NOW...

THREE Sizes of IRC®
"Skin-Packed" Fuse Resistors

This new 5 ohm IRC Fuse Resistor provides you with the same fine features as IRC’s dependable FR5.6 at 5.6 ohms and FR7.5 at 7.5 ohms:

- Sturdy terminal pins—both attached inside a rugged ceramic case.
- Improved plug-in type for fast, easy replacement in the newer TV receivers. Terminal pin holes facilitate attaching leads where necessary.
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- "Skin-Packed" cards protect each fuse resistor from dirt and handling.
- Type and range clearly identified on both fuse resistor and "Skin-Packed" card.

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INTERNATIONAL RESISTANCE CO.
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In Canada: International Resistance Co., Ltd., Toronto, Licensee
Yesterday we crossed the frontier of the atomic age. Today, we are entering the era of interplanetary space travel. There are no visible limits to the “miracles” to be developed tomorrow.

Great things have been happening at JFD, too. Nineteen months of intensive research into a virtually unknown principle of antenna performance has achieved a major breakthrough in television reception. For the first time, the science of antenna engineering has overcome the two primary barriers to long-distance pick-up—uneven antenna bandpass and reactive impedance components.

These significant improvements are made possible by the development of a spectacular new dipole system. As a result, the Satellite-Helix dipole system captures up to 35 per cent more signal and intensifies color reception—has less low band ghost pick-up and less back and side interference, and closer 300 ohm match.

Here are a few of the “extras” the new Satellite-Helix configuration will give you over other leading types:

<table>
<thead>
<tr>
<th>Over Reinforcing Wave Type</th>
<th>Over Focus Lens Type</th>
<th>Over Bat Dipole Type</th>
<th>Over Dipoles With Phase Reversing Stubs</th>
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</thead>
<tbody>
<tr>
<td>*1-2.5 db more gain</td>
<td>*flatter bandpass</td>
<td>*flatter bandpass</td>
<td>*2-4 db more gain</td>
</tr>
<tr>
<td>*sharper low band pattern</td>
<td>*2-3.5 db more gain</td>
<td>*2-3 db more gain</td>
<td>*flatter bandpass</td>
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<tr>
<td>*less reactive impedance</td>
<td>*less reactive</td>
<td>*less reactive</td>
<td>*higher front-to-back ratio</td>
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<td>*higher front-to-back</td>
<td>*impedance</td>
<td>*impedance</td>
<td>*better side rejection</td>
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<td>*better side rejection</td>
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</tbody>
</table>

Take a giant step today into the flawless reception of tomorrow. Install the remarkable Satellite-Helix on your next “problem” job with our money-back guarantee. See for yourself its “selling edge” that will keep you out front in TV antenna profits and customer confidence in your area in the competitive years ahead. Priced realistically at a non-inflated level, the Satellite-Helix is now on its way to your JFD distributor.

Edward Finkel
General Sales Manager

The new JFD Satellite-Helix
a Giant step in television antenna science

Pioneers in Electronics since 1929
JFD ELECTRONICS CORP.
6101 Sixteenth Avenue Brooklyn 4, New York

PF REPORTER • March, 1958
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Sprague’s complete ceramic capacitor line is now individually tagged for quick, complete identification—capacitance, tolerance, voltage, and type. No fumbling, no guessing about ratings...you’re always sure with Sprague tagged disc capacitors. Use them all the time. You’ll find that they also make excellent replacements for molded mica, ceramic tubular, and paper tubular capacitors in many applications.

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Be sure you get this useful and valuable information from your Sprague distributor, today! Or write Sprague Products Co., Distributors’ Division of Sprague Electric Company, 105 Marshall Street, North Adams, Mass.

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world's largest capacitor manufacturer

SPRAGUE RESEARCH IS CONSTANTLY PRODUCING NEW AND BETTER CAPACITORS FOR YOU
AGC CIRCUITS FOR '58

Several manufacturers have made design changes in this circuit, so you'll want to bone up on your theory. This feature describes the 6BU8 stages used in the Admiral Chassis 16J1 and Zenith 15A25 and 17A20 chassis. A subsequent article will deal with other popular make AGC circuits.

HOW TO ALIGN THE IF's

Okay—we give up. Your requests have been too numerous to ignore any longer—so in April's picture story, we'll give you all the "dope" you'll need to solve your alignment problems.

USING A SCOPE FOR SIGNAL TRACING

With good reason, many of you readers have been hungering for information on this subject. And the more you get, the more you want! Well, here's another one we're sure you'll like. Don't miss it!
INTRODUCING

the new line of TV Antennas by WINEGARD

Gives you all three! . . . performance . . . adaptability . . . low cost

MAN! These Scotch Stamps Are Worth Money to You! Get Free Antennas, tool sets and other valuable nationally advertised merchandise.

The thrifty way to buy your merchandise! With every Scotchman antenna you buy, you get valuable Scotch Stamps which you can turn in for useful premiums or for more antennas! Start saving Scotch Stamps now! Ask your distributor for free Scotch Stamp Saver.

There's a Winegard Scotchman antenna for every signal area . . . for every installation . . . for every budget! With just four basic Scotchman models (priced as low as $6.95 list) you can now solve just about any reception problem you run into.

In most of your installations, you will find that one or a stack of the four basic antennas is all you need. But for those tough reception problems, where you need more gain—or have severe interference, you can tailor-make a special Scotchman as needed, simply by using the new plug-in attachments shown on the opposite page. And you can do this at no more cost than your competitors charge for ordinary, less effective antennas.

Economy and adaptability are not all you get in the Scotchman! You get quality, too . . . the kind of quality features you are proud to point out to your customer . . . like: unbreakable TDM styrene insulators, special fatigue-resisting aluminum tubing, closed element and boom ends to eliminate windwhistle and vibration, precision die-cut elements . . . features usually found only in the highest priced antennas.

And, of course, all Winegard Scotchmen are completely factory pre-assembled. Elements lock into place automatically when you unfold them. Absolutely no antenna installs easier or quicker . . . and they're wonderfully compact and rugged.

On your next installation, do this: Try a Scotchman antenna in the only place it really counts . . . on one of your own customer's homes. See for yourself that the Scotchman can't be beat for performance and adaptability at such low cost!

A NOTE FROM JOHN WINEGARD

As an addition to our popular line of gold anodized Color'sceptors and Twilights, I am pleased to announce this new Scotchman series to give you a complete price range of quality all-channel Winegard antennas. You'll find valuable Scotch Stamps in each Scotchman carton which we will redeem for free antennas and other valuable premiums. This is our way of saying "thank you" for your business.

Sincerely,

John R. Winegard
President, Winegard Co.

This Free Pegboard Tool Set is yours with Scotch Stamps—Start Saving Scotch Stamps Now!
Priced as low as $6.95 LIST

MODEL 504: All-channel, high performance, 7-element fringe area antenna. Exclusively impedance-compensated Vee driven elements and patented Electro-Lens design. Easily converted to 12-element antenna for tough reception areas with Kit A. $19.95 list

MODEL 502: 4-element with new improved Vee driven element design for city and suburban areas. Exceptionally good reception on the high channels... almost bidirectional on low channels. Higher gain and better ghost rejection than conventional. A natural with Kit D. $9.95 list

MODEL 503: Near fringe and suburban area, all-channel 5-element antenna recommended for use in place of conicals. New Vee driven element design. Can be used with attachment Kits A, B, C or D. Ideal for stacking. $14.95 list

MODEL 501: 3-element antenna recommended for use in place of conicals. New Vee driven element design. Smooth forward response lobes and accurate impedance match on both high and low bands. Cuts ghosts. No finer antenna for city and suburban areas at this low price. $6.95 list

4 BASIC SCOTCHMAN TV ANTENNAS AND 4 ATTACHMENT KITS COMBINE TO MAKE MORE THAN 30 DIFFERENT COMBINATIONS! YOU CAN INCREASE THE GAIN OR FRONT-TO-BACK RATIO OF ANY MODEL

KIT A: HI-LO BOOST for higher gain and co-channel suppression. Adds two reflectors for extremely high front to back ratio. Adds 4-element patented Electro-Lens director for increased gain on all channels. Use with models 501, 502, 503 (illus.), 501 and 504. Gives up to 22% more gain.


KIT C: STACKING BAR KIT consists of two stacking bars, heavy duty support bracket and terminal insulator. Stacking two antennas of the same model increases sensitivity up to 40%. Can be used with all Scotchman models 501, 502, 503 (illus.) and 504.

KIT D: INSTALLATION KIT (pat. pend.). Universal tripod mount fits any gable, pitched or flat roof. All aluminum. Can't stain roof. No guy wires. 5½ ft. tall. One man can install. Includes mount, mast, lead-in wire, stand-offs and lightning arrestor. Can be used with rotor. Works well with all Scotchman models.

Ask your distributor or write for details on the money-making Winegard Scotchman line.
Costly irritating call backs! — The servicemen's dilemma — and everybody claims a cure. Astron's not shouting any claims, but simply presents the facts on how Astron designs capacitors to end call backs.

**Callback Causes**

1. Very high leakage due to poor shelf life.
2. High leakage due to corrosion in the tab and risers.
3. High leakage due to improper impregnation.
4. Particles and impurities in paper, causing breakdown.
5. Overloading the circuit due to faulty parts in the circuit.
6. Improperly hot aged.
7. Extreme heat build-up within the capacitor.
8. Continual power loss throughout the circuit.
9. Failures due to explosion and fire.

**Astron Facts**

2. Proper handling during assembly and close attention to manufacturing purities in chemicals and raw materials.
3. An extra long impregnation cycle.
4. 100% inspection and the use of only premium quality paper.
5. Safety margin foil is used and foil is formed at high voltage ratings which will stand higher surges.
6. A complete heat aging system is used.
7. Astron Capacitors have exceptionally low D. C. leakage current.
8. Astron Capacitors have low equivalent series resistance.
9. The use of high purity paper separators and safety vents.

Today's circuits require top performing capacitors. That's the way we build them at Astron. Use Astron Capacitors and do away with bothersome and costly call backs! Insist on Astron.

---

**Letters to the EDITOR**

Dear Editor:

I would like to see articles about the practical uses of the oscilloscope, showing setups using the scope alone and also with auxiliary test equipment. Include waveform! Most literature I've read seems to stress the theory of the scope's circuit.

V. Harris
East Orange, N. J.

You must really read "Coming Next Month" carefully. This issue contains the second of a 3-part series on this very subject. Part 1, "Regeneration," appeared in February, and Part 3, "Using a Scope to Signal-Trace Tests" will show up in April.—Editor

Dear Editor:

In my experience, the serviceman is constantly approached by his customers with the question, "How much is my set worth?" He has little difficulty answering his regular customers because he is familiar with their sets, but there always seems to be some new customer who has just moved into town with an unfamiliar brand of TV set which is not sold in the community. Rather than being completely stymied, the serviceman would like to have statistics that would help him to give some kind of an answer in such cases.

Charles O. Donaldson
Ann Arbor, Mich.

Suggest you get a copy of "TV Trade-In Blue Book," published by the National Appliance Trade-In Guide Co., Madison, Wis. at $5 per copy.—Editor

Dear Editor:

In "The Troubleshooter" in the January issue, an answer is furnished a gentleman who is concerned about proper magnetic strengths of various "ion traps"—a name which both he and your author seem to insist on applying to beam bending devices.

Actually, from the very outset of magnetically deflected CRT's, the "ion trap" has been built into the gun; it is an integral part of that assembly. At the worst, the beam bender might be called an "ion trap magnet" but certainly it is incorrect to refer to it as the ion trap.

Just one of those little errors that become a fixed part of our established electronic nomenclature. Two others come to mind: Calling the plural of antenna by the "no such" term of antennas instead of antennae, and the consistent failure to distinguish the property of inductance from the noun inductor when speaking of a device.

B. H. "Burt" Hansen
Inglewood, Calif.

Thanks, "Burt," for reminding us of our position as a "guiding light." We got to admit we ain't been to karefull
You can do more than ever before with this new portable

**AUTOMATIC MONEY-MAKER**

**TESTS TUBES AND TRANSISTORS Automatically**

WITH LABORATORY ACCURACY

- Saves Servicing Time
- Sells More Tubes
- Satisfies More Customers

**B&K MODEL 675 AUTOMATIC DYNA-QUIK**

DYNAMIC MUTUAL CONDUCTANCE TUBE & TRANSISTOR TESTER

Again, B&K helps servicemen give faster, better service at less cost and make more money. The new automatic Model 675 makes tube checking quick and easy in the home or shop. (Tests transistors, too.) Measures true dynamic mutual conductance. Makes complete tube test in seconds, under actual operating conditions of the set. Checks average set in a few minutes. Simple to operate. No multiple switching. No roll chart. Shows customer the true condition and life expectancy of tubes in the set, sells more tubes on-the-spot, saves call-backs. Quickly pays for itself.

Shows tube condition on "Good-Bad" scale and in micromhos. Large 4½" meter has two highly accurate ranges calibrated 0.0000 and 0.000100 micromhos. 7-pin and 9-pin straighteners are mounted on panel. Automatic line compensation. Special bridge monitors line voltage continuously. Light weight, easily portable in handsome leatherette covered carrying case. Operates on 105-125 volts 60 cycle a.c. Size: 13½" x 12¼" x 6". Net wt: 10½ lb. Net, $169.95

Also makers of famous CRT, DYNACARD, CALIBRATOR

See your B&K Distributor, or write for Bulletin 675-R

B&K MANUFACTURING CO.
3726 N. Southport Ave. • Chicago 13, Illinois


March, 1958 • PF REPORTER
"THERE'S ABSOLUTELY NOTHING, MADAME, THAT WILL MAKE ROCK'N ROLL SOUND LIKE RACHMANINOFF."

Right — but a new Webster cartridge will bring out the best in any record. Equally important, there's a Webster replacement cartridge to fit almost every model record player and changer. You'll make money on them, too. They're priced right — they're easy to install — there's never a call-back.

BUY WISELY...BUY WEBSTER!

V-8 Plug-in Cartridge
Ceramic cartridge and needle combination installs as a unit when needles are replaced. Available with a 1-mil and 3-mil sapphire point, or a 1-mil natural diamond and 3-mil sapphire point.

Free — large print of this Lichty cartoon suitable for framing. Write today!

ELECTRONICS DIVISION
WEBSTER ELECTRIC
WISCONSIN

about this here thing, but we feel that slightly relaxing our usage of terms to those most common to the average technician makes for easier reading. Definitions, after all, are (or will be) based on common usage.

We must take issue with you, however, on the plural of "antenna." "Antennae" are strictly for insects; those aluminum things on housetops are Americanized enough to be formally classified as "antennas." Webster's Unabridged backs us up if you'd care to check.—Editor

Dear Editor:
In the December PF Reporter, John Markus says the Better Business Bureau warns that any repairman who charges less than $4 to $7 base fee is suspect. If the Better Business Bureau made pamphlets on their survey of this information, please advise where I can get them. I would like very much to distribute them among my customers.

JAMES M. IVEY
Bladenboro, N.C.

Two pamphlets on TV service are available from BBB. "Safeguard" (4 pp., 5c) describes in detail the cost factors that make it expensive to equip and maintain a competent service shop. "TV Without Tears" (12 pp., 10c) gives case histories of service gyps and warns readers to stick to reputable concerns and not fall for price lures. By all means, your customers should read these pamphlets. This type of material can only increase their confidence in you.—Editor

Dear Editor:
I have recently found a method of unsoldering components from a printed wiring board which lessens the chance of breaking the board.

Take an ordinary vacuum cleaner and reduce the nozzle opening of the vacuum hose to approximately 3/4". Heat the solder joint, and vacuum the solder away as soon as it melts. The component can be removed very easily.

RAY URBAN
Ray's Electronics
Austin, Texas

Sounds like a dandy idea, Ray. By the way, have you lost any pocket-sized radios this way?—Editor

Dear Editor:
I waited for your January issue to see if it contained any explanation for the absence of the annual index in the December issue. I use your magazine as a reference quite often and the index saves a lot of time. PF Reporter is, to me, like a set of law books to a lawyer. Is an index for 1957 available?

FRANK AVILA
Richmond, California

Sorry you didn't see our notice on page 55 of the January issue, Frank. Yes, a 4-page index has been prepared and a copy has been sent you post-haste. Anybody else want one? It's free!—Editor

www.americanradiohistory.com
Mr. Independent Service Dealer: are you helping to support your "competitors"?

Not if you buy and use Raytheon Television and Radio Tubes. Raytheon does not have a factory TV-Radio service organization — does not compete with you in any way for service business. Raytheon believes that TV-Radio service is your business and serving you is Raytheon's.

Every time you buy a Raytheon Tube you buy from the first tube manufacturer to help independent service dealers. For more than thirteen years Raytheon, through their Distributors, has offered independent service dealers the many benefits of the Raytheon Bonded Dealer Program. Support through national advertising, Western Union Operator 25 service and Group Life Insurance are among other business building helps that Raytheon has pioneered for "independents".

But most important of all, Raytheon makes TV and Radio Tubes that are ideal for all replacement work, because they are designed to provide quality performance in all makes and models of TV and Radio sets. Use them with complete confidence that they are best for you ... and for your customers, too.

RAYTHEON MANUFACTURING COMPANY
Receiving and Cathode Ray Tube Operations

NEWTON 58, MASS.  CHICAGO, ILL.  ATLANTA 6, GA.  LOS ANGELES 7, CALIF.
55 Chapel Street  9501 Grand Ave. (Franklin Park)  1150 Zonolite Rd. N.E.  2419 So. Grand Ave.

Raytheon makes all these: Receiving and Picture Tubes, Reliable Subminiature and Miniature Tubes, Semiconductor Diodes and Transistors, Nucleonic Tubes, Microwave Tubes.

March, 1958 • PF REPORTER
Adding Elements to Change Dipole Response

As we have seen, the simple dipole possesses a bidirectional or figure-eight response pattern, making it susceptible to the reception of signals coming from two directions. Furthermore, since each lobe of the pattern is rather broad, we can move considerably off center and still obtain fairly appreciable amounts of signal. This means that the directivity of this array is only fair and unwanted signals from many directions will be received quite readily.

A simple way to improve dipole directivity is to position a wire (or rod) parallel to the dipole and a quarter wavelength behind it. See Fig. 1. This additional wire is about 5 per cent longer than the dipole and is not connected to either the receiver or the dipole. The name given to this wire is reflector, and its purpose is to respond to a portion of the arriving signal and re-radiate it. The direction of the radiation is perpendicular to the rod, so naturally some of the re-radiated signal reaches the dipole. Since there is a time lapse at the dipole between reception of the directly-received and re-radiated signals, cancellation will occur in one direction and reinforcement in the other.

