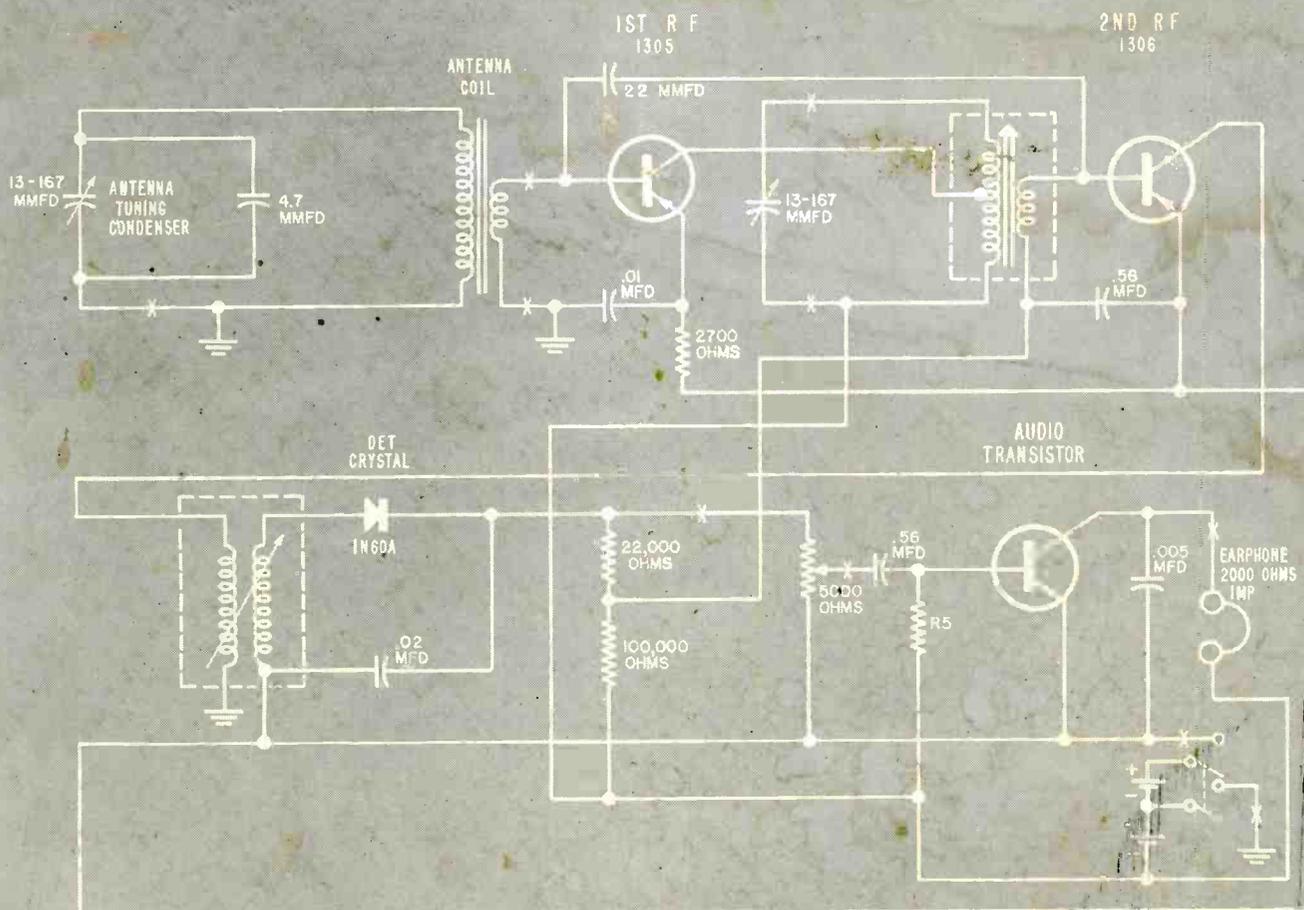


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SERVICE

THE TECHNICAL JOURNAL OF THE TELEVISION-RADIO TRADE



**Tiny three-transistor portable radio
with earphone output.**

See circuit analysis, this issue

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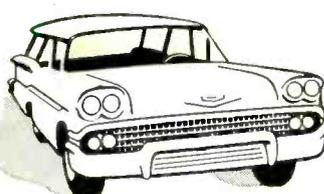
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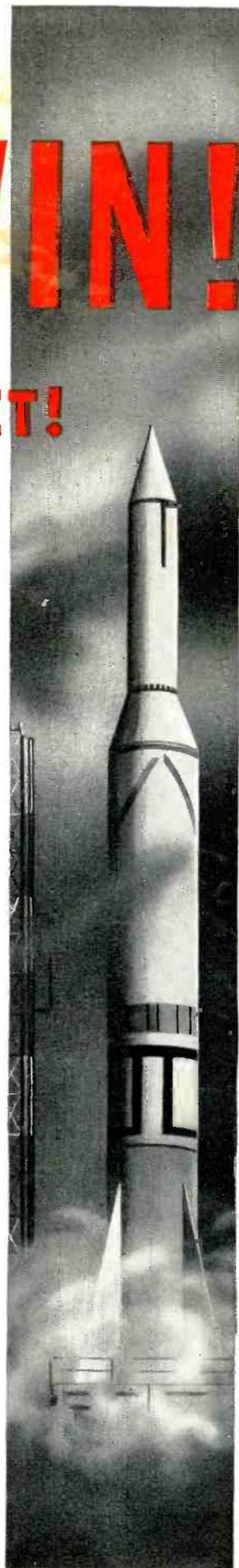
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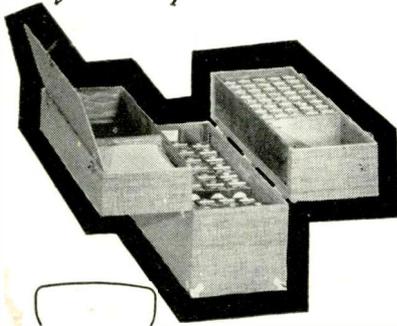
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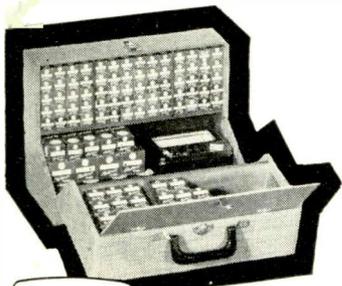
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MAY, 1958

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Sylvania comparisons point out—

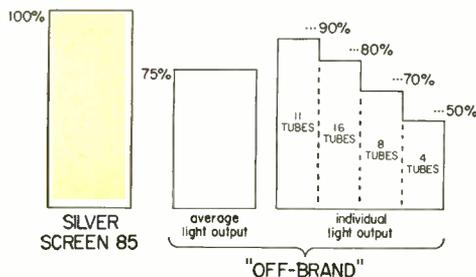
The big difference

Here's the inside story on why local "off-brands" don't measure up to Silver Screen 85® standards

If you're like most dealers, you know off-brand tubes don't have the same quality standards as first-line tubes. To help you see how big the difference is, Sylvania purchased a nationwide sample of sixty 21YP4A made by 19 different local tube makers. These tubes were put through the same production tests that all Sylvania tubes must pass.

Not a single local off-brand passed all 54 mechanical and electrical tests! Many of these were minor defects making little or no difference in whether or not the tube "lit up." But look how loose manufacturing controls can affect the important features of light output, focus, and life!

LIGHT OUTPUT



So far, 39 off-brand tubes have been compared with the *minimum* light output of Silver Screen 85. Five additional tubes couldn't even be tested. Eleven tubes were less than 90% as bright as the minimum for Silver Screen 85; 16 were less than 80%; 8 were less than 70%; and 4 were *less than 50%* as bright. Since most Silver Screen 85 tubes average as much as 125% of minimum standards, the difference becomes even greater. Small wonder that Silver Screen 85 is the easy way to more satisfied customers.

FOCUS

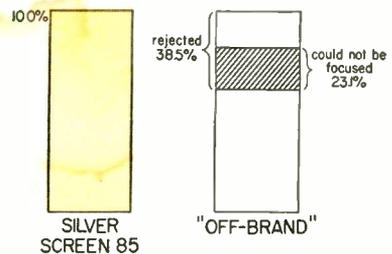
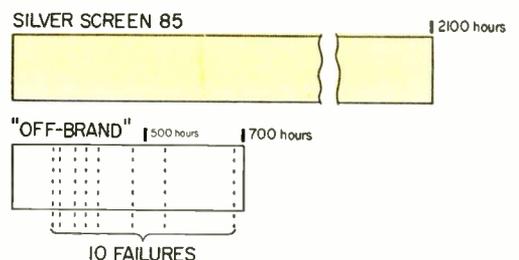


Chart 2 shows how these same 39 tubes stacked up to registered limits on focus voltage. 38.5% were rejected under these limits. Over half of all those rejected could not be focused in a TV receiver. Small wonder then that "Silver Screen 85" pictures are sharper, brighter, clearer.

LIFE TEST



Nineteen off-brand tubes were placed on Sylvania's standard 2000-hour life test. Chart 3 tells you how fast these tubes developed slow-heating cathodes. Over half, or ten units, failed to go beyond the 700-hour mark. Small wonder then that Silver Screen 85 gives you less troublesome callbacks.

Of all the off-brand tubes tested, Sylvania engineers estimate that 43% probably would not have operated properly in a TV set. Why gamble your reputation, customer satisfaction, and success. It's just *good business* to sell up to "first line" picture tubes; Silver Screen 85 picture tubes.

in Picture Tubes!



Take it from Bill Shipley: "Silver Screen 85' consumer advertising makes it easy to *sell-up* to 'first line' picture tubes."

New TV Campaign dramatizes test results . . . sells consumers up to "first line" picture tubes . . . builds more profitable sales and satisfied customers for dealers everywhere.

Sylvania's fabulous new family, "The Real McCoys," is one of the top new television shows of the season and has been named the "Sleeper of the Year." Week after week, on the "Real McCoys" Sylvania is making millions of set owners aware of the big difference in picture tubes.

New commercials like the "Brightness Test" are pre-selling consumers on the "first line" performance of Silver Screen 85.

For dealers everywhere it means more and more customers asking for "Silver Screen 85"—Pre-sold customers make satisfied customers—strengthening your business reputation and building long-range profitable growth.

Sylvania has designed this powerful new selling tool for you. Get behind it and *sell-up* to "first line" Silver Screen 85 picture tubes.

Highlights of Sylvania's TV "Brightness Test."



"Don't be fooled by picture tubes that look alike—they don't act alike."



Sylvania's Silver Screen 85 is over twice as bright as this "off-brand" tube.



"Insist on a nationally known 'Silver Screen 85'—there's one to fit every make TV."



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WEIGHT: 2.4 grams
STYLUS: .7 mil
MOUNT: EIA (RETMA) Standard $\frac{1}{2}$ "
and $\frac{7}{16}$ " centers
CHANNEL ISOLATION: 20 db

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FULL PAGE COLOR ADS & SPREADS IN Popular Electronics, High Fidelity, Hi-Fi & Music Review, Hi-Fi Music at Home, Audio, etc., are telling the E-V Stereo Story to ALL OF YOUR CUSTOMERS RIGHT NOW.

Here are some of the answers to your questions concerning stereo:

Q How does the COMPATIBLE E-V Stereo Cartridge differ from CONVENTIONAL cartridges?

A It has the ability to play both the new type stereophonic discs and conventional records. Inherent in its design is an improved monaural performance. *Exclusive* design for rumble suppression of 15 db or better will permit the use of Electro-Voice's Stereo Cartridge *with any type of changer or transcription player!*

Q Are stereo discs compatible with conventional cartridges?

A Most cartridges damage the stereo record. **STEREO DISCS SHOULD NOT BE PURCHASED UNTIL AN E-V STEREO CARTRIDGE IS INSTALLED.** Then, you may play monaural or stereo discs monaurally. When a second speaker and amplifier is added, you have stereophonic sound.

Q What about modification problems?

A Using an Electro-Voice Stereo Cartridge, which is constructed so that its output is already corrected to the RIAA curve, you will not require the equalization of the *second* amplifier. Inserting the cartridge is simple. It will fit virtually any standard tone or transcription arm. The addition of a second amplifier and speaker is not complicated.

Q What about record availability?

A Recordings by major record manufacturers will be available in mid-1958.

Q What effect will stereo cartridges and records have on present equipment?

A Only the cartridge will be obsolete. All other components are compatible with stereo.

Q What if the customer doesn't have a HI-FI system now . . . should he wait?

A NO. He should proceed as before—with one exception: he should use a stereo cartridge initially. When he is ready for stereo, he need add only a *second* speaker and amplifier.

Q How do you order the cartridges?

A Contact your Electro-Voice representative or distributor, or write directly to the factory for complete information. Ask for E-V Stereo Model 21D with .7 mil diamond stylus or E-V Stereo Model 26 DST Turnover with .7 mil diamond Stereo tip and 3 mil sapphire tip for monaural 78 rpm records (\$22.50).

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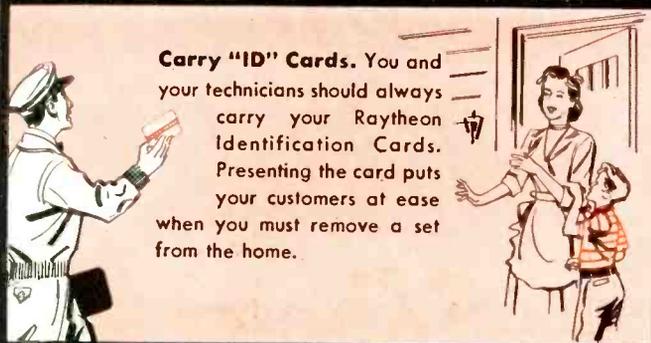
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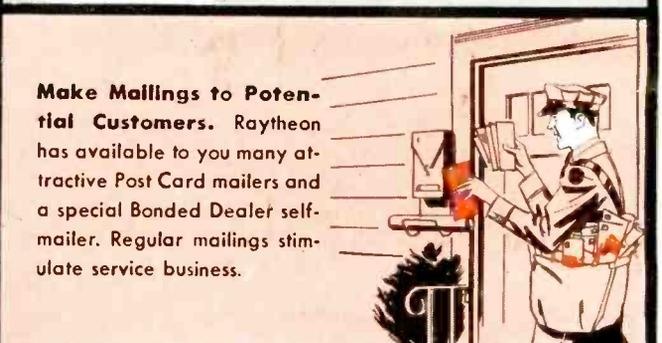
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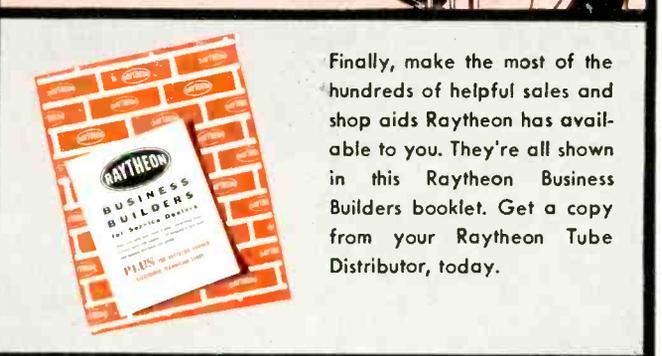
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Identify your shop. This traffic stopping metal sign will tell all passersby that you are the Bonded Dealer in your community — the Bonded Dealer that Raytheon is presenting to America as the top TV-Radio technician in the country.



Finally, make the most of the hundreds of helpful sales and shop aids Raytheon has available to you. They're all shown in this Raytheon Business Builders booklet. Get a copy from your Raytheon Tube Distributor, today.

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Parts Jobber and Service Man: Mutual Interdependence

IN MANY WAYS the Parts Jobber is one of the best friends the Service Man has. He functions as a vital link in a national supply chain which enables the Service industry to obtain needed replacement parts quickly and efficiently. The fact that most jobbers carry only standard-brand packaged parts produced by reputable manufacturers has been a boon to the Service Man, providing him with reasonable assurance that the part he installs will stand up in use.

Many jobber organizations have gone to great lengths to be helpful to the Service Man. They have provided him with technical information on new products and developments. Some distributors even maintain laboratories for checking test equipment and components, and the results of their investigations are available to the Service Man. Parts jobbers also aid Service Men by maintaining proper and business-like credit relations with them and by joint efforts in promotion and advertising campaigns.

It is for these reasons that SERVICE salutes the Parts Jobber on the occasion of the 21st annual Electronic Parts Distributors Show which is being held in Chicago on May 19-21. We extend our best wishes to the Electronic Industries Association, the National Electronic Distributors Association, the Association of Electronic Parts and Equipment Manufacturers and the other sponsoring organizations and urge them to continue to promote the interests of the Service Man as well as their own interests in a spirit of mutual interdependence.

Friendship is a two-way street, and the Parts Jobber depends on the Service Man, too. It is only by working together to handle and resolve the problems which face both mutually that the Service Industry and the Parts Distributor can assure a bright future for both groups.

THE LAST WORD on color is that this field is moving forward at a far faster pace than most people realize. Addressing shareholders at RCA's 39th annual meeting early this month, president John L. Burns pointed out that color television continues to advance not only in programming but also in merchandising.

Sales of color sets to consumers are running well ahead of last year, he reported, and intensive color promotions in many parts of the country are producing excellent results. Dealers are becoming convinced that their greatest future profits will be realized in color TV receivers.

The quality and performance of color TV sets improved considerably in 1958, Mr. Burns stated, and he looks forward to future increases in sales during the rest of the year. Progressive Service Men would be well advised to prepare now for a demand for color TV servicing that is sure to come sooner than most of us realize.

* * *

ANOTHER FIELD which is also moving rapidly forward is mobile radio systems. Despite generally unfavorable economic conditions, the mobile radio business has continued to grow at a rapid pace and those in a position to know believe this is only the beginning.

An indication of the expected growth in this field is contained in the testimony before a House Committee by Curtis Plummer, chief of FCC's Safety and Special Services Bureau. Mr. Plummer predicted an increase of 100,000 stations in the coming fiscal year.

The 425,000 stations now licensed, he pointed out, use approximately one and a half million fixed and mobile stations. Here is another activity which bears watching by the alert Service Man.

All-Transistorized Portable Radio Receivers [See Front Cover]

New Series Utilizes 3 to 9 Transistors With Stable Temperature Parameters

by ROBERT A. MAGNANT
Group Supervisor, Engineering Dept., Philco Corp.

TEMPERATURE STABILITY is always an essential part of good radio design, and it becomes especially important in a transistor radio. One of the best ways to insure good temperature stability is to choose transistors in which the temperature-dependent parameters are of the proper value to have little effect on the circuit operation. By the use of surface barrier transistors in the *rf*, *if* and detector stages, especially good results are obtained in this respect. Another method is to provide current stabilization, usually by means of an emitter resistor. Most audio stages require this type of temperature stabilization because of higher operating temperatures generated by the higher power levels.

A new line of transistorized portable radios¹ has just been placed on the market which makes use of both systems to insure stability within the desired temperature range. The sets range in size from a tiny three-transistor model to a nine-transistor all-wave portable. A description of the circuitry utilized in some of these sets follows.

