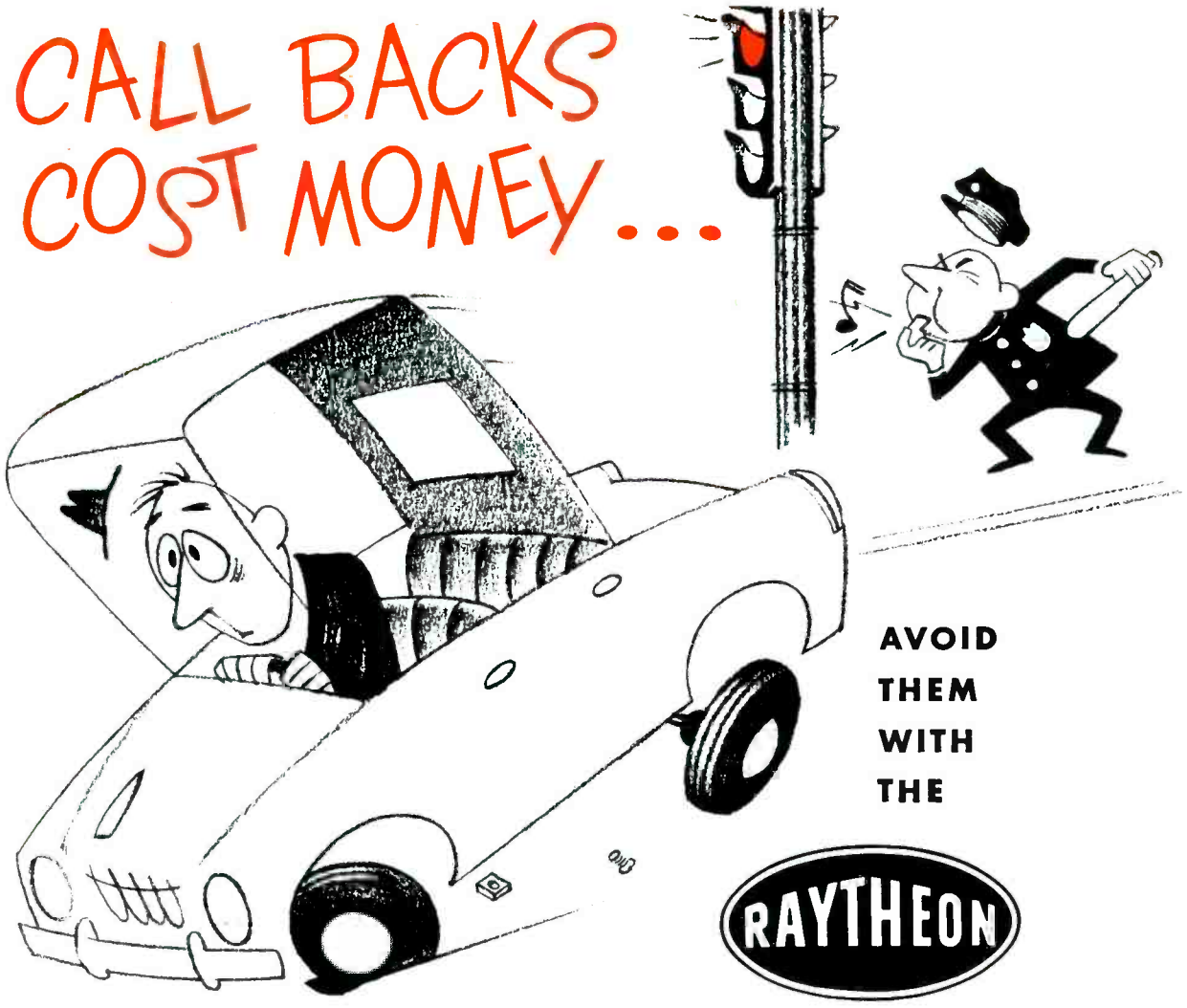
RADIO & TELEVISION NEWS

FEBRUARY
1954
35 CENTS
In Canada 40¢

INCLUDING
TV & Radio Engineering

IN THIS ISSUE

CALL BACKS COST MONEY...



AVOID THEM WITH THE

RAYTHEON

SERVICE SAVER PLAN

available through your RAYTHEON TUBE DISTRIBUTOR

The Raytheon Service Saver Plan, which permits customers to identify about 85% of all the troubles that may occur on the screen of a defective TV receiver — *and accurately transmit this information to the Service Dealer via telephone* — is helping to minimize costly call-backs two ways.

First, when a Service Dealer goes on a call knowing in advance what ails a TV receiver (thanks to Raytheon's Service Saver Plan), he goes completely equipped to do the job — no more running back to the shop for tubes or parts.

Second, customers frequently call about TV receiver trouble when a minor control adjustment is all that is needed to correct the fault. The Raytheon Service Saver Plan helps Service Dealers avoid these needless, unprofitable calls.

Ask your Raytheon Tube Distributor to tell you how to put the Raytheon Service Saver Plan to work for you.

RAYTHEON RADIO AND TELEVISION TUBES cut call-backs, too! Their outstanding quality reduces early tube failures to a minimum. Use them. You'll find them Right . . . for Sound and Sight . . . and *you!*