This is illustrated in Fig. 2 where the responses of a single dipole and of a dipole with a reflector are compared. Note that what we actually have done is to considerably reduce the size of the lobe which extended in the direction of the reflector. A portion of this lobe still exists, indicating that some signal can still be received from this direction, but it will be considerably weaker than the same signal approaching the antenna from the opposite direction. Thus, where the simple dipole was bidirectional, the same array with the addition of the reflector is now largely unidirectional. Furthermore, the amplitude of the remaining large lobe is greater by an average of about 4 to 5 db.

The gain of a dipole and reflector will depend on the distance between the two wires and the length of the reflector (assuming that the dipole is resonant at one specific frequency). For the sake of this discussion, and because it is generally true, we will assume that the reflector is 50% longer than the dipole. Under these conditions, the gain of this combination will vary with reflector spacing in the manner shown in Fig. 3. For very close spacing, the gain drops far below that of a simple dipole alone. As the distance between the two wires increases, the gain rises sharply, reaching a maximum at about 0.2 of a wavelength (at the operating frequency). The gain here is about 5 db; beyond this point, it slowly drops again.

This behavior can be explained by first noting the effect of the reflector element on the dipole and then by taking into account the distance between the two. An oncoming signal, approaching the dipole, energizes it. At the same time, some of this signal travels on to the reflector and excites this wire. If the two wires are .25 wavelength apart, the reflector interception occurs a quarter of a cycle later. At the time this happens, the dipole is re-radiating half of the energy it received* and some of this signal travels on to the reflector. This, too, takes a quarter of a cycle, and by now the reflector is ready to re-radiate all the energy it received a half cycle before. (Essentially all the energy received is re-radiated because the reflector is not loaded down by a transmission line.) Some of this energy travels back to the dipole where it combines (in phase) with the signal present here.

The foregoing, while revealing only a part of the energy interchange between the dipole and reflector, does demonstrate how the two wires interact with each other. The signal which the reflector re-transmits to the dipole is dependent on the spacing between the wires plus the length (i.e., resonant frequency) of the

* The other half of the signal received by the dipole is transferred to the transmission line if the two are matched.

---

**Fig. 1. Dipole with reflector.**

**Fig. 2. Response patterns of dipoles with and without a reflector.**

**Fig. 3. Gain curves of dipole and reflector (A) and dipole and director (B).**
THERE IS A DIFFERENCE
IN P.A. SPEAKERS

you get a lot more to sell with

Electro-Voice®

CDP® SPEAKERS

Yes, Electro-Voice gives you more to sell and more help in selling P.A. speakers. Hard-hitting, sales-pulling ads pre-sell architects, buyers in schools, universities, colleges, industry and all your prime P.A. prospects. They are told the CDP story... and what a terrific story it is. To tell it is to sell them!

HERE'S WHY CDP SPEAKERS ARE SO SUPERIOR, SO MUCH EASIER TO SELL THAN CONVENTIONAL P.A. HORN... 

High frequencies require one throat size and one horn taper rate; low frequencies require a different throat size and a different taper rate. The Electro-Voice CDP gives you a large horn (A), for lows and a second, smaller horn (B), coaxially mounted, for highs working from both sides of a single diaphragm (C). The Electro-Voice CDP gives you 2½ more octaves of sound reproduction... frequencies up to 10,000 cps. These 2½ octaves are indispensable for highest intelligibility. See the curve, compare response and efficiency. In addition, Electro-Voice CDP speaker disperses sound through a solid 120° angle for the widest coverage available in P.A. speakers.

You can hear the difference.

Conventional reentrant horns using single throat (D) and single horn (E) transmit highs along the same circuitous path as required for lows. As a result, the highs become attenuated, sharply decreasing intelligibility. Electro-Voice gives you P.A. speakers with a large horn for lows and a second, smaller horn, coaxially mounted, for highs. There is a difference and you can hear it.

CDP speakers are weather-proof, blast-proof and splash-proof, virtually indestructible. They're molded of fiberglass for better acoustical properties and extra strength.

Sell CDP Speakers... the speakers that sell because they are clearly superior. See your Electro-Voice Distributor TODAY. Get the facts and start selling the most revolutionary speakers in P.A. history... the Electro-Voice CDP.

Send for bulletin 195-R 83
Basically, all indoor antennas operate on the simple dipole principle. This means that in order to be useful on all channels, the dipole arms must be adjustable from approximately 25" to 103" which are the lengths necessary to resonate at the lowest frequencies of channels 13 and 2, respectively. To form a dipole, the arms of the antenna must be extended to the correct length and placed in a horizontal plane; however, since a perfect picture may not always be received (using the antenna in this configuration), it may be necessary to incline the arms of the dipole into a wide "V" shape. In this position the antenna is no longer a strict dipole but is instead something between a dipole and a tuning stub. Raising the arms of the antenna shortens them electrically, so you may find it necessary to physically lengthen them to achieve maximum signal pickup.

The lead-in wire is almost always 300-ohm twin-lead because it matches the receiver input impedance, a must if standing waves are to be avoided. However, there is an automatic 4-to-1 mismatch at the dipole, which is essentially a 72-ohm device. This mismatch causes a loss of signal, but this usually isn't serious except in weak or noisy signal areas.

Matching or phasing stubs that can be switched in and out of the dipole circuit in several combinations have been added to the indoor antenna to improve its reception ability. The switch may have anywhere from 5 to 12 positions and is generally adjusted to the position that gives best reception by a "trial-and-error" method. This switch is used in conjunction with rotating the antenna and lengthening or shortening the dipole arms to obtain the best possible reception. In addition to (or instead of) a switch for connecting the phasing or matching stubs, some designs include variable-value inductors or capacitors which can be adjusted to change the electrical length of the dipole elements; thus, the dipole arms can be physically shorter than 1/4 wavelength each and yet be the electrical equivalent. Also, antenna tuning is less susceptible to the hand capacity effects encountered when trying to lengthen or shorten the dipole.

Normally you think of an antenna as being properly oriented when the broadside of the dipole faces the station. This does not always hold true for indoor antennas, since there are usually many reflections within any given room. Thus, best reception on some stations is often obtained with the antenna pointed at some odd angle and reorientation is usually required when switching to other stations.

<table>
<thead>
<tr>
<th>TV Channel No.</th>
<th>Approximate Length</th>
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<tr>
<td>2</td>
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<td>25&quot;</td>
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### HALF-WAVE DIPOLE LENGTHS FOR TV CHANNELS

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**what do INDOOR**

**<RMS Model SV-A3 features 3-section aluminum arms which stem from a round, plastic housing and extend from 16" to 39" in length along axes from the vertical extreme to within a few degrees of horizontal.**

**Radion Model 900S is designed for rear mounting with 3-section arms which extend from 12" to 30" and swivel on adjustable-friction ball-and-socket joints, permitting 40° forward or rear arc and 180° side arc from a straight-up to straight-down position (latter when not in use).**

**<Radiant Model CT-231 uses 2-section dipole arms which will pivot on their axes more than 180° and extend from 20" to 37 1/2". The plastic, tear-shaped base has recessed screw-mounting facilities and a slotted thumb screw for adjusting pivot friction.**

**Channel Master Super Showman which, for all VHF channels as well as FM, has switch indexing that varies the inductors in series with the dipole arms. These internally-mounted inductors, combined with the inductive, end-loaded "hats" and extendable dipole arms, permit an accurate electrical dipole length to be obtained over a range of 54 to 216 mc. A parasitic reflector, physically spiralled at the center to increase its electrical length, provides a front-to-back ratio of up to 5:1, and a transformer matches antenna to receiver impedances. The housing swivels 360° on its tripod base.**

PF REPORTER • March, 1958

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you know about

ANTENNAS?

JFD Magic Genie is designed for rear-set mounting, which can be accomplished with the use of a special solvent (making the rubber mounting surface adhesive), bolts and nuts or wood screws (all hardware and solvent supplied). The 4-section, turret-mounted arms (maximum length 38") can be swiveled in practically any direction within the upper spherical area and can therefore assume a horizontal "V" position if desired. An inductive printed-circuit stub can be switched into the dipole circuit in series and parallel combinations to provide optimum performance on each channel.

Brach Model 5609 has extendable (total 38") 4-section arms that telescope into a rear-mounted plastic housing when not in use and that swivel in any direction to a maximum of 55° from vertical on ball-and-socket joints held in place by spring tension.

Amphenol Vi-Fi Model features 5-section, ball-and-socket mounted, 27" arms which can be folded down and hidden with a hinged cover. The electrical length of the arms is extended through the use of variable-value inductors contained within the housing, which also conceals a separate UHF folded dipole having its own 300-ohm lead-in. The VHF 4-conductor lead-in is wired and connected to act as a matching transformer between the 72-ohm antenna and 300-ohm set impedances.

Snyder Imperial Model 10D has only one visible dipole arm, a 4-section unipole which can be extended to 48" and collapses to 7". This unit takes advantage of the vertically-polarized signal components developed within a room by reflection. A 12-position switch connects a concealed dipole arm and a 300-ohm matching stub in and out of the circuit for improved reception at various frequencies.

Dynamic Model DB500 has two phasing elements oriented 90° from each other and connected in various configurations to the dipole (adjustable from 18° to 34°) through a 12-position switch. A high-pass filter in the twin-lead serves to minimize low-frequency noise interference. The dipole arms can be positioned individually at any point from vertical to horizontal.

G-C Telco Models 8146, 7 and 8 are rear-mounting units having 4, 5, and 6-section dipole rods which are extendable to 29", 37" and 44", respectively, and which can be stored within the housing when not in use. Ball-and-socket joints permit each arm to be swiveled approximately 55° from vertical in any direction.

March, 1958 • PF REPORTER
Unfortunately, signal tracing in itself seldom will correct a fault in a receiver—yet without some expedient means of trouble localization, the technician may find himself making needless time-consuming measurements and parts substitutions. Signal tracing is of tremendous value in overcoming the first and seemingly ominous barrier—namely, that of isolating the trouble to one particular stage or section. Why place such an emphasis on trouble localization? Because it not only represents the major time spent on most shop repairs, but is also a real test of the technician's servicing skill. Actually, the mechanics of pin-pointing a defect and making necessary corrections are only secondary factors in successful servicing.

Due to a lack of knowledge of either circuit functions or the application of test equipment (or the lack of necessary equipment), many technicians feel a little lost when probing ahead of the video detector circuit. This article should clear up some of the uncertainties connected with RF and IF signal tracing besides presenting several logical methods of approach.

Aside from a complete loss of signal, there are many other trouble symptoms that may result from a fault in the RF or IF circuits. Some of these are: picture and sync distortion caused by hum modulation or interference, weak or snowy pictures, ringing caused by regeneration, smeared picture or loss of detail and last but not least, intermittent picture and sound. When confronted with any one of the symptoms just mentioned, we often come to the realization that the trouble is originating somewhere ahead of the video detector. Sometimes we can further isolate the trouble, however, by carefully analyzing all of the symptoms involved. For example, with loss of video, we should also check for the presence of sound and/or snow.

Practically all modern receivers employ an intercarrier sound system; therefore, a missing picture with the presence of sound normally indicates that the fault is beyond the sound take-off point. On the other hand, if the sound is also affected, we should direct our search to those stages designed to pass both picture and sound. In a few cases, however, sufficient sound energy may be passed by a defective stage which is apparently blocking picture information. Actually, some picture carrier energy must get through to the detector in order for the heterodyne action which produces the 4.5-mc sound signal to take place. It is conceivable, however, that the video frequencies may be too low in amplitude to reproduce a noticeable picture.

Snow in a raster is also a key clue in the isolating procedure, since it is the result of thermal agitation within the converter tube. Its absence usually indicates that the trouble is beyond the mixer stage. When snow does appear, however, the signal is being lost ahead of this stage and may be due to a faulty antenna system. We should never lose sight of the fact that our trouble may be resulting from only a poor antenna connection, from more than one defective tube, or from a simple misadjustment of an AGC or sensitivity control. In the same vein, we must remember that proper operation of the tuner and IF strip depends not only on received signal strength, but also on AGC and B+ voltages. A quick check of these may save precious time when trouble is apparently affecting RF or IF operation.

When loss of signal is encountered, the first step the technician usually takes, after tube substitutions, is a few quick voltages measurements with a VTVM. Checking all plate, grid, and cathode points.
along the IF strip requires little time and will often locate the defective stage immediately, but what happens in those all-too-often instances when the voltages appear to be within tolerance? At this point, the average technician might wonder if the tuner is delivering a signal, if the crystal detector is bad, or even if the transmitter is on the air. Undoubtedly the only way to be sure is to adopt a signal tracing procedure of some sort.

**The RF Probe**

The oscilloscope is very useful as a signal tracer in practically all circuits of a television receiver. This also holds true for the RF/IF stages, but because even a wide-band TV service scope will not respond to frequencies much over 3 to 4 megacycles, one cannot observe signals in these sections using an ordinary direct probe. To overcome this problem, the technician need only use a demodulator probe, which, in actuality, serves as a mobile video detector circuit and converts the modulation to frequencies which will be readily passed by the scope’s amplifier circuits.

The schematic of Fig. 2 represents a simple detector probe suitable for signal tracing with an oscilloscope. A crystal diode, such as a 1N34 germanium type, rectifies the modulated RF or IF frequency, and the output developed across the input shunt capacitance of the scope varies in accordance with the peak amplitude of the input signal. A somewhat more elaborate probe circuit, designed primarily for TV alignment work, is shown in Fig. 3. The capacitor and resistor at the input of the probe are used for isolation purposes, while a conventional germanium crystal diode serves as the rectifier. The 10K-ohm resistor acts as a diode load and the 220-ohm resistor, together with a pair of .001 mfd capacitors, forms an RF filter network.

**Scoping the TV Signal**

Several signal tracing methods may be used, but the one chosen by the technician is usually determined by the nature of the trouble, the test instruments available and how well acquainted he is with the circuitry involved. Generally, a signal tracing procedure will require less time than is necessary to tell about it.

A completely dead stage in an IF strip can sometimes be located by merely touching a metal-tipped probe to the grids and plates of the amplifier tubes and noting whether or not there are clicks in the sound or flashes on the screen. When encountering the inoperative stage, one will usually find that he can obtain a click or flash by contacting the plate connection, but not when touching the grid of the same stage. Sometimes this simple approach may work for the experienced screwdriver mechanic, but it’s far from fool-proof and is of little value when running down troubles other than a completely dead stage.

A more reliable and systematic approach is to use a detector probe and an oscilloscope. Using a probe to demodulate the TV signal of a local station, the technician can

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*Please turn to page 71*
Unfavorable vibrations, which develop during industrial processing, can be the result of any number of causes, among which are liquid hammer, valve singing, shaft movement and cutting-tool chatter. The consequences of vibration are noise, discomfort, wear, malfunction, or destructive failure which must be limited to acceptable levels. Machine tool operations are often hampered by minute vibrations which produce rough, inaccurate finishes and result in damage to cutting tools. The machines used in our daily living, transportation vehicles on land, sea, and air and our complete mechanical environment exhibit vibratory motion; therefore, in research, production and usage, vibration must be sensed, measured and controlled.

The vibration sensers of today make the smooth-running, high-powered automobile engine a reality instead of an engineer’s dream. The forge plant controls the quality of each casting by ultrasonic flaw detection. The castings are milled on machines which are checked for vibrations originating from their cutting and rotating members. Drilling and boring machines must be free of vibrations to assure accurately-machined pieces. The shape, weight and composition of each engine part must not contribute to harmful resonant frequencies. Finally, the completed engine is tested for vibration, and the hoped for result is a quiet engine with a soft, even purr.

Vibration is a recurrent physical movement which has three qualities: amplitude or displacement, frequency and velocity of motion. These three are related very simply by the formula \( F = \frac{V}{2D} \), where \( F \) = cycles per second, \( V \) = inches per second, and \( D \) = peak-to-peak displacement in inches. Thus, when any two vibration characteristics are known, the third can be easily determined. To illustrate the use of this formula, let’s see how it was applied in an actual case.

A production line was halted because a turret lathe had developed the trouble symptom of abnormally short tool life. A microscopic view of the cutting edge indicated very little wear; however, severe chipping and fracturing had obviously taken place, a condition which could be the result of an abnormal vibratory action. The first step toward localizing the problem was to determine the values of two of the vibration characteristics. This was done with the use of the vibration pickup instrument shown in Fig. 1. The unit was bolted to the tool post and connected to the meter which indicated that the vibration was most excessive at 600 cps and that the amplitude (displacement) was .0003". Knowing this, the foregoing equation was applied and the velocity was determined to be .36 inches per second. The combination of data indicated that the trouble was isolated to the tool supports or was the result of improper cutting speed.

Tightening the tool post and changing cutting speeds did not correct the trouble. The complete tool mount and base were then disassembled, and the trouble was found to be the result of improper seating of the tool post to the base. Rerinding and lapping the post and seat eliminated the vibration.

The production line was stopped only 20 minutes by this problem. Vibration tracers reduced the down-time of this production line from 3 or 4 hours to a short 20 minutes for problem analysis and corrective measures. Since the importance of such test units is obvious, we shall now examine the workings of some typical instruments.

**Resistive and Capacitive Sensers**

Vibration sensers generate an electronic signal by sensing at least two of the three variables, usually frequency and displacement as in the foregoing example. The carbon-granule pickup shown in Fig. 2 is very much like the carbon mike used in audio work and functions as a resistive senser. The compression of the carbon reduces its resistance in proportion...
to the degree of pressure; thus, displacement is determined by the change in resistance, and frequency is indicated by the number of compressions per second.

The capacitive sensor of Fig. 3 resembles the capacity mikes in both construction and operation; i.e., the diaphragm serves as the movable plate of a capacitor connected across the output terminals. Displacement is thus determined by the amount of change in capacity value, and the rate of change indicates the frequency. The plates are heavier than those used in the standard microphone since these sensors must be capable of rather severe shock measurements in addition to dynamic vibrations.

Magnetic Sensors

Another common type of vibration sensor involves the use of an induction coil and two basic principles of magnetism. The amount of voltage generated across a coil by a magnetic field cutting its windings is a function of the rate of field movement. When the magnet moves slowly, the voltage across the coil will be small regardless of the total movement. Also, reversing the direction of movement will reverse the generated voltage polarity; thus, velocity and frequency are the two vibration characteristics which can be measured by this unit.

A magnetic sensing unit is shown schematically in Fig. 4. As vibration moves the magnet, the coil generates a voltage which is applied to an RC-coupled, wideband amplifier consisting of several stages. After the signal is amplified, it is applied simultaneously to the two sections of a dual diode V1. V1A couples only the negative portion of the signal to V2, a cathode coupled multivibrator with its input grid resistor R3 returned directly to cathode rather than ground.

This circuit is similar to the vertical sweep oscillator in many television sets, the only difference being that fixed bias on the input section is always zero and V2B therefore cannot bias V2A into cutoff via the cathode resistor R4. The voltage developed across R4 during V2A conduction will bias V2B beyond cutoff, however, V2A conducts until a negative pulse is applied to its grid; and as conduction decreases, so does the voltage across R4, until it reaches a level which will permit V2B to conduct. Capacitor C3 will then couple a negative pulse back to the grid of V2A, and V2A will stay cut off until C3 discharges. When this happens, V2A comes back into conduction and remains in this stage until the next input pulse reaches its grid.