Three-Transistor Portable

The smallest unit² in the line, approximately as large as a king-sized pack of cigarettes is shown in Fig. 2 and illustrated schematically on the cover and in Fig. 1. It will fit into a shirt or vest pocket, and an ear-phone attachment permits the owner to use the set without disturbing other people in the area.

This model uses two tuned *rf* stages followed by a diode detector and an audio output stage which drives the earphone. Because of the low power requirements of the earphone, it was possible to use a battery voltage of

only 2.6 volts. Since the current drain is also small, it was decided to use small mercury cells which are consistent with the size of package but which would give a reasonable battery life. For this reason two P630 cells were used which allow approximately 150 hours of use.

One of the major problems in any radio is that of obtaining good stage tracking without elaborate precautions which add to the cost. This was handled on this set by use of a dual tuning knob which provides both coarse and fine tuning. The antenna and first *rf* tuning condensers have separate knobs which are loosely coupled mechanically. This permits them to be rotated together easily and still provide individual adjustment of each condenser so that both stages may be perfectly tuned to the incoming signal. The exact tuning obtained by this dual-knob method often surpasses that achieved on

more expensive sets with standard one-knob tuning systems.

After the incoming signal is amplified by the tuned antenna and first *rf* stage it is fed to a broad-band second *rf* stage for further amplification and thence to a diode detector. The detected audio is then fed to the audio amplifier which raises the level high enough to drive the earphone.

A newer version of this model will soon be on the market with improved sensitivity. This is being achieved in the same package size by the addition of *audio reflexing* to the first *rf* stage. Reflexing is the principle of using one transistor to amplify signals of two different frequencies. In this case, the detected audio signal is fed back to the first *rf* stage where it is further amplified before being applied to the audio output stage, thus considerably improving the sensitivity of the receiver.

Seven-Transistor Portable

A seven-transistor radio³ which operates as a high-performance portable

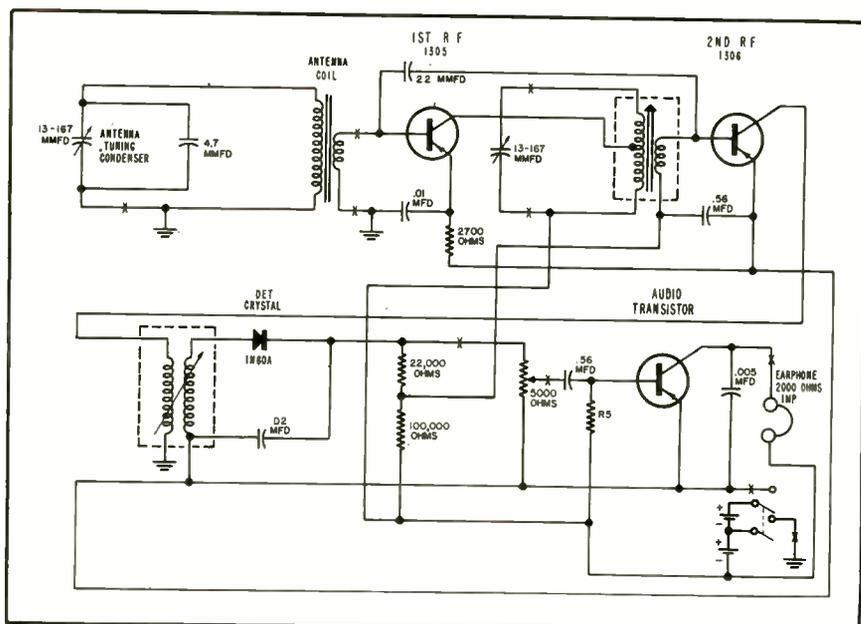


FIG. 1: SCHEMATIC DIAGRAM of Philco model T-3 portable radio receiver which utilizes only three transistors in the entire circuit.

¹Manufactured by Philco Corp. ²Philco model T-3. ³Philco model T-701.

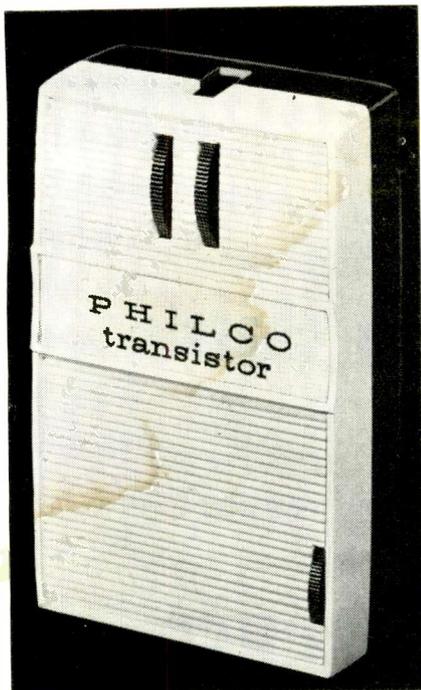


FIG. 2: **THREE-TRANSISTOR** portable radio is approximately same size as pack of king-sized cigarettes.

and yet has sufficient power output to take the place of conventional line-powered table model radios is also included in this series. This set, shown schematically in Fig. 4, has a 200 mw class B push-pull output system with a heavy-magnet 4-in. speaker and operates from four standard D-size flashlight batteries. Since a heavy-magnet speaker is considerably more efficient in converting electrical power to acoustical power, this 200 mw system will provide a sound volume equal to that produced by sets with much greater power output but employing a light-magnet speaker.

Dual Antenna System

To take full advantage of a good output system it is necessary to have sufficient gain ahead of it to receive

all the desired stations without noise interference. This is greatly aided by the use of the dual *Magnecor* scan-tenna used on this set. By proper phasing of the coils on the dual *Magnecor* during assembly, considerably more power is obtained from a given broadcast signal than is possible with single antennas usually used in this size of radio.

Transistor Stages

In addition to the antenna, seven transistors are used in the set to provide the necessary gain. The system makeup is as follows: converter stage, two *if* stages, a transistor power detector, an audio amplifier stage, and the push-pull output stage. The operation of these stages is conventional, except that there are four tuned *if* circuits instead of the usual three to provide better adjacent channel attenuation. The transistor detector provides both detection and amplification and is an important factor in the overall gain picture.

Nine-Transistor Portable

The largest set in this series is a nine-transistor all-wave portable radio.⁶ It has seven bands including the broadcast band, a 2 to 4 *mc* band, a 4 to 8 *mc* band and four spread bands at 16, 19, 25 and 31 meters. This portable set is shown in Fig. 3.

The set uses a tuned *rf* stage, a separate oscillator which has its own power supply for frequency stability, a mixer stage, two *if* stages, a transistor detector stage, an audio amplifier stage, and a push-pull class B output stage. The power supply is 6 volts, provided by four standard D-size flashlight batteries, for the main part of the set. Two separate flashlight batteries for collector and emitter stabilization of the oscillator



FIG. 3: **PHILCO'S ALL-WAVE PORTABLE** model T-9 utilizes nine transistors and is powered by D-size flashlight batteries.

are also included. The power output is 250 mw into a heavy magnet 4-inch speaker.

Four-Transistor Model

There is also a coat pocket or purse size model⁶ employing four transistors and powered by four pen-light cells. The *Magnecor* antenna is followed by a converter stage, and two stages of *if* amplification. The *if* signal is demodulated by a diode detector and the resulting audio signal is reflexed in the second *if* stage which takes the place of an audio driver. This amplified audio signal is then applied to the audio output stage for sufficient power amplification to drive the speaker. This set has a class A output stage which provides 25 mw to a 2 $\frac{3}{4}$ -in. speaker.

⁴Philco model T-700. ⁵Philco model T-9. ⁶Philco model T-4.

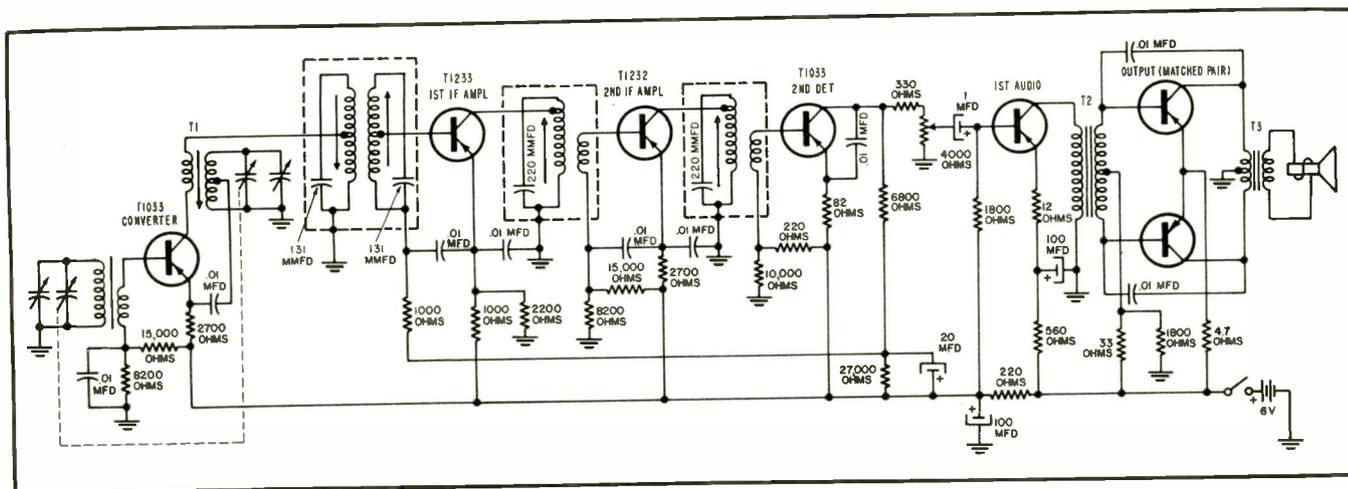


FIG. 4: **CIRCUIT DIAGRAM** of seven-transistor Philco model T-701 portable radio.

EVEN THOUGH THE DADDY OF

3 reasons why there are
NO printed circuits in Zenith TV chassis



standard HANDcrafted circuitry means:

1

LESS SERVICE HEADACHES



standard HANDcrafted circuitry means:

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*Even though Dr. Alexander Ellett, head of Zenith's research department, is recognized as the daddy of printed circuitry through his work on radio proximity fuses, still Zenith uses no printed circuitry in its TV chassis because it means more service headaches and often causes service delays.

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Installing Hi-Fi Speakers and Enclosures To Improve Sound System in Home

by ROBERT MILLER*
and FREDERIC ZELLER

SERVICE MEN are frequently asked by their customers if it is possible to build a hi-fi installation which will utilize standard radio or TV receivers now functioning in their homes. The answer is that very often a startling improvement can be made in the sound quality by modifying or adding to the speaker in the original equipment, and that this constitutes a good start toward a more fully developed high fidelity system.

The weakest link in console radios, phonographs, TV sets and packaged hi-fi sets is usually the speaker. Almost invariably the amplifier circuit used in these units is capable of producing a much closer approximation to hi-fi than can the commercial loudspeakers which the manufacturer is forced to use in order to keep his price at a competitive level. Considerably better sound quality can often be obtained by the substitution or addition of hi-fi loudspeakers. This may be done in many different ways, depending on the requirements and budget of the customer.

The simplest and least expensive way is the addition of a simple capacitor network, balance control and *tweeter* (Fig. 1) to a system that has a single large-cone speaker. Most speakers of this type tend to be deficient in the high-frequency range above 5000 cps.

The inclusion of a 4-mfd capacitor with an 8-ohm *tweeter* will give a crossover frequency of 5000 cps and immediately add surprising highs and brilliance to the reproduction. The balance control allows adjustment of *tweeter* level to suit personal listening

*Technical Service Manager, University Loudspeakers, Inc.

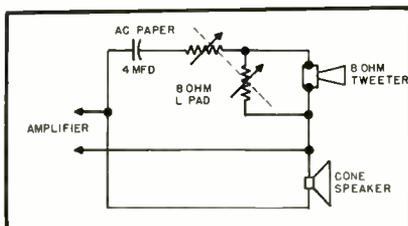


FIG. 1: CIRCUIT DIAGRAM of simple capacitor network.

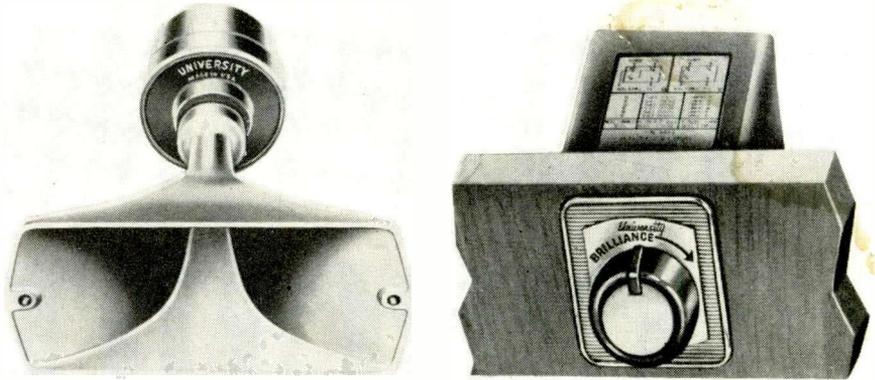


FIG. 2: TYPICAL HORN TWEETER is shown at left and a crossover network with balance control at right.

taste. For more accurate frequency separation, standard networks¹ are available from various high fidelity speaker manufacturers. A typical horn tweeter and a crossover network with balance control are shown in Fig. 2.

Although the addition of a *tweeter* results in greater sharpness and clarity, response will be still further improved if a wide-range hi-fi speaker were substituted for the commercial one in the set. By itself, a wide-range speaker should be capable of handling frequencies from low bass up to 13,000 cycles, and with *tweeter* and network added the range is increased well beyond 15,000.

While some of the amplifiers used in commercial equipment have a selection of output impedance taps available, most have a basic output impedance of 3-4 ohms. Matching such amplifiers with 8-ohm high-fidelity speakers is no problem, however, since a slight mismatch is often permissible. A slight loss in power may sometimes result, but the higher efficiency of the new speaker will usually compensate for this. When the power loss seems too great, and quality of reproduction seems to suffer, the use of a 4-ohm to 8-ohm line matching transformer should be utilized.

When an 8-ohm tweeter is used with 3-or-4-ohm original equipment speaker, more energy will be passed to the cone speaker, which has a lower impedance. This can create a desirable situation in that the listener frequently wants more bass than most systems deliver. Since the added horn-type tweeter has inherently

greater efficiency, tweeter output will still be sufficient to balance the increased energy from the cone woofer. This sometimes eliminates the need for a balance control on the tweeter.

Where space is cramped or cutting an additional hole for a tweeter is difficult, a coaxial or three-way speaker provides a good solution. These are available in 8-inch to 15-inch models and usually have built-in networks. The best type of coaxial speaker usually consists of a large cone woofer for bass and middle range and a separately driven horn-loaded tweeter for high-frequency reproduction. (Fig. 3). In this type of coaxial design there is no interaction between the two components, and quality of reproduction can be as good as that of most comparable two-speaker systems.

One of the greatest difficulties experienced with any speaker is the reproduction of bass notes. The part played by the enclosure in assisting a speaker to reproduce low frequencies is often overlooked. A speaker operating in open air without any enclosure does not reproduce any bass, even though low-frequency cone movement is readily observed. A "short circuit" exists between the front and rear of the speaker cone, and when the path length from the cone front to cone rear is of a distance equivalent to the speaker diameter, low frequencies are cancelled before the acoustic waves can form sufficient length to be heard.

Since the wave length of a 50-cycle

¹Such as University model N1 shown in Fig. 2.

note is approximately 22 feet long, it becomes immediately apparent that a simple baffle board measuring 11 feet by 11 feet produces a strongly audible 50-cycle note because the path length of sound from speaker front to speaker rear is 22 feet. *Folding* this baffle board produces a correspondingly smaller, open-backed box, and adding a back panel completes the basic closed box or *infinite baffle* which is the simplest of speaker enclosures.

Bass Reflex Port

In order to obtain good results from a 12-inch speaker, an *infinite baffle* would have to be at least 8 and 15 cubic feet, respectively. However, it is possible to obtain excellent results from a much smaller more convenient enclosure by making use of various design approaches. Perhaps the simplest and most extensively used of these is the *phase-inversion* method. This provides an additional opening in the baffle board on which the speaker is mounted—called a *bass reflex port*. Further, the interior of the enclosure is heavily padded to absorb the higher frequencies. The *port*, therefore, allows the rear radiations of lower frequency to reinforce the directly radiated sound to provide an *acoustic bass boost*. The size of the

bass reflex port depends on the resonant frequency of the speaker employed and on the cubic capacity of the enclosure. Precise information can usually be obtained from the speaker manufacturer.

Commercial equipment usually encountered by Service Men use open-back enclosures. This is true of even many of the so-called hi-fi packaged sets. Obviously, this results in bass cancellation at some point in the frequency range, the precise point depending on the path length of sound from the front to the rear of the speaker. To compensate for this the original speaker is often designed with a *bump* in the higher bass range to create an illusion of deeper bass, and so circumvent the higher cost of a sealed and properly modified enclosure.

Some larger commercial radio, TV and phonograph cabinets of the console or floor variety lend themselves to complete "sealing" of the speaker enclosure space and Service Men have often done just that to improve the sound quality when substituting hi-fi speakers. Obviously, many of these enclosures are not of optimum size for maximum performance. Nevertheless substantially improved reproduction is possible by sealing available

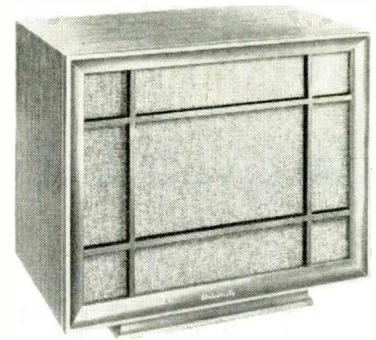


FIG. 4: PRE-ASSEMBLED UNIT complete with speakers and network.

space wherever practicable to make an airtight enclosure.

Before this is done, however, it is advisable to strengthen the corners of the future enclosure by the addition of $\frac{3}{4}$ -inch x $\frac{3}{4}$ -inch cleats. Any panel added for sealing should be of $\frac{3}{4}$ -inch minimum thickness plywood. The added panels should be secured with a screw in every corner and additional screws along the edges no more than 4 in. apart. A layer of fibreglas at least 1-inch thick should be used to cover all of the back panel, all of one side panel, and all of the top panel. For optimum lower frequency response, a *bass reflex port* as discussed earlier should be cut.

Certain higher quality packaged hi-fi units may already have some sort of an enclosure. If such a system fails to meet the specifications previously given, improvement of the enclosure or the substitution or addition of better speakers will result in improved sound quality. The ideal solution of course, is to hook up a separate enclosure complete with hi-fi speakers to the existing radio, TV or phonograph. It is important to note in this connection that most commercial radio, TV, phonographs have a low output power rating, sometimes no more than 2½ watts, so that a high efficiency speaker system should be employed.

There are several methods of adding a separate enclosure. The simplest way is to simply buy a pre-assembled unit complete with speakers and networks, ready to connect. (Fig. 4). These units often make attractive pieces of furniture which can be accommodated either in a corner or against the wall of a room.

Another method is to buy an enclosure, choose a suitable speaker or speakers, and then mount and connect them. This has the advantage for the customer in that he can start with a single wide-range speaker and progressively expand his system according to taste and budget.

