanently in the same installation with a fixed number of loudspeakers, a single impedance output may be satisfactory, such output being arranged to match the particular output load to which it will be connected. For example, if four 16-ohm loudspeakers are connected in parallel, a load of 4 ohms will result. So an amplifier with a single 4-ohm output would be adequate. However, the additional cost of multiple-matching facilities on a power amplifier is negligible; thus, it is probably advisable to get the additional tappings in case the installation requires modifying at any time.

If you contemplate undertaking the larger kind of installation, using high impedance or constant-voltage distribution for the loudspeaker system, then an amplifier with at least one tapping at a higher impedance than 16 ohms, say 250 or 600 ohms, will be required.

Phono Repair Tips

IF LOW-PITCHED RUMBLING sound comes from a loudspeaker on an intermix type phono using velocity tripping° (trip link causes a trip pawl to engage a projection on the turntable hub and start the mechanism into cycle) while a record is being played, motor grommets should be checked to be sure that the motor is freely suspended on them. Motor lead wires should have enough slack to allow the

motor to float. Motor rumble may also be caused by an unbalanced motor rotor. If this is the case, the motor must be replaced.

Defective turntable bearings are another cause of rumble. They should be checked for dirt, defective balls, binding between balls and ball retainer and rough surfaces on washers. The ball bearing, sleeve bearing and washers should be cleaned and lubricated with light mineral oil.

A rapid thumping sound while the motor is running may indicate a flat spot on the idler wheel. This condition should clear up within ten minutes of running time. If thumping continues, the turntable should be removed and the rubber tire on the idler wheel checked. If the tire surface is not smooth and even, it should be replaced. Should the idler-wheel bearing show signs of excessive wear (or be extremely wobbly), the idler wheel should be replaced.

Dragging

Dragging of the cartridge on the record is often caused by a bent needle which must be replaced. Loose cartridge mounting screws can also be at fault.

Improper Needle Setdown

Failure of a needle to set down properly on 10″ records is generally caused by a poorly adjusted pickup arm. Setdown position of the needle is adjusted by means of a screw mounted on the hinge arm assembly. When the correct setdown is obtained for the 10″ position, the 12″ and 7″ setdown will also be correct.

Another cause of improper needle setdown is binding in the pickup arm shaft and sleeve. Burrs and rough surfaces should be filed off, and the shaft polished and lubricated.

The 7″ setdown lever and 12″ record selector should be checked to be sure there is no interference with their operation. Again, a bent needle may be at fault; replacement will be necessary.

A broken 12″ selector spring might also be responsible for improper needle setdown. If this is the case, the selector will not cock.

A 12″ disc with an undersize diameter could cause failure of the needle to set down properly. Setdown position of the needle for 12″ records is determined by the edge of the record striking the 12-inch selector. If the disc has a diameter of less than 11⅞″, ± 1/32″, it may fail to depress the selector far enough.

*Such as the Zenith S-14068,69,70.

Tube-Transistor Tests

(*Continued from page* 32)

to the base. This current is a function of temperature, resistivity of the germanium, resistance from base to ground, and the extent of contamination on the surface of the transistor. This leakage current is somewhat of a nuisance current, comparable to the grid current in a gaseous tube.

Portable Transistor Tester†

A transistor tester which checks leakage current* is diagrammed in Fig. 1 (p. 32). A portable model, it incorporates a front panel ammeter (reading *good, fair* and *bad*) and a 6-volt battery, to be used for checking *npn* and *pnp* type transistors.

With the circuit as shown (switch open), a reading of over .75 *ma* at room temperature indicates that the transistor under test must be replaced.

Transistors are essentially current amplifiers; that is, a small change in base current produces a large change in collector current. An important check, therefore, is the amount of current gain. This can be accomplished by the Fig. 1 unit with the switch closed. An increase of at least .3 *ma* indicates a good transistor. With a high gain transistor such as the 2N43, the collector current may increase almost 3 *ma*.

High leakage or shorted transistors checked with this unit will read poor, marginal transistors will read fair, and good ones will read good. Generally, acceptable *pnp* transistors read good while, because of the inherent small leakage current of the rate-grown *npn* type, transistors such as the 2N78 hardly indicate any leakage current at all.

With the gain button depressed, an increase of at least one scale division indicates a satisfactory transistor. It should be kept in mind, however, that this corresponds to the acceptable gain of the lowest gain transistor rated.

Combination Tube-Transistor Checker‡

The wiring diagram of a combination tube and transistor tester** appears in Fig. 2 (p. 32). The transistor checking section of this unit is independent of the remaining circuitry, incorporating 1.5- and 3-volt batteries, an ammeter, and a switch. The tester, essentially a balanced-bridge device, has a null balance, the transistor form-

*G.E. **RCP model 325.

ing one arm of the bridge. Three positions of the master test switch are used for *npn* transistors, and three positions for *pnp* transistors, so that proper battery polarity can be maintained. For position *1* in either direction, 1-*ma dc* is delivered to the transistor under test. In position *2*, the base current is adjusted by the balance control, so that the transistor draws precisely 1 *ma* and becomes one arm of the bridge circuit. In position 3, the base current is changed by exactly 10 microamperes, and the gain is read directly on the meter.

Protection for the meter from reverse current, caused by a shorted transistor, is provided by a germanium diode-limiting circuit.

The tube-testing portion of the unit shown is powered from a 115-volt *ac* line. Featured are automatic short testing between all tube elements, separate plate conductance and grid conductance checks, a 440-volt high-voltage supply for testing picture tubes, and a separate screen grid supply. The unit also provides a check for ballast tubes and pilot lamps; incorporated also is a picture-tube rejuvenating circuit. An automatic monitor circuit reveals the line voltage at all times.