Since this circuit goes through one complete cycle for every input pulse, it is called a one stable state (V2A conducting) multivibrator. The primary reason for using this type of pulse generator is the constant amplitude, constant duration pulse it forms. The input pulse may be of varying shapes and amplitudes, but the output will always be the same (changing in frequency, of course, in accordance with the input signal).

V2A generates a positive pulse which is coupled through a small value capacitor to a clipping circuit. Diode V3A passes the negative spike to ground and diode V3B passes the positive pulse to capacitor C5. Resistor R7 completes the conduction path for the diode. The voltage across C5 is proportional to the average value of the pulses applied to V3B, and since the amplitude and duration of the applied pulses are constant, the average voltage depends only upon their repetition rate. Thus, the voltage across C5 is actually a measure of the frequency of vibration. The VTVM circuit of V4 is used to determine what that voltage is.
Chip In. We salute the technicians of Western Electronics Assn., Cheyenne, Wyo., who banded together to take care of member Joe Delhaute's service calls during his illness. They donated their time and presented all servicing receipts to Mr. Delhaute. When an ad was placed in the local newspapers to inform the public of the situation, calls to the Delhaute shop increased.

The good will generated by this incident should last for a long time. We know that most TV servicemen are honest human beings, but it makes us feel good to see somebody demonstrating this fact to the world.

"No School Today; The TV Blew a Tube!" The next generation of youngsters may be pinning their fondest hopes on "tough dog" sets to provide a good excuse for getting out of schoolwork. About 200 schools are already using closed-circuit classroom TV in some way, and a tremendous boom could develop in this field as electronic teaching techniques become better developed. The largest single installation is in the Hagerstown, Md., area, where a 5-year investigation of school TV's possibilities is being backed by EIA and the Ford Foundation. All schools in an entire county are being connected by cable, and a variety of courses are being taught from central studios.

Here's another opportunity for the alert service shop to create new business. How about letting school boards know that competent service will be promptly available for any TV equipment they decide to buy?

Transistor TV. Motorola unveiled a fully transistorized 14" portable recently, but doesn't plan to market it commercially until the price of transistors comes down. (The set requires 31 of them.) Far from being a miniaturized unit, it's fairly hefty—32 lbs. But it's a true cordless portable, powered by two nickel-cadmium batteries which are recharged after each 6 hours of operation by plugging the set into an AC line for 2 hours. Longer playing time for any battery-operated TV won't be practical until someone figures out a way of drastically reducing sweep-power requirements.

Test Your Tact. Success in making home service calls depends on a lot of little things, such as your ability to keep a straight face while making sensible replies to customers' comments. No matter how wacky or downright ignorant such comments may sound to you, they are usually spoken in all earnestness.

One time we answered a call from an old lady whose complaint was intermittent flashing and streaking in the picture. We were unable to induce these symptoms in the set, and told her, "The trouble may be in the transmitter." "Oh, but it couldn't be," she declared. "I'm sure we had that replaced the last time the set was fixed."

Could you have maintained your professional dignity after that one? Better try; for all you know, she might own the station!

Sample of Pay TV. Subscription television may get its first real on-the-air test soon. Sometime after the first of this month, the FCC plans to act on station applications which it began accepting last December. The first request for toll operation was filed by a Philadelphia firm seeking to try out pay TV on UHF Channel 29. The proposed station would furnish to subscribers a combination decoder and UHF converter, and would supply a program of major sports events for a flat yearly fee—$30 for homes and $100 for commercial establishments. Special events such as stage shows would also be put on periodically, with an extra fee collected for these.

Transistor Tip. When circuit tracing in transistorized equipment, do you have trouble telling a p-n-p transistor from an n-p-n? If so, check the collector voltage. If this is negative with respect to the emitter voltage, the transistor is of the p-n-p class; if positive, the transistor is n-p-n.

Understanding this point will also help you remember how to connect a battery to a transistor circuit—provided that you know which class of transistor you are working with. The middle letter of the class designation (p-n-p or n-p-n) always indicates whether the positive or negative terminal of the battery should be returned to the collector circuit.
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March, 1958 • PF REPORTER
Poor Vertical Sync
A Philco Model A-T1818 has always had poor vertical hold. By changing R95 (sync separator grid resistor) to 510K, vertical hold was made perfect, but then the lower half of the picture tended to weave back and forth horizontally at a rapid random rate. Is some change in the sync separator still necessary to compensate for this condition?

Carl H. Miller
N. Wildwood, N. J.

The best approach would be to restore good horizontal sync by restoring R95 to its original value, and then to search for the real cause of the poor vertical sync. Changing R95 reduced the ability of the sync separator to produce clean horizontal sync pulses in its output.

Check the waveform at the grid of the phase inverter V15A, using a scope sweep frequency of 30 cps. Are the vertical and horizontal pulses of equal height and normal appearance? If so, look beyond the grid of V15A for your trouble. The vertical integrator circuit may not be operating properly because of a defective capacitor or some other cause. Instead of replacing individual components, you might be able to install a modern "packaged-circuit" type of integrator.

If the vertical pulses at the grid of V15A are lower in amplitude than the horizontal pulses, check back through the sync and video circuits to find the cause of this condition. One possibility is a decrease in value of a coupling capacitor such as C92.

P. A. Interference Pickup
In our place of business, we have an adding machine that "sounds off" in our P. A. system. Using an isolated AC line circuit and grounding the machine has not cured the trouble.

B. W. Premo
Arroyo Grande, Calif.

You have eliminated direct pickup from the power line as a possible cause, and so we can only assume that radiation is feeding into the P. A. system either from the machine itself or from the power line to which it is connected. By any chance, do the P. A. system wires run parallel to the power line wiring for any distance? If so, shielding of the audio cables may help.

Oscillator Adjustments
In some TV sets, the oscillator adjustment slugs for individual channels are not accessible without removing the chassis. I understand there is often a general oscillator adjustment which is located on top of the tuner. Sometimes there are two adjustments, one for low channels and one for high. How can I identify these adjustments on the chassis and on the schematic?

Anthony C. Juliano
Findlay, Ohio

The trend is away from general oscillator adjustments of the type you describe. In most late-model sets, individual channel slugs and the fine tuning control provide the only means of changing oscillator frequency. However, some tuners—particularly the older RCA and Standard Coil types—do have a coarse oscillator frequency adjustment on top of the chassis. On a schematic, it is shown in parallel with the fine tuning control. Check its location before turning any screws! This adjustment may improve over-all oscillator alignment in some cases, but probably you will also have to check the individual channel slugs to obtain a really good job of alignment.

The Channel 6 and 13 screws located on the top and side of certain RCA tuners, as described on page 56 of the October, 1957 issue, are entirely conventional single-channel type, except for their physical location. Since they are in a switch-type tuner, they do have some effect upon oscillator frequency on lower channels; nevertheless, they are not meant to be used as "general" adjustments.

Sweep Generator Output

In all the articles I have read on the subject, it is advised that a sweep generator with a perfectly flat output be used to avoid misleading results. I have a sweep generator which I believe to be of a good make, but I have some doubt as to whether the output is absolutely flat. Assuming that some slight variations occur in the output, is it possible to align a TV tuner with any degree of accuracy?

Roy A. High
Oakland, Calif.

The outputs of most generators used for TV servicing are not perfectly flat. There may be considerable variation over the entire range of the unit, but you should be concerned only with amplitude changes over the portion of the range being used. A variation of as much as ±2 db can be tolerated for alignment of tuners—except those used in color receivers.

Many makes of sweep generators on the market have reasonably flat outputs over a given sweep range (±1 db or better). Even if output varies considerably, a technician can use a generator with success if he knows what variations to expect and takes these into account when inspecting response curves.

Slight Vertical Trouble

On a Motorola Chassis TS-52, the vertical hold just barely locks in. If the height control is adjusted for an undersized raster, hold is improved; but if the raster is made even slightly oversized, all hold is lost and the picture rolls slowly. The blanking bar appears normal. Tubes have been checked and substitutions made in the sync and vertical stages, and voltage checks have also been tried.

Charles Andrews
Rochester, N. Y.

We assume that the vertical hold control is barely locked in at one extreme of its rotation. This behavior indicates that the free-running frequency of the oscillator is too far from the normal value of 60 cps, with the result that the range of the hold control is insufficient to bring the circuit to the correct frequency. The vertical oscillator in this chassis is a multivibrator, so its natural frequency is determined by RC time constants and a check of resistor and capacitor values in the circuit is in order.

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CBS tubes are mechanically transferred from the aging conveyor (left) to the automated tester (right) where they undergo up to 27 characteristics tests controlled by adjustable plug-in units.

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Special Resistor Applications

Do you know the purpose and function of each resistor in the horizontal output and high voltage circuit? Through a more complete knowledge of these components, discussed below, you will be better able to deal with any problems that arise. Fig. 1 shows the five resistors associated with the horizontal output tube. Two 47-ohm, 1/2-watt resistors are used as parasitic suppressors to prevent oscillations which would otherwise be sustained by the lead inductance and stray capacitance associated with the respective tube elements. The values of these components are not critical and can vary between 47 and 150 ohms. A substantial increase in the resistance of the grid-circuit unit, however, could cause distortion of the driving signal and a resultant nonlinear horizontal sweep. Should the 47-ohm unit in the screen grid circuit increase by any appreciable amount, there would be a reduction of the screen potential and a corresponding reduction of horizontal sweep width.

The 1-meg, 1/2-watt resistor in the control grid circuit serves as a load for the drive signal. Any increase or decrease in the value of this unit will result in improper input impedance to the horizontal output stage and also change the loading on the horizontal oscillator stage. This can cause width or linearity troubles in addition to possible oscillator instability.

The 100-ohm, 2-watt resistor in the cathode circuit provides a self-bias voltage so that the tube will operate on the linear portion of its curve and, in addition, act as a protector for the tube should there be a loss of grid-drive signal.

The 8,200-ohm, 4-watt resistor in the screen grid circuit reduces screen voltage to the desired level and limits screen current to the specified value. Any material increase in the value of this resistor would reduce the screen voltage and cause a reduction of width, while a decrease in resistance would increase screen voltage and thus screen current to the point where it could damage the tube.

In Fig. 2, the 6.8K-ohm, 2-watt resistor is used to decouple the vertical and horizontal sweep sections. There is a filter capacitor (not shown) on the vertical end of this resistor to shunt all vertical signals to chassis ground. Any decrease in the value of this resistor will reduce the isolation between the two circuits and cause interaction, while any significant increase will lower the voltage applied to the vertical section and possibly cause insufficient vertical sweep.

Fig. 3 features a horizontal yoke circuit. The placement of the 1,000-ohm resistor is familiar to most technicians, and the fact that it helps to prevent yoke ringing is also general knowledge. Just how this is accomplished is not well understood. The capacitor is included to lower the resonant frequency of the winding and reduces its susceptibility to oscillate when pulsed. The resistor lowers circuit Q and further reduces the tendency of the yoke to ring. Omission of this resistor (when it is specified) will result in severe ringing. The voltage across the top half of the yoke coil divides between the resistor and the capacitor in the ratio of their impedances and makes it possible to use a capacitor having a lower voltage rating. The 470-ohm, 1/2-watt unit shown in parallel with the 22 mfd, 400-volt yoke return capacitor is included for centering purposes. Since the yoke is connected across the flyback transformer and the plate current of the horizontal output tube flows through the transformer, a portion of this DC current, limited principally by the resistor, flows through the yoke. This sets up a reference magnetic field and helps to center the raster. The 22-mfd capacitor is included to prevent pulses from developing across the resistor and lowers its wattage requirements.

In the circuit configuration of Fig. 4, the 1,000-ohm resistor is the only component installed to prevent yoke ringing; however, it also is important to raster centering since it provides a DC path to the yoke. This, in addition to the fact that it is subject to a small amount of pulse voltage, is the reason for
It's brand new! Extra heavy. The King-size "8" Ball, for today's king-size market... but at a regular price! Popular proved ball mount... adjusts up to 35°. Sleek and modern for today's cars. Triple chrome plated. 4 sections extend to 57". 54" lead cable. Outside, one-man installation. Boost your profits with this King of new antennas. Order the Model TCF-4 Super "8" today!
its 2-watt power rating. The presence of ringing in the picture or a failure for the raster to center normally would indicate that this resistor may be defective.

The circuit shown in Fig. 5 is only the portion of the flyback transformer to which the width coil connects. The sharply resonant circuit of the .001 capacitor, width coil and transformer winding could generate spurious oscillations which might introduce ringing in the picture, overheating of the width coil or damage to the flyback. The 4.7K-ohm, 1-watt resistor acts as a damper by reducing the Q of the circuit, thereby limiting or eliminating the undesirable oscillations.

The resistors in Fig. 6 are usually incorporated in the high voltage circuit when a simple half-wave rectifier is employed. The 3.3-ohm unit will vary in value from less than one ohm up to 6 or 7 ohms depending on circuit requirements, and will either be of a special wire-wound or composition construction. The primary purpose of this resistor is to limit rectifier filament current, but in so doing, it also reduces the load presented to the transformer by the filament circuit.

The first use needs no explanation, but since the latter may not be so universally understood, let's consider it for a moment. You can readily see that the total impedance of a single turn of large wire (such as the high voltage filament wire) and the rectifier tube filament is extremely low, and the lower this impedance, the greater is the load it presents to the transformer. The addition of a small resistor increases the total impedance and reduces the load placed on the transformer. The net result is an increase of high voltage and a reduction of heat loss in the transformer.

This doesn't mean that you can add a resistor to a circuit not designed for it and improve or increase the high voltage, because in actual practice this will cause the rectifier to operate at too low a filament temperature and result in filament "suck out" and short tube life.

The 220K-ohm resistors in this same circuit may be of different values in other receivers, but the function will remain the same—serving as the resistive element in a pi-section RC filter (Fig. 7) where the second capacitor (not shown in Fig. 6) is the capacity between the inner and outer coatings of the picture tube. Resistors having ratings of from ½ to 2 watts will be found in this application; however, when replacing them, it is best to use a unit having as high a wattage as possible. Physical size should be the controlling factor and either a carbon or composition unit may be used.

**Tuner and Control Cleaner**

An idea developed by Injectorall Co. of Brooklyn, N. Y. is the needle-spray applicator incorporated with their tuner and control cleaner (see Fig. 8). The applicator makes it possible to inject...
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the wax-free lubricant and cleaner into small and otherwise inaccessible areas and thus not only permits the technician to do a better job more quickly, but saves on the use of the fluid itself. Incidentally, actual trial uses of the fluid prove that it does a good job in eliminating noisy operation due to dirty tuner contacts or control elements.

Color CRT "Burn-In"

A recent Sylvania service manual gives the following warning on set-up and convergence procedures. "Caution: Before performing the set-up and convergence procedures on a new color receiver or a color receiver with a new picture tube, the receiver should be operated for at least four hours under normal station reception conditions to prevent burning the color lines or dots into the unaged phosphor of the picture tube."

Since a color bar pattern was recently burned into a receiver of another make during a troubleshooting procedure in our labs, it is our suggestion that this precaution be observed for all color receivers. In our own case, we found that the "burned-in" bar pattern could be erased by tuning in a station and adjusting the vertical hold control to produce a slow rolling of the picture. Several hours of operation cured the "burn-in" condition, but the preventive measure rather than the cure should be employed if possible.

Change in RCA Focus Circuit

The resistive element of the 200K-ohm focus control used in many RCA color chassis (Fig. 9) may become charred or burned at the setting where best focus is obtained due to focus-rectifier current. To eliminate this condition, RCA specifies that a 56K-ohm, 1-watt resistor be installed between the variable arm of the control and the 1V2 plate. The leads in this resistor should be insulated with vinyl spaghetti and dressed away from all other components as much as possible. The RCA part number of the focus control in question is 102150 and the recommended replacement is 102150-B, the B indicating that the 56-ohm resistor is included. Make the addition of the resistor on the next service call and prevent subsequent focus-control failure.
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This test point eliminates the need for shifting horizontal centering to view the stripe—a most desirable feature since beam convergence changes with a change of centering.

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At one time or another, you've probably had do-it-yourselfers bring in sets with tubes missing, in the wrong sockets, etc. But, boy! This past week, I had it; not one but two—and they both owned soldering irons!

The symptoms on the first set seemed simple enough; the horizontal blanking bar appeared at the center of the screen—the left half of the picture was on the right side and the right half on the left side. The set was brought to the shop by the customer, who left after explaining that the picture could not be straightened out by adjustment of the usual controls.

I made the usual attempts, without success, to correct the trouble by adjustment of the service controls. I tried new tubes, of course, and after being satisfied that a little scope-snooping was called for, relegated the set to the "Ham Shack" for further study. Perhaps I'm peculiar, but I like this TV service work and often take the tough ones home to the basement workshop where the amateur radio station adds diversion in the evening hours. I "hang around" on 3910 kc, where the Indiana Fone Net meets, and breeze with the gang after net time for many happy hours.

The first evening with this troubled TV found me devoting most of my attention to the sounds from the short wave receiver—only half consciously probing at the test points, reading scope patterns, etc., until it finally became obvious that this job was not going to be so easy. Everything seemed to check good, but the trouble still existed!

I listened less and less attentively to the banterings on the air, even began talking to myself a little, and when someone suddenly passed the frequency to me, I'm afraid I might have transmitted something like this, "This is . . . why doesn't that pattern stay steady? . . . W9PQZ . . . what is that slight oscillation? . . . Sorry gang, I'm afraid I wasn't listening . . . this thing should line up ok . . . Say fellows, sign me out. I've got an idea. W9PQZ clear."

Well, that idea didn't work, and neither did any other I could come up with. A glance at the clock sent me reluctantly off to bed with that divided picture-night-marishly entering my dreams for the night.

The press of business kept my mind off that freakish set the ensuing day, but at dinner the wife sensed my impatience to fly off to the basement "shack." Normally I'm an easy-going guy and enjoy those evenings when fellow "hams" or would-be nobices drop in through the convenient outside door to spend time with me in the shack. But I was probably a little curt when an unexpected license aspirant came bounding in with a cheery greeting. While I planned to devote all my attention to that 180° phase shift problem, I succumbed and turned on the rig, but carried almost no part of the conversation with the hams nor with my guest. I checked and re-checked every portion of that circuitry, but the only thing I could find that was even a little off-base was the 6AL5 AFC detector. No bad parts could be found, and even substitutions made no changes in the symptoms. There was a slight oscillation of the voltmeter needle when measuring on the feedback side of the tube; but man, believe me, there were no bad parts in that TV set! Another wasted evening, another sleepless night, and my regular business found me growing tired and often flashing back mentally to that two-eyed monster in the basement.