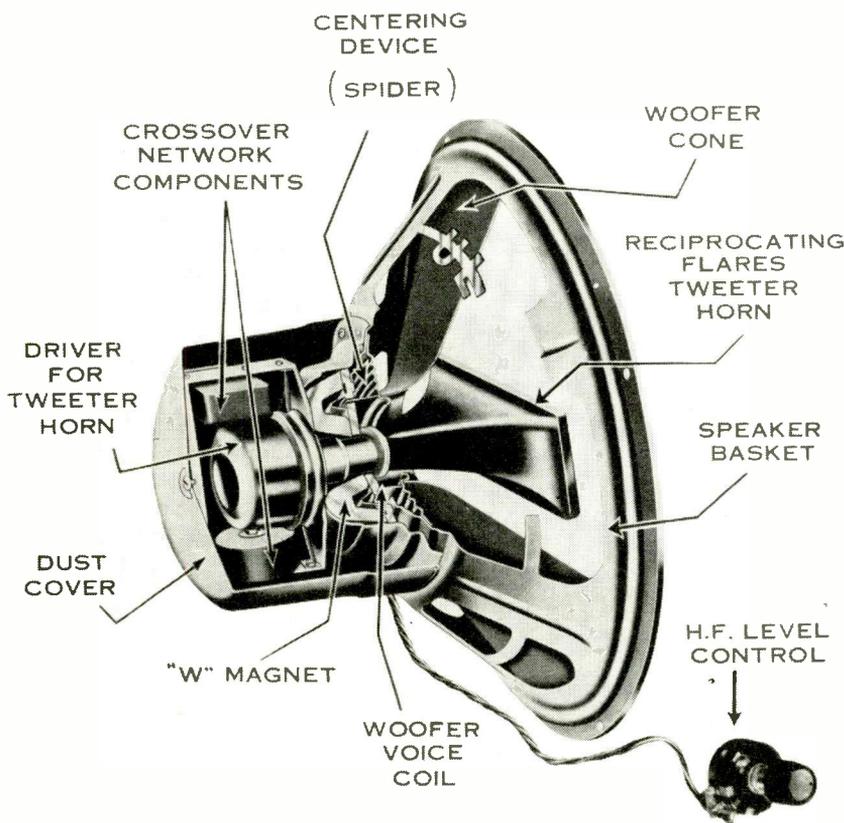


FIG. 3: COAXIAL SPEAKER consisting of large cone woofer for bass and middle range and a horn-loaded tweeter for high frequencies.

(All photographs courtesy of University Loudspeakers, Inc.)

DC Power Supply For Transistorized Equipment and Low-Voltage Devices

by R. C. CROSSLEY
Electro Products Laboratories

ORIGINALLY DESIGNED to meet the needs of an engineer for transistor design work, this power supply has become a service instrument because of its acceptance and usefulness in the field. The unit is a dual-range power supply, 0-32 v (at continuous currents up to 40 amps) and 0-16 v (at continuous currents up to 8 amps), with both ranges continuously and smoothly variable over both ranges. Important to the design engineer and useful to the Service Man is the maximum *rms* ripple voltage figure of less than 0.1%.

Utilizing a patented method of conduction cooling, the heat normally generated during operation of the selenium rectifiers is more efficiently dissipated by mounting the rectifiers directly to the sides of the cabinet. Adequate air ventilating louvers are provided at the top of the unit, as shown in Fig. 1.

Component Features

Component-wise, the *dc* power supply, illustrated schematically in Fig. 2, has a line filter which minimizes the effects of transient voltages that might be carried on the supply line. Also included is a heavy-duty carbon brush control transformer for smooth adjustment of the output voltage and D'Arsonval meters. A full-wave selenium rectifier bridge feeds a two-section *lc* filter, each with its own bleeder resistor. An ammeter monitors the

*Electro Products model EFB.

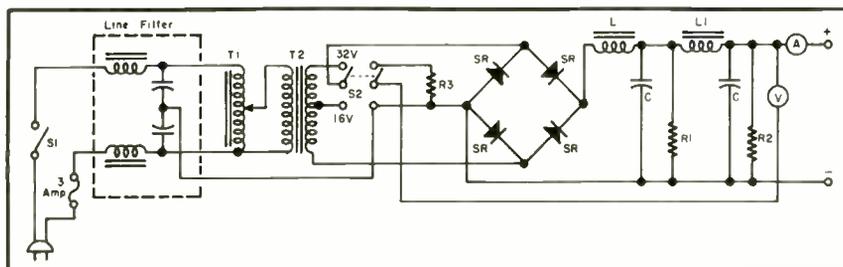


FIG. 2: SCHEMATIC DIAGRAM of Electro model EFB filtered *dc* power supply.

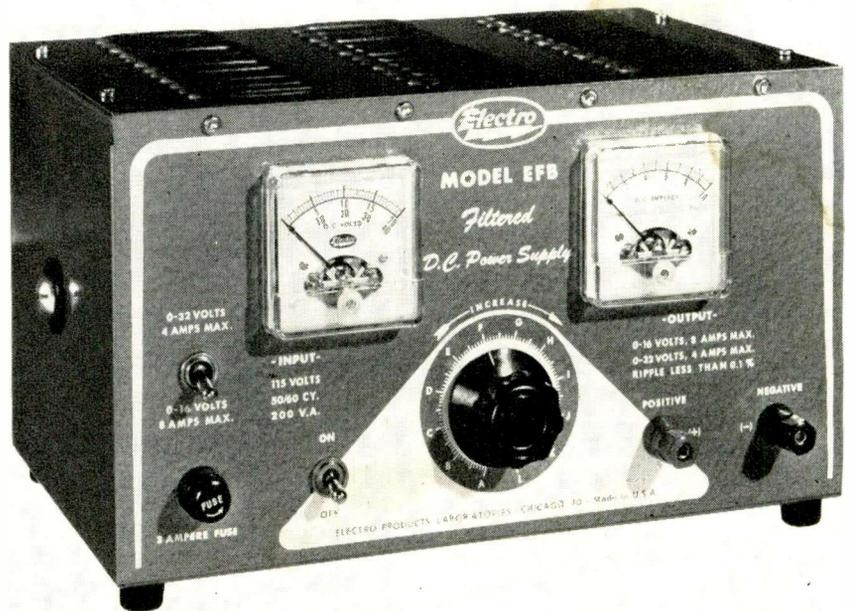


FIG. 1: DC POWER SUPPLY suitable for servicing transistorized and other low-voltage equipment.

high-side output current and a dual-range voltmeter across the arm of the bridge reads the output voltage.

Controls

The single-knob control, shown in Fig. 1, determines increments on transformer *T1* for output voltage adjustment. The toggle switch, used to select the desired output voltage-current range, automatically selects the corresponding voltmeter scale.

Two square clear-plastic panel meters with D'Arsonval movements assure accuracy in output voltage and current readings. Clearly labeled and color-coded multi-purpose output terminals are located on the front panel.

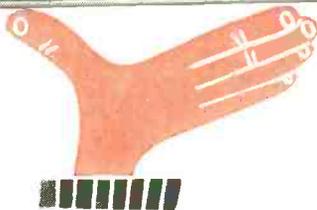
A 3-amp *ac* line fuse also is easily accessible from the panel. Perhaps equally important and often overlooked is the rating information printed directly on the front panel. This enables anyone not familiar with the equipment to know exactly the load the power supply can safely handle. This information is printed just below the *dc* ammeter.

Servicing Features

To anyone interested in servicing not only transistorized equipment but also relays, solenoids, telephone circuits and other low-voltage devices, the output performance characteristics are extremely useful. These are graphically illustrated in Figs. 3 and 4.

A separate set of curves for each of the two output voltage ranges completely describes *dc* voltage, *dc* current and *rms* ripple voltages. For example, when the user is drawing 3 amps at any voltage on the 0-32 v output range, the guaranteed maximum *ac* ripple voltage present at the output terminals will not exceed 7.7 *mv*. Also, should the user be drawing

(Continued on page 29)



**NEW TO-5 TEL-OHMIQE®
capacitor analyzer**

measures all 4 . . . plus

1 CAPACITANCE	2 POWER FACTOR	3 LEAKAGE CURRENT	4 INSULATION RESISTANCE	extra feature TURNS RATIO
Measures up to 2000 μ f in five overlapping ranges . . . including an accurate 1 to 100 μ f range, exclusive with Sprague.	Power factor of electrolytic capacitors is measured by the highly accurate bridge method. Reads up to 55% in three ranges for convenience in measurement.	Leakage current of electrolytics is measured directly on the meter, with exact rated voltage up to 600 v. applied from continuously adjustable power supply. Two ranges — 0-6-60 ma.	Insulation resistance of paper, ceramic, and mica capacitors is read directly on meter . . . up to 20,000 megohms.	In addition to its function as a complete capacitor analyzer, the TO-5 also measures the turns ratio of power and audio transformers.

The NEW TO-5 TEL-OHMIQE Capacitor Analyzer is one of the fastest and surest ways of measuring . . . capacitance, power factor, leakage current, insulation resistance, and turns ratio. This compact, easy-to-use instrument has the highest accuracy of any instrument of its type available to the service trade.

New jumbo dial makes meter reading easy. Special color-keyed pushbuttons permit instant range selection . . . and allow automatic safety discharge of capacitors after testing. Magic-eye tube simplifies bridge balancing for capacitance and power factor measurements.

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This 4-in-1 test instrument is only 8 $\frac{7}{8}$ " high, 14 $\frac{5}{8}$ " wide, and 6 $\frac{1}{8}$ " deep . . . weighs a mere 12 $\frac{1}{2}$ pounds. The complete price for . . .

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Electronic Parts

Precision and Miniaturized Equipment Featured at the Hilton

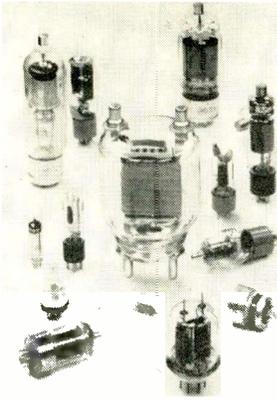


FIG. 1: CBS-HYTRON industrial tube line.

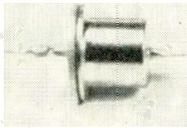


FIG. 2: GENERAL INSTRUMENT PT5 top-hat silicon rectifier.

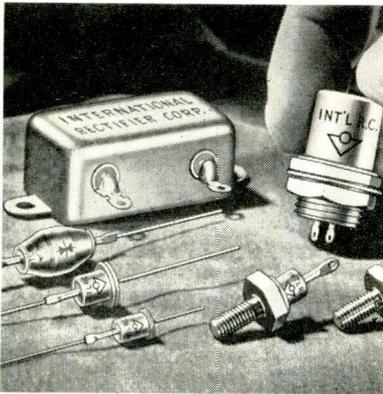


FIG. 3: INTERNATIONAL RECTIFIER silicon voltage regulator and reference diodes.

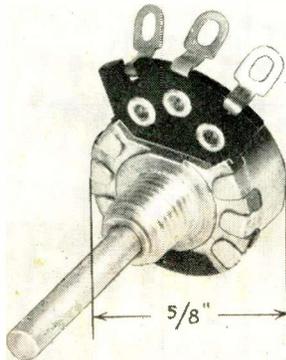


FIG. 4: CLAROSTAT miniature carbon potentiometer.

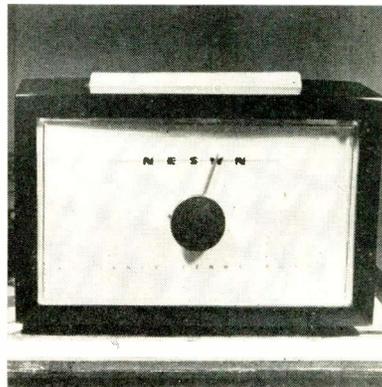


FIG. 5: ALLIANCE T-12 Tenna-Rotor.

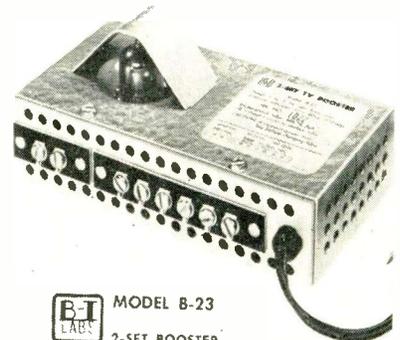


FIG. 6: BLONDER-TONGUE B-23 two-set booster.

THE ELECTRONIC Parts Distributors Show, being held in Chicago at the Conrad Hilton hotel from May 19th through 21st, shows a shift in the industry toward precision and industrial-type components and equipment, as well as further emphasis on miniaturization. Many manufacturers in the audio field are exhibiting stereophonic equipment which has sprung into overnight prominence.

Replacement components have been refined or entirely redesigned to provide greater reliability and to make the job of installation easier. New packaging methods have been adopted throughout the industry to make the stocking and selection of replacement parts faster and more convenient.

Among tube manufacturers the production trend points toward the increasing importance of industrial and special purpose tubes (Fig. 1) in addition to further refinements in original equipment and replacement units.

In the rectifier field a wide variety of silicon diode types are being stressed. Units are being manufactured in top-hat, double-anode, multiple-junction high-voltage and reference element types (Figs. 2, 3). A miniaturized silicon voltage variable capacitor is being shown by International Rectifier Corporation.

All-purpose high-density selenium replacement rectifiers are featured by the General Instrument Distributor Division. A series of selenium contact protectors for arc suppression in ac circuits is also being introduced by International Rectifier Corporation.

A self-service merchandising dis-

play of *Discap* ceramic capacitors with 5-of-a-kind units packaged on a 3 x 5 card is featured in the P. R. Mallory and Company booth. Display is being used to introduce the units to the service trade.

Clarostat Manufacturing Company's exhibit features many precision units in addition to their standard line of replacement resistors and potentiometers (Fig. 4). Also on display is the *Greenohm V* vitreous enamel power resistor line.

A compact flat-loopstick radio replacement antenna designed for greater signal pickup and increased selectivity is being shown by Superex Electronics Corporation.

In the television antenna field the Finney Company is featuring its twin-driven *Geomatic* models, custom-designed models for particular areas, and a high-power antenna developed for tracking of earth satellites.

A new parabolic *uhf* antenna (see page 28) is featured in the Channel Master exhibit.

Trio Manufacturing Company is featuring their *Colorite* antenna designed specifically for b-w and color reception in metropolitan and suburban areas.

An antenna rotor (Fig. 5) featuring a direction indicator which automatically gives compass direction of antenna is being introduced by The Alliance Manufacturing Company.

Blonder-Tongue Laboratories are showing an all-channel *vhf* two-set booster (Fig. 6) designed to bring in sharper and clearer pictures. Unit amplifies signal on one or two sets whether both or just one set is in operation.

Show Roundup

and Stereo Components to Be Hotel in Chicago

An extra-heavy adjustable auto radio antenna *Super 8* with 8-ball mount that allows adjustment up to 35 degrees is being exhibited by Ward Products Corporation. Unit has a 54-inch lead cable.

Electro Products Laboratories is featuring a dual-purpose *dc* power supply kit (Fig. 7) for servicing transistor portable radios and 12-volt auto sets.

Fourteen work-bench hook-up wire dispenser kits (Fig. 8), each containing a metal dispenser rack and an assortment of popular sizes and colors of vinyl, vinyl-nylon, textile, or teflon insulated hook-up wires are being introduced by Belden Manufacturing Company. Kits are available in sizes 20 through 26 and contain either 5, 8 or 10 different colored spools.

Vaco Products Company is introducing its *Red Cap* screwdriver line (Fig. 9) with tempered steel blades and red, shockproof plastic handles. Seven units in the line are a No. 1 Phillips with a 3-inch blade, No. 2 Phillips with a 4-inch blade, 3/16-inch round blade in both 4 and 6-inch lengths, 1/4-inch round blade in 4 and 6-inch lengths, and a 5/16 inch round blade 6 inches long.

A knee-hole work bench with eight drawer-cabinets (Fig. 10) is included in the *Equipto* line. More than 16 bench and cabinet units are available in a wide variety of combinations.

Jensen Industries is exhibiting a new line of 32 phono cartridges (Fig. 11) designed to replace 80% of existing units. Cartridges feature a simplified needle changing method and a built-in needle guard.

A low-mass damped *true pivot*

stylus arm construction is featured in the *RC 666* phono cartridge shown by the Recoton Corporation.

Ronette Sales Corporation is exhibiting its *Binofluid* stereophonic cartridge said to be compatible with both monaural and stereo discs. Unit can be used as a replacement cartridge in existing phonos.

A pictorial self-service replacement-needle catalog designed for the servicing field is being introduced by the Duotone Company. Featured in the catalog are photos of nearly all phono-graph models produced since the introduction of long-playing records.

American Microphone Manufacturing Company is featuring a tape recorder-conference microphone (Fig. 12) with a push button that can be depressed to talk or switched on permanently for conference use. Included is a clip-on stand for resting the unit on conference tables. Stand can also be used as a lavalier to support the microphone in speaking position on the chest.

A hi-fi speaker system in a low-boy enclosure is being exhibited by University Loudspeakers. Model is available with two different three-way speaker systems or as an enclosure only.

David Bogen Company is introducing a stereophonic adapter amplifier, *ST10*, designed to convert existing monaural systems for two-channel use. Unit is said to require only an extra speaker to achieve stereophonic reproduction. Adapter can be used with a tape recorder (with proper playback heads); magnetic, crystal or ceramic stereo cartridges; or with an FM-AM stereo tuner.

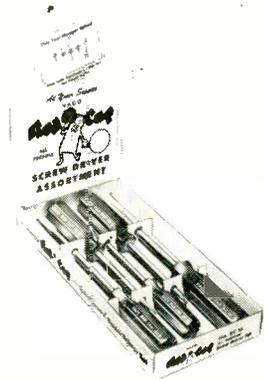


FIG. 9: VACO Red Cap screw driver line.



FIG. 10: EQUIPTO work bench.

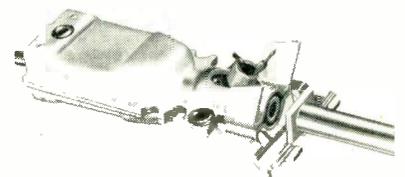


FIG. 11: JENSEN INDUSTRIES replacement cartridge.



FIG. 7: ELECTRO-PRODUCTS KPS-2 transistor dc power supply kit.



FIG. 8: BELDEN hook-up wire dispenser kit.

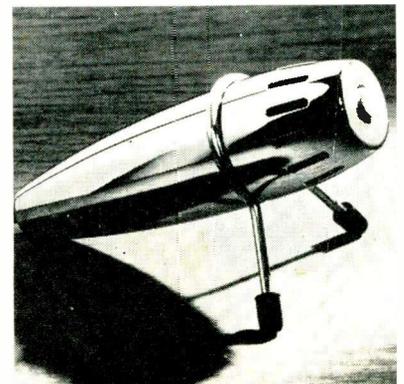


FIG. 12: AMERICAN MICROPHONE 204 tape recorder-conference mike.