All triodes can be tested for both plate and grid conductance. The plate conductance test is accomplished by operating a lever switch (S_6), which is held in place while a pushbutton switch (S_7) is depressed to measure the relative G_m, with a signal voltage applied in this manner to the tube grid. The meter has a 100-microampere movement.

Grid Conductance Tests

Grid conductance tests are performed by depressing a pushbutton (G_c) while a *plate test* lever switch is held in the *plate* position.

Signal voltage applied through a switch (S_7) is taken from the opposite end of the power transformer, from which both plate and screen voltages are supplied. This provides a 60-cycle signal out-of-phase with plate and screen voltages, which has been found to provide an accurate measure of G_m.

The pentode test is the same as the triode test, except that a screen voltage of 72 is selected by a separate switch. The current read is therefore true plate current, not plate and grid current.

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†*Based on notes prepared by* ***Hugh R. Lowry*** of ***General Electric.***

‡*From report by* ***Robert E. Ricketts, chief engineer of Radio City Products, Inc.***

Transistor Book Publication Ceremony

William P. Bevitt **(left), transistor applications engineer in the commercial engineering department at CBS-Hytron, presenting advance copy of his book on transistors and transistor circuits at book-publication meeting to** Benjamin Alexander, **manager of CBS-Hytron's semiconductor operations in Lowell, Mass.**

TV Antennas

(*Continued from page 42*)

tic spray protects bolts and nuts used to hold the reflector to the cross-arm.

Another part of the antenna system that should be sprayed is the twin-lead section which extends from the antenna insulator to the first standoff insulator. Since this portion may be flexed by the winds, the plastic coating affords added stiffness. This section of twin lead should be strung tightly between the antenna insulator and the first standoff to add rigidity and minimize movement from the wind. Constant flexing of this section may break off the twin lead from the antenna insulator terminals.

The U-bolt section, which clamps the cross-arm to the mast, should also be sprayed. Here a liberal application of the protective plastic coating is important to prevent corrosion or rust formation and consequent loosening of the cross-arm from the mast.

It is also a good idea to use the plastic spray on every standoff insulator at both the metal clamp section where the insulator clamps around the

Spraying silver (or aluminum) enamel on antenna reflectors; several coats applied in succession to provide extra protection. The twin-lead section should be pulled tight before antenna is fixed firmly on the roof.

Coming Event

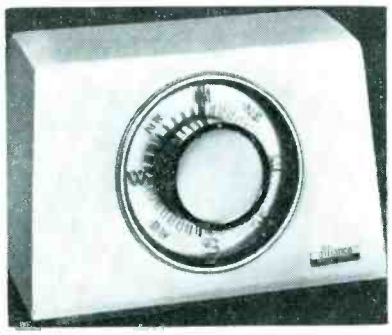
Fifth Annual Convention-Trade Show
National Community Television Association
June 12, 13, 14
William Penn Hotel, Pittsburgh, Pa.

mast, as well as at the standoff insulator portion. Spraying at the latter will minimize losses and will also lock the twin lead more firmly into the insulator of the standoff. Other places where the spray is recommended are the clamps which hold the mast to the house.

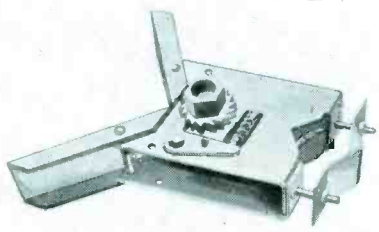
If a chimney mount bracket is utilized, the entire bracket, plus the bolts and nuts, should be sprayed liberally. If guy wires are used, the spray should be used on the guy wire ring where the guy wire is fastened to the antenna mast, as well as at the other end of the guy wire which fastens to an eye-bolt on the side or roof of the house. If turnbuckles are employed in the guy wire, they should be sprayed also, since turnbuckles often rust easily and become the weakest link in the antenna system. A rusty turnbuckle may give way during high winds and cause collapse of the antenna.

A few minutes spent in giving the antenna system a protective coating will pay off in extended antenna life and customer satisfaction.

[All photos courtesy of the Snyder Manufacturing Co.; antenna shown is model AX-100 Torque-Tenna.]



Decorator color rotator control cases available in forest green, ivory and mahogany grain finishes, that will be featured in rotor campaign stressing importance of antenna rotation in color-TV reception. (Models T-12 (manual control) and U-98 (automatic); Alliance Manufacturing Co., Alliance, O.)



TV antenna mast mount with a ratchet grip which can be used on chimney or similar area where a strap is employed. Will fit all masts up to 1¾" diameter. Made of heavy gage steel, plated to prevent rust, and supplied with 24' of strapping. (Models 9218 and 9219 Ratchet Mount; the Television Hardware Mfg. Co. (Division of General Cement Mfg. Co.) 919 Taylor Ave., Rockford, Ill.)

[Additional TV-antenna development news on page 70.]

Transistor Car Radio

(*Continued from page* 19)

resistor, which biases the base .3 volt negative, with respect to the emitter. Under static conditions a small amount (about 45 *ma*) of base-emitter current will flow. The collector circuits are connected in reverse bias, since the collectors are connected to ground through one-half of the output transformer primary winding. The collectors are negative, with respect to the emitter, by the battery voltage.

The audio signal from the first audio amplifier (12BF6) is coupled into the output stage through an input transformer. As the base of one transistor is driven positive, the other base is being driven negative. The base that is being driven negative will cause an increase in forward bias and an increase in current through the emitter and collector circuits. The base that is driven positive will receive a decrease in forward bias, and the emitter and collector currents of that transistor will naturally decrease. On the other half cycle of the audio signal, the operation is reversed and the transistor that was lying dormant will now amplify the signal, while the other transistor will be driven toward cutoff. This results in push-pull operation, very similar to the conventional push-pull circuit using tubes. The input signal will be reproduced in the primary of the output transformer, but will be greatly increased in power. The output transformer transfers this audio power to the speaker.