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Excellence in Electronics

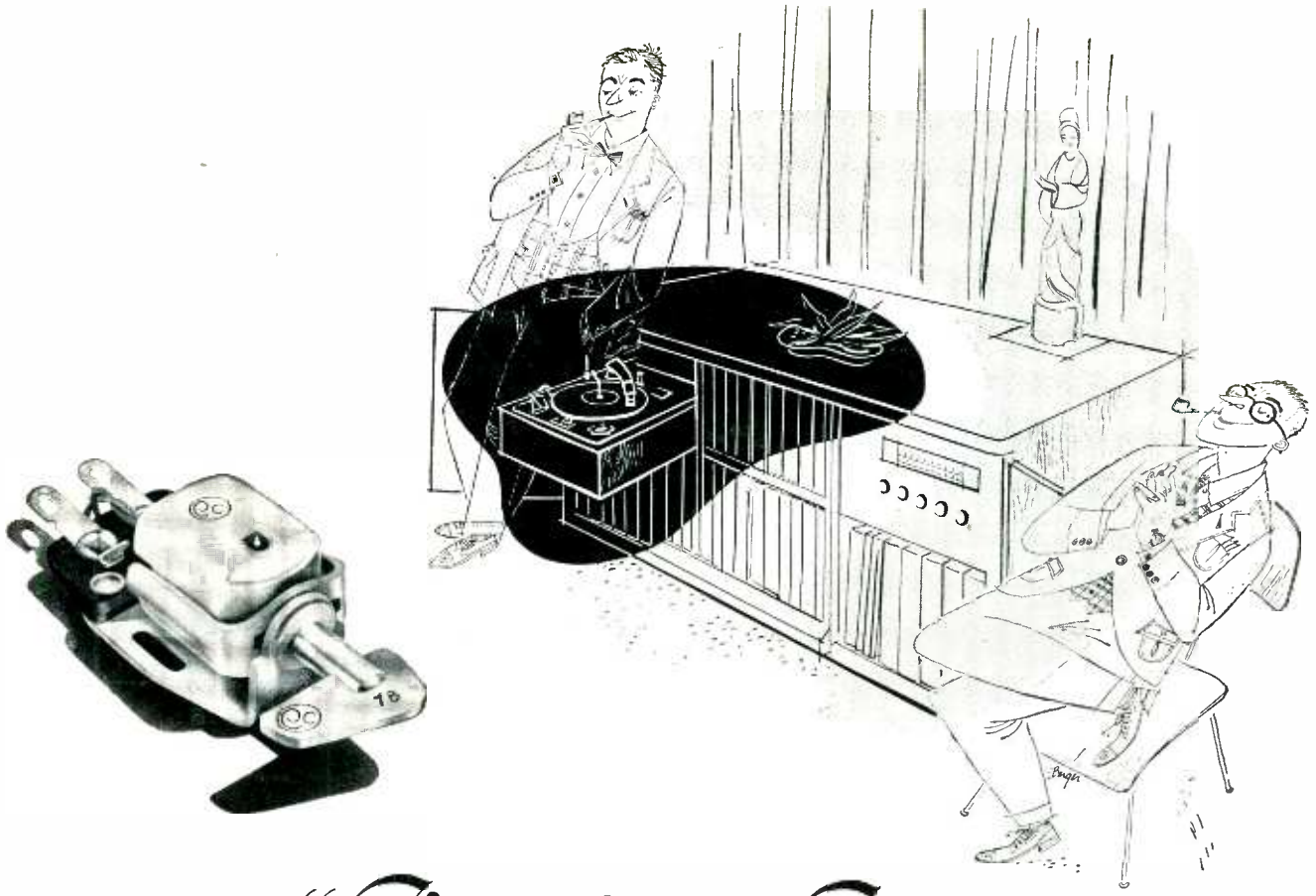
RAYTHEON MANUFACTURING COMPANY

Receiving Tube Division

Newton, Mass., Chicago, Ill., Atlanta, Ga., Los Angeles, Cal.

RAYTHEON MAKES ALL THESE:

RECEIVING AND PICTURE TUBES • RELIABLE SUBMINIATURE AND MINIATURE TUBES • SEMICONDUCTOR DIODES AND TRANSISTORS • NUCLEONIC TUBES • MICROWAVE TUBES



"I'm glad I waited..."

Here's how I solved a problem that bothered me . . . and may be bothering you.

Many of my favorite recordings happen to be 78's. They mean as much to me as any of my newer LP's or 45's. Changing pickups was often a real nuisance—and yet I wasn't willing to give up the superior quality of my two Pickering cartridges.

Last fall my dealer offered a suggestion. "Wait a little longer," he said. "You'll be glad you did."

He was right. I now have Pickering's new turn-over cartridge. A simple flip of the handy lever and I'm ready to play any favorite that fits my mood—whether it's standard or microgroove. *More than that,* I'd swear my recordings sound better than ever.

I'm glad I waited . . . but you won't have to.

Ask your dealer to show you this convenient new turn-over cartridge. Have him demonstrate it. See if you, too, don't hear the difference!

PICKERING ***and company incorporated • Oceanside, L. I., New York***

PICKERING PROFESSIONAL AUDIO COMPONENTS

"For those who can hear the difference"

...Demonstrated and sold by Leading Radio Parts Distributors everywhere. For the one nearest you and for detailed literature, write Dept. C-3

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COVER PHOTO: This big load-life oven, built to test resistors under load at raised temperatures, is part of the equipment used by IRC in its test program. (See page 68) (Ektachrome by Henry Gregg)

First in radio-television-audio-electronics

Average Paid Circulation over 230,000

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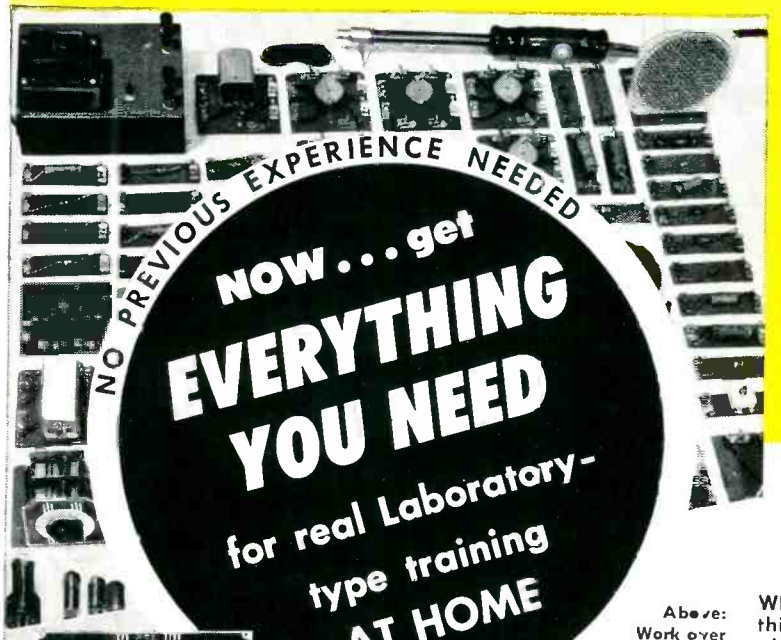
FEBRUARY, 1954

DEPARTMENTS

VOLUME 51 • NUMBER 2

SUBSCRIPTION SERVICE: All communications concerning subscriptions should be addressed to Circulation Dept., 64 E. Lake St., Chicago 1, Ill. Subscribers should allow at least four weeks for change of address.