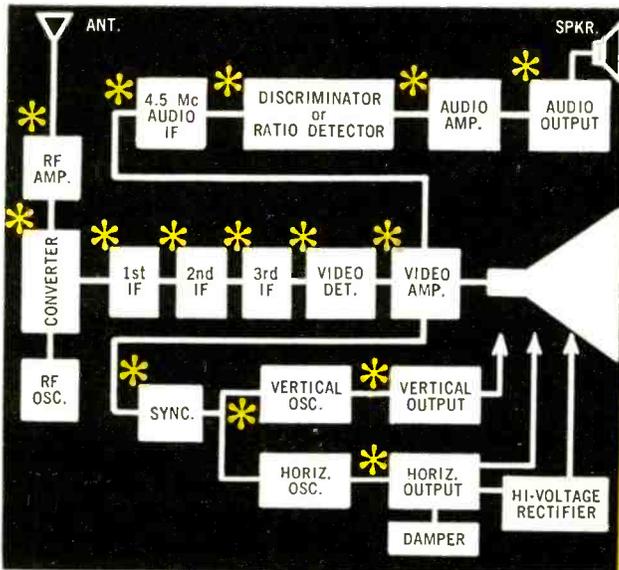
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**DIRECT
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*test each stage
SEPARATELY*

and watch the
result on the
TV set itself



UNIQUE NEW SIGNAL-INJECTION TECHNIQUE Saves TV Trouble-Shooting Time and Work

-  **R.F.** Supplies complete r.f. and i.f. signals with video and audio modulation to quickly trouble-shoot each stage in each of the sections of the TV receiver. Enables you to check the r.f. sensitivity and AGC settings of TV receivers.
-  **VIDEO** Reproduces a complete test pattern on the screen of the TV picture tube and injects signals into each video stage of the TV receiver for fast, visual trouble-shooting and correction—anywhere, anytime. Makes it easy to check bandwidth, resolution, shading and contrast capabilities of the TV set.
-  **SYNC** Provides composite signal, sync positive and negative.
- SWEEP CIRCUIT DRIVING PULSES** Provides separate vertical and horizontal driving pulses for trouble-shooting deflection circuits.
- INTERMITTENTS** Test signal injection also aids in locating intermittent troubles.
-  **AUDIO** Provides a 4.5 mc sound channel, FM modulated with approximately 25 kc deviation. (This audio carrier is modulated either from a built-in 400 cycle tone generator, or from your own external audio source.) Injection of the 400 cycle tone signal simplifies trouble-shooting of the audio section.
-  **COLOR** Enables you to trouble-shoot and signal trace color circuits in color TV sets.
Generates white dot and crosshatch patterns on the TV screen for color TV convergence adjustments.
Generates full color rainbow pattern of orange, red, magenta, blue, cyan, green to test color sync circuits, check range of hue control, align color demodulators, etc.
-  **SET ADJUSTMENT** Enables you to check and adjust the vertical and horizontal linearity, size and aspect ratio of television receivers.



NEW
B&K
MODEL 1075



QUICK, DIRECT, COMPLETE TV TROUBLE-SHOOTING

Now, by point-to-point signal injection and test pattern reproduction, you can easily trouble-shoot and signal trace *any stage throughout the video, audio and sweep sections of black & white and color TV receivers.* With the remarkable new Model 1075 B&K TELEVISION ANALYST, you can quickly isolate and diagnose TV troubles (including intermittents). By use of the generated test pattern, you can *actually see* the condition directly on the picture tube of the television set itself. No external scope is needed. The TELEVISION ANALYST is practically a *complete TV service shop in one instrument!* **Net, \$259⁹⁵**

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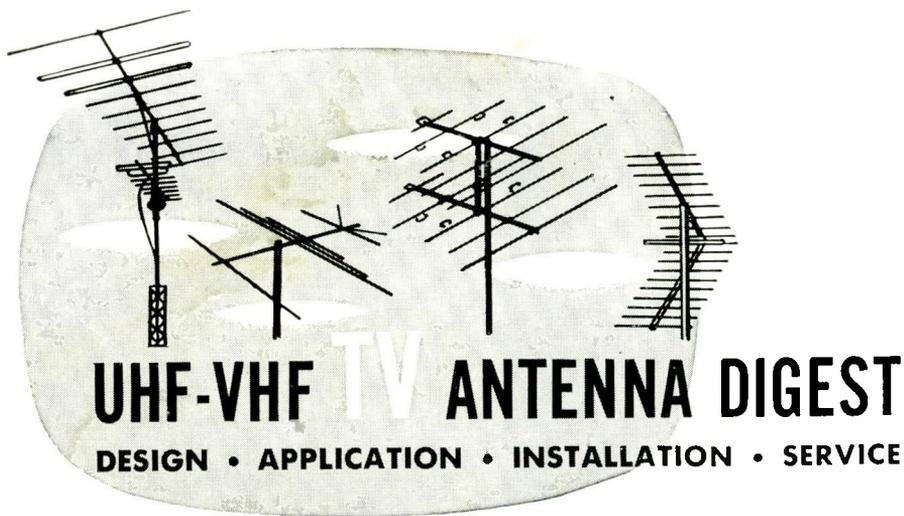
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New Indoor Antenna With Dipole Matching Transformer



by RUDOLPH T. PLEMICH

IN THE EARLY days of television, primary signal areas generally were inadequate to provide sufficient signal strength for TV sets in large metropolitan areas without the use of outdoor antennas. With the greatly increased number of TV receivers, outdoor antenna roof space became increasingly difficult to obtain, especially in large apartment buildings, and was often a source of friction between landlord and tenant. For these reasons many set owners in large cities were forced to operate with indoor antennas, though the results were rarely as satisfactory as with an outdoor installation.

In the last few years, however, primary signal areas have been expanding as TV transmitting stations have increased their output, raised the height of transmitting antennas or both. As the effective radiated power of TV stations has increased, the results obtained with indoor antennas have shown corresponding improvement, and their use has even become possible in what were formerly secondary and fringe signal areas.

Most indoor antennas in use today, however, have a number of objectionable features. The styling is often bulky, they have long dipole elements, and often require channel switching. These have been a source of constant annoyance to set owners and are probably largely responsible for limiting the spread of indoor-antenna use.

A new indoor antenna, designated the Vi-Fi[®], has been developed recently which eliminates these objections. This antenna is shown in Fig. 1 with the dipole elements fully

extended, with the elements telescoped and folded into the case, and with the roll-up dust cover closed. When fully closed, the indoor antenna measures 9½ in. long, 3 in. wide, and 1½ in. high.

Dipole Matching Transformer

Physically, the dipole is about the simplest type of antenna. It is a well-known fact that a simple dipole has a characteristic impedance of 72-ohms while the nominal TV set input is usually 300-ohms. Practically, this 4 to 1 impedance mismatch not only results in lower signal to the TV input, but produces all sorts of trick effects, such as ghosts. Folding the dipole

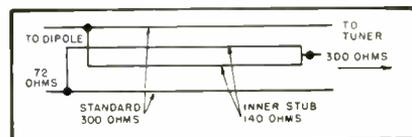


FIG. 2: OPERATING PRINCIPLE OF dipole matching transformer.

changes the impedance to 300-ohms, but this presents mechanical problems which would impair the basic simplicity of the design.

This basic matching problem was solved by utilizing the electrical principle illustrated in Fig. 2. Inside the ordinary 300-ohm lead are placed two additional strands of wire. The center matching stub (two inner wires) is 35½ in. long, and the outer set is 39 in. long. Effectively, the two outer wires constitute an open wire transmission line of a quarter-wave length. This length is cut for the center of the TV band.

The two inner wires also constitute a quarter-wave transmission line with an impedance of about 140 ohms since the two wires are spaced closer together. Note that one end of the line is shorted. Hence, the two tied together give an impedance of approximately 72 ohms, the nominal impedance of the dipole.

Each dipole element for *vhf* channel 13 is only 27 in., while that for channel 2 is 48 in. Measurements show that elements 27 in. long provide impedance mismatches as high as

(Continued on page 26)

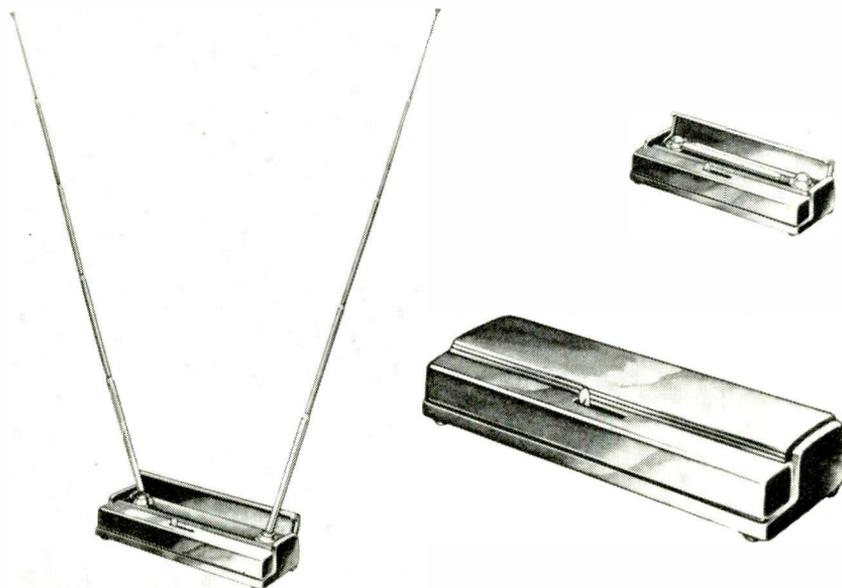
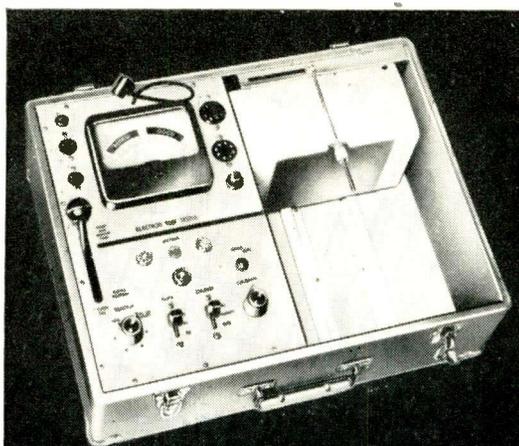


FIG. 1: THREE VIEWS OF VI-FI indoor antenna show unit with elements fully extended, with dipoles telescoped and folded into case, and with dust cover closed.

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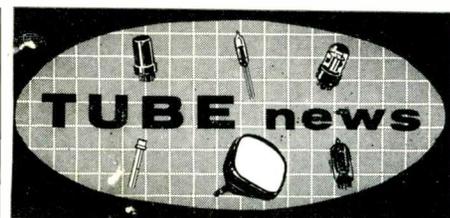
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Earth's Field Effects on Color TV Tubes†

DUE TO BULB shape, the distance traveled by an electron is greater for the edge of the screen than for the center. Considering first the vertical component of the field, the deflection, the motion of the apparent source of electrons in the deflection plane, and the misregistration in color-TV tubes between beams and dots will obviously be larger for the two sides of the screen than for the center. At the top and bottom of the screen, while the distance traveled is the same as for the sides, the vertical field is not normal to the beam path. The net effects are actually somewhat less at top and bottom than at the screen center. When the center of the screen is purified, there is a misregistration of about .002" at the sides and less than .001" in the opposite direction at top and bottom. If there is also a horizontal component perpendicular to the tube axis, as when a tube is aimed east or west, the pattern is, of course, similar but rotated. In the frame-type tube, this effect is attenuated sufficiently so that other effects are more significant.

The field component parallel to the tube axis has a different effect. All beams scanned to the edge of the screen have a radial velocity component which is perpendicular to this axial field component resulting in a tangential displacement of as much as three to four mils, in some locations. This is counter-clockwise when the tube is aimed in a northerly direction, clockwise when it is aimed in a southerly direction and zero when the tube is aimed east or west. No correction can be designed into the tube, although a steel aperture mask is of some help in reducing the effect. The best method of compensating for this effect is a so-called *field neutralizing coil* which is wound around the large end of the tube and connected to a variable *dc* source. This coil produces an axial field which bucks out the

†Part II of an article based on a talk delivered at the IRE-EIA Fall Meeting, Toronto, Canada, by G. A. Burdick, TV Picture-Tube Division, Sylvania Electric Products, Inc. Part I appeared in March 1958 issue of SERVICE.

axial earth's field component—not perfectly, but adequately.

Up to now, it would appear that the steel mask and frame are the answer to such a problem, since they provide free shielding. Actually, the frame has been termed a fluxshunt rather than a shield, since its action is more aptly described by this name. While the frame attenuates the field, it also distorts it. It is difficult to measure the magnitude and direction of this distorted field, since the field is weak and varies rapidly near the frame, necessitating the use of a small but sensitive gaussmeter. It is equally difficult to present a picture of a three dimensional vector field on a slide. Fig. 1, a two dimensional plot, illustrates the major distortion; the drawing represents a plot of the field in the plane of a rectangular frame, the arrows representing magnitude and direction. Only the component in this plane is represented on this figure, the axial component being ignored. In the vicinity of the frame, the field is actually reversed in direction, which tends to counteract the effect of the field further back in the cone region of the tube. The apparent electron source, therefore, appears to be closer to the axis for the top and bottom of the tube than for the center and sides.

The field is, of course, different for each frame-mask assembly and for each orientation of the tube and variation in the earth's field. To determine accurately a multitude of fields and raytrace electron paths is a practical impossibility if not a theoretical one.

Color-TV tubes being made at the present time, such as the 21CYP22, normally require a compromise purity magnet adjustment and may require some external aid in the form of a shield, field neutralizing coil, or adjustable magnets for some of the possible geographical locations and orientations, but may be satisfactory without external help in other orientations. Adjustable magnets have the advantage of flexibility and cost, while the field neutralizing coil has the advantage of simplicity of adjustment.

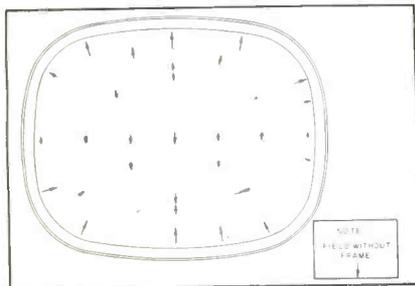


FIG. 1: TWO DIMENSIONAL PLOT of a field in the rectangular frame of a color tube; arrows represent magnitude and direction.

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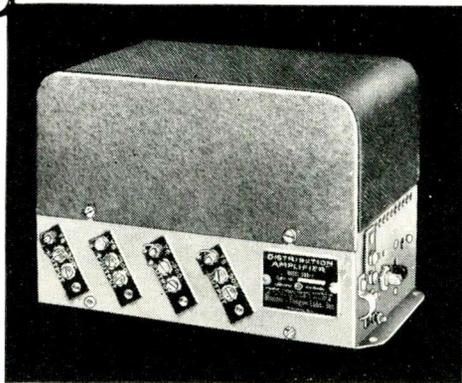
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Antenna Digest

(Continued from page 21)

30 to 1 in the low *vlf* bands and 7 to 1 in the high *vlf* bands. These mismatches are apparently due to a large capacitive reactance. The picture appears with numerous *ghosts* and *smears*.

Cancellation of the large value of capacitive reactance is accomplished by adding an equal inductive reactance to each dipole element. This brings the dipole element to resonance at a particular frequency and thereby provides a good impedance match. An additional problem arising is that of keeping the impedance matched from channel to channel. Slug tuned coils, mechanically ganged as shown in Fig. 3, provided the answer.

Two ferrite rods are held together by a plastic rod made of Cyclocac[®]†, which does not affect tuning. Note that the tuning tab is not centered on the rod. This is done in order to have the ferrite in the coil on the left just enter the coil at the B end while the ferrite on the right is just entering its coil at the C end. Each dipole element is thus balanced and its length is adjusted electrically.

Advantages of Slug Tuning

This method of slug tuning eliminates one of the major problems of indoor antennas. When a dipole element length is adjusted by hand a body capacitance is added to the antenna. A properly adjusted picture obtained in this fashion may fade away or distort in one form or another when the hand is removed from the dipole element. The *slide tuner* on the Vi-Fi antenna tends to overcome this defect.

Experimental impedance values of the antenna were measured, with the tuner and the matching transformer installed. The mismatch across the high *vlf* band had dropped as low as 3 to 1 while the low band *vlf* values dropped as low as 1.5 to 1. The com-

†Registered trademark, Marbon Chemical Div. of Borg-Warner Corp.

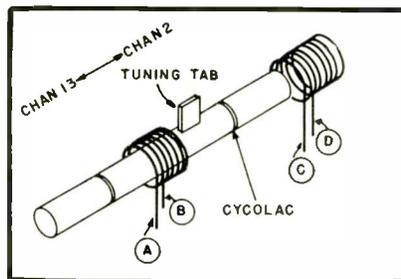


FIG. 3: ARRANGEMENT OF SLUG-TUNED coils in Vi-Fi indoor antenna.

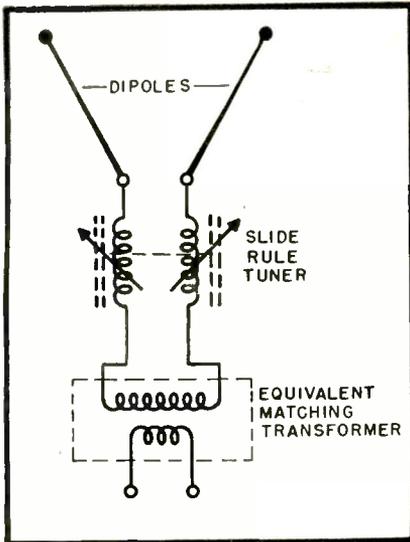


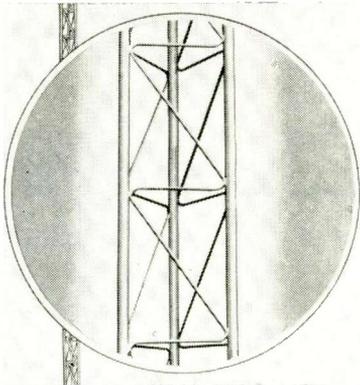
FIG. 4: SCHEMATIC DIAGRAM of Amphenol Vi-Fi Indoor Antenna.

plete schematic for the antenna appears in Fig. 4.