A thermistor (95) is used in parallel with the 4.7 and 39-ohm resistors in the emitter-bleeder network. The thermistor is bolted directly to the chassis and will vary the bleeder resistance as the temperature of the chassis varies. This serves to compensate automatically the forward bias of the base-emitter circuit to counteract conductivity changes that come about due to chassis temperature changes.

In the power supply, the vibrator is replaced by two 2N174 transistors, connected in a blocking-oscillator type circuit. The power transformer used in this unit is quite different than that found in most auto radios. Since the $B+$ current drain of the radio is very small, a small transformer, but one-inch square, is required. The winding is on a small ferrite core. This transformer consists of center-tapped primary and center-tapped secondary windings, and a third winding, untapped, which we will refer to as the induction winding. This induction winding is shown just below the primary winding on the schematic.

The emitters of the two transistors are tied together and returned to the

A+ voltage through an on-off switch. The collectors of the two transistors are connected to ground through one-half of the power transformer primary winding. This applies a reverse bias on the collector as compared to the emitter. A bleeder-resistance network is present between the emitters (−12 *v*) and ground. This network consists of 10-ohm and 150-ohm resistors (R_{78} and R_{97}). As the on-off switch is turned on, the +12 volts of the car's battery is connected to the two emitters and to the bleeder network. Due to the bleeder action, approximately .75 of a volt will be dropped across the 10-ohm resistor. The forward bias on the base-emitter circuit of the lower transistor at this instant is .75 *v*. The bias on the upper transistor will be zero since there is no current flow through a 10-ohm resistor (R_{77}). The forward bias on the lower transistor will cause that unit to conduct. The collector current flows through the lower half of the power-transformer primary winding and induces a voltage in the primary induction winding. This induced voltage will cause a .47-mfd capacitor (C_{87}) in this circuit to charge. The charge current for this capacitor will flow through R_{78} in a direction that causes an increased voltage drop across the resistor and increases the forward bias of the base-emitter circuit for the lower transistor. Increasing the forward bias causes a corresponding increase in collector current and an increase in the induced voltage in the induction winding. In a very short part of the cycle, the transistor resistance between emitter and collector falls to a very low value. The collector current increases at a more leisurely rate, being limited chiefly by the inductance in the collector circuit.

This action takes place until the transistor times the base current. collector current equals *beta* of the When this point is reached, the collector current cannot increase further and with no further increase in collector current, the induced voltage in the induction winding will disappear. With the disappearance of the induced voltage, the forward bias of the lower transistor will immediately return to .75 *v*, causing that transistor to offer more resistance to collector current flow. The current through the lower half of the primary winding will now start to decay, inducing a voltage of opposite polarity in the induction winding. The .47-mfd capacitor (C_{87}) will discharge and attempt to charge again with the opposite polarity.

The discharging and charging current for this capacitor will flow

(*Continued on page 67*)

Versatile Service Shop

(*Continued from page 17*)

side by side. Across the front and the back and the shelf are *ac* receptacle strips to supply power to instruments and equipment being repaired. A number of drawers provide space for such things as chassis extension cables, test leads for the instruments not in use, lesser used tools, and many other small items that usually tend to clutter up a shop. Small partitions have been built in at the ends of the shelf for indexes, parts-replacement catalogs, mirrors, and phono test records.

The nearest *vhf* stations are in Baltimore and Washington, about 80 to 90 airline miles away; Philadelphia is about 100 miles (airline) away. This puts us in a type of fringe area that requires more elaborate antennas. We also have an *uhf* station (channel 16) in town, which carries some network programs. A few set owners are content to receive only this local station. The majority, however, still want reception of the *vhf* stations in Baltimore, Washington and Philadelphia; and are willing to buy the proper antenna installation.

A good antenna system must be used for satisfactory reception of the *vhf* channels in this area, and every antenna must use a rotator.

About half of the antennas in the community are on top of homes; the other half are mounted on creosoted poles fifty to sixty-five feet in height. Antenna installations vary in cost from $75 to $300; the average cost of an installation with a twenty-foot pushup and a rotor is between $100 and $135.

One truck with ladders is used primarily for antenna work. The installation of new antennas and the service, repair, and replacement of old antennas accounts for about one-fifth of our yearly volume.

The benches that are used for television service are also equipped with the necessary power supplies for auto radio work. We have plenty of parking space outdoors to perform this type of service, and in inclement weather we have access to the facilities of a garage next door.

We have also been active in *hi-fi* sound system work. During the past months, we have installed five custom *hi-fi* systems at an average of about $400 per system, and a $2,000 intercom system in one of the local elementary schools. This type of work, besides being profitable in itself, has helped to boost our reputation and bring in new customers.

Three years ago we bought the test equipment necessary to work on two-way radio installation and service; a lab-type signal generator, *rf* wattmeter, frequency meter, and FM deviation meter, plus three 6-volt power supplies. Each power supply is capable of 20 amperes continuous duty. A panel containing two meters and a triple-pole switch, underneath the shelf of the bench, connects the three power supplies in parallel for six volts at sixty amps, or two of them in series for twelve volts at twenty amps. This is capable of handling the power requirement of almost any two-way radio mobile unit. The investment in this equipment for two-way radio service was about $1,700.

We feel that two-way radio is a growing business and will become extremely important to us in the future. Last year we installed approximately fifty mobile units and five base stations. Our schedule now calls for the installation of twenty-seven mobile units, one 250-watt base station, and one 60-watt base station. This work will keep two men busy full-time for almost three weeks.

Our experiences have underscored the fact that a properly-managed small community shop that provides prompt, courteous, and honest service can prosper. The operator can make a very comfortable living and enjoy independence.