We live in a typical small town, so it was not unusual that I should happen to meet the owner of this set on the town square. When he inquired as to the progress on his set, I could only confess that I was nowhere and that it looked as if the road ahead led to the same place. After paying him pleasant respects I started to hurry away, but his parting remark brought me back with a suddenness which to him must have been startling. "Did you say it has been like this ever since YOU replaced the high-voltage transformer? Is that what you said?"

"Yeah!" There was pride in his voice. "Everything worked swell right off the bat, all but for that darn line."

I gulped my food, skipped the coffee and sneaked down to the basement full of new hope, and as you may have guessed by now, I quickly traced out and corrected the customer's wiring job and had the set humming like a top. He had done a beautiful bit of workmanship, each joint faultlessly connected and carefully soldered, but the leads to the AFC coil had been reversed; hence the 180° phase shift.

The next evening found me, as usual, with another set that had been a little too much to finish during the day. This set had an
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interesting history. It was a split-chassis Philco. The customer came in carrying the sweep chassis and asked for a new 6BQ6 horizontal output tube, also informing me that the fuse was blown. I replaced the tube, which was obviously bad because the plate cap had blown off, and bridged across the fuse with a snap-on double-ended fuse holder, casually remarking that I was putting in a 1.6-amp fuse. The customer was interested in the neat little device that bridges pigtail fuses, and volunteered that the fuse which had blown was actually a 2-amp fuse instead of the specified 1.6-amp rating. I thought very little of his comment at the time because I, too, have been guilty of going to the next highest fuse when necessary, especially out in the field where an exact replacement will require a round trip back to the shop.

Since he had not brought the picture tube, yoke, speaker with field-coil choke, and RF chassis, all I could do was take a quick look for obvious problems, and, seeing none, send him on his way. But he didn’t stay away long. He returned soon with the whole set and announced that it had barely started to warm up when the fuse blew again. Being busy, I had him leave the set for further attention, and had already resolved to take this one to the shack for my evening’s entertainment.

Another would-be novice dropped into the shack on this eventful evening. Since he was building a power supply on which he wanted some advice, I pushed aside the ailing TV, which by this time had already defied my systematic search for the short which was blowing fuses, and turned my attention to the novice’s problems. He was trying for an ambitious voltage-doubler circuit, one well beyond his knowledge, and I was hard put to describe its principles and explain his errors. So I took him to the ailing Philco to show him how the selenium rectifiers and filter capacitors worked together to develop the AC input voltage to a higher usable DC value.

At the risk of losing another fuse (which I did), I fired up the set, intending to show him the 250 volts of output from the second selenium. I placed the meter probe on the rectifier, fired up the set with the “suicide” cord, watched the needle climb to a sizzling 80 volts, and quickly fade to nothing as the fuse blew! Being a blow-hard know-it-all, I started to explain to him that whatever was shorting out and causing the fuse to blow was drawing such a large amount of current that the voltage was being affected drastically. But I knew I was wrong even as the words were rushing out! I had already used the ohmmeter enough to know that no such drastic short could possibly exist in this set. In fact, as I studied over what I had said to the poor unsuspecting chap, I realized that for the second set in a row, I was stuck by a do-it-yourselfer! I had already used the capacitor checker on the filters, had killed the horizontal oscillator and determined that it wasn’t development of boosted B+ that was doing it and, in fact, after 3 hours on the set I was no further along than I had been at the beginning. In short, I was stuck!

With a shrug and a promise to get back to it the next night, I turned full attention to the problems of the would-be ham and suggested that he should not only make the corrections required in his power supply but also provide fusing to protect his equipment. To demonstrate this principle of fusing, what could be better than to let him again examine the ailing Philco to note first hand how fusing should be installed and how a relatively inexpensive little fuse could save extensive damage. Thus, the Philco came in for study under the unpracticed eye of the novice (bless him). He, of course, had to follow the entrance of the house current into the filament transformer, through the fuse, to the selenium rectifiers and thence to the filters—but he couldn’t get there. He said there was a “dead end”!

By now I was tired of looking at that Philco, and as a matter of fact, I was getting tired of looking at the novice too. Let’s face it, I was just plain tired and wanted to go to bed, but my mother taught me to be a gentleman at all costs, so I propped open my eyelids and with a sigh of resigna-
tion once again approached the ailing circuit which had no bad components.

I looked to where the novice was pointing, and, sure enough, that's what it was—a "dead end!" A wire from somewhere just came over to a solder lug next to the one to which the fuse connected, and there it stopped; not grounded, no hidden parts, just a dead end! It only took a minute to trace that wire on to the logical conclusion of its other end, which was, after a short trip through a 5-ohm resistor, the selenium rectifier. And then the remark of the customer drove home! "That's a 2-amp fuse in there." How did he know it was a 2-amp fuse? Logically enough, he must have known because he must have installed it! The schematic in Fig. 1 shows where he had connected the fuse. Moving the pigtail of the fuse over one solder lug, a distance of 3/8", cleared up another puzzler and sent me to bed with a song in my heart.

So if any of you boys want to become hams, come over any time you wish, ask all the fool questions you want to, and stay as late as you like.

And as for do-it-yourselfers, they are still very good customers, especially when you charge by the hour for finding their mistakes. But from now on, each customer who brings in his set instead of having us pick it up will be shocked by my questions. "Do you have a brace & bit, saw, or hammer around your home? And does your work shop include a soldering iron?"
The selection and use of Hand Tools

by Calvin C. Young, Jr.

Fig. 1. Assorted wiring pliers for TV.

Fig. 2. Assorted styles, sizes of cutters.

The previous article on hand tools (January, 1958) dealt with the various hand drivers used in radio and TV servicing. This concluding installment covers the remainder of the common hand tools such as wiring pliers, cutters, adjustable wrenches, adjustable pliers, hex and spline wrenches, wire strippers, bolt cutters, wire and cable tackers, tube aids and miscellaneous tools.

Wiring Pliers

In the broad category of wiring pliers, we find everything from a standard long-nose plier to a special TV plier with a tip cutter. Let's have a look at each type and see how they differ in characteristics and usage. The standard long-nose plier is the most common type and, as shown at lower left in Fig. 1, may incorporate a cutting surface along its jaws. The long jaws that protrude from the pivot point are tapered to facilitate the making of connections in confined spaces and have serrations or teeth at the tip to provide a gripping surface.

Even though this tool can be used to grasp a nut or bolt having a head size of 1 3/4" or smaller, it is not designed for removing or installing bolts and nuts because the gripping surfaces of the jaws, when opened, are not parallel to each other, and are therefore, prone to slippage when used in this application. The only time a bolt or nut should be gripped with any wiring plier is when you are inserting the bolt in a recessed space or starting a nut on a bolt that cannot be reached with the fingers. Because of their slenderness, the jaws of long-nose pliers can be broken by the normal stress required to remove or tighten a nut or bolt.

Fig. 1 shows a number of variations in long-nose pliers, and each has a particular usefulness. The plier with insulated handles (lower center) is particularly designed for work involving heavy wire and large surfaces and is very useful in working on "hot" circuits (where utmost caution should always be observed).

The removable cutter blade on the spring-loaded pliers is easily replaced should it become nicked or dulled in usage. This cutter has a shearing action (like scissors) instead of the pinching action of most cutters, and may be used for both very soft and very hard wire as well as regular hookup types. The spring-loaded jaws open automatically when the handles are released so that they are always ready to grasp the next connection.

The curved-nose pliers shown at the upper left in Fig. 1 are very helpful in getting into corners and other places in which a straight plier cannot readily be used. The special plier developed especially for TV wiring (upper center in Fig. 1) features a gripping surface at its extreme tip (narrow tip on small slender jaws) and a cutter only 1/4" from the tip. This special construction makes much simpler the job of connecting wire and component leads to terminals, tube-socket lugs and other confined spaces. The small tip cutter permits excess lead length to be removed after soldering, even in very compact units. The needle-nose pliers (upper right) are most useful when working with small wire in extremely confined spaces. Due to the long, tapered jaws, heavy wire should not be handled (bent or twisted) with these pliers. To do so will result in damage to the pliers.

Cutters

The most familiar wire cutters are the standard 6 1/4" diagonal cutters commonly referred to as "dykes." The jaws of this cutter are small enough to fit into many places in a TV or radio chassis and large enough to cut the largest sizes of wire normally used in TV and radio work. This plier may also be used to cut the smaller sizes of guy wire if the extreme inner portion of the jaws is employed. However, this use, if extensive, may make the "dykes" unsuitable for cutting copper wire.

There are a variety of other sizes and styles of cutters (Fig. 2) which are intended for use in the TV and radio service trades. The heavy 7 1/2" type is just the thing for cutting larger sizes of copper wire and guy wire of the sizes normally used in antenna work. The plastic coating on the handles provides voltage insulation and also a very comfortable hand grip. The head of this cutter features heavy jaws and a large, heavy-duty pivot to prevent springing during the cutting action.

The smaller 5 1/2" style with spring-loaded jaws features both a smaller handle and a smaller head than the standard 6 1/4" size, and is suitable for cutting all copper wire, aluminum wire and copper braid used in TV and radio receivers. The spring-loaded
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Hardware Note: All shafts and bushings insulated from circuit elements. 1/32 x 1/8" long bushing. 1/8" dia. shaft, round, 1/4" long. Complete with bar knob and dial plates.

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feature makes cutting jobs easier since the cutters will automatically open when the handle is released. The smaller, thinner jaws and smaller pivot point make this cutter a poor bet for antenna work, but these same features make it excellent for TV bench use.

The 4½" design features both a very small, narrow head and closely-matched cutting surfaces. Cutters of this size are meant only for use on small size hookup wire and component leads. Using them to cut anything larger or harder will cause damage to the jaws or the pivot.

The 5½" unit has a replaceable blade which operates on a shearing action to cut extremely soft or hard wires and also features spring-loaded jaws. Even though the cutter blade is replaceable if it becomes dulled, man loose with a pair of pliers and he will "goop up" every bolt and nut in sight. Pliers have a very useful place in the service kit, providing they are correctly employed.

Both the slip-joint and the adjustable plier are intended for use in holding irregularly-shaped objects for which no wrench is available. They are designed with machined teeth that bite into the object being held—a necessity if the object is to be held firmly. This causes a certain amount of marring to the surface of the object; therefore, a good rule to follow is never to use pliers if the resultant damage to the object will interfere with its subsequent use or appearance.

If you find it necessary to employ a pair of pliers to remove a bolt or nut, grip the head of the bolt with the pliers and then remove the nut with a wrench. If a bolt or nut does become damaged

**Fig. 3. Slip-joint and adjustable pliers.**

wire of too large a size should not be cut since this could loosen the pivot and ruin the pliers. They will cut standard guy wire and aluminum ground wire with equal ease.

The small-size 4" end nippers and 5½" transverse cutters are most valuable for working on printed wiring boards. The transverse cutters with their longer, slimmer jaws will reach into confined spaces for flush cut-off of wires and component leads, while the end cutters with heavier and wider jaws will permit cutting old terminals from filter capacitors, potentiometers, etc. Larger end cutters, 5½" and 7½", are also available for heavier-duty flush cut-off work.

**Adjustable and Slip-Joint Pliers**

These tools (Fig. 3) are probably the most misused of any ever invented. Turn the average
in the process, replace it rather than have chewed-up screw heads class you as a novice or sloppy workman.

**Adjustable Wrenches**

The 4", 6" and 8" versions (Fig. 4) have jaw openings of ½", ¾" and 1" respectively, and are a very handy assortment of tools to have on hand. A word here—just because these tools offer extreme versatility in the sizes of their jaw openings, don't depend on them for your entire wrench requirements, since they do have certain limitations. The adjustable wrench is not as strong as a one-piece wrench, and should not be used to tighten or loosen bolts or nuts under high torque levels. It is far better to use them as they were intended—as a second wrench or to fit bolts and nuts of sizes not commonly encountered in your work.

In order to provide a reasonable measure of strength, and at the same time be adjustable, these wrenches have rather large heads for their span; this precludes them from use in confined areas. In line

---

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Old Hands at Dependability

with the inherent strength of the adjustable wrench, it is weakest when opened to its maximum limit. Furthermore, there is a right and a wrong way to apply torque with an adjustable wrench. Fig. 5 illustrates the correct way. The force on the movable jaw should always be into the head, not away from it. This places minimum strain on the wrench and prevents springing of the movable jaw.

If you closely examine an adjustable wrench, you will see that there is a certain amount of play between the fixed and movable jaws. This is due to normal clearance between the gear teeth on the movable jaw and the threads on the adjusting wheel (see Fig. 6). For this reason, always tighten the wrench to take up all the slack after slipping it around the bolt head or nut.

Miscellaneous Tools

In this group are such tools as tube pullers, slug retrievers, plastic hammer, bolt cutters, wire strippers, tube-pin straighteners, plus hex and spline wrenches. These are items the technician is sure to need periodically.

In Fig. 7 we have pictured tools that can be classed as tube aids, and for brevity we will consider all of these as a group. The miniature tube-pin straighteners are constructed so that they can be fastened to the bench in a convenient location and are of different colors (9-pin is blue and 7-pin is red) for ease in identification. Since the pins of miniature tubes can easily (and often do) become bent, these tools are a must for every shop.

The miniature tube pullers are available in both 7- and 9-pin sizes as shown. The rubber insert in each unit grips the tube and per-
mits it to be extracted. Pushing on the top plunger causes a plastic cap to press down on the tube and free it from the puller. The plastic cap is hollowed out to clear the glass nipple on top of the tube.

The long tongs are most useful in removing either octal-based tubes that have become too hot to handle, or any tube located in such a way that tube removal and subsequent reinstallation would be almost impossible without a tube-handling device of this type.

The combination solderless-terminal connector, bolt cutter, wire stripper and wire cutter (Fig. 8) is a handy tool for any service shop. When used with a supply of assorted solderless terminals, antenna installations and the replacement of lead wire on indoor-type antennas is a breeze. The bolt-cutter feature is a real time saver. You've undoubtedly experienced the need for a ¼" or ½" bolt and could find none shorter than 3". With this handy tool, you
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Fig. 11. Assortment of hex and spline wrenches most often needed.

just screw the bolt into the correct hole (10-32, 10-24, 8-32, 6-32 and 4-40 can be cut) and cut it to the desired length, allowing approximately 1/8” for the thickness of the top cutter blade. Unscrewing the shortened bolt from the cutter readies it for use—no filing or honing of the bolt is necessary.

The hand tacker shown in Fig. 9 is a heavy-duty stapler which uses 50-gauge wire staples in lengths of 1/4”, 3/16”, 3/8”, 1/2” and 9/16”. This unit is handy for such jobs as securing acoustic insulation to hi-fi speaker cabinets, fastening speaker and intercom wire or cable to wooden beams and stapling heavy cardboard window displays together. Another excellent use (and one that should be considered much more often than it is) is the restapling of interconnecting cables on the insides of cabinets.

Wire strippers are often thought of as production-line tools, and yet they are very handy items to have around the service shop. The kit in Fig. 10 comes with an assortment of cutter blades so that practically any wire size can be stripped. This is the type of tool you’ll need on that P.A. installation, or when rewiring a complete chassis section or building a kit. The wire stripper features two sets of hex (Allen) wrenches.

Fig. 12. Stevens-Walden screw-holding hex wrenches.
jaws—one set to grip and hold the wire and the other to cut and strip the insulation away. The cutter jaws are removable, and 9 sets of cutter blades are supplied, expanding the usage to 24 sizes of wire including twin-lead conductors of both small and large diameter.

The hex and spline wrenches in Fig. 11 are most often required in the servicing of record changers, tape recorders and any number of small electrical appliances. While not needed as often as some of the other tools, nothing will take the place of a hex or spline wrench, so it's a good idea to be prepared and always have them on hand.

The screw-holding units in Fig. 12 feature one split end which spreads by spring action to grip an Allen screw and permit its easy installation. The 90° end may then be used to tighten the screw to the desired torque.

Have you ever, in the course of adjusting the local oscillator slugs in a current tuner, turned the slug too far and had to pull the chassis to retrieve it? If you have, then you know the value of the retriever tool being used in Fig. 13. This tool can save up to 15 or 20 minutes every time a slug is accidentally screwed in too far.

Summary
While this two-part series hasn’t covered all of the possible hand tools a technician might employ in his daily work, we have dealt with those most often used. Employing your tools skillfully will not only save you time and energy, but will also impress your customers with your craftsmanship, as well as increasing word-of-mouth advertising to your benefit.

---

Fig. 13. Hunter slug retriever in use.

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I enclose a Tobe boxtop
Checking RF Response

Since the alignment procedure for TV tuners is often omitted in service information, many TV service technicians ask the question: “How do I set up my generator and scope to check the RF response of a tuner?” Here then, are a few basic instructions and hints for setting up equipment to perform this particular operation.

The arrangement in Fig. 1 will serve for most practical applications of this type. In this setup, the sweep generator is connected to the receiver antenna terminals through a simple resistive matching network. Matching and termination of the output cable is usually necessary to obtain a maximum generator output and to prevent the development of interfering standing waves. The network is designed to present an input impedance that matches the characteristic impedance of the output cable (50 to 100 ohms), and to present an output impedance that matches the input of the receiver (75 ohms unbalanced or 300 ohms balanced).

The center frequency of the sweep generator should be set midway between the video and sound RF carriers of the channel selected. The sweep width should be adjusted for approximately 10 mc, and the sweep modulation voltage applied to the horizontal input terminals of the scope for a synchronized sweep.

From the vertical input terminals of the scope, the hot lead of a direct cable is connected to the tuner “looker point” through a 10K-ohm resistor, while the ground lead is attached to receiver chassis. The series resistor can be eliminated if one is already incorporated in the tuner. The “looker point” is usually located in the grid circuit of the tuner-mixer stage and is often terminated on top of the tuner housing.

It is often desirable to clamp the tuner AGC at approximately 1.5 volts negative. This can be accomplished by using a battery or special bias supply, connecting the positive terminal to chassis ground and the negative terminal to the AGC line at the tuner input. If a response curve of sufficient amplitude cannot be obtained, however, the negative supply should then be removed and the tuner AGC point grounded to chassis.

To obtain a usable response curve, especially on the higher channels, it may be necessary to operate the generator at maximum output and the scope at maximum gain. Once the curve is established on the scope screen, the frequency response can be checked by injecting video and sound carrier marker signals. A separate generator should be employed if the sweep generator has no marker output of its own. The signal from the marker generator can be applied (or loosely coupled) to the sweep output through a small series capacitor or by merely laying the marker output cable across the matching network to the antenna terminals.

4-in-1 Capacitor Analyzer

Sprague Products Co., North Adams, Mass., has recently introduced their Model TO-5 “Tele-Ohmike” Capacitor Analyzer, designed especially for measuring capacitance, power factor, leakage, and insulation resistance of capacitors. In addition, the instrument (Fig. 2) will also check the turns-ratio of certain iron-core transformers.