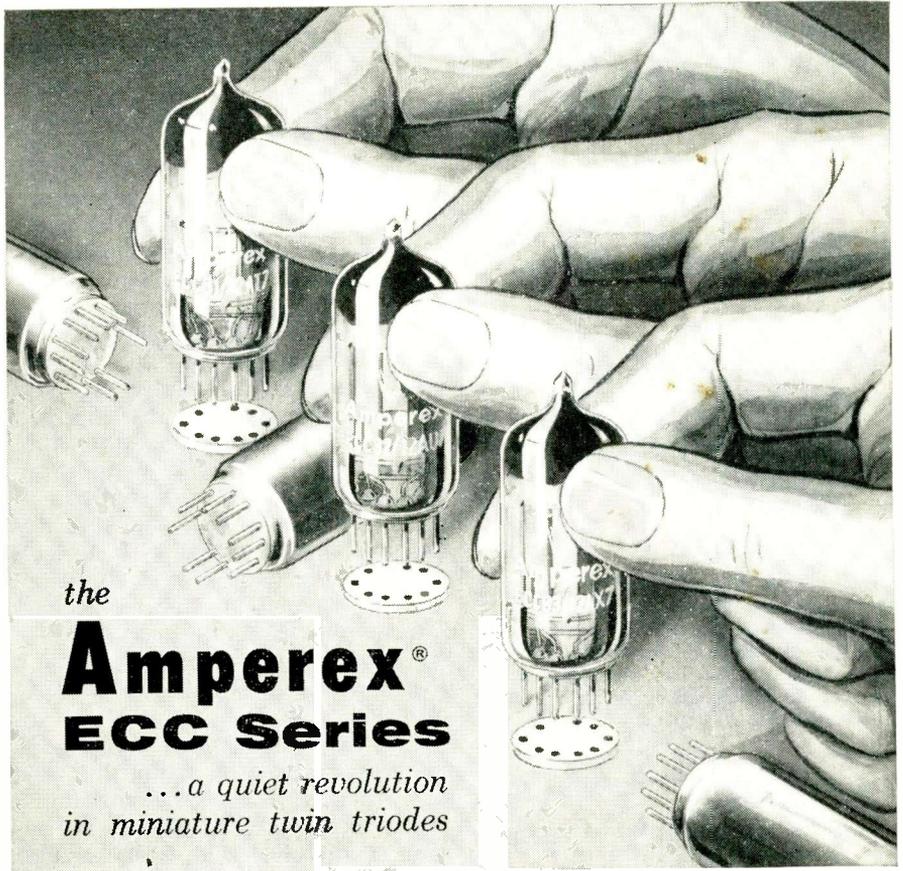
The *vlf* dipoles were collapsed to their shortest length, and the impedance was measured in the *uhf* band. Plotted values netted a mismatch which ran as high as 20 to 1. This was attributed to the fixed inductance in each leg of the dipole. Since this inductance could not be switched or tuned out, without affecting the performance of the *vlf* antenna, a separate folded dipole was designed, mounted under the bottom cover, and a standard length of 300-ohm twin lead was used for connection to the set. Experimental measurements were then taken and the mismatch had dropped to an average of 3 to 1 over the entire *uhf* band.

The antenna was field tested in several metropolitan areas with satisfactory results.

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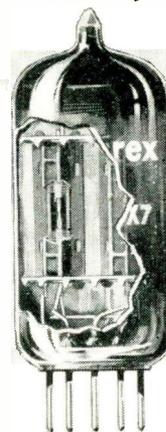
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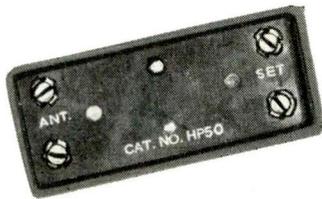
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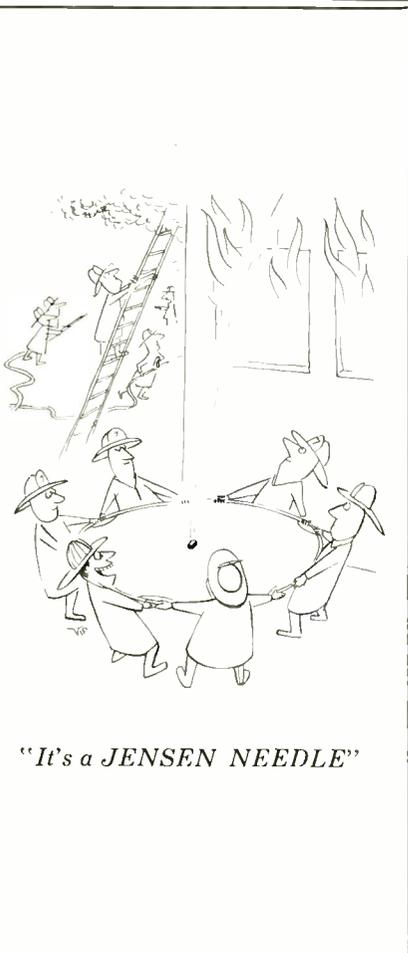
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Signal Distribution Pattern of Ultrahigh Parabolic Antenna System

A NUMBER OF READERS have expressed interest in the *uhf* parabolic antenna described in a recent report¹ and have requested further clarification of the antenna distribution patterns discussed and illustrated in this article. The authors pointed out that all antennas have a natural tendency to develop a narrower beam as frequency increases. Most of the time this is a desirable feature. However with parabolic antenna, too narrow a beam in the dipole system would be a disadvantage since it would prevent the dipole from picking up reflected signal from the outer edges of the screen. A major objective in the design of this antenna, therefore, was to maintain a uniform beam width over *all uhf* channels.

Fig. 1 shows the antenna and three patterns produced by it. For the sake of clarity, the diagram shows the antenna acting as a transmitter rather than as a receiver. This is permissible since the theory of reciprocity states that the patterns of an antenna are identical regardless of whether the antenna is used to receive or transmit the signal.

Fig. 1a shows the ultrahigh parabolic antenna² discussed in the article

¹*Ultrahigh Parabolic Antenna System Design and Installation, Harold Harris and Paul Mattern, SERVICE, APRIL, 1958.*

²*Para-Scope antenna produced by Channel Master Corp.*

in its normal operating position. The ideal distribution pattern, which the designers of this antenna strove to obtain at all frequencies, is illustrated in Fig. 1b, where the beam is wide enough to illuminate the entire surface of the screen. With higher frequencies, however, the dipole asserts its natural tendency toward a narrower beam, producing the pattern shown in Fig. 1c. Only the inner part of the screen is illuminated by this signal, with a resultant decrease in gain. This tendency is overcome by varying the design of the feed system.

Overcorrecting the feed system will produce too wide a pattern as shown in Fig. 1d. This pattern is also inefficient because a portion of the signal escapes beyond the outer edges of the screen and is not utilized. A properly designed antenna will hold the beam width constant so that the entire screen is illuminated over the full range of the ultrahigh frequencies.

Although the horizontal pattern is normally of more concern to the Service Man, the vertical pattern is of equal importance in an antenna of this type. The feed system receives its signal from a round screen, as illustrated in Fig. 1a. Therefore both horizontal and vertical beam widths must be matched as closely as possible so that the dipole can receive signals with equal efficiency from all points on the round screen.

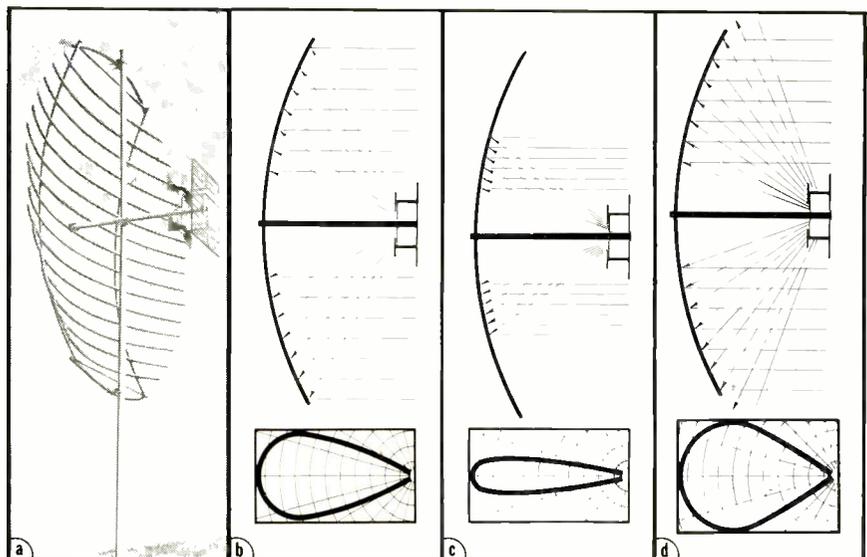


FIG. 1a: PARABOLIC ANTENNA in normal operating position. **Fig. 1b: Ideal distribution pattern** produced by this type of antenna. **Fig. 1c: Signal distribution pattern** with a narrow beam which is not properly corrected. **Fig. 1d: Pattern resulting from an overcorrected beam** which is too wide to be fully reflected by the screen. The patterns shown in both Figs. 1c and 1d result in decreased gain.

Power Supply

(Continued from page 16)

8 amps at 16 v on the 0-16 v range, a sudden reduction in the current from 8 to 4 amps will cause the output voltage to rise to 18.8 v. In this way the performance of this unit may be noted at all varying loads.

The floating output terminals make it easy to supply the required polarity to the circuits under test. All transistor car radios as well as transistor portables can be checked over the range of supply voltage variations that may be anticipated. This power supply also facilitates servicing of hybrid-type automobile receivers, since hybrid tubes are especially susceptible to ripple in the voltage supply.

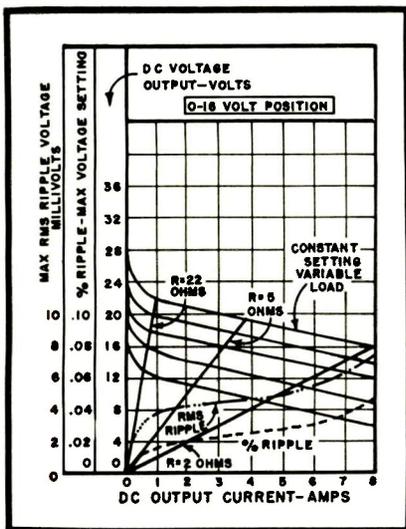


FIG. 3: PERFORMANCE CHARACTERISTICS of type EFB power supply in the 0 to 16 volt range.

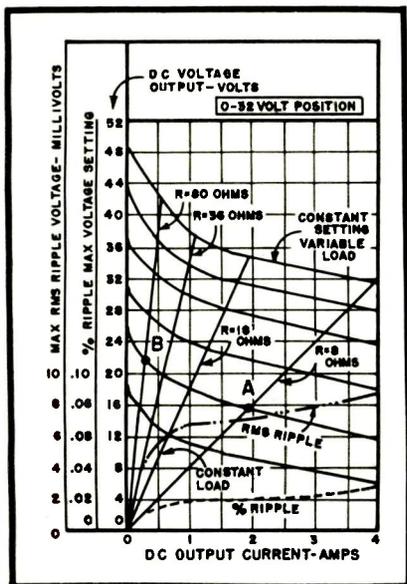


FIG. 4: PERFORMANCE CURVES of DC power supply unit in the 0 to 32 volt position.

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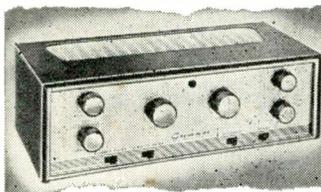
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Repairing Printed-Wiring Board Chassis*

by LEROY WOLFF, Field Service Engineer, Motorola, Inc.

IN REPAIRING p-w boards, the solder pot should *not be used* to solder the parts into the new board; this can be done much more efficiently with a soldering iron. *Be sure the iron tip is clean and well-tinned.* Apply the tip of the iron to the lead or lug, installed in its mounting eyelet on the board, long enough to heat it sufficiently to flow solder. Use 60/40 resin-core solder. The solder should be applied to the lead or lug long enough to allow solder to flow down it, the mounting hole filled and a little protrusion formed on the other side of the board; then the iron should be removed immediately. A joint made in this way will never cause trouble, nor is there any danger of damaging the board. A little intelligent practice will soon provide the facility of operation needed to make a good connection every time, and to do it swiftly without damage to the board. One should

bear in mind that the mass of the lead or lug will be a factor in the length of time the iron must be applied, and this can only be judged by observation and experience.

The board should be supported adequately while assembling and soldering it.

Replacement of Individual Parts

Standard Two-Lead Resistors and Capacitors: Sometimes, where positive indication that a resistor or capacitor is defective exists, it may be possible to replace the defective unit without removing the chassis from the cabinet. If the leads of the defective unit are long enough, they should be clipped as close as possible to the

*Third and final part of a series on this subject. For earlier articles, see SERVICE, Jan. 1958 and Feb. 1958.

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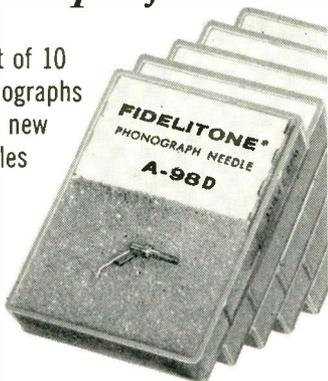
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unit, and these leads should be used to connect and solder the replacement unit.

Res-Cap Assemblies

Multi-element assemblies of resistors and capacitors as used by Motorola are designated as *res-caps*. Usually, if one component in such an assembly fails, the lead or leads connecting the unit to the board can be clipped loose and an individual component of the same value can be connected in its place, avoiding the necessity of replacing the entire unit. This is permissible, but care must be used in tracing connections to be sure that, because of an internal connection in the *res-cap* itself, some other component will not be left floating. For instance, in an intertube coupling assembly, the connections from the *res-cap* to the grid of the second tube may be connected inside the *res-cap* to one side of the interstage coupling capacitor and to the grid resistor of this tube. If the coupling capacitor shorts or becomes leaky and has to be replaced, it can be done by clipping the *res-cap* lead at the grid and also the lead from the coupling capacitor to the plate of the preceding tube and then using an individual unit of the same value. But, since clipping the original grid lead also removes the connection to the grid resistor, a separate grid resistor must also be installed; otherwise the grid would be left floating, which could lead to some unusual symptoms.

Excessive Heat Harmful

Res-cap connections are vulnerable to damage if excessive heat is allowed to travel up the leads and to their junction with the various components which have a Durez coating. Care should be exercised to protect them from this type of damage by good soldering technique.

Complete removal of *res-caps*, such as would be necessary in a transfer of components from a broken board, should always be made with the use of a soldering pot.

Multi-Lug Components

A soldering pot should be used for the removal of sockets transformers, electrolytics, gangs, etc. As previously mentioned, such items can be removed with an iron, but the operation is very slow and can easily result in damage to the board or component,

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8376

Miniaturized

Circuitry Analysis of

by FRED J. KITTY

General Instrument Corporation

THE UHF TV BAND was opened to commercial use late in 1952. This band, extending from 470 to 890 mc, afforded 70 additional channels (14 through 83) to provide properly for the anticipated growth of telecasting.

Since its inception, however, *uhf* has been in a difficult competitive position vis-a-vis *vhf*. One reason for this was the entrenched position of *vhf* at the time *uhf* was introduced. In addition, *uhf* also suffered in a technical comparison with *vhf* because of the higher frequencies involved.

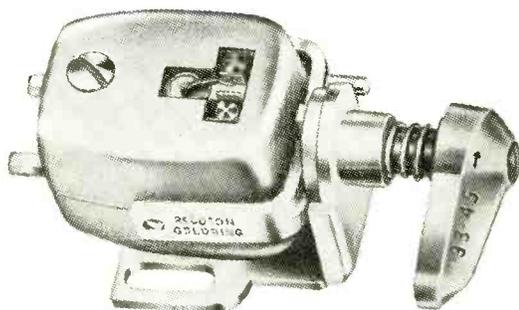
The performance of a *uhf* receiver is established by the *uhf* tuner. Due to the technical advantages favoring *vhf*, the history of *uhf*-tuner development has been basically a continuing struggle to improve performance particularly as regards noise factor. As a result of this effort, *uhf* receiver noise figures have improved by approximately 10 db in the last five years as compared to an improvement of perhaps 1 or 2 db in *vhf* receivers.

The key questions to be answered in the early days were: "Can you see a picture? How far is the station?" As noise figures improved, requirements were added involving such parameters as *if*, image and unbalanced signal rejection as well as antenna match. Somewhat later, maximum oscillator radiation limits were set by FCC. With the advent of color, oscillator drift and stricter passband specifications entered the picture.

While these technical requirements were being added, TV set prices were continuously being reduced. Consequently, TV set components, including both *vhf* and *uhf* tuners were being reduced in price and size. Thus, technical and economic factors dictated that the design of modern *uhf* tuners be quite sophisticated. In this regard, it might be noted that mechanical design was a major engineering element since the evolving TV set required a small, but sturdy, and utilitarian package.

As the state of the art advanced, it became clear that the most efficient

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Compensation-Type UHF Tuner

Ultrahigh Development With Radiation-Suppression Features

uhf receiving system, considering economic and technical factors, as well as FCC regulations, would be a single superheterodyne using a 6AF4A (or equivalent) as the oscillator and a crystal diode (IN82A or equivalent) mixer-converter, and an *if* frequency of 41.25 mc (sound) with no *rf* amplification ahead of the mixer.

Practically all present day *uhf* tuners are built along these lines. Furthermore, a variable capacitor assembly has evolved as the most common tuning method. Thus, assuming the basic merit of the circuits previously chosen, it is seen that the design of modern *uhf* tuners has become a matter of circuit and structural refinement.

Of the several areas of operation open to the designer, the one affording the most profit is that involving the design of the preselector and oscillator coaxial lines, which with variable capacitors, are the basic tuning elements. Two preselectors are provided to afford sufficient skirt selectivity. A single preselector would provide lower insertion loss and consequently a better noise factor, but image rejection specifications of 40-db minimum require two preselectors at the band-widths and *if* frequencies involved. Further, and regardless of the image specifications, two preselectors are required to insure adequate blocking of the local oscillator frequency; i.e., 43.5 mc above the signal frequency. Otherwise excessive oscillator energy will appear at the tuner antenna terminal and consequently the radiation will be above FCC limits. The loaded Q of the preselector circuit is governed by skirt selectivity; i. e., image rejection and oscillator radiation requirements. Since the insertion loss of a preselector varies inversely as the unloaded-to-loaded Q ratio, it is evident that a high unloaded Q is desirable. Loaded Q 's in *uhf* tuner preselectors run in the order of 25-50. To keep the insertion loss below $\frac{1}{2}$ db per preselector requires an unloaded-to-loaded Q ratio of 20. This, in turn, sets the requirement for unloaded Q 's in the 500-1000 range. The unloaded Q depends upon the impedance of the line (which in turn

is a function of the dimensional relationship between inner and outer conductors) and the length of the line.

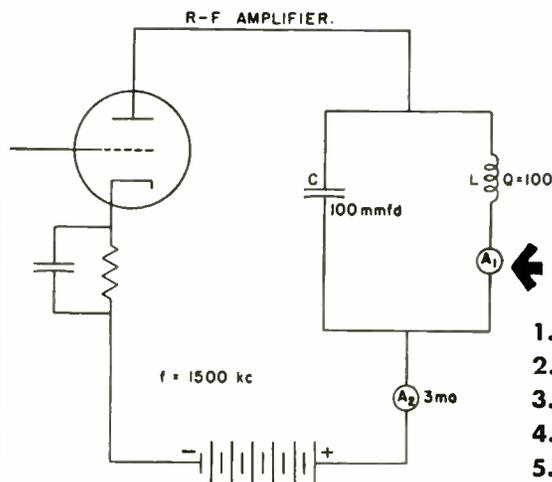
An additional requirement on the preselector lines is the ability to tune over the 470-890 mc range with a

reasonably sized set of capacitor plates. The amount of tuning capacity required is also a function of the impedance and length of the line. Prior to the development of the model

(Continued on page 36)

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S-12

Installing Motel Master Antennas

by TOM SHEA

Sales Engineer, Blonder-Tongue Laboratories

MANY MOTELS are now installing central antenna systems in place of individual antennas for each TV set. A discussion of the advantages of a master antenna installation and a description of a system suitable for use in 90 percent of existing motels appeared in a previous report.¹

Before considering the installation and servicing of master antenna systems, the basic design principles must first be established. For this purpose, we may consider the typical installation described previously¹ which is illustrated in Fig. 1. A proper understanding of design considerations will be extremely useful in troubleshooting and servicing the system.