Granco headquarters during Chicago Parts Show: Edgewater Beach Hotel, Chicago

New INSTRUMENTATION Developments

Dynamic selenium rectifier tester which pulses continuously rectifier under load conditions; flashing red light monitors pulsing action. Shorts, leakage and open circuit conditions are indicated on good-bad scale of meter. Five fixed resistor loads; calibrated to test rectifiers from 20 to 1000 ma. (Model 610; Winston Electronics. Inc., 4312 Main St., Philadelphia 27, Pa.)

(Above)

Tube checker (kit or factory wired) for performing emission and mutual conductance tests. Five tubes may be plugged into tester at one time and each checked separately by rotating a switch. Also said to test transistors and individual sections of multipurpose tubes. Gas and life tests are included. (Model 116; The Precise Development Corp., Oceanside, N. Y.)

WIDE-RANGE 5-INCH 'SCOPE

A wide-range 5-inch 'scope *3441-A*, that is said to permit polarity change to vertical input amplifiers and keep waveform on picture tube showing in conventional manner, has been introduced by the Triplett Electrical Instrument Co., 286 Harmon Rd., Bluffton, O.

Features include calibrated meter for comparison voltage measurements; multivibrator type internal sweep generator (providing linear sweep voltages up to 60 kc); wide frequency range for FM, b-w and color-TV servicing; internal phase-controlled horizontal sweep of supply frequency (facilitating use of 'scope with sweep generators); and calibrating meter with two ranges, 0-3 and 0-10 *v p-p*. Z-axis is provided for intensity modulation of trace.

* * *

PORTABLE WAVE ANALYZER

A portable wave analyzer for testing performance of hi-fi and music-system amplifiers (model *21*) has been developed by Donner Scientific Co., 2829 Seventh St., Berkeley, Calif. Used to measure harmonic and intermodulation distortition and amplitude and frequency over a range of 30 to 50,000 cps. Said to allow matching of tubes for minimum distortion and determine degree of performance deterioration caused by aging of components in amplifiers. Full scale deflection of meter, calibrated in both percentage and db; can be obtained with signal inputs of 500 *v* or as little as 160 microvolts *rms*.

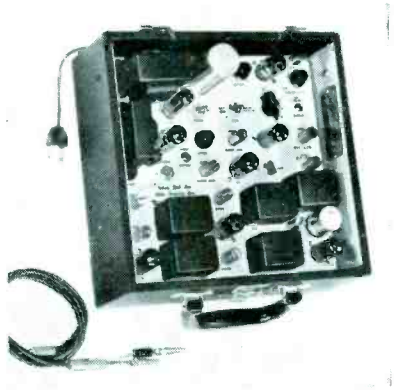
* * *

ELECTRONIC SWITCH

An electronic switch kit (model S-3) allowing simultaneous 'scope observation of two input signals by producing both, alternately, at its output is now available from Heath Co., 305 Territorial Rd., Benton Harbor, Mich. Four switching rates are selected by panel control. Provides gain for input signals. Frequency response is said to be ± 1 db 0 to 100 kc. Sync output to control 'scope sweep is included.

(Left)

A 6/12 volt dc power supply for servicing and operating low-power input 10-watt mobile communications equipment. Uses ac line source. Provides regulation to handle instantaneous current requirements from standby to transmission. Delivers 6 v to 20 amp or 12 v to 10 amp; instantaneous current to 30 amp available to meet transmission test requirements. Maximum ac output ripple less than 5% at maximum load. Utilizes bridge-type rectifiers and voltage control stepswitch. (Model H: Electro Products Laboratories, 4500 N. Ravenswood Ave., Chicago 40, Ill.)

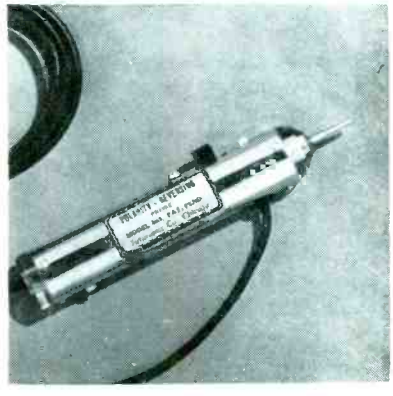


Portable color-display generator for color-TV sets. Provides three patterns for receiver screen; white line crosshatch, white dot and crystal-control color-display pattern. All generated frequencies are crystal controlled and locked together. Rf output frequency is in preset channels (2 through 6) to allow selection through built-in switching arrangement. Color display pattern sequence is orange, red, magenta, blue, cyan and green. Timer circuit included to hold sync over wide range of line voltages encountered in on-location servicing. Video output is 0-4 v p-p. Unit features 300-ohm output impedance; black positive or negative; 300 white dots (less those in blanking); sidelock color frequency crystal of 3.563795 mc; output 1 v p-p. Rf output voltage is .05 v maximum; .001 v minimum. Rf is modulated by all video outputs (60% modulation). (Model 660; The Hickok Electrical Instrument Co., 10521 Dupont Ave., Cleveland 8, O.)

* * *

(Below)

Polarity reversing probe for 1000, 20,000 or 100,000 ohms/volt voms. Provides control of signal polarity through miniature slide switch mounted in probe housing. Signal is fed to vom through small-diameter coaxial cable. Probe housing floats electrically for protection of operator. Unit features gold-plated steel housing and color-coded lucite end pieces. (Model 263; Futuramic Co., 2500 W. 23rd St., Chicago, Ill.)



Stacked Modules

(*Continued from page* 51)

cial, as well as military products. The conclusions of that study were as follows: (*1*) Modules could be used in almost every receiving tube circuit application which employed conventional components. (*2*) After the development of large production facilities, modules could be sold at a cost equivalent to the cost of the conventional components the module replaces.

At present modules are being used in a 6-tube *ac-dc* portable°; all of the components for this chassis are contained in two modules. A TV set manufacturer°° has announced that it will have a partially-modulized TV set available late this spring. Our company has announced that its module production facilities will be available to the radio-TV industry on or about the first of January, 1957.