Specifications and test features are:

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plus two!

New Triplett Model 630-PL

New Triplett Model 630-APL

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- Molded circuit panel for instant component replacement.
- Models 630-APL and 630-A feature 1/2% resistors for greater accuracy; long mirrored scales to eliminate parallax in reading.
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- 5000 ohms per volt sensitivity in A.C. ranges; 20,000 ohms per volt D.C.
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  - One switch will select any range; minimizes chance of incorrect settings and burnouts.
  - D.C. polarity reversing switch.
  - 5 to 500,000 cycles per second frequency response in A.C. measurements.
  - 5000 ohms per volt sensitivity in A.C. ranges; 20,000 ohms per volt D.C.

**how do you want it?**

- Reads from .1 ohm (4.4 ohm center scale) to 100 megohms; four ranges.
- Molded circuit panel for instant component replacement.
- Models 630-APL and 630-A feature 1/2% resistors for greater accuracy; long mirrored scales to eliminate parallax in reading.
- Banana-type leads for low contact resistance at jacks.

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Triplett Electrical Instrument Co.
Bluffton, Ohio

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1. Power Requirements — 115 volts, 50/60-cycle AC, power consumption 35 watts.

2. Capacitance — 5 ranges from 1 mmf to 2,000 mfd, special low range for values from 1 mmf to 100 mmf to obtain greater accuracy, push-button selection and automatic discharging features included.

3. Power Factor — 3 ranges provided — 0 to 20, 20 to 40, and 40 to 55; direct-reading scale for all electrolytics.

4. Electrolytic Leakage — adjustable DC supply permits measurement at exact rated voltage up to 600 volts, monitored by panel meter on either a 6- or 60-ma range, normal leakage values provided in manual.

5. Insulation Resistance — panel meter provides 2 scales for direct measurement of from 100 to 20,000 megohms; checks paper, mica, and ceramic capacitors for leakage with average minimum value given in manual.

6. Turns Ratio — 2 ranges for ratios of from 1.1 to 100:1 and for impedance ratios of from 1.1 to 10K:1, three test leads provided.

7. Size and Weight — 8½" x 14½" x 6½". 12½ lbs. net.

Reading over the instruction manual accompanying the TO-5, and boiling down some of the unit's specifications, I found that not only will the piece of equipment measure capacitances of electrolytics and small ceramics from 1 mmf up to 2,000 mfd, but even molded gimmick capacitors. Other noteworthy features include an electrolytic leakage test at rated working voltages, an automatic capacitor-discharge arrangement after each test, and a provision for measuring turns-ratio of power and audio-type transformers. A complete operating procedure for all measurements is given in the TO-5 manual.

One application for which I used this new analyzer involved a TV receiver, a 100-watt light bulb, and a Christmas-tree effect. Realizing that technicians are always interested in new and different troubleshooting procedures, I thought I might relate this particular experience.

A two-year old TV chassis which we often use in our test lab started developing a Christmas-tree trouble whenever it was left operating for any length of time. This horizontal instability was somewhat intermittent and its cause rather difficult to pin down.

Having a strong suspicion that one of the capacitors in the oscillator circuit was changing value as it heated, I decided to make a hot and cold check of certain ones with the Model TO-5. I planned to remove each capacitor from the circuit and measure its value while it was relatively cool — then apply heat, using a 100-watt bulb from a bench lamp, and measure it again. In this manner, I thought I might detect any unusual capacitance drift. Well, as it turned out, I failed to notice any change in the first two attempts, which involved molded mica units. In my third try, however, I struck pay dirt.

Removing an .01 paper tubular from the horizontal oscillator circuit and placing it directly across the positive and negative test terminals of the TO-5, I first measured its capacitance cold. I depressed the range pushbutton "B," rotated the capacitance dial until I reached the widest tuning-eye opening, and then noted the value indicated under the hairline on the dial scale marked "C3." The unit measured exactly .011, which was well within its fixed manufacturing tolerance of 20%.

Disconnecting the capacitor from the analyzer and placing it under the lit bench lamp until I was sure it was at least as warm as it would ever get under normal operating conditions, I again connected it across the test terminals.
of the instrument and measured its capacitance. I once again varied the dial for the widest eye opening and found that the capacitor's value had changed considerably (see Fig. 3). The unit now measured .019 mfd, and as it cooled the capacitance gradually returned to the original value. Replacement of this capacitor cured the trouble.

Simpson's New "260"

The somewhat familiar-looking test instrument shown connected to the circuitry of an ailing TV in Fig. 4 is a completely new VOM announced recently by Simpson Electric Co. of Chicago. Designated the Model 260, Series III, this volt-ohm-milliammeter contains many design improvements over its older brother—the 260, Series II.

Specifications and functions are:
1. DC Voltmeter—7 ranges of 0 to 250 mv, 0 to 2.5v, 0 to 10v, 0 to 50v, 0 to 250v, 0 to 1,000v, and 0 to 5,000v; sensitivity 20,000 ohms/volt; accuracy ±3% of full-scale deflection.
2. AC Voltmeter—6 RMS ranges of 0 to 2.5v, 0 to 10v, 0 to 50v, 0 to 250v, 0 to 1,000v, and 0 to 5,000v; sensitivity 5,000 ohms/

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CHAPTER 5

POWER TRANSISTOR
for AUTO TRANSISTOR RECEIVERS

This new Raytheon PNP alloy-junction germanium transistor helps Service Dealers do more auto transistor receiver servicing. Designed especially for the output stage in automobile receivers, the 2N155 is used in the Ford receiver, and is an ideal replacement transistor for the power units in many other car receivers. Here is a list of the many transistor types this one, high quality, low cost Raytheon 2N155 transistor can be used to replace:

AR5 2N242
2N176 2N250
TS176 2N257
2N235 2N285
2N235A 2N301

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volt; frequency response essentially flat to over 10kc, within ±1.5db to 50kc, useful to 500kc.

3. AF Output—ranges of 0 to 2.5v, 0 to 10v, 0 to 50v, and 0 to 250v; output jacks provided with blocking capacitor; direct db scale from -20 to +10, zero db corresponds to 1 milliwatt of AC power across a 600-ohm impedance; on 10v-range add 12db, on 50v range add 26db and on 250v range add 40db to scale reading.

4. Ohmmeter—3 ranges of R × 1 (center-scale 12), 100, and 1,000; zero ohms-adjust provided on front panel, accuracy to within 3 degrees of value on scale arc; ranges operate on 1.5 and 7.5 volts DC, five 1.5-volt batteries supplied.

5. DC ammeter—6 ranges of 0 to 50 µa, 0 to 1 ma, 0 to 10 ma, 0 to 100 ma, 0 to 500 ma, and 0 to 10 amps; separate 50 µa- and 10-amp jacks provided on front panel.

6. Size and Weight—5¼” × 7” × 3½”, 3½ lbs.

When examining this meter and making use of it in various test and measurement checks over a period of several weeks, I discovered several new features that are not found in the older 260 line. One is a polarity-reversing switch which eliminates the need for lead reversal during DC-voltage or certain resistance measurements. Another is the fact that the meter scales of the new 260 are wide and the markings well spread out, making it very easy to interpret readings. The AC sensitivity of the new meter is now 5,000 ohms-per-volt with a usable frequency response of from 5 to 500,000-cycles.

Since the test procedures are relatively simple and the servicing applications fairly obvious, you may be interested in a brief description of the instrument's construction. From Fig. 4, one can see that the front panel has a 12-position range selector located in its center. The "zero
ohms" adjustment is directly to the right of the selector, while the combination AC/DC and polarity-reversing switch is to the left. Two separate jacks are located in each corner of the lower panel with white lettering identifying their functions. The carrying handle is attached to each side of the bakelite case and will pivot to support the instrument in a convenient sloping position if desired.

All circuit components of the meter are mounted to the front panel and the entire assembly can be slipped from its case by removing only four screws. A photograph of the instrument's working parts is shown in Fig. 5. When removing it from its case, I immediately noticed that the meter circuitry reflects modern design through the use of printed-wiring and the neat, systematic placement of components. Although the instrument is relatively compact, all replaceable parts are easily accessible as shown in Fig. 5.

Portable TV Transmitter

The relatively complex piece of equipment pictured in Fig. 6 is manufactured by Hickok Electrical Instrument Co. of Cleveland, Ohio. Identified as the Model 760 "Video Scanner," the instrument is capable of generating signals that can reproduce pictures or patterns on the screen of any TV receiver and is especially suited for signal-tracing, analyzing frequency response, making linearity or color convergence adjustments, and general TV troubleshooting.

Specification features are:
1. Power Requirements — 105 to 125 volts AC, 50/60 cps; power consumption 145 watts at 115 volts.
2. RF Output—video-sync modulated RF carrier for VHF channels 2 through 6; pretuned and selected by channel switch, variable from 50,000 microvolts down to snow-producing level; output impedance 90 ohms.
3. Video Output—video-sync signal in either positive or negative polarity, variable up to 2 volts peak-to-peak; output impedance 75 ohms; controlled sync to video modulation provided.
4. Other Features — framing frequencies 60 and 15,750 cps crystal-controlled; resolution in excess of 450 lines or bandwidth in excess of 5 mc; output cable provided; set of transparent slides including standard test pattern, white dot/bar and crosshatch designs plus blanks for grease-pencil use supplied with instrument.

Checking out one of these instruments in our lab the other day, I found that this picture-pattern generator is capable of converting any positive transparency of the correct size into a modulated RF signal for TV channels 2, 3, 4, 5 and 6. Or, it will provide a video signal of either polarity for operational checks of the video-picture tube circuits of any conventional receiver. A block diagram of the Model 760 circuitry is presented in Fig. 7.

Consulting the manual, I learned that the instrument operates on the principle of a flying spot scanner; i.e., when a positive transparency is placed between the scanner and the phototube as shown in the block diagram, the image appearing on the transparent slide is transposed from variations of light to electrical impulses. The various voltages developed as the scanning tube sweeps the image are similar to a video output signal from a TV camera. In addition to generating this video signal, however, the instrument also forms both vertical and horizontal sync pulses for proper synchronization of the receiver under test.

The 60- and 15,750-cycle sync is accurately derived from a crystal-controlled 315-kyc oscillator circuit. The vertical sync signal is pictured in the waveform of Fig. 8A, while horizontal sync is represented in Fig. 8B. These waveforms were obtained directly from the video output cable with the video polarity switch in its positive position and no slide in front of the scanning tube. Note the similarity between these pulses and those of a standard TV signal. The horizontal pulse contains a front and back porch, while the vertical is serrated to maintain horizontal sync during the vertical blanking interval.

When actually employing the
"Video Scanner," I first decided to view a few patterns on the screen of a normally operating receiver. In order to check the receiver's response from tuner to picture tube, I set up the generator for an RF output on channel 2, and connected the RF output cable to the antenna terminals, turning the RF and video attenuators fully clockwise. My next step was to insert the test-pattern slide into the slotted cover surrounding the phototube area, as illustrated in Fig. 6. I was careful to note the markings on the slide—"Top Front"—before slipping it down in front of the scanning tube.

With the set's brightness and contrast controls adjusted for normal operation, I immediately detected video information on the screen. To synchronize the picture, however, I found it necessary to adjust the vertical and horizontal hold controls of the receiver. After reducing the generator's RF and video attenuators slightly, I obtained a very presentable pattern.

I also set up the unit to deliver a video output and injected this at various check points in the detector, video amplifier, and picture tube circuits. In my first attempt, the picture appeared negative on the screen—that is, the blacks were white and the whites were black. This I quickly corrected by merely flipping the video polarity switch to its opposite position.

Since the ratio between sync and video modulation is made variable by means of a sync-level control, the Model 760 is also useful.
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ful for checking sync circuit operation. Using a scope, the technician can monitor the input and output of a sync system under various sync-to-video ratios and at different RF signal levels. As a portable TV transmitter, the 760 is of further value in servicing both monochrome and color TV receivers—not to mention its applications in checking TV boosters, antennas, and distribution systems.

**Speedy Tube Testing**

The piece of equipment shown in operation in Fig. 9 represents one of the new pre-wired socket type portable tube checkers. Developed and produced by B&K Mfg. Co., Chicago, the Model 650 "Dyna-Quik" Mutual Conductance Tube-Transistor Tester is capable of performing tests on over 500 tube types, including those most commonly used in radio and TV. Due to its compactness and ease of operation, the instrument is ideal to carry on service calls.

Specifications and test features are:

1. **Power Requirements**—105 to 125 volts AC, 60 cps, line fuse and automatic voltage compensator provided.

2. **Panel Features**—53 pre-wired tube sockets plus 16 spares for future modernization; n-p-n and p-n-p transistor sockets; diode and rectifier test jacks; 7-pin miniature and 9-pin tube-pin straighteners; 4½" meter calibrated in REPLACE?-GOOD, two ranges of 0-6,000 and 0-18,000 micromhos, a grid emission scale, and a GOOD?-POOR scale for transistors; heater continuity and short indicators also provided.

3. **Size and Weight**—portable case 15¾" × 15" × 16½", 19½ lbs. net.

4. **Leakage, Gas, and Shorts Test**—tubes are automatically checked for these defects plus grid emission; leakage and shorts up to 1 megohm are indicated on neon lamp; gas and grid emission by meter deflection.

5. **Dynamic Mutual Conductance Test**—all popular amplifier tubes including multi-section types are tested in pre-wired sockets; Gm indicated on RE-

Fig. 9. "The Dyna-Quik" Tube and Transistor Tester features pre-wired sockets.

PLACE?-GOOD or micromho scale; life-expectancy test also provided.

6. **Heater Continuity Test**—rapid test of filament continuity provided on heater-voltage switch, neon indicator on front panel.

7. **Diode-Rectifier Test**—forward-to-reverse conduction ratio for all germanium and silicon diodes as well as selenium, copper oxide, and silicon rectifiers.

8. **Transistor Tests**—checks all junction, point-contact, and barrier-type transistors for leakage and gain; indications shown on separate meter scale.

In order to familiarize you with the Model 650, let's see exactly how a tube is tested in the unit. As a typical example, I selected a 12AU7 which had been in operation over a year in one of our lab test receivers. Following instructions, I turned on the instrument by means of the OFF-ON LIFE switch in the lower right-hand corner of the test panel. In so doing, the red pilot light just above the switch came on. I noted that the most popular and frequently used tube types were listed beside their respective test sockets on both panels, so I located the appropriate one, set the heater switch to 12 volts, and plugged the tube in (making sure that the test lever was in its SHORT-GRID EMISSION position before placing the tube in the socket).

I next set the sensitivity control to the value stipulated beside the tube designation on the panel. Without touching another knob or button, the instrument
Fig. 10. The Model 650 tube-data pad—a flip-open index for quick reference.

was now supposed to test the tube for leakage, gas, grid emission and for any direct shorts. Leakage and shorts are indicated by a neon lamp located directly above the panel meter, while any gas or grid emission was to show up by a deflection of the meter needle.

Noting that the tube passed this first test, I then moved the test lever up to its next position marked TEST 1. Since a 12AU7 is a dual-triode, only one section of the tube is tested for mutual conductance when the test lever is in this position. I determined the condition of this triode section by referring to the REPLACE?-GOOD scale of the meter. In this particular instance, the reading was okay, so I then moved the test lever up another notch to the TEST 2 position. I found that this second section was a little weaker than the first but that it still registered in the GOOD area.

This completed the tube testing procedure except for a special LIFE TEST which is somewhat of an additional feature in the Model 650. The life test consists primarily of a mutual conductance measurement under a condition of low heater voltage. The tube heater or filament is operated at a 10 to 15% reduction in line voltage by placing the ON-OFF-LIFE TEST lever in its upper position. If a sharp drop in Gm is noticed, the chances of continued trouble-free operation are doubtful.

Another interesting feature of the Model 650 is its built-in tube reference pad. (See Fig. 10.) The pad is an automatic flip-open index giving complete setup information for tube types, as well as an average Gm in micromhos for all amplifiers.
The oscilloscope is one of the most versatile instruments you can own—if you know how to use it, that is. Since many of the troubles encountered in TV servicing have to do with the sweep sections, this article will acquaint the reader with suitable methods of using an oscilloscope in making tests of sweep circuitry and will also inquire into the requirements of scope characteristics for sweep servicing. The emphasis is placed on how to apply a suitable scope in the correct manner and how to interpret the patterns which are displayed.

Oscilloscope Bandwidth Requirements

While extremely wide-band response is not required of a scope utilized in sweep-circuit servicing, there are certain minimum requirements which must be observed if waveform distortion is to be avoided. A scope having a flat response up to 2 mc is completely satisfactory and will faithfully reproduce fine details of sweep waveforms, such as transient ringing and peaking-pulse detail. This is best illustrated by a comparison of the waveforms in Fig. 1.

Medium frequency response in the vertical amplifier, such as provided by scopes intended primarily for alignment work and which have a flat response up to several hundred kilocycles, has the effect of smoothing off and filtering out such waveform details as transient ringing and tends to distort the waveshapes of pulses. The shape of such waveforms as sawtooth waves, which are of primary interest in sweep-circuit work, may also be distorted noticeably.

Poor frequency response (in terms of sweep-servicing requirements) as provided by oscilloscopes intended primarily for audio-frequency tests, causes the reproduced waveform to lack important higher-frequency components, and also introduces distortion due to phase shift of these components. The practical result of these deficiencies can be seen from the photographs in Fig. 1.

Waveform Voltage Considerations

When applying an oscilloscope in a sweep or high-voltage circuit, it is sometimes necessary to utilize a suitable probe to avoid overload due to excessive waveform voltage. Scopes are rated by their manufacturers for maximum input voltage on any setting of the attenuator, and the highest voltage which can be applied without distortion in the reproduced waveform is usually on the order of 600 peak volts.

Not only is waveform clipping and distortion encountered when the applied signal voltage is excessive, but actual damage to the scope may result. The input blocking capacitor may be punctured, the attenuator resistors may be charred, and similar damage incurred to the various components of the input system. Suitable probes should be utilized to avoid these difficulties.

The driving voltage to the horizontal-output tube has a value from 75 to 150 peak-to-peak volts in normal receiver operation. Thus, this waveform may be applied directly to the scope input terminals without danger of overload or damage. However, there
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is another consideration in checking this waveform which must be heeded in numerous cases—the grid impedance of the horizontal output tube may be sufficiently high that direct application of the scope input cable may load the grid circuit and produce waveform distortion. For example, the circuit shown in Fig. 2 is subject to such loading. The problem can be circumvented by utilizing a 10-to-1 low-capacitance probe, providing a step-up of input impedance of ten times and reducing the loading imposed on the grid circuit by the probe to a satisfactorily small value.