The basic design principle may be

summed up briefly. First, satisfactory picture must be obtained on all desired channels with a standard broadband antenna feeding a standard TV receiver. Then, if the gain at the head end is equal to or greater than the calculated loss in the distribution section, satisfactory reception will be assured at all outlets.

There are four basic steps to be followed in the design of a motel master antenna system. First is the layout of the main cable run. Next the type of tapoffs to be used must be determined. The next step is to calculate the distribution system loss. Finally an amplifier must be selected which will overcome this loss.

Blueprints or a drawing of the motel will be helpful in determining the layout of the main cable run. As in the motel design shown in Fig. 1, horizontal cable runs are most economical for long, low structures. These are best located in an attic or a crawl space. RG 11/U coax should be used, and the run should be split into the number of branches that permit the shortest possible cable runs.

The type of tapoff used will depend upon the physical requirements to be met within the structure. For new construction, a flush-mounted single wall outlet is generally preferred. A single-outlet tapoff suitable for outdoor system installation is used where an indoor run system is not feasible, and an indoor two-outlet tapoff may be utilized where an attic or crawl space main cable run is possible. The motel system shown in Fig. 1 utilizes two-outlet indoor tapoff as conditions will allow for them. This installation, which provides two outlets with each tapoff, cuts installation time and labor costs in half.

Calculating Losses

The total system loss is calculated from the last TV set on the longest branch line to the head end. This will determine how much gain will be required in the amplifier to be used. The unit for measuring signal gain or loss used in system calculations is the db. The db is used for practical reasons because it allows for simple addition or subtraction in arriving at the resultant loss or gain of signal strength.

The four losses that must be taken into account are the main cable loss,

¹Installing Master TV Antenna System in Motels, Tom Shea, SERVICE; April, 1958.



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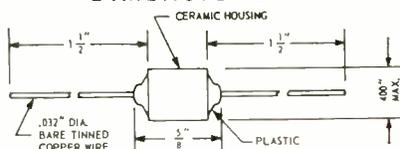


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SPECIFICATIONS

	40K	K-200		40K	K-200
MAX. AC INPUT VOLTAGE	130	130	APPROX. RECTIFIER VOLTAGE DROP	2	2
MAX. PEAK INVERSE VOLTAGE	400	360	MAX. OPERATING TEMP.	100 C.	100 C.
MAX. PEAK CURRENT (MA)	7500	2000	MAX. SURGE CURRENT (AMPS)	30	20
MAX. DC CURRENT (MA)	750	200	MIN. SURGE LIMITING RESIS. (OHMS)	7.5	10

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FIG. 1: TYPICAL MASTER antenna system suitable for use in 90% of existing motels.

the tapoff isolation loss, the tapoff insertion loss and the splitter loss. In a main cable consisting of 300 feet of RG-11 U coax, such as is used in the installation previously described and illustrated in Fig. 1, the loss is approximately 9 db. The tapoff isolation loss was previously¹ given at 17 db and the tapoff insertion loss at 0.5 db for each tapoff in the branch line being considered. With 15 tapoffs in each branch, the total tapoff insertion loss may be regarded as 7.5 db. Finally the two-way line splitter² described in this installation provides a loss of 3 db. Adding up the losses, we arrive at a total distribution loss of 36.5 db for the entire system.

With a system loss of 36.5 db to overcome, an amplifier with at least that much gain must be used. It is also desirable to use a broadband amplifier which will amplify all VHF channels. The broadband amplifier³ described in this installation has a gain of 37 db. After subtracting the 36.5 db system loss, the net gain in the last TV set in each branch is 0.5 db over the original antenna signal strength. If fewer than 15 tapoffs are used in each branch or the length of the cable is less than 300 feet, the resultant signal gain at the last TV set will be increased.

Testing Installations

The master antenna installation described here may be checked for proper signal strength and direction at various test points designated in Fig. 1. The required test set-up is shown in Fig. 2 and requires an attenuator, a matching transformer, and a portable TV set. The attenuator pad provides a 0 to 45 db range of attenuation in 3 db steps. The basic requirement at all test points is that snow-free and interference-free re-

(Continued on page 38)

¹Blonder-Tongue MDC-2.

³Blonder-Tongue type MLA.

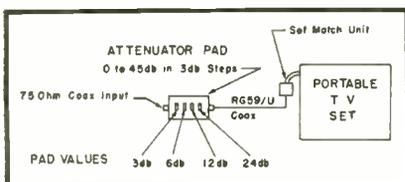
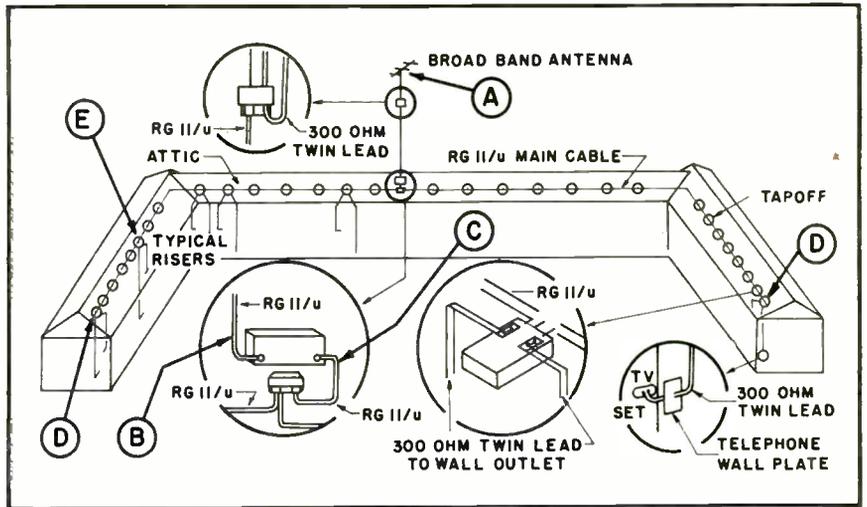


FIG. 2: TEST SET-UP and connections required for checking installation of master antenna system from various test points.

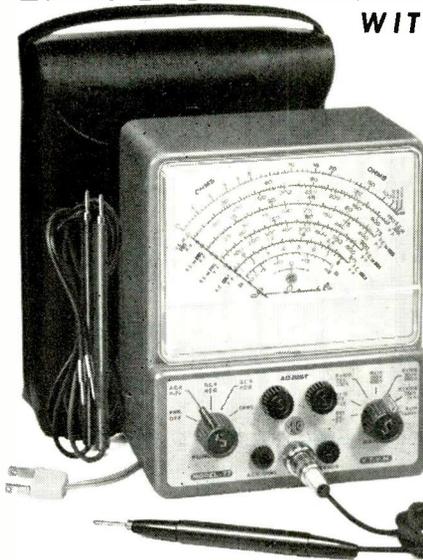


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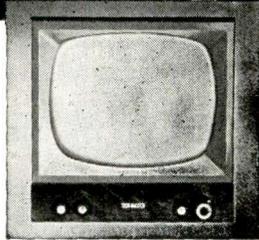


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Miniaturized UHF Tuner

(Continued from page 33)

described* requirements were achieved through the use of lines 3" long. In this model the lines are 2 7/16" long, allowing a reduction in tuner length from 3 3/4" to 2 3/4", an important consideration in the small, shallow TV sets of the present era. The key to this size compression was in the choice of the proper compromise in coax-line dimensions resulting in a line impedance close enough to afford almost optimum Q and at the same time allowing for reasonable tuning capacity.

With the proper selection of cross section dimensions to afford proper Q and tunability, the remainder of the preselector design is that of setting the loadings at antenna and mixer together with the coupling between the two circuits. These parameters are adjusted to give a bandpass slightly overcoupled at the extremes of the range and critically coupled at mid-band. Loadings are determined by the shapes and locations of the antenna and mixer coupling loops in the coaxial lines.

The design of the oscillator is governed by three basic requirements:

- (1) Provide sufficient output to drive the mixer crystal at an efficient operating point.
- (2) Keep power output level low enough to avoid excessive radiation.
- (3) Keep thermal drift low.
- (4) Provide essentially linear frequency calibration.

The basic circuitry used in the oscillator is a grounded plate, tuned-grid modified Colpitts.

It is to be noted that the first two requirements above are in contradiction and compromises have to be made. In general, too, at uhf peculiar resonances and nodal points are encountered with resultant oscillator weak or dead spots. It is important to eliminate these in order that the oscillator drive be not excessive at some frequencies in compensating for the low activity points. In this tuner these dips have been eliminated, as shown by proper oscillator activity over the entire band with B+ voltages as low as 40 v at the oscillator plate.

The main advantage derived from operation at low plate voltages is a

*G. I.-F. W. Stckles model 204.

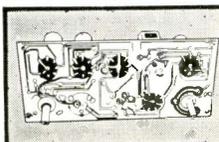
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Available in all practical Tin-Lead Alloys; 40/60, 50/50 and 60/40 in diameters of 3/32", 1/16", 3/64", 1/32" and others.



Printed Circuit Soldering
On Copper-etched boards use 60% Tin-40% Lead Alloy . . . for those that are Silver-surfaced use 3% Silver-61 1/2% Tin-35 1/2% Lead

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model	description	list
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AC60	Joins 3 sets to 1 antenna	4.00
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 Brooklyn 4, New York

design affording radiation within FCC limits. In the past this has been achieved only with the costlier plate-tuned grid type of oscillator where the ground currents are lower than in the tuned grid-grounded plate design. To achieve such relatively uniform activity each possible absorbing element had to be carefully tracked down and eliminated, detuned or de-coupled.

Drift Compensating Capacitors

A more difficult problem was that of making provision in the design for the addition of drift compensating capacitors. Addition of capacity lowers the maximum frequency obtainable with a given impedance. Modifying the impedance to allow more capacity results in decreased oscillator efficiency. Thus a proper compromise must be arrived at. An additional handicap here is that in small size tuners there is a greater amount of minimum capacity (due to geometry) than is the case for larger sized tuners. Heretofore, full compensation had been achieved only in larger tuners. The importance of proper compensation is vastly multiplied for color-TV, since a relatively slight change in frequency will cause loss of color in the picture. With the compensation provided there is now a maximum drift in the order of 200-300 kc. This should be compared to drifts upwards of 1½ mc in uncompensated tuners.

PICTURE TUBE BRIGHTENER



A PICTURE-TUBE brightener, SP 110, for use with RCA-type 110° tubes, has been introduced by Anchor Products Co., 2712 W. Montrose Ave., Chicago 18, Ill.

Adjustment is said to adapt unit for either series or parallel-wired filaments. Can be used on electrostatic or electromagnetic-focus tubes. [SERVICE]

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Flat from DC-4.5 mc, usable to 10 mc. VERT. AMPL.: sens. 25 rms mv/in; input Z 3 megs; direct-coupled & push-pull thruout; K-follower coupling bet. stages; 4-step freq-compensated attenuator up to 1000:1. SWEEP: perfectly linear 10 cps-100 kc (ext. cap. for range to 1 cps); pre-set TV V & H positions; auto. sync. ampl. & lim. PLUS: direct or cap. coupling; bal. or unbal. inputs; edge-lit engraved lucite graph screen; dimmer; filter; bezel fits std photo equip. High intensity trace CRT. 0.06 usec rise time. Push-pull hor. ampl., flat to 400 kc, sens. 0.6 rms mv/in. Built-in volt. calib. Z-axis mod. Sawtooth & 60 cps outputs. Astig. control. Retrace blanking. Phasing control.



NEW TV-FM SWEEP GENERATOR & MARKER

#368
 Factory-wired and tested \$119⁹⁵
 Also available as kit \$69⁹⁵

Entirely electronic sweep circuit (no mechanical devices) with accurately biased inductor for excellent linearity. Extremely flat RF output; new AGC circuit automatically adjusts osc. for max. output on each band with min. ampl. variations. Exceptional tuning accuracy: edge-lit hairlines eliminate parallax. Sweep Osc. Range 3-216 mc in 5 fund. bands. Variable Marker Range 2-75 mc in 3 fund. bands; 60-225 mc on harmonic band. 4.5 mc Xtal Marker Osc., xtal supplied. Ext. Marker provision. Sweep Width 0-3 mc lowest max. deviation to 0-30 mc highest max. dev. 2-way blanking. Narrow range phasing. Attenuators: Marker Size, RF Fine, RF Coarse (4-step decade). Cables: output, scope horiz., scope vertical.



NEW DYNAMIC CONDUCTANCE Tube & Transistor Tester

#666
 Factory-wired and tested \$109⁹⁵
 Also available as kit \$69⁹⁵

COMPLETE with steel cover and handle.

SPEED, ease, unexcelled accuracy & thoroughness. Tests all receiving tubes (and picture tubes with adapter). Composite indication of Gm, Gp & peak emission. Simultaneous sel. of any 1 of 4 combinations of 3 plate voltages, 3 screen voltages, 3 ranges of continuously variable grid voltage (with 5% accurate pot). New series-string voltages: for 600, 450, 300 ma types. Sensitive 200 ua meter. 5 ranges meter sensitivity (1% shunts & 5% pot). 10 SIX-position lever switches: free-point connection of each tube pin. 10 pushbuttons: rapid insert of any tube element in leakage test circuit & speedy sel. of individual sections of multi-section tubes in merit tests. Direct-reading of inter-element leakage in ohms. New gear-driven rollchart. Checks n-p-n & p-n-p transistors: separate meter readings of collector leakage current & Beta using internal dc power supply.

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TRANSISTOR POWER SUPPLY

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Especially designed to operate, service and test transistor portable radios and low power transistor circuits.

Highest quality components combined with careful engineering make this instrument extremely reliable and useful for laboratory and service applications.

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SPECIFICATIONS

Input: 115 Volts 50/60 cycles
 Output Voltage: 0-15 Volts and 0-30 Volts
 Output Current: 0-15 MA and 0-60 MA
 Accuracy: 2% on both voltage and current
 Ripple: Less than 500 microvolts (.002% at full output)
 Regulation: 1.2 Volts Maximum; Zero to full load current
 Internal Impedance: Less than 20 ohms DC to Radio Frequencies (including 7.0 ohm Meter Fuse, optionally removable)
 Terminals: 5-Way Binding Post
 Size: 10" x 6 1/2" x 5 3/4"
 Weight: 16 pounds

FEATURES

- Continuously adjustable output using variable autoformer control, setting of all transistor battery voltages.
- Two output voltage ranges for accurate setting of all transistor battery voltages.
- Two output current ranges monitor current for single transistor or entire set.
- Extremely low ripple for testing lowest level transistor circuits.
- Very low internal impedance providing excellent regulation.
- Precision D'Arsonval meters provide laboratory accuracy.
- Millimeter protected by front panel fuse; additional internal line fuse.
- Output isolated from line and case.
- Attractive Slope — Front, Maroon Hammerloid Cabinet — Rubber feet.

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Manufactured by

COMPANY 3100 N. ELSTON AVENUE CHICAGO 18, ILL

There's always something new being developed by Perma-Power

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Motel Antennas

(Continued from page 35)

ception be obtained on all desired channels.

Test point A, directly off the antenna, is taken with the attenuator and set-matching transformer by-passed, producing no attenuation. Test point B, the input to the amplifier, is also taken without attenuation. Before checking test point C, the output of the amplifier, connect the attenuator so that 36 db of attenuation is provided. Test point D checks the end of each branch before the tapoffs are installed and requires 24 db attenuation. The last test point E, at each TV outlet, requires no attenuation and consequently is made with the attenuator and set matching unit by-passed.

Picture Troubles

Any sudden marked change in reception is a sure indication of trouble. The type of picture trouble often gives a good hint as to what may be wrong with the system. A weak snowy picture indicates insufficient signal, weak amplifier tubes, open or poorly made connections, defective transmission lines. To correct a weak signal, increase the amplification.

Multiple ghosts or smear is often a sign of an open or short circuit in transmission line or of improper line or equipment termination. "Windshield wiper," "herringbone pattern," complete picture breakup, or "ride through" of one channel into several others are usually caused by an overloaded amplifier or unbalanced signals in the line. To correct overloading of the amplifier, reduce amplifier gain.

Diagonal lines in pix, light herringbone pattern, Venetian blind, swirling patterns, or complete pix blackout may be the result of RF interference from FM stations, other radio service, TV-set local oscillator radiation, line amplifier oscillation, co-channel or adjacent channel interference from another TV station. Local TV-set oscillation can be cured only by checking individual sets and tapoffs for proper connections. Coax cable in the vicinity of the receiver must be grounded.

Dark moving horizontal bars in pix may be caused by an improperly tuned TV set. If the set is tuned properly and bars still appear, then the difficulty is due to 60-cycle ac in the picture signal. Examine the am-



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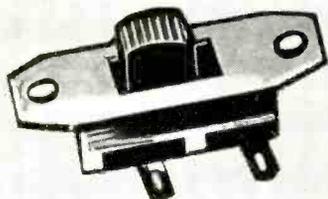


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PORT WASHINGTON, NEW YORK

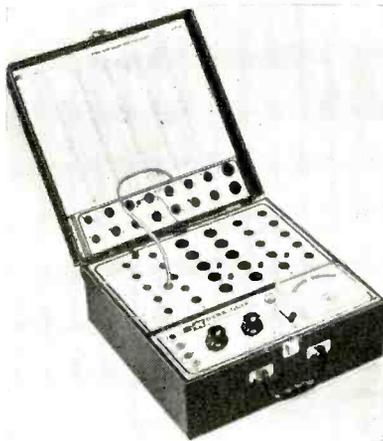
plifier for detective tubes, rectifiers, *dc* filter condensers, or other power supply components. If *ac* bars appears in just one receiver, look for *ac* trouble in that receiver rather than in the line.

Light streaks shooting horizontally through *pix* indicate interference from automobile ignition, neon or fluorescent lights, electric motors, high voltage power line or intermittent cable connections. This may be corrected by a high-pass *rf* filter used at the amplifier inputs.

A weak signal on some channels with normal signals on others is usually due to a mismatched, open, or short-circuited transmission line. These line faults occur in such a way as to form a trap for the channels affected. Check all line terminations and connections.

The following hints will prove useful to the Service Man installing a master antenna system of this type. First make sure to ground all equipment. Use a lightning arrester to save equipment from possible damage from lightning. Make certain that the antenna mounting is structurally sound. Use guy wires when necessary. Finally pay careful attention to all basic installation techniques, especially soldering. A poorly soldered connection may be difficult to locate after the system has been installed.

PORTABLE TUBE TESTER



A MULTIPLE-SOCKET dynamic - mutual-conductance tube tester, 500B Dyna-Quik, with tests for shorts, grid emission, gas content and leakage, has been announced by B&K Manufacturing Co., 3726 N. Southport Ave., Chicago 13, Ill.