Now IN YOUR OWN HOME Learn TELEVISION RADIO-ELECTRONICS the Amazingly Effective D. T. I. WAY



Above: Work over 300 fascinating experiments with this equipment

—with the aid of BOTH HOME EQUIPMENT and HOME MOVIES

What will mailing the coupon below *do for YOU*? Just this! You'll find out about one of today's most remarkable . . . practical ways to prepare to get into America's amazing billion dollar opportunity field of TELEVISION-RADIO-ELECTRONICS. You'll see how to get into fascinating work that pays well . . . that offers one of America's most promising futures . . . that enables you to start your own business almost "on a shoe string," if you prefer this to a job opportunity.

And above all, you'll get some GOOD NEWS especially welcomed by men anxious to earn REAL MONEY in this thrilling field. For you'll see that NOW you can get the kind of practical, laboratory-type training so desirable for making real progress in Television-Radio-Electronics *AND WITHOUT* LEAVING HOME.

You'll see that DeVry Technical Institute sends everything needed to set up your own HOME LABORATORY. You get and keep the same type of basic electronic equipment used in our modern Chicago Training Laboratories. You get home training that includes the knowledge and experience gained from training thousands of students first hand in Chicago. And to top it all, you use DTI's amazingly effective and exclusive home training aid—INSTRUCTIVE MOVIES. But why not get the complete story? Mail coupon today for information-packed literature.

1. Build over 300 fascinating experiments from 16 BIG SHIPMENTS of Electronic-Radio parts which you KEEP.

2. Build valuable commercial-type test equipment—as shown to the left—which you KEEP. This includes a quality 5 INCH oscilloscope and jewel bearing Multi-Meter—both highly useful for Television work.

3. Build and keep a big 21 INCH TV Set. (D.T.I. offers another home training in Television-Radio-Electronics, but without the TV set.)

4. Use a 16 mm. movie projector and new series of highly instructive movies—a wonderful aid to help you grasp important fundamentals faster . . . easier . . . better.

5. Enjoy well-illustrated, easy-to-read lessons with handy FOLD-OUT diagrams.

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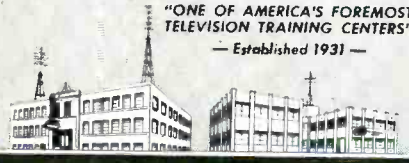

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Street..... Apt.....
City..... Zone..... State.....

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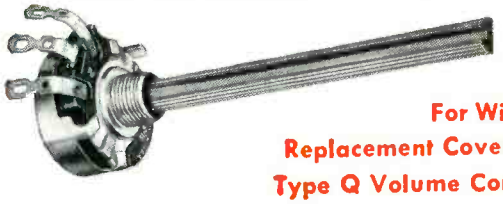
IRC Volume Control Plant, Asheville, North Carolina.

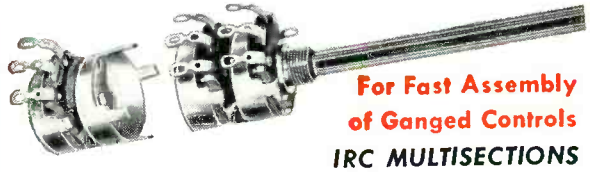
Name your requirement; it's in full production *now* at IRC's new volume control manufacturing plant. From no other single source can you get such wide replacement coverage. And no other replacement control gives you the IRC combination of easy installation and trouble-free performance.

Compare IRC's Replacement Control Line with any other:



For Widest Replacement Coverage Type Q Volume Control

82 values—7 tapers—give greatest TV, AM, FM coverage with least stock. Flatted, knurled and slotted Knobmaster Fixed Shaft fits most knobs without alteration. 13 Interchangeable Fixed Shafts give fast conversion to "specials" with fixed shaft security. Small ¼" long bushing and compact 15/16" design ideal for small sets—yet handle large set needs as well. Cushioned-turn rotation. Quiet element. Handsome appearance.

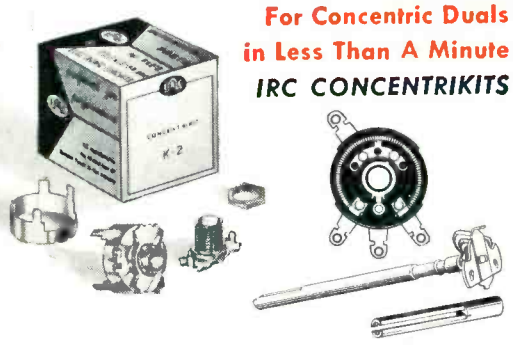


For Fast Assembly of Ganged Controls IRC MULTISECTIONS

In just a few minutes you can assemble standard duals, triples, even quadruples—with IRC Multisections and Q Controls. Simply remove control cover and attach Multisection. Over 15,000,000 combinations. 20 resistance values. Switches can be added. Use to provide low-cost L Pads and T Pads.

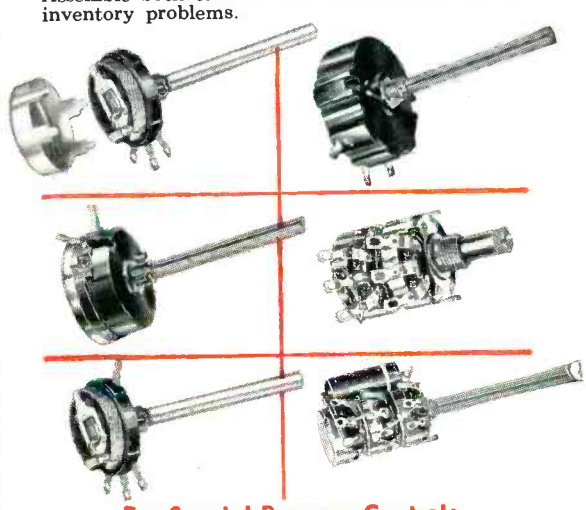
Factory-Assembled IRC EXACT DUPLICATES

IRC's complete line includes 492 Factory-Assembled Exact Duplicate Concentric Duals. Mechanical fit and electrical operation double-money-back guaranteed—specifications are based on set manufacturers' procurement prints. Resistance values are matched; tapers are closely followed; shaft lengths are never less than manufacturers' nominal—never more than 3/32" longer. Cover more than 5,000 TV sets. Carbon and wire wound.