The module will cause a change and a simplification in set repair techniques. In the event that a component becomes defective, trouble isolation only involves the determination of the defective stage. The defective module can then be removed and replaced by a complete unit. The total cost to a customer of a service call involving a defective component should remain approximately what it is today. The time saved in isolating a trouble down to a stage, rather than a component, should offset the higher list price of the replacement part. The saving in time should permit the Service Man to make a greater number of calls and repairs.

At present there are seven video circuits available and shortly a number of new circuits including audio, digital computer and voltage regulator types, are to be put into the product line.

Service Men will be called on ever increasingly to develop new methods and techniques for using and servicing these new products.

———

°*Motorola* °°*Emerson*

Color-TV

(*Continued from page* 21)

the horizontal sync pulse, but whose frequency (3.58 mc) and phase is accurately controlled at transmitter.

A b-w station's signal has three basic component signals; sound, video and deflection sync. Since the two additional signals, chrominance and color burst, are added to a b-w station's signal to comprise a complete color signal, there are five separate signals for the Service Man to consider when servicing; sound, video, deflection sync, chrominance, and color burst. The sound, video, and deflection sync signals are identical for both color and b-w, but the chrominance and color-burst signals are new and different. The chrominance signal is simply the color video information and the color burst is nothing more than a sync signal.

The five component signals of color transmission are selected by the tuner, amplified, converted to *if*, and amplified by the *if* amplifier. Signals are then separated and coupled to two detectors; sound-chroma and luminance. Luminance detector handles video and deflection-sync, while sound-chroma detectors handle sound, chrominance and color-burst.

Transistor Car Radio

(*Continued from page 63*)

through the two 10-ohm resistors (R_{77} and R_{78}), driving the base of the lower transistor positive with respect to its emitter and the base of the upper transistor negative with respect to its emitter. This biases the lower transistor in the reverse direction, cutting off its collector current completely. The upper transistor is now biased in the forward direction and collector current will start flowing through the upper primary winding of the power transformer. The voltage induced in the induction winding again appears, but in the opposite polarity as before, causing a forward bias on the upper transistor. Again the collector current will arise to *beta* times the base current of the upper transistor, at which time it will collapse and the cycle starts over again.

The frequency of oscillation is 20,000 cps, which is above the audio range, and thus no hum or buzz can be heard in the radio.

A .00022-mfd capacitor (C_{38}) is used to absorb the inductive kick of the transformer, as one transistor starts conducting and the other is cutoff. This inductive kick could place very high inverse voltages on the components for very short intervals which could be destructive.

The .47-ohm resistors in the emitter circuits of the 2N174 transistors and the .3-ohm resistors in the emitter circuits of the 2N173 transistors are *dc* degenerating resistors that adjust the forward bias applied to the transistors to prevent thermal runaway.

‡*Information in this report is based on transistor circuitry studies, presented as a part of the Delco Radio electronic school conducted in thirty General Motors training centers located throughout the country.*

•

UHF/VHF Front End

(*Continued from page 24*)

stagger tuned for rejection over the range from 41 to 46 *mc*. A 30-mmfd feedthrough furnishes low-side capacitive coupling to the pi-input circuit. A 12-mmfd capacitor increases the inductance of the input coil and provides *dc* blocking for *agc* voltages.

The input signal and *agc* bias are applied to the *rf* grid. A feedthrough plate-return capacitor provides a 180° phase shift for the neutralizing feedback.

A screen-grid peaking coil raises the impedance of the pentode input grid over the high-band *vhf* range; a screen-dropping resistor increases the screen damping.

Service Engineering

(*Continued from page* 28)

proper operation is to be assured, the main *A* current cannot pass through it. To overcome this a relay is used; this is activated through the ignition switch, while the main current passes through the relay contacts. Thus, the advantages of the switch are utilized, without hurting equipment performance.

Even though the transmitter and receiver used in our line of mobile equipment is identical with that supplied for station equipment, the maximum sensitivity available is rarely used to the greatest advantage. This is due to the effects of the car's ignition system, a built-in noise generator that constantly forces pulses of noise into the receivers. Fortunately, there are ways to reduce this noise.

The following noises are most predominate when a weak signal is being received, audio levels are incorrectly set, and the receiver is incorrectly aligned.

Ignition noise is identified by a regular popping noise heard in the speaker. The noise repetition rate increases as the engine speed is increased.

To remedy, resistor spark plugs or resistive ignition cable should be used in the high-voltage lines.

All clips, that depend upon pressure to make contact with the wire, should be soldered on the high-voltage lead.

Distributor points should be checked for signs of arcing; pitted points are a good indication of this. If this is found, the capacitor across points should be checked for value.

A coax capacitor should be connected to the *A* lead ignition coil to prevent noise from being fed back into the *A* system.

Generator noise appears in the speaker as a high-frequency whine as the engine speed is increased.

This can be suppressed by using a .5-mfd coax capacitor, rated high enough for the generator output to kill this noise. The capacitor should be inserted in series with the armature lead at the generator.

TV Tuners

(*Continued from page* 23)

antenna impedance for optimum noise figure; assure good selectivity and the highest possible rejection of unbalanced signals; transform the symmetrical signal from the twin leak input to a symmetrical signal needed at the grid of the amplifier; and contain minimum losses, because any loss in the input circuit deteriorates the noise figure of the tuner.