Unit shows tube condition on good-bad scale and in micromhos. Life test is said to show life expectancy of tubes in set. One switch is used for all tests. Popular tube-type settings are listed directly on socket panels; complete quick reference chart inside cover. Bridge monitors line voltage for automatic compensation. Seven and nine-pin straighteners on panel. Further information in bulletin TAD-18. [SERVICE]

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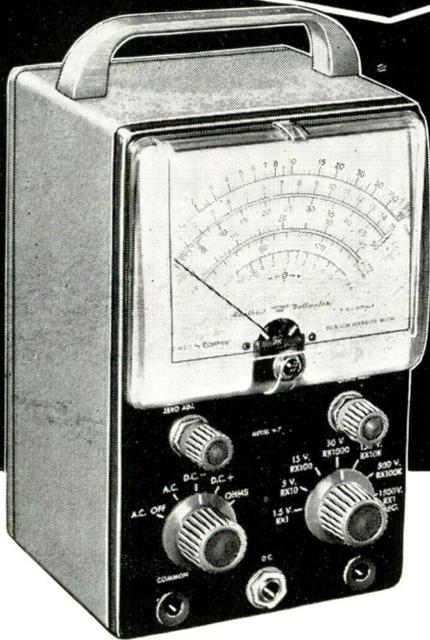


Make one antenna do the work of two — at a neat profit for you. Low loss ferrite core transformer design for top-notch set isolation and signal transfer. Write for JFD Service-Saver brochure showing 40 money-making TV accessories now at your JFD distributor.

model	description	list
BC2	Joins 2 sets	\$2.85
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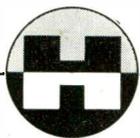


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Servicing Upright

by E. A. MUELLER

A RECENT REPORT¹ discussed the opportunities in the small appliance servicing and points out that the Service Man, because of his retail experience and specialized training, is in an ideal position to develop this field as a source of supplementary income. One of the most common of these small appliances is the home vacuum cleaner, and a few hints on their servicing may prove useful to the Service Man.

As is generally known, there are two distinct types of vacuums in the home cleaning field. The older of the two styles is commonly called an *upright* cleaner, and is operated by a handle from the motor unit. It has an exterior bag or dirt container, and in almost all cases employs the principle of a revolving brush mounted in the nozzle. The brush is driven by a rubber belt operating from a pulley which is in effect an extension of the rotor, or armature, shaft.

The nozzle of the *upright* vac is adjusted about $\frac{1}{4}$ in. above the carpet surface, so that in operation the area of carpet immediately under the nozzle is lifted by suction into contact with the nozzle providing an air pocket between carpet and floor. This air pocket acts as a cushion against which the revolving brush beats and agitates the carpet to loosen grit and dirt imbedded in the base of the nap. This makes it possible for the suction to draw air through the carpet, taking with it the loosened grit. The disadvantage of the *upright* cleaner is that attachments for cleaning edges of wall-to-wall carpet, furniture and drapes are clumsy to use and lack sufficient power for straight-suction cleaning.

A second variety of vacuum is the straight suction cleaner, either the tank type² or the canister type.³ These cleaners operate on the principle of straight suction without agitation, and necessarily employ a much higher degree of suction than the *upright* style. It is generally much more efficient for accessory cleaning, and the attachments are more convenient to use.

Modern tank units are built with varying degrees of mobility and utilize a flexible hose, with swivel couplings, to connect the motor and with a multi-

¹Small Appliance Service Opportunities, E. A. Mueller, SERVICE, February, 1958.

²Such as the Electrolux.

³Such as General Electric models.

Home Vacuum Cleaners

Electric Sweeper Service Co.

tude of attachment tools. Theoretically, the disadvantage of this type for use on carpeting is that its lack of revolving brush prevents brushing of the nap and agitation of imbedded grit, making it efficient only for surface cleaning.

As these two styles are quite different, it is to be expected that the servicing procedures, except for the motors, would vary from one to the other. In this article we will consider the servicing problems common to upright cleaners. Tank-type cleaners and vacuum-cleaner motors, which are common to both styles, will be covered in a later report.

Aside from faulty motors, the four most common complaints encountered in servicing uprights are those associated with the bag or dirt container, the brush and belt, the cord and switch, and the fan or impeller. These difficulties account for between 60 and 75 per cent of vacuum repairs and are far easier to remedy and generally much more profitable than the more difficult motor repairs.

Bag or Dirt Container

The condition of the bag or dirt container ranks first as a trouble source because so few users understand its function. A bag must be efficient in two respects. It must be of a material woven and chemically treated to retain dust with a minimum of leakage, but it must also be sufficiently porous to permit a volume of air to pass through which is in direct proportion to the volume drawn in through the nozzle creating suction. If there is, or has been, a moisture condition in the cloth bags, if the bag is not emptied often enough, or if the pores of the material become dust clogged by long use, then it is possible there may be as much as 60% loss in efficiency. These cloth bags *cannot be washed*, they must be replaced.

A quick way to test bag efficiency is to turn on the cleaner and then compress the bag between the flat of your hands. If it compresses easily and without effort, the chances are it is in good condition. However, if the bag offers resistance and is blown up "hard," it is definite evidence that the bag needs replacing.

Many uprights are now sold with a special zippered cloth bag which holds paper disposable inserts. It is

important ANNOUNCEMENT about the TOBE contest and on the next two pages!

Did you know that Tobe is the fastest growing service capacitor line in the U.S.? Even so, we still are getting letters every day from dealers who want to enter our big 50-Prize contest (see ad on next spread) but can't... because their nearest distributor is not yet stocking new Tobe Service Capacitors.

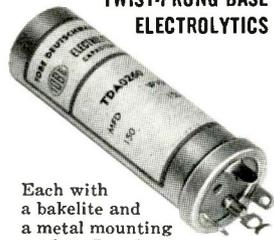
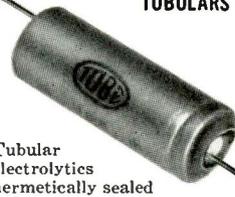
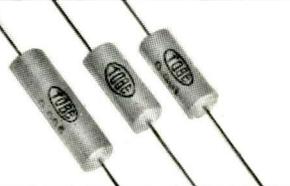
For this reason we are *extending* the Tobe contest from May 30 to June 30—and *making a very special offer besides!* We want YOU to have a chance at that Ford Ranch Wagon, the mink stole and all the other prizes. And we want you to familiarize yourself with Tobe—since 1922 one of America's most popular original equipment capacitor lines.

SPECIAL OFFER! THREE FREE CAPACITORS.

Send in your contest entry (entry blank on next page) today... *without a boxtop*. It only takes a minute to write a good entry. Enclose with your entry an order for any Tobe capacitor described below. We will remove the boxtop and attach it to your entry. Send no money—we will bill you through your distributor. And we will also include, with your Tobe Capacitor, *three* of our tough little "Tobemite" molded plastic tubulars for popular applications *absolutely free*. Send in your entry—and order as many Tobe's described below as you want—today!

WRITE FOR THESE TOBE SERVICE CAPACITORS TODAY

(all prices are dealer net)

<p>TWIST-PRONG BASE ELECTROLYTICS</p>  <p>Each with a bakelite and a metal mounting washer. Popular "Preferred Type" plan.</p>	<p>"JET" ELECTROLYTIC TUBULARS</p>  <p>Tubular electrolytics hermetically sealed into aluminum containers protected in a transparent red plastic sleeve.</p>	<p>MYLAR * TUBULARS</p>  <p>These brilliant capacitors are ideal for use in humid climates—thanks to DuPont's Mylar, world's finest insulation.</p> <p>*A DuPont Trademark</p>
<p>ALSO: Metal Cased Paper Capacitors, Threaded Neck Capacitors, Disc Ceramic Capacitors, Metal Cased Tubulars, Phenolic-Cased Printed Circuit Capacitors.</p> <p>YOU'LL RECEIVE FREE: 3 "TOBEMITE" MOLDED PLASTIC TUBULARS in popular applications. These are America's finest molded tubulars, and they're far smaller than other equally rated capacitors.</p> 		



TOBE SERVICE CAPACITORS

CLIP THIS ORDER FORM TO YOUR CONTEST ENTRY BLANK (SEE NEXT PAGE)

TOBE DEUTSCHMANN, Service Division, 2900 Columbia Ave., Indianapolis 5, Ind.

Please send me _____ Tobe Replacement Service Capacitors as follows:

Quantity Indicate Rating & Characteristics

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Twist-Prong . . .		
Tobemite		

Remove the boxtop before shipping and hold with my contest entry attached.

Please send me the complete Tobe Capacitor Catalog.

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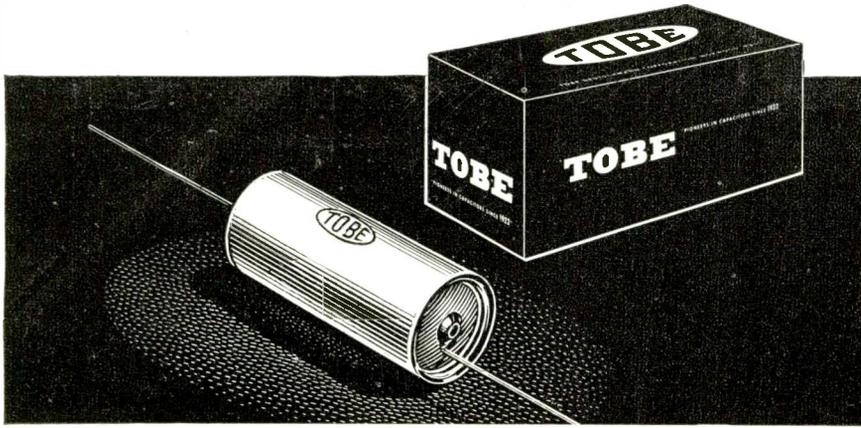
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MY JOBBER IS _____

I understand I will also receive 3 Tobe Molded Tubular Capacitors absolutely FREE. My jobber will bill me for the other capacitor(s) indicated. (Offer ends midnight, June 30, 1958.)

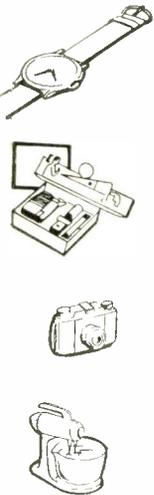
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Tobe Service Capacitors



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"I prefer Tobe Service Capacitors in my work because _____

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I enclose a Tobe boxtop

more convenient for present day housewives to discard the paper unit when full and zip in a fresh insert. These special zipper units can be obtained for all upright cleaners, even where not a part of original equipment.

Brush and Belt

Number two source of complaint is the condition of the brush and belt. Belts are molded of rubber so that there can be stretch tension to drive the brush. Even the best of crude rubber will stretch and deteriorate with age and then no longer drive the brush. The more important difficulty is that many housewives pick up safety pins, hairpins and similar objects in careless operation of the cleaner. One pin can slice a brand new belt in two. Make sure the belt is in good condition, and sell the customer an extra one as a spare.

Except for the Hoover cleaner, most revolving brushes have a method of lowering the brush within the nozzle to compensate for wear, extending its life two to four times. Common-sense inspection of the brush-end mounting will reveal this to any mechanically inclined person. For instance, the Royal brush has a square mounting piece on the brush end which is off center and each side is numbered. The numeral 1 is faced up on each end when a new brush is installed, and as the bristle wears the ends are turned one-quarter turn lowering the brush in the nozzle.

Other makes such as Hamilton Beach and G.E. have spring clip adjustment in the nozzle mounting. The Hoover, with its barrel construction and metal bar beater, has no such adjustment and the bristled metal strips which insert into the barrel must be replaced every six to nine months. The brush bristle in all cases should extend about 1/16 in. through (or outside of) the nozzle opening for best operation.

Revolving brushes are prone to collect thread, strings, and lint, and should be watched and kept free and clean. It is not unusual for a careless housekeeper to bring a cleaner in for repair with so much thread and lint bound around the brush that the bristle is matted down solidly and the brush is useless. Care must be taken in checking to make sure the tufts of bristle are not thinned out.

Cord and Switch

The most common cause of complete failure is a break in the cord. Just as preventive service in other re-

spects is usually disregarded by the housewife, it is even more forgotten when it comes to vacuum cleaners. Cord ages, cracks, becomes brittle and unsafe, and should be replaced when these symptoms are noticed. Most frequently a break appears at the two major wear points, the wall plug and the switch.

Reconnecting Switch

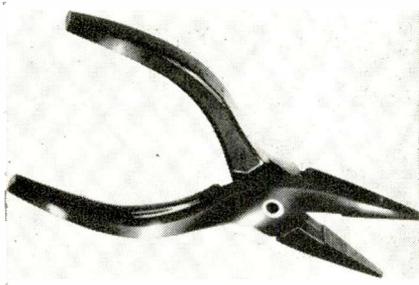
If the general appearance of the cord is good, and continuity check indicates there is a break, a safe procedure is to cut about six inches off the cleaner end of the cord and reconnect to the handle switch, and about three inches from the opposite end install a new *spring action* rubber male plug. With continued use switch contacts and springs will wear and a new switch can be easily installed.

Occasionally, either by accident or carelessness, a solid object such as a small piece of gravel, metal screw or nut, or even a chip of porcelain is picked up and, in going through the fan chamber, chips or breaks one or more of the blades of the suction fan. This causes the blade to be out of balance, and the turning at high speed literally shakes the unit to pieces.

Fan Blade or Impellor

Almost all fan blades are threaded directly onto the armature or motor shaft, and except for Kirby, the belt pulley also threads onto the shaft and locks the fan in place. In the case of Kirby, the fan and pulley are one-unit assemblies, and are threaded on together. In the case of Hoover, late-model Apex, and Eureka, the fan just slides on the shaft and the pulley is threaded on against the fan hub, holding it tightly by pressure.

LONG-NOSE PLIERS



INSULATED LONG-NOSE pliers, 8387, for repairing high-voltage sections of TV sets, have been announced by General Cement Manufacturing Co., 400 S. Wyman St., Rockford, Ill.

Pliers are constructed of high-impact plastic, are non-magnetic and will not interfere with circuit operation. [SERVICE]

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Then, send your entry to us with the top from any TOBE capacitor carton, or the plastic box some TOBE capacitors are packed in.



That's all there is to it. Enter as many times as you wish, providing each entry is accompanied by a TOBE carton top or the plastic box. Use entry blank below. Additional entry blanks can be obtained from your TOBE DISTRIBUTOR.



Contest closes June 30.

Contest is open to all service-men over 21 years of age residing in the continental United States. Employees of the TOBE DEUTSCHMANN CORPORATION and their advertising agency are excluded. All entries become the property of TOBE DEUTSCHMANN CORPORATION. Decisions of the judges are final. In case of ties, duplicate prizes will be awarded. Contest closes June 30, 1958. Winners will be announced July 31st.



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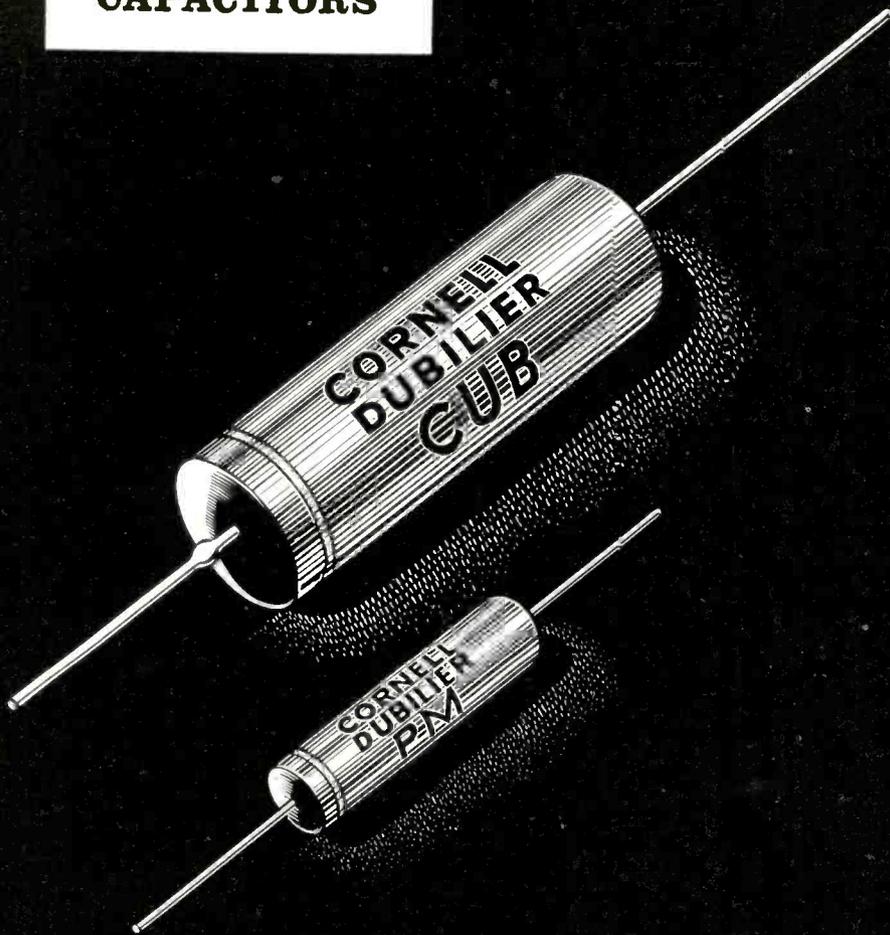
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For a lasting service job, use C-D CUBS or PM'S. Your local C-D distributor carries complete stocks. For full data, ask for catalog 200D-3, or write Cornell-Dubilier Electric Corporation, South Plainfield, New Jersey, Dept. S-58B.



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Old Hands at Dependability

ASSOCIATIONS

NATESA

REPRESENTATIVES of 51 Service Men's associations attended the NATESA Spring Directors Meeting at Springfield, Mo., on April 27th.

George Crossland of General Electric's tube department spoke to the group about *Customer Relations*.

Another feature of the program was the demonstration of test equipment by *Winston Starks*, president of Winston Electronics, and *Norm Peterson*, engineer of Kingston Electronic Corp.

Friends of Service Management awards were presented to Sylvania Electric Products, CBS - Hytron, Sprague Products Company, Howard W. Sams and Company, and P. R. Mallory and Company.

Subjects discussed by the NATESA directors included captive service, licensing, emblems, membership extension, wholesale abuses, state association status, phony trade schools, adverse publicity, and the NATESA advertising and publicity program.

It was voted to open membership to all state groups. Fourteen new groups were accepted as members at the meeting, bringing the total membership to 98 associations. Plans were made for the Annual NATESA convention which will be held at the Congress hotel in Chicago from August 21st through 24th.

TSG, San Francisco, Calif.

Edwin R. Hawkins has been elected president of the San Francisco Television Service Guild. Other officers include *J. Jerome Strauss*, vice president; *Bill Finnerty*, secretary; and *Mrs. Gibson Bories*, treasurer. Directors for the year are *Andy Cerisier*, *Earl Crocker*, *Ned Gramlich*, *Walt Kolbuss*, *Bryant McGrath*, *Jim Miller* and *Roy Norton*. *B. Gross* was reappointed executive secretary.

ARTS, New York City

THE Associated Radio-Television Servicemen of New York have issued a chart of minimum labor rates for TV repair work. Chart is included on a suggested bill form that has been distributed to members of the group.

FRTSA, Pennsylvania

THE Federation of Radio and Television Service Associations passed a resolution condemning "certain" radio, TV and hi-fi manufacturers for "footballing free labor and service for periods of up to one year," at a recent meeting.