For Concentric Duals in Less Than A Minute IRC CONCENTRIKITS

Here's coverage of more than 5,000 TV models. Revolutionary 4-piece Universal Concentrikits assemble with shafts and elements in less than a minute to give you the exact duplicate replacement control you want. Mechanical fit and electrical operation double-money-back guaranteed. Assemble both carbons and wire wounds. Fewer inventory problems.



For Special Purpose Controls IRC's Complete Line

2-Watt Wire Wounds—2 styles, full rounded shaft and Knobmaster shaft. *High Voltage Controls*—2-watt carbon-element control with Knobmaster shaft. *4-Watt Wire Wounds*—2 styles, short, knurled and slotted shaft or Knobmaster shaft. *TV Attenuators*—Carbon-element control for adjustment of signal input. *TV Centering Controls*—2-Watt Wire Wound Control with centering tap. *Loudness Controls*—Continuously variable, bring higher fidelity to ordinary audio.

No other brand of replacement controls offers you wider variety — greater efficiency. Send for New IRC Control Catalog DC1D.

For one-source-service on all your control requirements, order from your IRC Distributor.

IRC

INTERNATIONAL RESISTANCE COMPANY

415 N. Broad Street, Philadelphia 8, Pa.

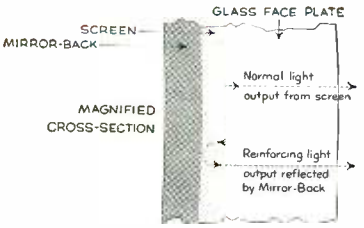
In Canada: International Resistance Co., Ltd., Toronto, Licensee

Wherever the Circuit Says

Arthur Godfrey, famous CBS-TV star

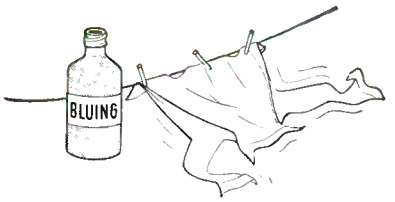
GET BETTER THAN NEW-SET PERFORMANCE

WITH CBS-HYTRON MIRROR-BACK SCREEN



Mirror-Back (aluminized) screen mirrors *all* the light output to the viewer. Offers: Brighter pictures. Greater contrast. Better resolution. Reduced strain on other components. Full effective anode potential. Prevention of cross-burns. And longer life. For greater customer satisfaction . . . more profit, replace with original CBS-Hytron Mirror-Back tubes. Many types now available.

WITH CBS-HYTRON BLUE-WHITE SCREEN



Ever notice how a shirt laundered with bluing appears whiter? With the CBS-Hytron Blue-White screen, whites are whiter; blacks, blacker. Expanded gray scale gives noticeably sharper pictures in fringe areas. No wonder CBS-Hytron's original Blue-White screen has become the universally preferred standard. Your customers, too, will prefer Blue-White screens.

WITH CBS-HYTRON SMALL-SPOT GUN

Smaller the spot produced by electron beam, sharper the picture. New lens focusing system of CBS-Hytron Small-Spot Gun reduces spot size 30 per cent. Prove it. Replace with a new CBS-Hytron Small-Spot tube. *See*, yourself, the superior resolution. Profit more. Combine all three: CBS-Hytron Mirror-Back . . . Blue-White Screen . . . Small-Spot Gun. Get and give that better-than-new-set thrill!

LOOK TO CBS-HYTRON FOR COLOR, TOO!

New CBS-Colortron stresses simplicity. Offers many advantages: Simpler construction. Fool-proof assembly. Lower cost. Lighter weight. Adaptability to mass production in large sizes. Improved contrast. Simplified focusing . . . circuitry . . . adjustment. Resistance to overload. Greater stability. All stemming from unique spherical mask and face plate. You'll appreciate these advantages when *you* start servicing color TV.

FREE CATALOG . . . CBS-HYTRON BUSINESS BUILDERS

Describes all CBS-Hytron Business Builders to date: *Certified* Quality Service tags, streamers, decals, illuminated and flange signs, clocks, postal cards, and ad mats. The famous CBS-Hytron service tools. Technical literature. Price lists. Special offers. Get your Business Builders Catalog, PA-37, today . . . from your distributor, or direct.

NEW . . . *FREE* CBS-COLORTRON DATA

For a look into the future, get complete advance data on the new, revolutionary CBS-Colortron: Construction . . . operation . . . application . . . installation and adjustment . . . electrical and mechanical data. FREE . . . from your CBS-Hytron distributor . . . or direct.

CBS HYTRON

Manufacturers of Receiving Tubes Since 1921

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RECEIVING • TRANSMITTING • SPECIAL-PURPOSE • TV PICTURE TUBES • GERMANIUM DIODES AND TRANSISTORS

For the RECORD

BY THE EDITOR

RETROSPECT

ONE of the greatest thrills that I have had during the past 15 years as your editor was the expected announcement by the FCC on December 17 of last year giving approval of a compatible color television system. Our readers may recall my editorial four years ago which was written several months prior to any decision or approval for any color television system. The title of my editorial was, "Why The Rush For Color Television?" and in that editorial I made the following statement: "Several of the systems under development do show promise. Unfortunately, the better systems fall short of being compatible. It may be that a combination of systems can be devised, utilizing the best features of each, which will result in something really worth considering. Only time will tell."