The cascode circuit is a unique amplifier with special properties. It has the gain of a pentode (the ideal tube for optimum gain) and the noise of a triode (the ideal tube for minimum noise). The cascode amplifier uses two triodes series-connected, so that the input triode is connected as a grounded-cathode triode and the output triode is connected as a grounded-grid triode. The input triode acts like a power amplifier, which transforms the high input impedance appearing at its grid to a low output impedance appearing at its plate, which is necessary to match the low input impedance required at the input of the grounded-grid (output) triode. The output impedance of the cascode circuit is a high impedance. With such a circuit, using high transconductance dual-triodes, it is possible to achieve 25 to 30 db of *rf* amplifier stage gain. Typical tubes designed for cascode use are the 6BZ7, 6BQ7A, 6BK7A, 6BC8, and 6BS8. The 6BZ7, 6BS8 and 6BQ7A are sharp cutoff triodes. The 6BK7A is semi-remote cutoff and the 6BC8 is a remote cutoff tube. Most tuner manufacturers prefer sharp cutoff triodes for cascode operation because of the magnitude of *agc* voltage available from simple *agc* systems. One great disadvantage of the cascode circuit is the required $B+$ voltage, which approximates 250. For low $B+$ TV receivers, the pentode *rf* stage is more desirable because to date rather poor cascode gains have been realized at near 125 volts cascode-stage $B+$.

Tuners also might be classified by the mixer-oscillator circuit arrangement. Two types of mixer circuits are used at present in *vhf* tuner work; either the triode or pentode circuit. The triode mixer has a low noise output (a most desirable property, particularly in mixers) compared to the pentode, but has the disadvantage of low conversion gain. The triode also has the advantage of being less microphonic, but the further disadvantage of high oscillator and incoming tuner *rf*-voltage feedthrough from mixer input to output. A similar problem of mixer output feeding back into the mixer input makes triode mixers less desirable. Most manufacturers now use a pentode mixer, with the local oscillator triode in the same envelope. The most typical mixer-oscillator tubes are the 6U8 and 6AT8. In the past, the 6J6 was widely used as a triode mixer-triode oscillator, but is now giving way to triode-pentode types.

COMPONENTS

MINIATURE RF NOISE SUPPRESSION FILTERS

Miniaturized *rf* noise suppression filters, *AF1108*, containing 14 toroids and 8 capacitor sections, with a noise suppression range of .15 to 1000 mc., have been designed by Astron Corp., 255 Grant Ave., East Newark, N. J.

Filters are hermetically sealed and are currently being produced for portable field equipment.

° ° °

5.6 OHM PLUG-IN FUSE-TYPE RESISTORS

Plug-in 5.6-ohm fuse-type resistors, *FZ1 Fuzohm*, have been announced by Clarostat Manufacturing Co., Inc., Dover, N. H.

° ° °

DUAL AUTO ANTENNAS

Three dual auto antenna sets, *Fireball FBD-35A*, *Nautilus NTD-14* and *Monarch RD-35*, have been announced by The Tenna Manufacturing Co., 7580 Garfield Blvd., Cleveland 25, O.

Each set features two antennas (one with a 1′ cable and the other with a 6′ cable), a 15′ cable with built-in 75-mmfd capacitor, T-connector and cable clips. *Fireball* model sweeps back at 50° angle. *Nautilus* has a tear drop mounting base with 25° sweep. *Monarch* disappears into seamless shield tube and is adjustable from flat to 30°.

° ° °

SMALL SIZE COMPOSITION ELEMENT CONTROL

Composition element, ⅝″ diameter, tab or bushing mounted, .2-watt controls (*series 44*) in 500 ohms to 5 megohms range, are now being made by Clarostat Manufacturing Co., Inc., Dover, N. H. Available with or without switch; switches *spst* or *dpst* for low voltage applications.

° ° °

FERRITE COIL ANTENNA

A replacement ferrite coil antenna for the broadcast range, *Ferri-Loop FL-6*, has been made available by Vidaire Electronics Manufacturing Corp., Lynbrook, N. Y.

Unit is packaged in a plastic bag with hardware, mounting brackets and instruction sheet.

New Quarters For Shure

New manufacturing and administrative building at 222 Hartrey Ave., Evanston, Ill., now occupied by Shure Brothers, Inc.

TV Parts... Accessories

ZENITH HORIZONTAL OUTPUT REPLACEMENTS

Horizontal and high-voltage output transformers, HVO-53, for use as replacements in Zenith television sets have been introduced by the Merit Coil and Transformer Corp., 4427 North Clark St., Chicago 40.

° ° °

METAL-TO-GLASS/ALUMINIZED CONVERSION KIT

A conversion kit, *C3*, which allows changeover from 21" metal picture-tube to all-glass or aluminized tube on all 21" Emerson TV sets, including side-tuning models is now being produced by the Colman Tool & Machine Co., Box 7026, Amarillo, Texas.

° ° °

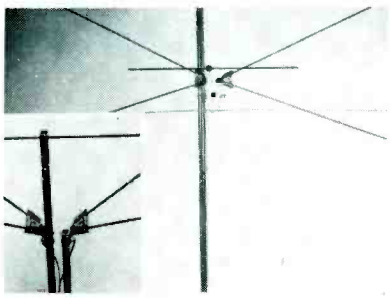
PICTURE TUBE BRIGHTENER

An all-purpose picture-tube brightener, the UB-160 Universal Britener, is now being offered by Anchor Products Company, 2712 W. Montrose Ave., Chicago.

The unit employs an isolation type transformer and operates with either series or parallel-wired filament circuits.

(Above)
John Winegard (left) **president of the Winegard Co., Ron Korf, manager of the Union Supply Wholesale Co., (Burlington, Ia.) and Hugh B. Cummings,** (right), **Winegard general manager, with the recently-developed Winegard** color-beam **antenna.**

(Below)
All-metal conical antenna with solid aluminum elements mounted on a giant tuning fork, which is said to eliminate common insulator. Closeup shows air-gap separating opposing elements of the antenna. (Miracle tuned-insulator model; Allweather Antennas Manufacturing Corp., 350 S. Egg Harbor Road, Hammonton, N. J.)