The group questioned the use of these policies by manufacturers who

fix fees that may be charged by independent Service Men fulfilling warranties.

The group also drafted a letter to be sent to the Bell Telephone Company of Pennsylvania in which the telephone company's free service listings in classified directories are labeled as "another form of bait advertising."

Milan Krupa was named to head a committee formed to look into the possibility of cosponsoring a Radio Repair Month in conjunction with the Pennsylvania Broadcasters Association.

CETA, New York City

At a recent meeting the Certified Electronic Technicians Association elected *Robert Cornell*, president; *John Hendricks*, vice president; *Nick Colon, Jr.*, treasurer; *Charles Baines*, recording secretary; *Alfred Schab-huttl*, corresponding secretary; and *Graham Holzhausen*, sergeant at arms.

RTA, Pasadena, Calif.

Reese Thomas, general manager of the Pasadena Merchants Association, presented a lecture on "Collecting Your Bills" at a recent meeting of RTA.

ESFETA, New York

At the annual meeting of the Empire State Federation of Electronic Technicians Associations *Robert Larsen* was elected president. Other new officers of the group are *Irving J. Toner*, vice president; *George Carlson*, secretary; *Dan Hurley*, treasurer; and *Frank Kurowski*, sergeant at arms.

TTSDA, Benton Harbor, Mich.

William Toth has been elected president of the Tri-County Television Service Dealers Association. *Robert Wiley* was named vice president; *Ray Blackburn*, recording secretary; *Jim Clupper*, corresponding secretary; *Ed Roscher*, treasurer; and *Carl Janke*, trustee.

TA, South Oakland County, Mich.

The South Oakland County Television Association has chosen *Sam Baldwin* as president. Other new officers of the group are *John Hengel*, vice president; *John Palmer*, secretary; and *Harold Ingalls*, treasurer.

Members of the board of directors are *John Werbinski*, *Dick Schneider* and *Mike Mosier*.

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HOME AIR CONDITIONING by *J. Derman, H. Seaman, F. Makstein*. Modern up-to-the-minute text provides a firm foundation air conditioning theory upon which the practical know-how for installation and repair can be built. Starting with the basic physics of air conditioning, all component parts including compressors, condensers, capillary tubes etc. and their functions are covered. Typical window and packaged installations are described and illustrated. Smaller commercial installations are included. Troubleshooting and repair techniques explained. Recent and future developments in air conditioning covered. More than 100 illustrations support text. \$3.50.

REPAIRING HI-FI SYSTEMS, by *David Fidelman*. This book deals with finding the troubles and repairing faults in hi-fi equipment with no test instruments—simple equipment—and elaborate equipment. Typical troubles are analyzed and repaired through a system of logical steps. Soft cover, 212 pp., illus. #205. \$3.90.

REPAIRING TELEVISION RECEIVERS, by *Cyrus Glickstein*. The most modern completely practical book, written by an expert with long experience in television receiver repair. Devoted to troubleshooting and repair techniques which are modern, yet down-to-earth. Covers the use of simple as well as elaborate test equipment of all kinds. Profusely illustrated. Soft cover, 212 pp., 5½" x 8½", illus. #191, Only \$4.40.

3rd SUPPLEMENT to the RECEIVING TUBE SUBSTITUTION GUIDEBOOK, by *H. A. Middleton*. A must for every technician! Contains more than 830 latest receiving tube substitutions • more than 200 picture tube substitutions • more than 230 American to European tube substitutions • more than 200 European to American tube substitutions • a cumulative index listing the tube types treated in the basic book and all 3 supplements. It pays for itself almost immediately! #139-3—Soft cover, 72 pp., 8½" x 11", illus. Only \$1.35.

RECEIVING TUBE SUBSTITUTION GUIDEBOOK, by *H. A. Middleton*. #135—Soft cover, 224 pp., 8½" x 11", illus., \$3.00.

FIRST SUPPLEMENT, #139—Soft cover, 48 pp., 8½" x 11", illus., \$.99.

SECOND SUPPLEMENT, #139-2—Soft cover, 48 pp., 8½" x 11", illus., \$.99.

ADVANCED TV SERVICING TECHNIQUES, by *Zbar and Schildkraut*. A complete advanced TV servicing course, developed by the Radio-Electronics-Television Manufacturers Association. Shows how to use every conceivable type of test equipment, how to service every part of a TV receiver. Explains latest techniques. Soft cover, 8¼" x 11".

MAIN TEXT, 192 pp., illus. #161. \$3.60.

LABORATORY WORKBOOK, 32 pp. #161-2. \$.95.

TV PICTURE TUBE-CHASSIS GUIDE, by *Rider Lab Staff*. This easy-to-use TV tube type chassis guide covers all picture tube types used in TV receiver production from 1946 to February 1957—over 7,000 listings. Organized by chassis number, and in some cases, by models so that the technician can immediately locate the correct picture tube type simply by knowing the chassis number. #204, Only \$1.35.

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CATALOGS—BOOKS

CHICAGO STANDARD TRANSFORMER CORP., 3501 Addison St., Chicago 18, Ill., has issued a wall chart, DH-1, listing Stancor replacement flybacks and yokes by original manufacturers' part numbers. Set manufacturers are listed alphabetically. [SERVICE]

GENERAL ELECTRIC Co., Television Receiver Dept., Syracuse, N. Y., has published volume 3 of G.E.'s *TV Service Guide* covering TV receivers manufactured from 1955 to 1957, including the 110° line. Also contains production-change information and component-location diagrams. Features included are a photo index; schematic diagrams of chassis, *vhf* and *uhf* tuners; a replacement parts list of appearance items, electrical components and main chassis; diagrams describing tube and trimmer locations as well as test points in both top and bottom chassis views. [SERVICE]

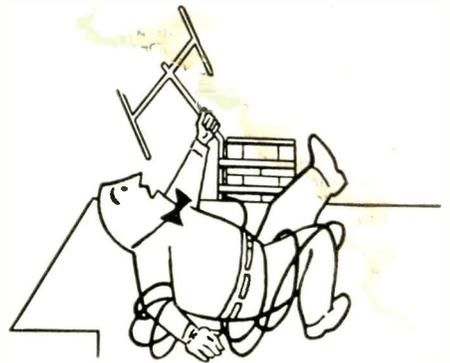
NELSON PUBLISHING Co., P.O. Box 36, Redding Ridge, Conn., has published *Television Interference, Its Causes and Cures* by *Philip S. Rand*. Book is divided into 10 chapters covering TV interference sources and types, locating interference, TV receivers, transmitters, shielding and filtering, special *vhf* problems, design and use of high and low-pass filters, external harmonic generation and industrial, medical and public-utility interference. Included is a bibliography, list of TV interference committees, frequencies of amateur band harmonics, table of U.S. TV channels and frequencies, tables of worldwide TV standards and channels and excerpts from FCC rules.—56 pages; priced at \$1.75. [SERVICE]

ELECTRONIC PUBLISHING Co., Inc., 180 N. Wacker Drive, Chicago 6, Ill., has issued a new edition of *Dave Rice's Official Pricing Digest* with resale prices for over 63,000 replacement parts. A table of flat rate and hourly service charges showing regional and national averages is included. Price data are arranged alphabetically by manufacturers and products numerically by part number. Priced at \$2.50. [SERVICE]

Etco, 33-00 Northern Blvd., Long Island City 1, N. Y., has released a 16-page illustrated catalog, C-158, covering an FM tuner, preamplifier, integrated and power amplifiers, bookshelf and floor speaker systems, *vtvms*, *voms*, scopes, tube and transistor testers, signal and sweep generators, battery eliminators, substitution boxes, flyback tester, battery tester, RCL bridge, electronic switch, voltage calibrator and accessory probes available in both kit and wired form. [SERVICE]

GENERAL ELECTRIC Co., Semiconductor Products Dept., Syracuse, N. Y., has released a 4-page illustrated brochure, ECG-292, with specifications and performance graphs on 2N43 and 2N44 germanium alloy junction transistors. [SERVICE]

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MULTIPLE-SOCKET TUBE TESTER

A 41-SOCKET tube tester, FC-2, has been announced by Century Electronics Co., Inc., 111 Roosevelt Ave., Mineola, N. Y.

Two settings are used for quality, interelement short and leakage, gas content and life expectancy tests said to check more than 600 tube types. Circuitry has been designed to accommodate new tubes without modification; new listings are issued periodically.

Uses D'Arsonval type meter protected against burnout. Tester is line-isolated and line-voltage compensation is included. Has 7- and 9-pin straighteners on panel. Picture tube adapter cable allows unit to be used as a picture-tube tester-rejuvenator for all picture tubes including short-neck 110° types. [SERVICE]

PERSONNEL

ROBERT WECHSLER has been named advertising, sales promotion and public relations manager of American Geloso Electronics, Inc., 312 Seventh Ave., New York 1, N. Y.

THOMAS & SUKUP, INC., 5226 N. Keystone Ave., Indianapolis, Ind., has been appointed as representative for Amperex Electronic Corp., Inc., in Indiana and Kentucky.

GERARD CAFARO and GEORGE KULPER have been named sales engineers for the rectifier division of Audio Devices, Inc., 444 Madison Ave., New York 22, N. Y.

AMES F. GIORDANO has been appointed chief engineer of Blonder-Tongue Laboratories, Inc., 9-25 Alling St., Newark 2, N. J.

ROLAND A. REUTHER has been named assistant to the vice president of Cleveland Institute of Radio Electronics, 4900 Euclid Ave., Cleveland 3, Ohio.

ROBERT G. FURLONG has been appointed sales manager of the television receiver division of Allen B. Du Mont Laboratories, Inc., 750 Bloomfield Ave., Clifton, N. J.

DON JONSON has been named sales manager of G-C Electronics Manufacturing Company division of G-C Textron, Inc.

PETER HUMENIUK has been appointed manager, engineering of the television receiver department of General Electric Co., Electronics Park, Syracuse, N. Y.

JOSEPH R. OWEN has been named manager of advertising and sales promotion of the specialty electronic components department of General Electric Co., Syracuse, N. Y.

JOHN A. MCCORMICK has been appointed manager of system sales for two-way radio units, communication products department, General Electric Co., Syracuse, N. Y.

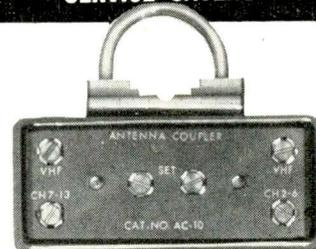
JERRY MELTZER has been named sales manager of the newly formed General Instrument Distributor Div., 240 Wythe Ave., Brooklyn 11, N. Y.

D. O. REINERT has been named manager, mobile and microwave service sales, technical products department, RCA Service Co., Inc., Camden 8, N. J.

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model	antenna systems	list
AC10	Joins Ch. 2-6 to 7-13	\$3.50
AC20	Joins Ch. 2-13 to 14-83	3.75
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- ★ Selenium Rectifiers checks forward and reverse currents.

Controls are accurately set for each transistor by referring to replaceable set-up chart on rear. Test leads or socket provides for fast hook-up. See your parts distributor.



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AUREL G. PETRASEK has been promoted to manager, merchandising, receiving tubes, RCA Electron Tube Div., Harrison, N. J.

GEORGE SAPIN has been appointed manager, advertising and sales promotion—entertainment market, RCA Electron Tube Division.

ROBERT L. SHAW has been named general marketing manager and HARRY H. MARTIN general manufacturing manager of Sylvania Home Electronics, Batavia, N. Y.

MERLE W. KREMER has been appointed vice president and general manager of the parts division of Sylvania Electric Products, Inc., Warren, Pa.

RAYMOND H. HILGERS has been named sales representative for the mid-west region of the electronic tube division of Westinghouse Electric Corp.

HARRY SCHECHTER has joined Zenith Radio Corp., 6001 Dickens Ave., Chicago 39, Ill., as merchandising assistant to the vice president and director of sales.

JOHN K. RUSSELL has been appointed district sales representative for Cleveland, Detroit, Columbus, Grand Rapids and Saginaw by Zenith Radio Corp.

HARRY RONAN has been promoted to manager, two-way radio sales, for the communications and industrial electronics division of Motorola, Inc., 4501 W. Augusta Blvd., Chicago 51, Ill.

ROBERT B. MEANS has been appointed manager, western district, entertainment sales, of the RCA Electron Tube Div., Harrison, N. Y.

H. J. BENHAM has been appointed manager, central service region, technical products service department of RCA Service Co.

CHESTER A. GRONZIK has been named works manager of Entron, Inc., 4902 Lawrence St., Bladensburg, Md.

NORMAN CAPLAN has been appointed manager, communications products department, telecommunications division, RCA, Camden, N. J.

ROBERT M. BOWIE has been named vice president of Sylvania Research Laboratories, Bayside, N. Y.

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85-6500 cps. 25 W.



SA-HF \$36.00 list
80-10,000 cps. 30 W.



SA-30 \$47.50 list
built-in matching trans.
80-10,000 cps. 30 W.



PA-HF \$47.50 list
70-10,000 cps. 50 W.

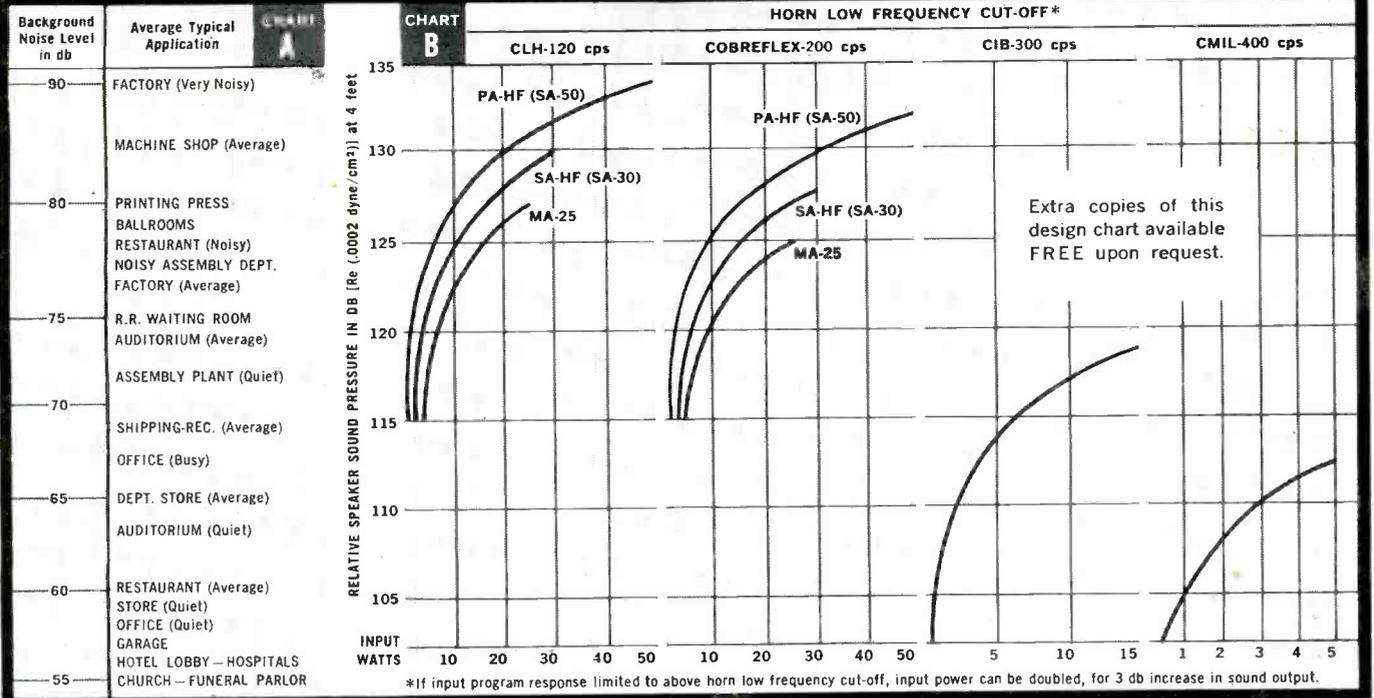


PA-50 \$57.50 list
built-in matching trans.
70-10,000 cps. 50 W.

Only University gives you the choice of speakers you need to ensure greatest economy of amplifier power, equipment and installation costs. No wasteful, "cure-all, do-all" compromises here. Each speaker is designed to do its specific kind of job most efficiently and reliably, with plenty of room for future expansion. Each speaker incorporates many exclusive features to fulfill every possible application. The chart below graphically shows the relative differences between these four speakers in terms of sound out-

put, input power, and low frequency response. Simply choose the intended application and determine the appropriate speakers. Or, depending upon existing operating prerequisites, select the speaker(s) capable of doing the job. That's all there is to it.

NOW AVAILABLE—Free Product Catalog. Or send \$1 for the NEW 64-page University TECHNOLOG, the complete speaker system planning manual. Desk X-4, University Loudspeakers, Inc., 80 S. Kensico Ave., White Plains, N.Y.



HOW TO USE THIS CHART

- Determine sound pressure needed by finding noise level from Chart A, add loss of db in Table C and add adjusting factor in Table D.
- Draw horizontal line across Chart B corresponding to the db figure just calculated. This now establishes which speakers can be considered.
- A vertical line drawn to the base of Chart B shows the input power needed for each qualifying speaker.
- Now, further selection may be based upon frequency

response necessary (see Horn Cut-Off, Chart B), initial cost, operating economy and reserve power desired.

5. The CIB and CMIL may also be used in high noise levels by employing several throughout the listening area.

Example: Factory — noise level 90 db, 320,000 cu. ft., live acoustics, music and speech
 $90 + 25 + 5 = 120$ db required

Qualifying speakers are CLH or Cobreflex, with any of the drivers. Final choice is determined by driver characteristics and installation problems. (Send for TECHNOLOG or Product Catalog.)

ROOM VOLUME CU. FT.	INDOORS			OUTDOORS	
	LIVE	NEUTRAL	DEAD	FURTHEST DISTANCE FT.	DB LOSS
1,000	0	3	6	4	0
3,200	5	8	11	8	6
10,000	10	13	16	16	12
32,000	15	18	21	32	18
100,000	20	23	26	64	24
320,000	25	28	31	128	30
1,000,000	30	33	36	256	36

PROGRAM ADJUSTING FACTOR		INDOORS DB	OUTDOORS DB
		SPEECH	4
MUSIC	6	11	
MUSIC & SPEECH	5	9	



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anatomy
of the
tube...
LESSON #1



GRID

How RCA builds special
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RCA's redesign of the 6AF4-A has resulted in minimized slump, product uniformity, and projected average life of 4,000 hours or more!

Here are some of the materials RCA "prescribes" in manufacturing the new 6AF4-A. The grid is plated with Palladium, a rare metal capable of withstanding high temperatures. The use of this grid structure minimizes interelectrode leakage, prevents grid loading, and as a result, provides stable tube performance. The cathode, a nickel alloy, is specially selected to reduce interface resistance and thus minimizes slump. The use of pins which are silver-plated reduces skin effect at ultra-high frequencies and improves tuner performance.

All these features, in addition to dynamic life tests, help to assure long and dependable performance. No wonder RCA's 6AF4-A is tops!

So, here's the #1 lesson in radio, phonograph, and TV service—when ordering tubes for replacement, specify "RCA Tubes only."



RADIO CORPORATION OF AMERICA
Electron Tube Division

Harrison, N. J.