And time did tell! The events that followed are now a matter of record and in spite of the fact that the FCC saw fit to give the nod to the *CBS* incompatible revolving color disc system on September 1, 1950 our faith in our industry's ingenuity and know-how remained unshaken. In my editorial of December, 1950 I stated: "Dealers and servicemen are already feeling the impact, not only of the FCC's color decision, but the attendant publicity which implies that color service will soon be available on full schedule. Such publicity creates doubt in the minds of the public as to the advisability of purchasing a present black-and-white television set." Remember those promises in the dailies?

In this same editorial I said: "Must servicemen be emissaries to John Q. Public in an attempt to convince him that the FCC just couldn't wait for some practical method for color television that, according to most engineers, can be fully developed within a reasonably short time? Is it unreasonable to assume that within a short length of time there will be developed an acceptable compatible television system, employing new developments and making use of those already under test?" And I concluded with the following: "These United States are blessed with the finest electronic technicians in all the world. Is it not probable that this 'brain power' will develop a real honest-to-goodness compatible television system for the public? Developments in recent months have definitely shown real progress in the dot-simultaneous system, the tricolor tube and others, to the point where it is quite probable that the entire goal in achieving a flicker-free compatible color television system may be almost at arm's reach. This feeling is shared by the vast majority in the television industry who know what can be perfected to give the public what it really wants, and not what the FCC and *CBS* want it to have. It now appears that the *CBS* system (except for superior rendition) is so impractical that it may die out when the public learns all the facts . . ."

The following months saw the acquisition of *Hytron* and *Air King* by *CBS*. That was in 1951. *Hytron* has since made a great contribution to color tube development (RADIO & TELEVISION NEWS, December, 1953) and has made other contributions towards a compatible system. *Hazeltine,* in 1951, also produced a satisfactory color picture using only a 4 mc. bandwidth for the picture information. It is interesting to here note that *RCA* has now recorded color video information on magnetic tape approaching this same bandwidth (see page 55). *Bell Laboratories, General Electric, Philco,* and others were undertaking extensive research during this period.

The NTSC was organized to study the entire matter of compatible television circuitry and to place recommendations before the FCC for their consideration. Fortunately the Korean situation held back further color development for some time.

In my editorial of June, 1951 I said: "At least one highly qualified observer has expressed the opinion that when engineers can agree on such a system and can back their decision up with experimental evidence, they will receive a favorable hearing from the FCC, irrespective of the Supreme Court decision in the present controversy. It appears, then, that in spite of the defense emergency, an all-electronic, compatible, high-quality color television system will be available for the general public within a reasonable period of time. We have stated many times that the public may be the deciding factor in the final choice of a color television system—and we still believe that to be so, regardless of legal entanglements and public gimmicks."

The smoke of battle has cleared. No individual or laboratory can claim all the glory and credit for producing compatible color TV. It has been a combined industry effort! We'll wind this column up as we did in June, 1951: "One thing is certain—if the television set owner has not had the opportunity of witnessing good color television he has missed the thrill of a lifetime in video enjoyment." . O.R.

ADJUSTABLE

for added gain on the cha

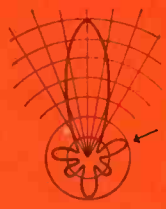
NEW 82 CHANNEL FALCON "VARI-CON"

- Provides all channel reception, VHF and UHF!
- Variable patterns eliminate ghosts and co-channel interference!
- Single lead-in operation!
- Provides a very sharp lobe on UHF!
- Provides excellent reception on VHF while peaked for UHF!
- With two-bay model, you can point and peak one antenna in one direction and point and peak the other bay in another direction — obtaining excellent results from both with but a single lead-in!
- No isolation transformer or network to give trouble, attenuate the signal, or add to installation cost!
- Low, low price!

VARIABLE PATTERNS OVERCOME "GHOST" AND CO-CHANNEL PROBLEMS

With other antennas you're "stuck" with a fixed pattern that nothing short of a hack-saw can change. NOT SO WITH THE "VARI-CON"! By changing the angle of the dipole elements — and it takes only seconds — it is possible to shift the positions of minor lobes and nulls to fit any particular reception problem. There are very few cases of ghost or co-channel interference that can't be quickly solved by use of the "VARI-CON".

Ghost pickup may be encountered at this setting.



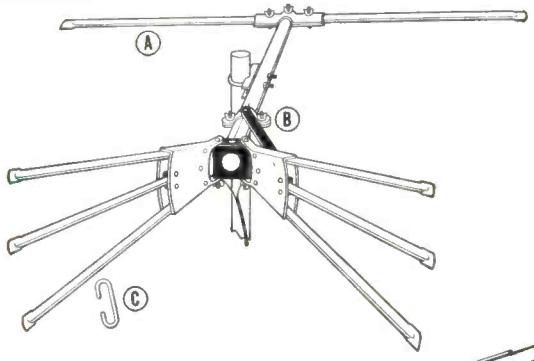
Ghost signal being received on a minor lobe.

Slight adjustment of "VARI-CON" changes horizontal pattern.

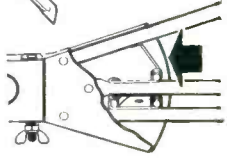
Ghost eliminated because unwanted signal now appears at a "null" point.