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BENCH-FIELD TOOLS . . .

MINIATURE SCREW-HOLDING SCREW DRIVER

A miniature screwdriver to hold extremely tiny screws securely while starting or removing, is now available from Walsco Electronics Corp., 3602 Crenshaw Boulevard, Los Angeles 16, Calif.

Screwdriver holds screws as small as No. *1* to *4* used in transistor radios and similar instruments. Available in both 4" and 7" lengths; tool has a ⅛" diameter shank.

* * *

CHASSIS-SET HAND TRUCK

A magnesium hand truck, *Hyker*, which walks upstairs on rubber-covered legs when its handles are pumped, has been developed by L-S Heating and Engineering Co., 900 W. Lycoming St., Philadelphia 40, Pa.

Unit lifts loads over furniture and obstructions on screw-operated lifter shelf.

* * *

MINIATURE PENCIL IRON

A midget size pencil soldering iron that weighs an ounce, and has a ⅛" tip has been designed by the Wall Manufacturing Co., Grove City, Penn. Features thermostatic action which, it is said, controls heat so that fusing and tip-burning are eliminated.

Overall length is 7½", with either copper or *Walloy* tip. Free catalog is available.

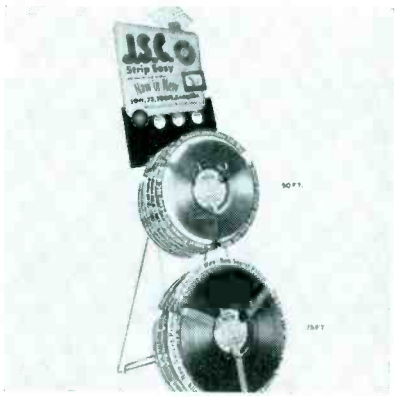
* * *

HINGE-HANDLE SOCKET WRENCH

A hinge-handle socket wrench, *Rotahead 5457*, combining a ½" square-drive reversible ratchet with a conventional hinge handle, has been introduced by Plomb Tool Co., 2208 Santa Fe Ave., Los Angeles 58, Calif.

Pressure on unit head allows handle to rotate freely in either direction; release of pressure engages drive plug for positive turning of socket wrench.

Color Leadin Display Rack



All-color pastel-shade TV leadin display that holds 50', 75' and 100' coils. Colors have been selected to match interior and exterior home color schemes. (Jersey Specialty Co., Inc.)

TV-TUBE DEVELOPMENTS

MULTIUNIT miniatures, 5CG8 and 6CG8†, have been designed for use as combined oscillator and mixer tubes in TV sets using 40-mc *if*.

Each type contains a medium-mu triode unit, a sharp-cutoff pentode unit in one envelope, and a common cathode with two leads connected to separate base-pin terminals.

A low grid-No. *1*-to-plate capacitance of the pentode-mixer unit serves to minimize feedback problems encountered in mixer circuits operating at an *if* of 40 mc. The low output capacitance of the mixer unit enables the tube to work into a high-impedance plate circuit.

The pentode unit in each type may be used in the AM section as a pentode mixer and in the FM section either as a pentode mixer or as a triode-connected mixer depending on signal-to-noise considerations. The triode unit of each type makes a satisfactory oscillator for AM or FM.

The 6CG8 has a heater rated at 6.3 *v*, .45 *a*. The 5CG8 is like the 6CG8, except that it has a 4.7-*v*, .6-*a* heater controlled for heating time.

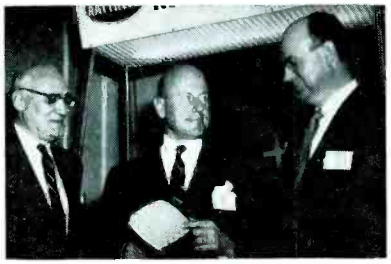
MEDIUM-MU TRIODE miniatures, 2BN4 and 6BN4†, are now available as *rf* amplifiers in grounded-cathode circuits of *vhf* TV tuners.

Each of these types has double base-pin connections for both cathode and grid. The double connections reduce effective lead inductance and lead resistance with consequent reduction in input conductance. The basing arrangement is also said to simplify isolation of the input and the output circuits and facilitate neutralization.

The 6BN4 has a heater rated at 6.3 *v*, .2 *a*; the 2BN4 is like the 6BN4 except that it has a 2.1-*v*, .6-*a* heater, controlled for series-string TV receivers.

†*RCA*.

Personal-TV 8½" Pix Tube



C. F. Adams, Jr., **(center) president of Raytheon Manufacturing Co., discussing mass-production plans for 8½" TV picture tubes expressly designed for portable TV receivers with** Curt Hammond, **manager of Raytheon's equipment tube sales (right), and** F. E. Anderson, **manager of distributor tube sales.**

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service-engineered
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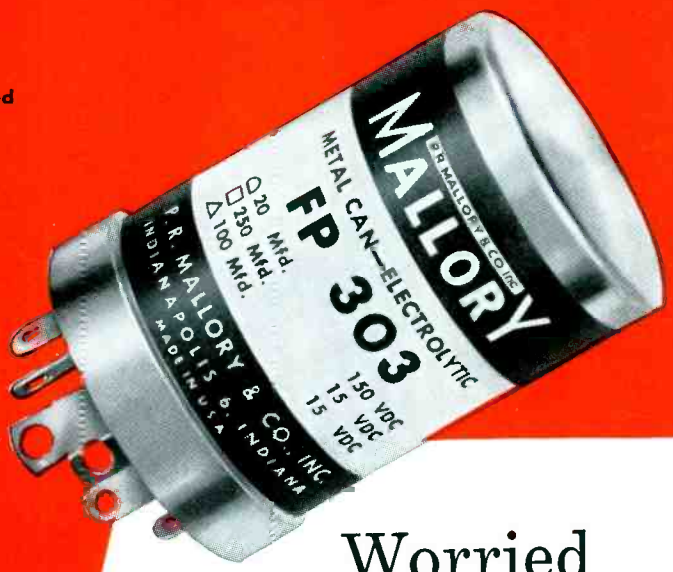

Worried about ripple? . . . *Use* FP CAPACITORS

High ripple currents in TV sets, especially in color, make ripple rating a major factor in choosing electrolytic capacitors. For these applications, you can be sure of getting the performance you need in Mallory FP capacitors.