The deflection voltage across the horizontal-output coils, on the other hand, appears across a relatively low value of circuit impedance, so that the loading imposed by a direct input cable to the scope is not a matter of concern. However, this waveform has a peak-to-peak voltage value ranging from approximately 1,500 to 3,000 volts. This waveform, illustrated in Fig. 3, will accordingly overload the vertical amplifier in a scope which is intended for application at voltages under 600. The result of such overload is to clip the waveform, or drive the input stage into grid current flow, or both, with the result that the reproduced waveform exhibits severe distortion, as illustrated in
Fig. 4. Deflection waveform shows distortion when voltage exceeds scope rating.

Fig. 4. Again, this difficulty usually can be avoided by use of a 10-to-1 low-capacitance probe. In this application, the probe is not utilized to obtain increased input impedance, but to take advantage of the incidental signal attenuation which the probe provides. Thus, a deflection voltage waveform having a value of 2,500 p-p volts is reduced to a value of 250 p-p volts. The only limitation in this regard is the input voltage rating of the probe itself, which in some cases is limited to 1,000 volts. If the voltage rating of the probe would be exceeded, it will be necessary to utilize a 100-to-1 capacitance-divider probe with its typical input rating of 10 to 20 kv.

Technicians sometimes suppose that the requirement for a suitable probe in such applications can be circumvented by expedients, such as by holding the exposed end of a test lead near the yoke terminal. While it is true that the waveform can be displayed on the scope screen by this means without scope overload, the method is incapable of providing data concerning the peak-to-peak voltage of the waveform. This information is as important as the shape of the display, since it is a general rule in troubleshooting work that circuit trouble may be indicated if the waveform voltage deviates more than 20% from its...
rated value. Some technicians are under the misapprehension that if the waveform voltage is far off value, the waveshape will also be incorrect. This is a very unsafe assumption, and one which is not true in numerous cases. The safe rule to follow in such work is to check the waveform both for proper shape and for its rated voltage within the 20% tolerance.

A particular word of caution is also in order concerning the use of such expedients when testing waveforms in vertical sweep circuits. The repetition rate in the vertical sweep circuits is 60 cps, and only compensated probes can effectively be utilized to obtain attenuation or impedance step-up. If the technician attempts to use expedients in such situations, severe waveform distortion will usually be encountered due to low-frequency loss and phase shift. These remarks apply with equal force, it may be observed, to the use of capacitance-divider probes in making vertical sweep-circuit tests. Capacitance-divider probes can be used without imposing distortion on the waveform only if their application is restricted to circuits operating at frequencies of 10 kc or higher.

It should be noted, however, that certain improvisations which are somewhat out of the class of expedients will serve to attenuate the voltage by a known factor. For example, the arrangement shown in Fig. 5 can be improvised and calibrated by sliding the two lead sections to obtain the desired 100-to-1 attenuation ratio, following which the lead sections can be bound together with tape.

**Current Waveform Considerations**

Most technicians nowadays are aware of the possibility of viewing current waveforms in addition to voltage waveforms. To view a waveform of the horizontal deflection current, for example, a resistor of approximately 5 ohms may

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**Fig. 5. Capacitance-divider which can be calibrated for 100-to-1 attenuation.**

(A) Ringing which produces alternate light and dark vertical stripes in raster.

(B) Nonlinear rise which causes cramping at right side of raster.

---

**Fig. 6. Deflection current waveforms.**
be inserted in series with the return lead from the horizontal deflection coils and the scope applied across the resistor. The current waveform in the deflection circuit then becomes displayed on the scope screen, as depicted in Fig. 6.

From this waveform, it is seen that various irregularities in circuit operation, such as nonlinearity and ringing, are set forth explicitly in this test. When ringing or other relatively high-frequency detail occurs in the pattern, it is necessary, of course, that the scope provide sufficient frequency response to accommodate the spurious frequency.

The scope can be calibrated in terms of peak-to-peak milliamperes just as it can be calibrated in terms of peak-to-peak volts. As an example of such calibration for current measurement, consider a situation in which a 5-ohm resistor is to be utilized to develop the current waveform. One milliampere of current through the resistor produces five millivolts of potential across the resistor terminals. Hence, if the scope is calibrated for five millivolts per square, it will be calibrated for one milliampere per square when utilized in combination with a 5-ohm resistor. The calibration is thus merely a routine application of Ohm’s Law.

It is worth noting that when current waveforms are under consideration, it is the peak-to-peak current values which are measured. The same reasons for using p-p values apply for current checks as well as for voltage checks—the current waveforms in general are nonsinusoidal, and are best discussed from a practical viewpoint in terms of peak-to-peak values. Note in this regard that Ohm’s Law applies to peak-to-peak values in the same manner as it applies to RMS values or DC values. Thus, resistance is equal to peak-to-peak voltage divided by peak-to-peak current.

The technician finds it helpful to view current waveforms on occasion because various sweep-circuit faults, such as alternate light-and-dark vertical bars which receiver manufacturers sometimes refer to as “curtain effect,” can be caused by faults other than ringing in the current waveform. If the current waveform is displayed on the scope screen and is found to be free from ringing, then investigation must be directed elsewhere. It is worth noting that curtain effect will become apparent in the raster when the ringing in the current waveform is quite small, as illustrated in Fig. 7. The results of this amount of ringing would be visible at a normal viewing distance, although usually they would not be considered objectionable by the average observer.

![Fig. 7. This amount of ringing produces vertical stripes which are not overly objectionable at normal viewing distance.](image-url)
Scope Application Precautions in Sweep-Circuit Tests

The electrical chassis of some TV receivers is coupled to the physical chassis through an RC branch as illustrated. The scope ground must be made to the electrical chassis (or B—bus) to avoid introduction of hum voltage into the pattern. To obtain an idea of the values of resistance and capacitance which cause difficulty when they occur in series with the ground-return lead of the scope, it may be observed in a typical case that the damper waveform exhibits a considerable amount of hum interference when 100,000 ohms, or 0.03 mfd is inserted in series with the ground-return lead. Even half these values of resistance or reactance introduce an objectionable amount of hum interference.

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The use of a 100-to-1 capacitance-divider probe to check the waveform at the high-voltage filter is appropriate, provided the 100-to-1 probe is rated for this application. It is possible to use either an AC or a DC scope in this ripple test, since a capacitance-divider probe passes only AC and blocks the flow of DC. The only precaution to utilize a probe having an input voltage rating which exceeds the output voltage of the high-voltage filter under test.

Use of a 100-to-1 resistive probe is not good practice in checking the waveform at the high-voltage filter. The frequency response of the probe is not appropriate, and its unshielded construction often permits the entry of stray fields, such as hum voltage. When used with a DC scope, the waveform is accompanied by a DC voltage of 25 or 30 volts, which may throw the pattern off-screen unless the scope has wide-range centering controls. When used with an AC scope, the full output voltage from the high-voltage filter will build up across the blocking capacitor in the scope input circuit and puncture the capacitor.

A choice of ground return is possible in making sweep-circuit checks in some instances. For example, when checking the waveform across the horizontal-deflection coils, the probe may be grounded to the "low" side of the deflection coils or to the receiver chassis. The latter connection has the advantage of keeping the scope case "cool", i.e., at true ground potential but the disadvantage of introducing some distortion into the display, in case the impedance of the decoupling circuit and power supply is appreciable.

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When it is desired to make the scope ground return to the "low" side of the deflection coils to obtain an undistorted waveform reproduction, it is a good precaution to insert a series blocking capacitor in the ground return lead to avoid raising the scope case to B+ potential. It is also necessary to choose a sufficiently high value of blocking capacitor that the AC impedance of the ground lead will be negligible.

The peak-to-peak voltage across the horizontal-deflection coils usually falls in the range from 1,500 to 3,000 volts. This voltage is sometimes sufficient to break down the input circuit of a 10-to-1 low-capacitance probe. If the probe happens to withstand the applied voltage, distortion may be encountered due to scope overload. Good practice dictates the use of a 100-to-1 capacitance-divider probe in such tests.

It is improper to attempt to use a 100-to-1 capacitance-divider probe in checking any of the waveforms in the vertical-deflection system. The reason for this limitation is the fact that vertical circuits operate at 60 cps and 100-to-1 capacitance-divider probes are uncompensated. Being uncompensated, such probes distort waveforms at frequencies below 10 kc. This is not a matter of concern, however, since the voltage encountered in vertical circuits are sufficiently low that a 10-to-1 low-capacitance probe can be utilized. Such 10-to-1 probes are compensated and reproduce 60-cycle waveforms without distortion.

In most cases, one side of the horizontal-deflection coil system is at or near ground potential. In some cases, however, as illustrated, both sides of the deflection system are well above ground potential. In such cases, it is not possible to insert a 3-ohm resistor in either of the leads to the deflection coils to view the current waveform, because the scope case must be connected to a point at or near ground potential. Failure to observe this precaution will result in severe impairment of circuit operation and possible damage to the scope.

The 11° Yokes can be utilized. Such capacitance probes distort waveform at frequencies below 10 kc. It is improper to attempt to use a 100-to-1 capacitance-divider probe in checking any of the waveforms in the vertical-deflection system. The reason for this limitation is the fact that vertical circuits operate at 60 cps and 100-to-1 capacitance-divider probes are uncompensated. Being uncompensated, such probes distort waveforms at frequencies below 10 kc. This is not a matter of concern, however, since the voltages encountered in vertical circuits are sufficiently low that a 10-to-1 low-capacitance probe can be utilized. Such 10-to-1 probes are compensated and reproduce 60-cycle waveforms without distortion.

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Remote Control for TV-Phono Combination

The "Son-r" remote control available on certain models of 1958 Admiral TV receivers is a wireless system of the acoustic type. In it, a hand-held remote transmitter contains metal rods which set up ultrasonic vibrations (in the 40-kc range) when keyed; these are picked up by a microphone on the TV set and converted to an electrical signal which is fed to an 8-tube control receiver. Set operation is regulated by relays mounted on this unit.

There are two versions of the "Son-r" system. The 8F1 is meant for use with a deluxe combination console that includes a 17D1 TV chassis, a record changer, an FM-AM radio tuner, and a hi-fi audio amplifier which receives inputs from all other units. The 8G1, very similar in layout to the 8F1, but equipped with much simpler switch and relay circuits, is employed with the 17J1, 16J1 and 16K1 TV chassis which have motorized tuning.

The control relays and their functions are as follows:

<table>
<thead>
<tr>
<th>Channel</th>
<th>Control Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>38.285</td>
<td>TV-Phono On-Off</td>
</tr>
<tr>
<td>40.805</td>
<td>TV-Phono Vol. Cont.</td>
</tr>
<tr>
<td>41.805</td>
<td>TV-Phono Vol. Cont.</td>
</tr>
</tbody>
</table>

Fig. 1. "Son-r" control receiver mounted on Admiral TV chassis.

Fig. 2. Schematic of "Son-r" control receiver chassis.
ON-OFF—Makes and breaks the AC power circuit to the controlled chassis. Operation of the relay throws a switch to the “On” position, where it comes to rest. Another signal impulse must be applied to the relay in order to return the switch to “Off.”

VOLUME CONTROL—Rotates the movable arm of an unusual 12-contact rotary switch that incorporates printed wiring. The contacts are parallel-wired into four groups so that there are effectively only four switch positions—zero, low, medium and high volume. The 12 contacts are necessary because the relay moves the switch arm through an arc of only 30° on each impulse. To produce the desired changes in volume, various combinations of resistors are shunted across the speaker voice coils (8F1) or the volume control circuit (8G1).

CHANNEL SELECTOR—Momentarily closes an AC power circuit and starts the cycle of the tuning motor. In the 8F1 only, this relay circuit passes through a “TV-Phono” switch so that the relay can be utilized to reject records when the TV is not in use.

TV-PHONO (8F1 only)—Moves a three-section switch back and forth between two resting positions. In the first or “TV” position, the channel selector relay is set up for remote TV tuning. AC power is applied to the TV chassis, and the output of the TV sound detector is connected to the hi-fi amplifier input. In the “Phono” position, the channel selector relay, AC power line and hi-fi input are switched to the phono reject trip coil, phono motor, and radio-phonograph signal output, respectively.

Fig. 1 is a photograph of the control receiver chassis, and Fig. 2 is a simplified schematic of that unit. Signals picked up by the microphone pass through a selective two-stage amplifier (V1 and V2A) and are tripled in frequency by the next stage, V2B. (Input and tripled frequencies associated with each relay are listed in Fig. 2.) The 6BN6 tube V3 limits the amplitude of the signals and applies them to a pair of discriminators, which are identical except for the tube types used. Note that the tripled frequency of any one of the signals will always fall 1.5 kc higher or lower than the center frequency of one of the discriminators. This means that each input signal will produce an effective response in one discriminator. For example, an “On-Off” signal (122.415 kc) will cause a positive output voltage to appear at pin 5 of the 123.915-kc discriminator V4, and an equal negative voltage to appear at pin 1. A 125.415-kc “Volume” signal will produce the same output voltages at V4, but the polarities will be reversed. Similar responses take place in the other discriminator V5 when “Channel Selector” or “TV-Phono” signals arrive.

The 6CM7 relay control tubes V6 and V7 have a fixed —27 volt grid bias obtained from a bias rectifier (the third diode section of the 6BJ7 tube V5). All 6CM7 sections remain cut off until this bias is overridden by a positive signal voltage from one of the discriminators. Then one of the control triodes is driven into conduction, and a relay in its plate circuit is energized when plate current reaches the correct pull-in value. The “On-Off” and “TV-Phono” relays require more current than the other two; therefore, they are controlled by the B sections of the 6CM7’s, which are designed for higher values of plate current than the A sections.

Ac Power and Interconnecting Circuits

The “Son-r” control receiver, which is fastened to the top edge of the vertical TV chassis, has its own power transformer and 6X4 rectifier (V8). The “Manual-Remote” switch, a customer control on the back of the TV set, controls the application of power to the “Son-r” receiver. IMPORTANT—if the TV is turned off by means of the remote relay, the control receiver will continue to operate until the main on-off switch on the TV cabinet is turned off or the set is unplugged.

AC power wiring associated with the 8G1 is relatively simple.
The control receiver is connected to the TV chassis through an 11-pin plug and socket. During remote operation, the primary power circuit of the TV set is completed through the contacts of the "On-Off" relay, across pins 5 and 7 of the plug. The primary winding of the 8G1 power transformer is wired across pins 5 and 3, and the contacts of the channel selector relay are connected to the tuning motor via pins 3 and 9. A shielded lead from the volume control switch is plugged into an audio jack on the TV chassis.

Space does not permit a detailed description of the complex interconnections between the 8F1 and other units in the deluxe combination receiver, but the most important features should be pointed out. The AC line cord is connected to the 8F1 chassis. The remote receiver, TV, and hi-fi unit have separate power transformers, and one side of each is connected directly to one side of the AC line. Several switches and relays are employed to complete the power circuits to the various chassis. To operate the 8F1, its "Remote-Manual" switch and a separate "Remote On-Off" switch on the TV chassis must both be in the remote position.

Fig. 4. Schematic of Rockland radio-phonograph.

If the 8F1 is operating, an "On-Off" keying signal will automatically turn on the power to the hi-fi amplifier, which in turn supplies power to the radio tuner. Power is also furnished to either the TV chassis or the phono motor, depending on the position of the "TV-Phono" relay contacts on the 8F1.

The manual TV power switch operates independently of the 8F1. When it is turned on, AC power energizes a special "TV Off-On" relay which closes the TV and hi-fi primary power circuits—provided that a special "TV-Radio" switch on the radio chassis is in the TV position.

Service Hints

Like their counterparts in other wireless remote systems, the
“Son-r” relay control circuits require a positive signal of predetermined strength in order to actuate the relays. In case a relay fails to operate, a quick troubleshooting check can be made by monitoring the grid voltage of the control tube while keying the transmitter. If this voltage does not rise enough to bring the tube out of cutoff, your next move should be to check the transmitter, microphone, and receiver tubes. If the grid voltage is OK, check the relay circuit itself.

Repeated or unwanted relay operation may indicate a loss of the fixed bias on the control tubes, or possibly regeneration or other troubles in the receiver circuits.

Realignment of the control receiver should be attempted only as a last resort. It is seldom required after changing tubes, but it might become necessary if the critical lead dress of the components in the tuned circuits is disturbed.

**Portable Transistor Radio-Phonograph**

A cordless transistorized radio and 45-rpm phonograph powered by four Size D flashlight batteries has been placed on the market by Rockland Precision Mfg., Orangeburg, N. Y. As shown in Fig. 3, all circuitry is mounted on two printed-board chassis fastened to the underside of the phono motorboard. One chassis includes a converter, two IF stages and a diode detector, while the other has a low-level audio driver and a push-pull audio output stage. Battery power is applied to the audio chassis at all times when the unit is in operation. Depending on the position of the “Radio-Phono” switch, power is also furnished to either the RF-IF chassis or the miniature phono motor. A second set of contacts on this switch connects the proper signal input to the audio amplifier.

The batteries are contained in a cardboard tube fastened to the case of the unit, and they can be taken out by unscrewing a metal retaining plate on one end of the case. Mounted in the other end of the case is a round 3” speaker.

A chassis schematic is shown in Fig. 4. In the unit studied, all transistors were RCA solder-in
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Shop Talk
(Continued from page 10)

reflector. Variation of either variable will have a direct effect on the response characteristics of the combination.

Now, when the reflector is positioned very close to the dipole, the voltage which the reflector radiates to the dipole is practically equal to the signal voltage which the dipole picks up directly, and is close to 180° out-of-phase with it.* As a result, the two cancel, and very little is left for the receiver to receive via the transmission line. As the reflector is moved away from the dipole, the time taken by the signal to travel to and from the reflector also enters the picture, and this alters the phase of the reflector signal reaching the dipole. This additional time lag serves to move the signals closer together in phase (at the dipole) and a strengthening occurs, raising the voltage in the dipole and producing a gain.

Beyond the optimum distance, the gain starts to drop off because the phases of the two signals in the dipole are again tending to move farther apart. Now, however, the drop-off is slow because with increased distance, less of the re-radiated reflector signal reaches the dipole. In other words, the coupling between the two wires decreases and less energy is transferred between them.

If the reflector completely eliminated one of the two original dipole lobes, the gain of the array would double or rise about 6 db. Since a small portion of the second lobe remains, the gain is somewhat less, on the order of 4 or 5 db.

Another effect that a reflector has on a dipole is to lower its impedance. It was noted previously that a dipole, by itself, had an impedance of 72 ohms. When a reflector is positioned near it, this value drops, becoming lower

* It might help the reader to understand this action by comparing it to two closely coupled circuits. In such circuits, the voltage in the primary and the induced voltage in the secondary differ by 180°.

Fig. 4. Dipole with director.

as the reflector is moved closer. With a spacing of .2 wavelength, the dipole impedance decreases to about 40 ohms. If a 72-ohm transmission line is used, much of the signal gain achieved through the use of a reflector is lost. With a 300-ohm line, no gain at all is obtained. In both cases, however, the unidirectional directivity remains, and in this sense the combination of dipole and reflector is beneficial.