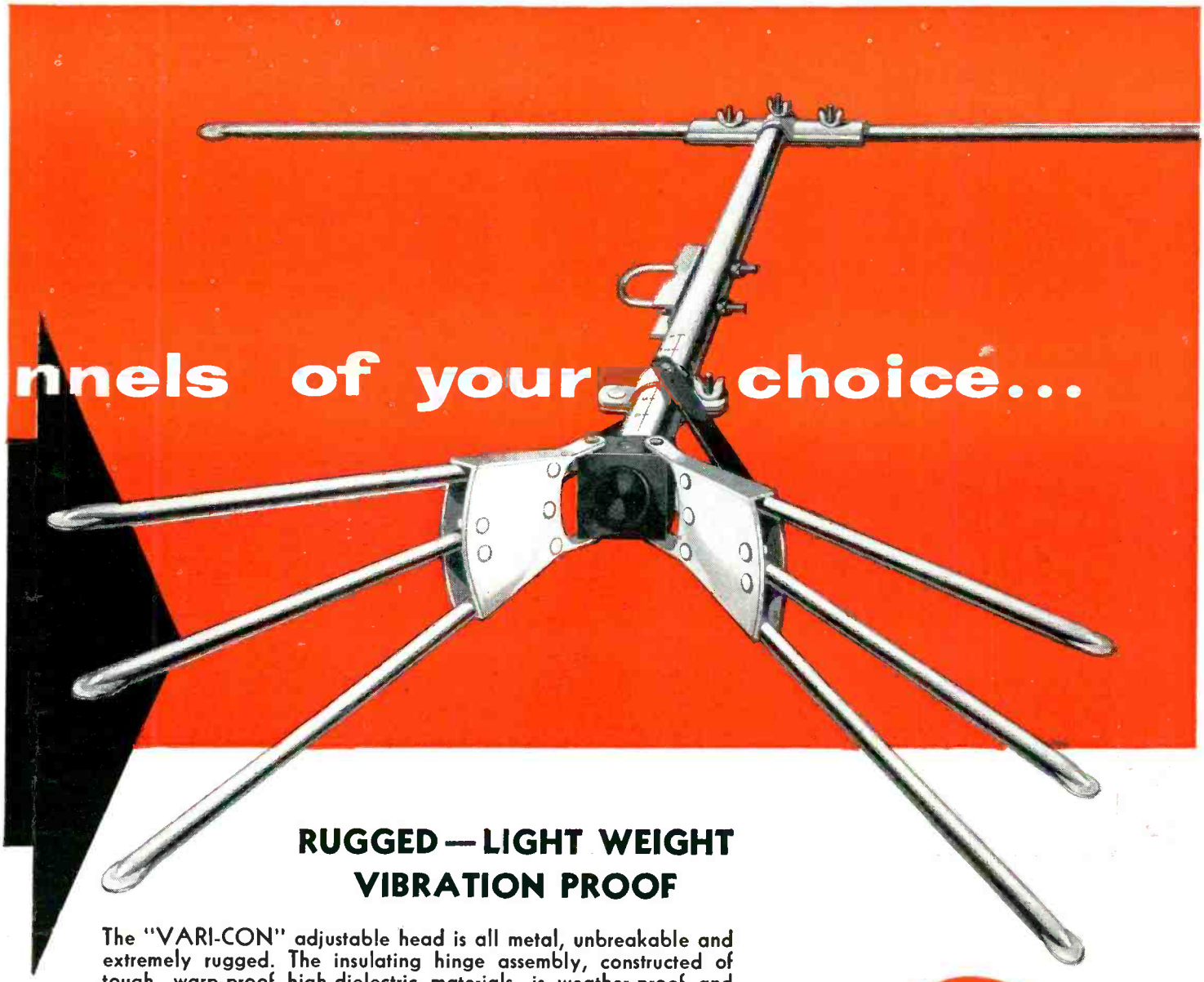
TOTAL ASSEMBLY AND PEAKING TIME — 10 SECONDS!

You only need swing reflector elements (A) into position and tighten wing nuts. Slide adjusting sleeve (B) to calibrated channel range on which added gain is desired and tighten wing nuts. It's just like opening an umbrella. Remove retaining clamps (C) from dipole elements; the elements automatically fan out and are locked securely in position by snap-action spring assemblies.



Once opened the elements are locked in rigid, vibration-proof position by the 90° angle of the arms. Spring action is NOT employed to hold elements in position.

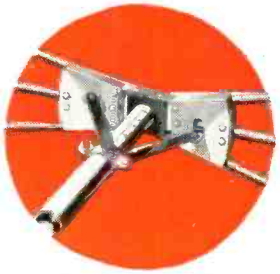




RUGGED — LIGHT WEIGHT VIBRATION PROOF

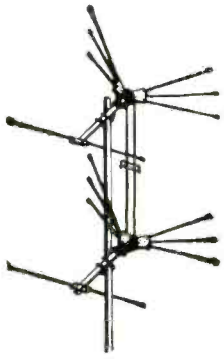
The "VARI-CON" adjustable head is all metal, unbreakable and extremely rugged. The insulating hinge assembly, constructed of tough, warp-proof high-dielectric materials, is weather-proof and can't short out. Full 48 inch elements are used, yet weight has been kept to a minimum without sacrificing rigidity.

The FALCON "VARI-CON" gives you all the desirable features of a conical PLUS adjustable, calibrated channel range peaking — for added gain where you need it . . . variable patterns, to cope with those difficult ghost and co-channel problems, plus all-channel VHF & UHF coverage! Give your customers the best — the FALCON "VARI-CON"!



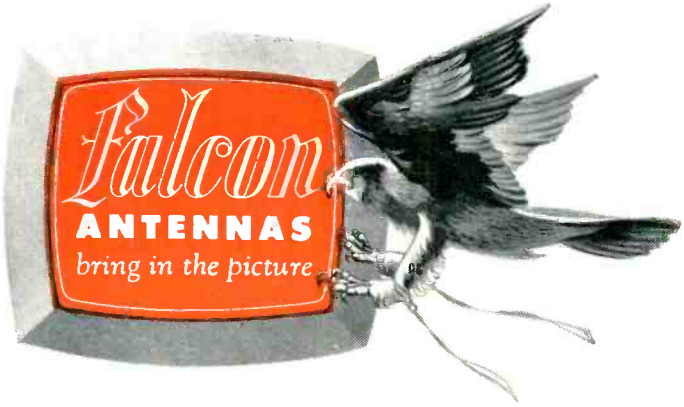
Heart of the "VARI-CON"

FALCON ELECTRONICS COMPANY, 2003 Cedar St., Quincy, Ill.



Stack VARI-CONs for even higher gain! One bay can be pointed and peaked in one direction, and the other bay pointed and peaked in a different direction. Three bay models also available.

Write for illustrated Spec Sheet.



$5,000

IN PRIZES

...easy to win

503

PRIZES!