Extensive life tests at ambient temperatures of 85° C prove that FP's can withstand 50 to 100% more ripple current than usual industry expectation for a given capacity and voltage rating. This extra performance comes from superior heat dissipating ability, made possible by the fabricated plate (FP) construction that puts more anode area and more electrolyte into a smaller can.

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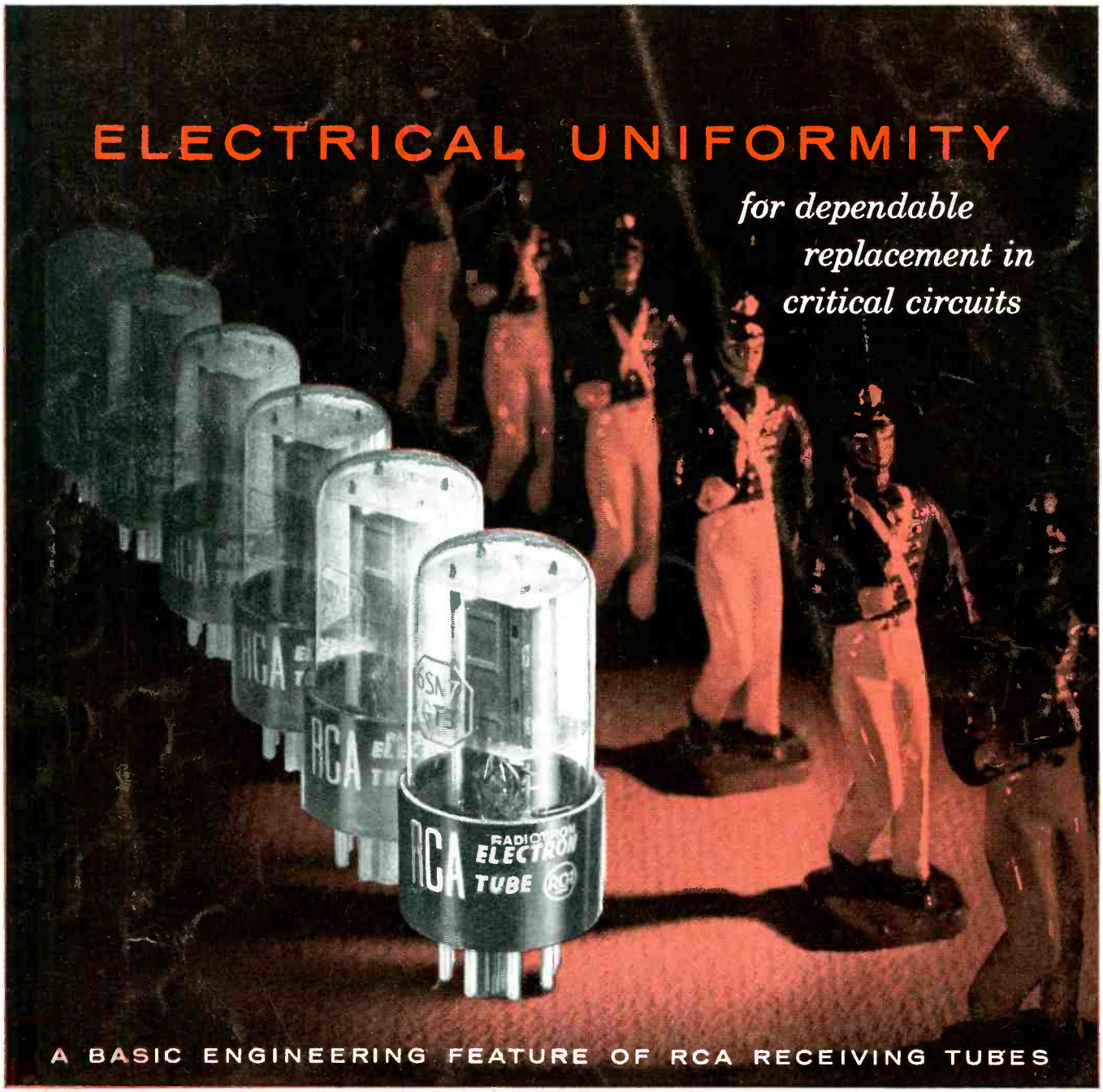

To cut down on "tube juggling" and circuit realigning, RCA controls the quality of your tubes for you—at the factory.

Take the RCA-6SN7-GTB, for example. Every single tube—not just one out of a batch—is subjected to no less than 11 tests for individual electrical characteristics. Before and during manufacturing, RCA closely controls such things as: (1) Cathode material to insure uniform cathode emission and minimize interface resistance, (2) Heater wire to assure even cathode temperature, (3) Grid dimensions and inside plate diameter to insure uniform transconductance, (4) Mica hole size and hole spacing to reduce microphonics.

Yes, you can rely on the electrical uniformity of RCA Receiving Tubes! Tell *your* distributor to fill *your* tube order with *RCA Tubes only!*

RECEIVING TUBES

RADIO CORPORATION OF AMERICA, HARRISON, N.J.

Just released: 28-page booklet, "RCA Receiving Tubes for AM, FM and TV." Up-to-date. Gives characteristics and socket connections for more than 600 types. See your RCA distributor for Form 1275-G, or write RCA, Commercial Engineering, Section 0000, Harrison, N.J.