Dipole and Director

If we take a dipole and mount nearby a second parallel wire which is somewhat shorter, we obtain a combination which also essentially possesses a unidirectional response. Note from Fig. 4,
however, that now the parasitic element, called a director, is in front of the dipole. In this position, the director first receives the incoming signal. This signal is partially absorbed, then re-radiated, with the dipole receiving some of the re-radiated signal. The phase of this signal is such that it combines favorably with the directly-received signal at the dipole, thereby providing a greater signal than if the dipole had been employed alone.

As with the dipole and reflector, the gain obtainable using a director depends on the distance between this element and its dipole. (We are assuming that the director length is fixed.) A graph showing this variation is illustrated in Fig. 3. Note that as rises to a peak at about 0.1 wavelength and thereafter decreases slowly, for the most part being less than the gain provided by a reflector. Thus if we are to use a director profitably, it must be positioned at 0.1 wavelength from the dipole.

The close positioning, however, poses a rather serious problem because at this distance, the coupling between director and dipole is so high that the impedance of the dipole is reduced to only 10 ohms. If we attempted to use any sort of conventional transmission line with this combination, the mismatch would be so great that relatively little signal would be transferred to the line. For this reason and also because a dipole with director provides a uniform response over a very narrow band of frequencies, this combination is seldom found; rather, the dipole and reflector is used. For the record, however, a dipole-director combination will possess a directivity pattern similar to that of a dipole-reflector assembly.

When using this simple combination of dipole and reflector, reception is limited to a fairly narrow range of frequencies. For example, if we cut the dipole so that it will be resonant at the center of the low VHF band (channel 4), then it will oper-

**Correction:** 2" to 3" for low, 1" to 2" for high, 300 ohm transmission line.
ate satisfactorily for channels 2 through 6, but on the two end channels, the gain will be easily less than half that achievable on channel 4. If it should happen that the signals at either or both extremes are weak, then it might become necessary to employ two separate antennas or a single antenna having a broader bandwidth. The simple dipole, even with reflector, is best reserved for those localities where the signals are strong and the over-all bandwidth (encompassing all desired channels) is not too wide.

Commercially, dipole antennas with reflectors appear as shown in Fig. 5. The rods are generally formed of hollow aluminum and are usually pinched at their ends to prevent the accumulation of moisture and dirt on the inside. The supporting rod is also constructed of aluminum, although its diameter is larger in order to provide the necessary rigidity and strength for support. Either a 72-ohm coaxial cable or 72-ohm flat twin lead should be used for connecting the antenna to the receiver. However, if a mismatch of impedances is unavoidable, it should be made in accordance with the strength of the signal as indicated in last month’s coverage.

The Folded Dipole

The folded dipole is formed using a conventional dipole with an equivalent additional section connected in parallel with it. See Fig. 6. By this simple act, the impedance, as seen at the antenna terminals, is increased by a factor of 4. Thus, the characteristic impedance of a folded dipole is 300 ohms (75 x 4).

The reason for this impedance increase cannot be explained simply, but the following will serve our purpose. Resistance of a circuit is determined by the current that flows when a voltage is impressed across it. In a comparison of the plain and folded dipole, we find that injecting the same power in both will produce less current flow in each section of the folded dipole. Actually, with parallel paths, the current flow is cut in half. From the equation for power (P = I^2R) we see that cutting I in half reduces the power to one-fourth. For the same received power, a current reduction of 1/2 at the feed point of the antenna means that the resistance here has increased by a factor of 4.

The higher impedance of the folded dipole enables it to be used with a high impedance transmission line. This is advantageous because line loss in inversely proportional to line impedance for any given set of conditions. This is clearly brought out by the graph in Fig. 7. In each instance No. 20 A.W.G. wires were used to form...
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suitable open wire transmission
lines having the impedances indi-
cated. Note that with increasing
impedance, the line loss at each
frequency drops.

Another advantage of a folded
dipole is its broader bandwidth.
While it still produces maximum
output at the frequency for which
it was cut, the drop-off from this
point is not as sharp as for a
simple dipole. This is desirable for
all types of television signals and
is especially significant when color
signals are to be received.

Finally, a folded dipole can be
attached directly to the antenna
supporting mast without upsetting
the electrical balance or the opera-
tion of the unit. The connection
should be made at the center of
the folded rod; it is here that the
electric field and ground at
this point does not disturb the
voltage or current distribution in
the array.

The over-all length of the folded
dipole is governed by the same de-
sign formula used for the simple
dipole. The spacing between the
two rods is not important as long
as this distance is small compared
to the over-all length of the array.
In commercial units, this spacing
is on the order of two or three
inches. The figure-eight response
pattern of the folded dipole is of-
ten converted to a unidirectional
pattern by the addition of a reflec-
tor (Fig. 8). The latter element
has the same effect on a folded
dipole that it does on the simple
dipole.

Popular versions of this array
are shown in Fig. 9. Fig. 9A shows
an in-line assembly designed for
high-low VHF coverage, wherein
the large folded dipole, being po-
positioned behind the small dipole,
serves as its reflector. Then a re-
lector rod is placed behind the
large dipole and serves as its reflec-
tor. The two sections are con-
nected by a short length of trans-
mision line to combine their sig-
nals, and then a single 300-ohm
line carries the full signal to the
receiver. Fig. 9B shows another
high-low arrangement whereby
two antennas are mounted on the
same mast and properly matched
with a connecting harness.

The higher impedance of the
folded dipole makes it attractive
for use in larger arrays (such as
the yagi) where the addition of re-
flectors and directors would soon reduce the impedance of a simple dipole to a value too low to be practical. By starting with the higher impedance of a folded dipole, it is possible to achieve a final value which is still within a workable range. We will investigate such arrays later.

One final word about reflectors. These can be made more effective if a mesh screen is employed in place of a rod. The only reason screens are not used very much at VHF is because they tend to be quite bulky. A mesh structure, incidentally, is as effective as a solid metallic sheet, provided that the mesh openings are on the order of 0.2 of a wavelength or less at the highest operating frequency. Screen dimensions are not critical, but the edges should extend for a short distance beyond the dipole elements.

![Fig. 9. Folded dipole in-line (Amphenol) and high-low (Cornell-Dubilier) arrays.](image)

---

"Servicing TV Sync Systems" by Jesse Dines

Valuable time-saving book for Service Technicians. Covers fully the theory of operation, circuit function and circuit variations of the 18 different types of sync systems used in TV receivers. Explains various types of sync separators, horizontal and vertical oscillator, and horizontal AFC circuits used in sync systems. Methods of analyzing and troubleshooting these circuits are supported by actual picture tube photos and waveforms illustrating types of sync troubles. Includes valuable data on oscillator coils, transformers and printed electronic circuits used in sync systems. Has chapter on practical servicing hints. This book will definitely help the technician to better understand and more easily service any type of sync system trouble. Written clearly and simply for quick and easy understanding. 320 pages; 221 illustrations, 5½ x 8½.

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March, 1958 • PF REPORTER
**GUIDE TO AUTO BATTERY POLARITIES**

This chart provides two basic items of information about the batteries in late-model automobiles: (1) the voltage; (2) the terminal (+ or -) grounded to the car frame.

These simple facts, which can so easily slip a person’s mind, are good to have at your fingertips when you are planning a car radio installation or connecting a radio to a bench power supply.

In the chart, the number 6 or 12 opposite each make of auto indicates the correct battery voltage, and the + or – sign designates the terminal that should be grounded.

You’ll note that listings of American cars are given only for 1954 and 1955 models, and here’s why: Starting in 1956, the U. S. auto industry greatly simplified matters by standardizing on a 12-volt, negative-ground electrical system. The only exception is Willys; 6-volt batteries have been used on all passenger vehicles of this make except the ‘58 station wagon.

As many foreign cars as possible have been included. Information is given only for current models, which account for the great majority of foreign autos in use in this country. Here’s a tip on installing radios in foreign cars: Dealers caution that the car should be brought in to them for adjustment of the voltage regulator. Failure to do so has been known to cause trouble in the car’s electrical system.

### U. S. CARS ’54 ’55

<table>
<thead>
<tr>
<th>Model</th>
<th>’54</th>
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<tbody>
<tr>
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<td>12–</td>
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<tr>
<td>Pontiac</td>
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<td></td>
</tr>
<tr>
<td>Packard</td>
<td>6+</td>
<td>12+</td>
</tr>
<tr>
<td>Buick</td>
<td>12–</td>
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<td>Cadillac</td>
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<td>Oldsmobile</td>
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<tr>
<td>Willys</td>
<td>6–</td>
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<tr>
<td>Chrysler</td>
<td>6+</td>
<td>or 12–</td>
</tr>
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</table>

###Practically all U. S. Passenger Cars for ’56-’58

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<th>Model</th>
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<tr>
<td>Dodge</td>
<td>12–</td>
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<tr>
<td>Ford</td>
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<tr>
<td>Hudson</td>
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<td>Lincoln</td>
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<td>Mercury</td>
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<td>Nash</td>
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<td>Plymouth</td>
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<td>Rambler</td>
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<td>Studebaker</td>
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<td>Willys</td>
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<tr>
<td>Chrysler</td>
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### SOME POPULAR FOREIGN CARS (Current Models)

<table>
<thead>
<tr>
<th>Model</th>
<th>Voltage</th>
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<tr>
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<td>12+</td>
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<tr>
<td>Austin</td>
<td>12+</td>
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<tr>
<td>Austin-Healey</td>
<td>12+</td>
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<tr>
<td>DKW</td>
<td>6–</td>
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<tr>
<td>Ford (English)</td>
<td>12+</td>
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<tr>
<td>Hillman</td>
<td>12+</td>
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<tr>
<td>Jaguar</td>
<td>12+</td>
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<tr>
<td>MG A</td>
<td>12+</td>
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<tr>
<td>Mercedes-Benz</td>
<td>12–</td>
</tr>
<tr>
<td>Morris</td>
<td>12+</td>
</tr>
<tr>
<td>Porsche</td>
<td>6–</td>
</tr>
<tr>
<td>Renault</td>
<td>6–</td>
</tr>
<tr>
<td>Simca</td>
<td>12–</td>
</tr>
<tr>
<td>Triumph</td>
<td>12+</td>
</tr>
<tr>
<td>Volkswagen</td>
<td>6–</td>
</tr>
<tr>
<td>Volvo</td>
<td>6–</td>
</tr>
</tbody>
</table>
Signal Tracing RF & IF

(Continued from page 15)

check for the presence of signal at all points between the tuner output and the video detector—limited only by the loading effect of his instruments and the sensitivity of his scope and the receiver itself. With a direct probe, we might first examine the composite signal across the detector load, point “A” in Fig. 4. If the signal at this point is weak, distorted, or absent entirely, the next step should be to clamp the AGC line at approximately −3 volts, thus eliminating the possibility of AGC trouble.

Using a general purpose scope, the technician may find it impossible to detect a signal ahead of the 2nd IF stage even in a normally operating receiver. With the use of a suitable scope preamplifier, however, a signal can often be detected at the antenna input terminals, particularly when homing in on a strong local station.

Although this procedure is usually limited by the sensitivity of the scope, in many cases the technician may be able to obtain a usable signal up to the output of the tuner. Fig. 5A represents a typical signal found on the 3rd IF grid of a normally operating receiver while Fig. 5B represents that obtained on the grid of the 1st IF. Notice the reduction in signal amplitude even with the scope gain set at maximum. Using this detector probe method, the technician should try sampling the signal at various IF points in a normally operating receiver before signal tracing a faulty set.

信号替换

信号替换

而不是依赖于信号从一个本地电视台的信号，技术员可能倾向于使用一个信号发生器在他的信号跟踪技术。无论所使用的信号发生器的类型，技术员将有两个一般性程序来选择。一个是其中他使用一个直接式示波器探头对视频检测器所连接的波形移动的信号发生器输出点。也许这是他所采用的最成功的方法，该方法通过一个直接式探头被使用，并且信号发生器被应用于各种关键位置。

首先考虑这种方法使用单个频率信号发生器。要求的这类仪器是它所覆盖的RF和IF范围并且包含对于内部调谐的基站频率的调节，例如400周。为了跟踪一个信号通过RF电路的一个站点，检查在所有频道，该生成器应该覆盖两个高和低带——54到88 Mc和174到216 Mc。为了检查只IF部分，但是，仪器需要覆盖的频率是20和40 Mc带。

在连接信号生成器给一个检查的IF系统，生成器频率是被调整到接近所得到的本地接收器的中间频率并且一个直接式探头从垂直输入终端的示波器被连接到视频检测器的负载。内部调谐的生成器频率是使用并且一个电容器为从20到50 mmf被放在在使用带有“hot”生成器负载的系列中，接地负载被连接到接收器的基准。该系列电容器将变小加载或者去调谐的影响的生成器并且将也block DC。从来没有，任何情况下，连接生成器直接到IF板，屏幕或者其他点的高潜在。如果你做，一个低电压的电阻器或者一个IF Coil可能将go up in a puff of smoke due to the low impedance path to ground offered by the generator's output circuit.

March, 1958 · PF REPORTER
The technician might begin the procedure by first placing the hot generator lead at the input of the video detector, which is shown as point "B" in Fig. 4. If the detector is passing a signal at all, the 400-cycle modulation will appear on the scope screen as shown in Fig. 6 and, providing the video section of the receiver is functioning properly, sound bars should appear on the picture tube screen as pictured in Fig. 7.

Stages preceding the detector can be checked in a like manner by injecting the signal into the IF and mixer grids, points "D," "F," "H," and "J." Under normal conditions, the output of the generator can be reduced as the point of injection is moved closer to the tuner because of the gain produced by each additional IF stage. It may be necessary, however, to vary the frequency of the generator to obtain a satisfactory indication on the scope or picture tube when switching the lead from point to point. The relative amplification of each IF tube can be checked by comparing the peak signal values obtained at the grid and plate.

Operation of the tuner can be checked by adjusting the generator to the center RF frequency of any given TV channel. As an example, suppose we adjust the tuner to receive channel 6, then set the generator frequency to approximately 86 mc and again modulate the carrier with a 400-cycle signal. With the scope connected across the detector load, we then apply the signal to the receiver's antenna terminals, and if the tuner and all succeeding circuits are operative, the 400-cycle modulation will appear on the scope screen as well as on the face of the picture tube.

Using a VTVM

If the technician has a signal generator without provisions for internal modulation, he can substitute a vacuum-tube voltmeter in place of the scope and obtain a relative signal indication by the AC voltage developed at the video detector. In this arrangement, the VTVM is connected across the detector load and the unmodulated RF or IF signal from the generator applied to test points "D" through "K" of Fig. 4. A low DC voltage range of the meter is used and the generator frequency is varied for a maximum signal indication at each point. With the AGC line clamped at a -3 volts, this method of signal tracing is very effective in locating an inoperative stage in either the RF or IF section.

The Sweep Method

While the foregoing procedures are relatively simple and require only a minimum amount of test equipment, they are principally useful in locating weak or completely inoperative stages and are quite limited when it comes to pin-pointing causes of other troubles, such as regeneration, smear, loss of picture detail, etc.

A more complex, yet highly ac-
accurate, means of tracking down RF and IF troubles is to pass a sweep frequency signal through the system while monitoring the resultant response curve with a scope. This operation is the same as that used for a conventional RF or IF alignment check. The AGC line is clamped, the generator is set to sweep the RF or IF band, a direct scope probe is connected across the detector load and the synchronized sweep voltage from the generator is applied to the horizontal input of the scope.

When checking the IF strip, the RF oscillator should be disabled and a small capacitor placed in series with the hot generator lead. Injecting the sweep signal into the 1st IF under normal conditions, the technician might obtain a response curve similar to that shown in Fig. 8A. Moving the generator lead to the 2nd or 3rd IF grid, the response will change somewhat and will naturally be of less amplitude, as pictured in Fig. 8B.

Using a suitable detector probe with the scope, the frequency response of individual IF circuits can be checked by placing the generator lead on the grid of one stage and the scope probe on the grid of the following stage. If the generator output is too high or if the generator lead is placed directly on an IF grid, the stage involved, or one following, may tend to overload. This condition will usually cause the response curve to reverse in polarity and take on a weird shape such as that shown by the waveform of Fig. 9.

Using a direct probe, the RF response of a tuner can also be determined by placing the scope probe on the grid test point of the mixer stage which is usually made available on top of the tuner. To prevent detuning, a 10K-ohm resistor might also be placed in series with the scope probe at this point, although this component is often present in the tuner. In this operation, the signal generator should have an output of at least 100,000 microvolts and the scope should have fairly good sensitivity. (Its frequency response need not be considered at all.) For optimum performance, the sweep generator cable should be terminated and matched when connected to the antenna input terminals of the receiver. This can be accomplished by placing a resistive pad in series with the generator leads as illustrated in Fig. 10. The output impedance of the generator cable is represented by “Z” in the small table of Fig. 10, and values of the series and shunt resistors R1 and R2 are given for three typical impedances.

When merely signal tracing, the technician should not attempt to compare his findings with the response curves given in the receiver’s alignment instructions. With a little practice on normally operating receivers, however, he should be able to easily locate a defective stage using this sweep signal method.

Other Instruments

Rather than to employ a conventional generator, the technician may prefer to use an instrument especially designed for signal tracing. Generators of this nature often provide simulated TV signals for operating RF, IF, sync, and even sweep circuits. Specialized scopes incorporating preamplifiers and using an indirect method of coupling or sampling of the signal are also ideal for troubleshooting the RF and IF sections of a TV receiver. Instruments of this select group, however, have distinctive operating procedures too specialized to be covered here.

Fig. 9. Abnormal response curve resulting from overloading in the IF strip.

Fig. 10. Diagram of generator to antenna matching pad and resistance table.

Localize troubles in TV, radios, amplifiers, etc., right from the top of the chassis...and without making a single direct connection to the circuit! The new Wintronix Model 850 does all this by the modern, easy-to-use Induced Waveform method. Helps you quickly spot those often overlooked tube and circuit defects that mean callbacks or extra troubleshooting.

Simply connect the output of the Model 850 to any 'scope, then slip the Phantom Detector Probe successively over each tube in the receiver under test. By viewing the waveform of the received signal (from b'dcast station or generator) at each stage, you quickly localize troubles to the offending stage. Works equally well for RF, IF, video, sync, and audio circuits. A real time and trouble-saver for portable TV.

See and try the new Wintronix Induced Waveform Analyzer at your local Wintronix dealer or write for free literature.
Now let's go back to point "A" and see what is happening to the positive half of the signal wave available at the output of the amplifier section. The positive portion of the wave is coupled through C6 to the plate of V1B. The rectified voltage is equal to the peak value of the input signal. Using the VTVM circuit to measure the voltage across C7 will indicate the velocity of the vibration, thereby providing the value of a second factor in the formula for vibration characteristics.