$2000 - 1st prize

$500 - 2nd prize, $100 - 3rd prize
100 - $10 prizes, 400 - $5 prizes

HOW TO WIN

To win one of these 503 prizes all you have to do is complete in 25 words or less "I like Pyramid capacitors because_____." You fill in this statement on a Pyramid contest entry blank which can be obtained from any electronic parts jobber selling Pyramid capacitors. You have this entry blank countersigned by your jobber or one of his salesmen and forward it to us attached to a Pyramid Dry Electrolytic Capacitor box top —the top being the part which carries the description of the item. There is no limit to the number of entries which you may make in this contest but each entry must be accompanied by a box top. Full rules for the contest appear on the entry blank.

It's so easy. Here is the kind of statement that might win:

"I like Pyramid capacitors because they always check out perfectly and don't deteriorate and so I know I won't have to call back at my expense."

"I like Pyramid capacitors because the line is so complete that I can always get what I need and don't have to worry about an off-brand capacitor."

PYRAMID

PYRAMID FEATURES:

1. Only one quality—the best at no premium. All Pyramid capacitors are made of materials commanded by rigid military specifications.
2. All Pyramid capacitors are non-hygroscopic.
3. Highest quality insulator material used in all production results in low leakage factor.
4. Exclusive non-contamination technique guarantees close tolerances and no deterioration. Peak performances for life.
5. Pyramid capacitors operate unchanged at ambient temperature of 85° centigrade.
6. Designed by service technicians across the country for their requirements.
7. Individually packaged for protection.
8. Permanently legible, high visibility ratings on each item.
9. 100% absolute electronic inspection before shipment.

Pyramid is in its 10th year as a leading manufacturer of high-quality capacitors.

PYRAMID ELECTRIC COMPANY
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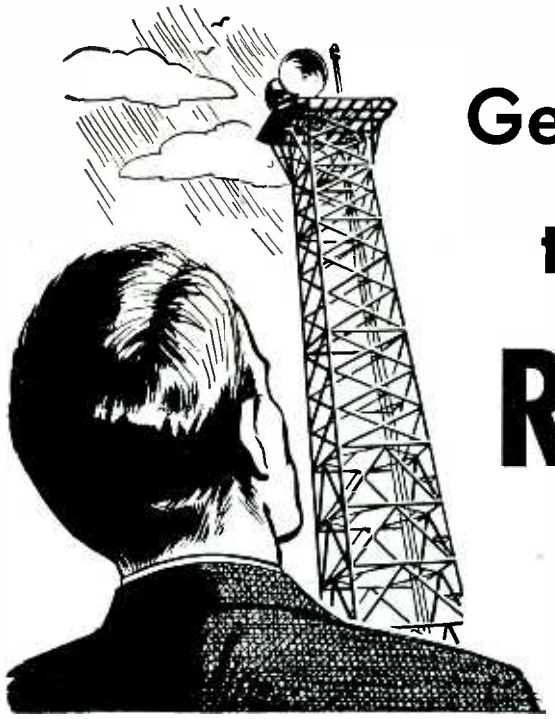

Get yourself on the beam to the BIG MONEY in RADIO AND TV

THAT'S the way to become an expert Radio or Television service man. Study the bedrock theories and principles. These are vitally important. Nothing can take their place—not even the most elaborate kits.

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I.C.S. offers you two new courses in radio and television servicing—one for beginners, the other for experienced amateurs.

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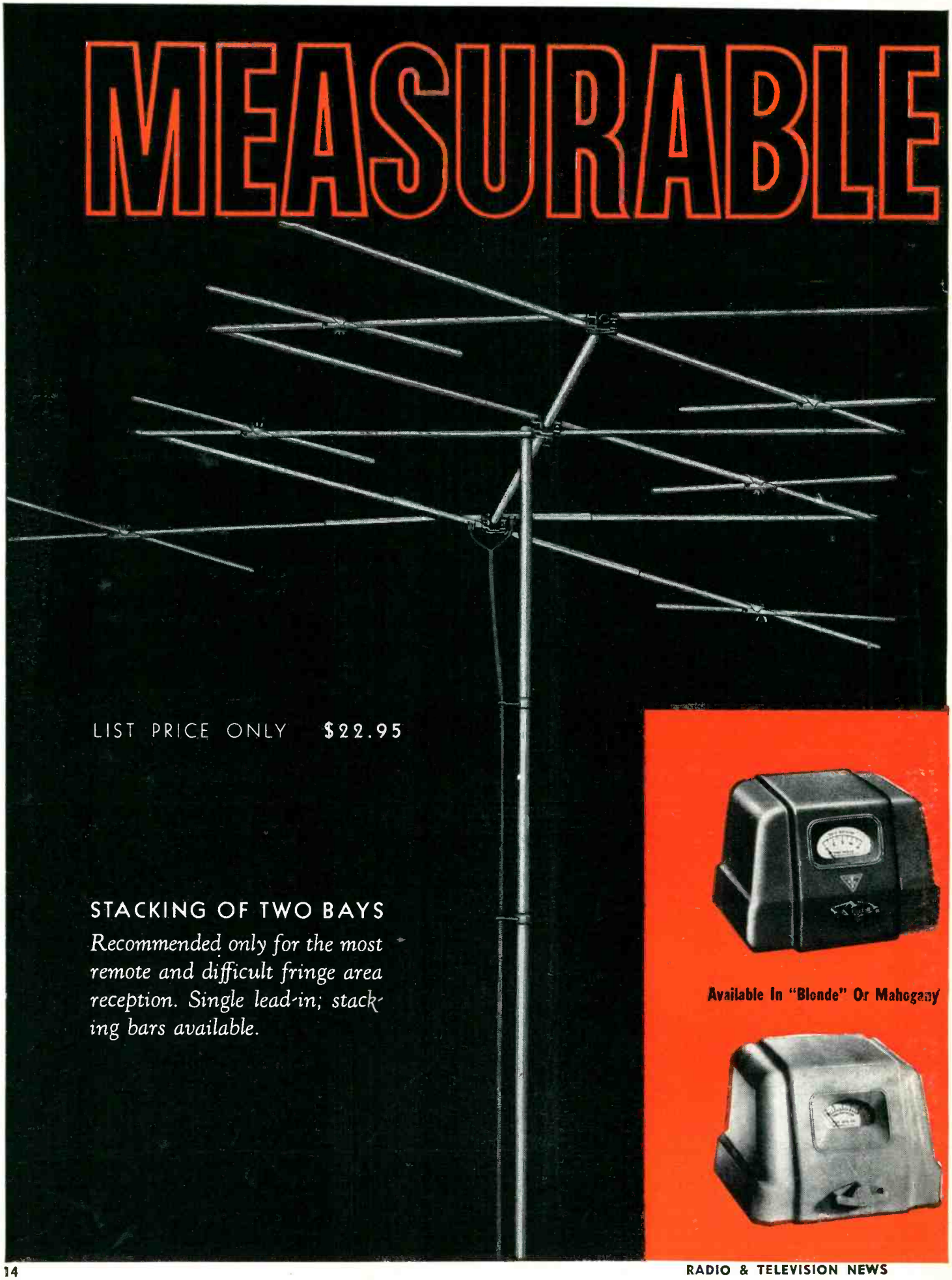