The magnetic pickup previously described is used principally in high frequency sensing units. As shown in Fig. 5A, a permanent magnet is usually used to provide the field for a soft iron core. As long as it is under the influence of the permanent magnet, the core can be used to induce a voltage across the coil. Ultrasonic displacement reverses direction so many times a second that the movement cannot be transmitted to the probe by actual physical contact; instead, shock waves are produced in the coil. Figure 5B shows the compression-expansion effects of shock waves, and under
**Crystal Transducers**

Another type of ultrasonic transducer is the crystal. Transducers use either quartz or barium titanate; but unlike the frequency-controlling crystal used in communications, the ultrasonic crystal is relatively thick, with diameters ranging from \( \frac{1}{2} \) to \( 1 \frac{1}{2} \) in. Fig. 6 shows three common constructions for crystal transducers. Fig. 6A is the simplest, with a quartz crystal imbedded in a molded plastic case and silvered on top and bottom to provide contact surfaces for the output leads. Fig. 6B shows a quartz plate used as a contact plate to reduce wear. The sensing element in Fig. 6C is barium titanate, but the protective quartz contact plate is retained.

The signal developed by a crystal is due to the effect deformation has on crystals. A small voltage is formed when a crystal is compressed, twisted, or bent. The crystal develops enough voltage to drive a single stage amplifier which can be used to control a recorder or produce a correction voltage. The reverse is also true; if a voltage is applied to a crystal, it will change its shape or dimensions.

For thickness measurement the crystal is driven by an FM sweep generator. As the resonant frequency of the material is passed over, there is a sharp rise in output current. This signal can be applied to the vertical input terminals of an oscilloscope, and by using the FM modulation signal for horizontal deflection, a frequency response curve of the crystal circuit will be obtained. Each division of the screen along the horizontal axis will correspond to a different frequency; thus, when the generator passes through the resonant frequency, the trace will rise very rapidly and then return to the base line. (This is the same procedure which is used to obtain their influence, the core of the coil changes diameter. In this case, induction by the magnetic field takes place as a result of the coil windings moving through the field rather than through motion of the field; however, frequency and magnitude of vibration are transmitted by the field to the coil just the same.)
on the right side of the instrument. The pickup is similar to that illustrated in Fig. 6A; however, the crystal and case has been shaped to fit the curvature of the tank.

**Flaw Detection**

A slightly different approach is required for flaw detection. Resonance is very useful in thickness tests, but flaws do not affect resonance unless they are fairly large. The Sperry "Reflectoscope" shown in Fig. 8 operates on a time base rather than the frequency base used in the instrument of Fig. 7. Pulses of a particular frequency are transmitted through the unit under test. The pulses travel at a predictable rate through any material, and by sensing the time lapse between the transmitted and reflected pulse, the depth of a flaw can be directly measured. Notice from the scope waveform in Fig. 9 that the flaw stands out almost as well as the reflection from the bottom surface of the piece under test.

While the markers are spaced by frequency, it is a simple matter to convert frequency to time. The formula, \( T = 1/F \) shows that one operation will yield the time between marker pulses; thus, when the speed of sound through the substance under test is known, the thickness of the substance and the depth of any flaws can be determined. The markers in Fig. 9 are spaced one microsecond apart, and the speed of sound through this substance is one cm per microsecond. The flaw is located 1.75 cm below the surface, and the piece under test is 3.25 cm thick.

This is only one type of thickness measurement; there are many more. Thickness, width, length, height, and curved dimensions are all extremely important in industrial work. Electronic instruments used to determine these characteristics will be described next month.

---

**Arrow Staple Guns**

Can't damage wire or cable because driving blade automatically stops staple at right height! That's why Arrow Staple Guns are proved safer on jobs all over the country. And Arrow staples have tremendous holding power because they're resin-coated, have diverging points that lock into wood.

- T-25 (shown) for wires up to 1/4" in diameter. (Hi-Fi wire, radiant heating, bell, thermostat, telephone, inter-com, etc.) tapered striking edge gets into tight corners. Uses \( \frac{1}{8} \), \( \frac{1}{4} \), and \( \frac{3}{8} \) staples. List $15
- T-25B For burglar alarm wiring. Drives staples flush. List $15
- T-75 For non-metallic sheathed cable, Romex cable or any other object (such as copper tubing) up to 1/4" in diameter. Uses \( \frac{1}{8} \), \( \frac{1}{4} \), and \( \frac{3}{8} \) Arrow staples. List $15

**Arrow Fastener Company, Inc.**

One Junius Street, Brooklyn 17, N. Y.

---

**Yeats Shorty Station Wagon & Panel Pick-Up Appliance Dolly**

Only 47" tall, this new YEATS dolly is designed for TV and appliance men who make deliveries by station wagon or panel truck. No need to depart appliance for loading into the "wagon" or pick-up. YEATS "Shorty" will slide into your vehicle with ease. Has aluminum alloy frame with padded felt front, quick lasting (30 seconds) strip rotchet, and endless, rubber belt step glide. New YEATS folding platform attachment, at left, saves breaking work handling TV chassis or table models. Call your YEATS dealer today!

**YEATS Model No. 5**

- Aluminum alloy
- Height 47"
- Weight 32 lbs.

Folding platform is 13 1/2" x 24 1/2" attaches instantly. (Platform only) $9.95.

“Everlast” Covers & Pads

YEATS semi-fitted covers are made of tough water repellent fabric with adjustable straps and soft, scratchless white flannel linings. All shapes and sizes. Write.

**Furniture Pod**

SEND postcard for full information on our complete line TODAY!

YEATS Appliance Dolly

2103 N. 12th St.

**Yeats Sales Co.**

Milwaukee, Wis.
Subminiature Electrolytics

Type EC aluminum-foil electrolytic capacitors made by Cornell-Dubilier Electric Corp., South Plainfield, N. J., are new subminiature units designed for transistorized equipment or low-B+ vacuum-tube circuits. These components are available in working-voltage ratings from 3 to 75 volts DC and in capacitance ratings which range from 1 to 250 mfd, depending on voltage rating. Housed in tubular ceramic cases, they are sealed with a moisture and heat resistant resin. Stable capacitance value, low DC leakage current, and long shelf life are obtained with the use of special materials and processing techniques.

For further information, check 4IP on Literature Card.

Chassis-Holding Jig

An improved type of chassis jig for use in bench servicing, the "Phono and Radio Repair Stand" (Cat. No. 5212), has been introduced by General Cement Mfg. Co., Rockford, Ill. The chassis to be serviced is suspended between two upright braces which can be adjusted to hold chassis of any length up to approximately 18". The clamps that grip the chassis are secured to the braces by large locknuts; when these are loosened slightly, the chassis can be rotated to any desired position. The opening between the jaws of the clamp is adjusted by turning a knurled locknut, and one jaw is equipped with a rubber insert to provide a non-marring grip.

For further information, check 49P on Literature Card.

Outdoor Antenna Kits

JFD Electronics Corp., Brooklyn, N. Y., is now making its Fireball, Junior-Felix, and Super-Helix Colortennas available in kits that contain all hardware needed for installation. Accessory parts furnished include an aluminum mast with "Trimount" base, 50 feet of twin lead, 6 assorted stand-offs and 3 "self-sealing" nails. Model numbers and retail prices of "Colortenna-Paks" are as follows: Standard Fireball, FB500TP, $29.95; Gold Anodized Fireball, AB500TP, $34.95; Standard Super-Helix, RX511TP, $29.95; Gold Anodized Super-Helix, AX511TP, $34.95; Standard Junior-Helix, JX311TP, $24.95; and Gold Anodized Junior-Helix, AX311TP, $29.95.

For further information, check 48P on Literature Card.
FOR A
darker
tv
picture

Rely on the tube that has always been specified by leading independent set makers.

Blue Chip Quality
TUNG-SOL®
Magic Mirror Aluminized PICTURE TUBES

TUNG-SOL ELECTRIC INC., Newark 4, N. J. Sales Offices: Atlanta, Ga.; Columbus, Ohio; Culver City, Calif.; Dallas, Tex.; Denver, Colo.; Detroit, Mich.; Irvington, N. J.; Melrose Park, Ill.; Newark, N. J.; Seattle, Wash.

Signal-Boosting TV Set Coupler

Blonder-Tongue Labs., Inc., Newark, N. J., has announced production of a Model B-23 Two-Set Booster which couples a single antenna to two or three TV sets through a one-tube broadband amplifier. When connected to two receivers, the unit provides a gain of 2 to 6 db instead of the loss encountered in passive couplers. The 6¼" x 3¼" x 2½" booster is designed to operate continuously, drawing 120 ma at 117 volts AC to supply power to the 6BK7A amplifier circuit. List price is $23.95.

For further information, check 50P on Literature Card.

CRT Rejuvenator

A redesigned Model RE-2 "Rejuvatube," featuring facilities for testing and rejuvenating 110° and color picture tubes, has been introduced by Central Electronics, Inc., Chicago, Ill. Another new feature of the RE-2 is a gas-test circuit for picture tubes. All circuitry for handling color and 110° tubes is contained in a 2⅞" cube-socket adapter that plugs into the main chassis of the unit. This adapter is also available separately as an accessory for Model RE-1 rejuvenators.

For further information, check 51P on Literature Card.

Self-Holding Connector

E-Z-Hook Test Products, Covington, Ky., is marketing a new item in its line of self-holding test prods and connectors. Called the "Sub," the unit is 2½" in over-all length and is equipped with "E-Z-Hook" spring-loaded connectors at both ends. The principal use of "Subs" is to permit temporary circuit connections, such as component substitution during testing, to be made quickly and easily. These plastic-bodied connectors are supplied in 6 colors at a cost of 69¢ each.

For further information, check 52P on Literature Card.

DC Microammeter

A portable vacuum-tube microammeter (Type WV-84B) has been introduced by the Components Division of RCA, Camden, N. J. A bridge circuit consisting of two 3S4 tubes and two 22½-volt batteries is employed to measure weak currents, and a choice of 6 meter ranges with full-scale readings of 0.01 to 1,000 µa is offered. The meter produces only slight loading of the circuit under test; voltage drop across the instrument at
For a brighter picture

Rely on the tube that has always been a favorite with leading independent service dealers.

Blue Chip Quality

TUNG-SOL® RECEIVING TUBES

TUNG-SOL makes All-Glass Sealed Beam Lamps, Miniature Lamps, Signal Flashers, Picture Tubes, Radio, TV and Special Purpose Electron Tubes and Semiconductor Products.

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ACCESSORIES
1P. E-Z-HOOK—A convenient reference sheet titled "How to Build the Five Most Useful Scope Probes," with schematic, mechanical component layout, etc. See ad page 31.
2P. PERMA-POWER—Brochure describing new "P"-tube bolometers. See ad page 63.

ANTENNAS
3P. AMPHENOL—Sales aids and technical data on new "2-TV" indoor TV anten- na. See ad page 48.
4P. JFD ELECTRONICS—1958 TV antenna catalog. See page 1.
5P. TELCO (G-C)—Catalog No. A-58 shows a complete line of 100 different types of antennas. See ad page 58.

ANTENNA DISTRIBUTION

BOOKS
7P. GERNBSECK—Descriptive literature on Gemschack library books. See ad page 49.

BUSINESS FORMS
8P. OELRICH—24-page catalog pictures and describes binding forms, forms, sales aids, and record systems. See ad page 65.

CAPACITORS
9P. CENTRAL—Bulletin on new "Ultra- Kopp," micro-miniature ceramic-disc capacitors for low-voltage use which require extremely high capacities and low power factors. See ad page 42.
10P. CONAIR—Data sheet of molded "MYLAR" capacitors. See ad page 42.
11P. SPRAGUE—"The ABC's of Ceramic Capacitors"—a brochure covering both theory and applications of these components. See ad page 2.

COMPONENTS
12P. IRC—DLR, Form G-534, Replacement Parts Catalog. See ad page 2.

CHEMICALS
13P. KRYLON—Catalog pages describing crystal-clear rust release, dulling spray, spray enamels and varnishes, and metal primers. See ad page 41.
14P. ECLIPSE—"Bulletin #23 on Fono Magic, a compound of special rubber and carbon that eliminates turntable slipping and dragging and keeps automatic changers cycling properly. See ad page 65.

FUSES
15P. RUSSELL—Complete TV Fuse Guide, from page, shows types and upper ratings of fuses used in various TV sets. See ad page 19.
16P. LITTLEFUSE—Up-to-date cross reference card showing LC fuses and list prices. See ad page 40.

GENERAL CATALOGS
17P. UCP—Information on "1958 Radio-Electronic Master," detailing the 150,000 products cataloged in this buying guide. See ad page 68.

PICTURE TUBES
18P. DUMBRO—Picture tube data chart. See ad page 27.

POWER SUPPLIES

PHONO NEEDLES
20P. JENSEN INDUSTRIES—Assorted Dealer Aids. See ad page 70.

RESISTORS
21P. CLAROSTAT—No. 58 Distributor catalog of resistor products for radio, TV and industrial applications. Form No. 75X0000. See ad page 35.

SERVICE CASE
22P. MASTRA—Complete data on "Testmaster," a new convertible master tube and tool trolley box with room for over 360 tubes plus tools and equipment. See ad page 57.

SOLDER
23P. BRITISH INDUSTRIES—Brochures on Multi-core "VAPIT" Alloy and Multi-core 5-core Solder. See ad page 64.

SPEAKERS
24P. ELECTRO-VOICE—Bulletin. 1311 gives complete story on CDP's, coaxial, P.A. pro- jectors. Includes data on diffraction horns, increased coverage, polar patterns and features of the CDP line. See ad page 11.
27P. UTAH RADIO—16-page catalog plus AIC's of Reproducers catalog. See ad page 56.

TEST EQUIPMENT
28P. AFFILIATED TV LABS—Catalog sheets, literature, and sales plans for and information on various TV service centers. See ad page 49.
29P. B & K—Bulletin 1221 gives information on \& B-K Dyna-Scan Model 1050 Portable Video and Audio Generator that transmits picture or pattern and sound at any time to any number of TV sets. Also Bulletin on other B & K equipment. See ads pages 7 & 26.
30P. B & M MFG—One-page flyer describing the induc- tive alternating and its functions. See ad page 60.
31P. DOSS—Details Modifiers for D-100 Sweep Analy- zer. D-200 Master and D-500 Shave Oscillator. See ad page 67.
32P. EICO—12-page catalog shows how to save 50% or electronic test instruments and lab equipment in both kits and factory-wired form. See ad page 31.
33P. HICKOK—Descriptive brochure on new "Cardmatic" portable tube tester priced for the TV technician.
34P. EICO—Information on TV tube testing and analyzing TV deflection circuits. See ads pages 36, 66, and 75.
36P. SERVICE INSTRUMENTS—New LCI Leakage Checker literature. See ad pages 14, 30, and 70.
37P. TRIPLET—Literature describing new 60-API voltmeter-milliammeter. See ad page 43.
39P. WINSTON—One-page flyer on full line of equipment. See ad pages 72 and 73.

TOOLS
38P. ARROW FASTENER—16-page multicolor catalog. See ad page 40.
39P. TV TESTER—Complete manual on TV circuit testing, giving full details on testing machinery, feeders, hammer testers, gun firing tips, and staples. See ad page 16.
41P. CBS HYTRON—New CBS Tool Catalog PA-6. See ad page 17.
42P. STEVENS-WELDER—Catalog on "Spintites" and "Grip Spintites." See ad page 49.
43P. PACO—Catalog on specialty service tools for radio-TV. See ad page 49.
44P. YEATS—4-page catalog describing appliance dolly and padded covers for servicing TV sets. See ad page 31.
45P. XCLITILE—Illustrated catalog on full line plus literature on new products. See ad page 51.

TRANSFORMERS & COILS
46P. MERIT—Catalog No. 5811 illustrates and describes more than 500 replacement items. See ad page 44.
47P. CHICAGO STANDARD—100-page TV Transformer Replacement guide, cross-referenced for over 7000 transformers of 98 manufacturers. See ad page 59.

WIRE
48P. WRIGHT STEEL—Catalog sheet and folder including description and sizes of wire strand.
This is your latest index supplement! For complete photofact listings use it with the February 1958 master index! Throw away all other supplements.
Start the year right - with a subscription to the new 1958 Television Tube Location Guide. Receive your new binder and first 40 charts almost a year in advance of the bound volume. Remember, this special and exclusive service costs you less than a penny-per-new-model for coverage you need today!

**1958 TELEVISION TUBE LOCATION GUIDE SUBSCRIPTION**

YOUR NEW 1958 SUBSCRIPTION INCLUDES:

- ✓ 40 Charts plus index and new binder
- ✓ 40 Charts—new index mailed April 1958
- ✓ 40 Charts—new index mailed July 1958
- ✓ 40 Charts—complete cumulative index mailed Oct. 1958

... all for $3.95

**START RECEIVING TUBE LOCATION CHARTS ON CURRENT MODEL TV'S ALMOST A YEAR IN ADVANCE OF THE PAPER-BOUND EDITION!!**

Available now from your Sams Distributor.
You're in the spotlight for the BIGGEST SHOW OF ALL TIME!

RCA offers every TV service-dealer a “front-row-center” ticket to a service-selling program! You are the “star” in this big performance:

☆ National Television Servicemen’s Week—
and you can win valuable prizes in the exciting RCA “Mystery Shopper” contest!

4th Annual NTSW
March 24-29, 1958!

“National Television Servicemen’s Week”—
“showing” for the 4th consecutive year in national magazines such as Life and TV Guide, television and radio commercials, nation-wide publicity... local newspaper advertising and special attention-getting displays and promotion kits—gives you the “star” billing.

Valuable Prizes Offered!

See the “RCA MYSTERY-SHOPPER CONTEST” ad appearing in other trade magazines this month. You can win one of 192 big awards. Every service-dealer who enters receives a gift, just for entering. Contact your RCA tube distributor for full details.

Attention Getters! Traffic Stoppers! Business Builders!

A dazzling “cast” of NTSW stickers, streamers, cards, displays, premiums, mailers, broadsides, signs of all kinds—all available through your RCA TUBE DISTRIBUTOR. See him now!

Never before in the history of the TV service-industry has there been such a tremendous “cast” of featured “players” to back up a “star” performer—you, the independent TV service-dealer.

Yes, RCA is putting you in the spotlight to help you • gain greater public recognition than ever before • build customer good-will • promote your skill and experience • merchandise your sales and service business.

Take a bow! You're the “star”! Contact your RCA TUBE DISTRIBUTOR now for full details!

RADIO CORPORATION OF AMERICA
Electron Tube Division
Harrison, N.J.
PUT YOUR MONEY WITH THE WINNER

LITTelfuse

Quality, Service, Range, and such winning service aids as the Fuse Caddy, One-Call Kits, LC Fuse Caddy, Packaged Snap-On Holders, Fuse-Retainer Assortments, Single-Fuse Channels, participation in Howard Sams Photofact Folders.