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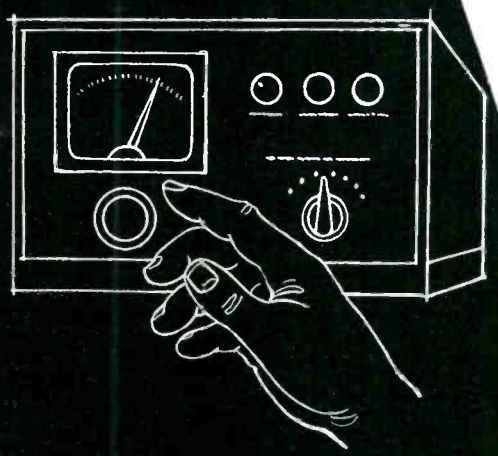
Recommended only for the most remote and difficult fringe area reception. Single lead-in; stacking bars available.

Available In "Blonde" Or Mahogany

higher gain than any other All-Channel VHF Antenna!



New TRIO "TWIN-SIX"

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ONE BAY DOES IT ALL

- No stacking necessary for most fringe areas.
- Exclusive Zig-Zag principle provides that additional gain.
- Single lead-in operation.
- Excellent UHF reception in primary and near fringe areas.
- Rugged "bridge-type" construction, low wind resistance, attractive appearance.
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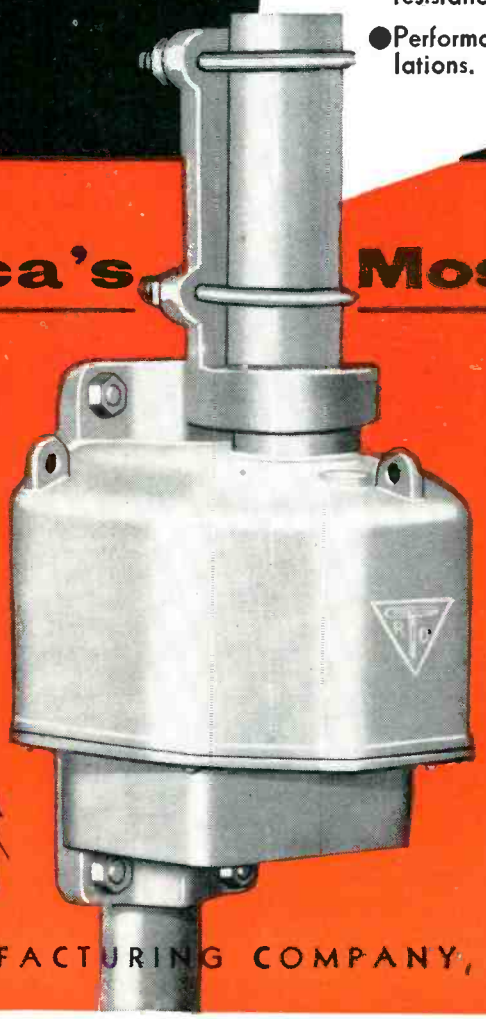

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Spot Radio News

*** Presenting latest information on the Radio Industry.**

By RADIO & TELEVISION NEWS' WASHINGTON EDITOR

POLISHING OF THE final script for color TV's princely entrance onto the dazzling stage set for '54, breathlessly awaited not only by the nation but by the world after thousands of turbulent days of delay, practically choked the calendar of the Commission in the closing days of '53.

There were few days that members of the staff and allied groups did not have to meet to discuss some phase of the hue decision as it would appear on the official record. Some sessions lasted for hours and revolved about problems of cost, complexity of receiver design, station changes and additions, compatibility, conversions, term definitions, color fidelity, servicing and installation, and the long-term nature of the standards, plus color-system patents and their criss-cross relationship to members of industry who did and did not participate in the NTSC studies.

In the meantime, set makers were feverishly pushing their pilot lines of color chassis for exhibition at dealer meetings during the annual shows in Chicago, Los Angeles, and New York. Some chassis producers told the Commission that they would have as many as 100 tricolor sets ready for demonstration during these important yearly conclaves.

Officialdom was also notified that one of the four types of color tubes would be used in these models (*RCA, Lawrence, CBS-Hytron,* and *Rauland*) and that corresponding changes in the picture-tube circuitry would obtain in these receivers. Of course, all will follow the basic receiver standards prescribed by the National Television System Committee. Most of the receivers, it was said, would use about 36 tubes, exclusive of the picture tube, and carry tentative list prices of between $795 and $1000.

Industry associations also reported to the Commission that they were considering the publication of a pamphlet aimed at the technician level which would detail some of the key aspects of color TV, and offer answers to basic problems that might be encountered. It was also announced that several manufacturers were planning field lectures on color TV for dealers and technicians, with the association's booklet being used as a classroom primer. Originally, plans called for a series of cooperatively-sponsored talks, but this idea was shelved because of a lack of manpower and also symposium-routing problems.

Two commissioners, George E. Sterling and Headman Rosel H. Hyde, experienced an interesting afternoon of viewing with color a few weeks ago, during the special broadcast of "Carmen" from New York. The government agents sat in the labs of the FCC at Laurel, Maryland, about twenty miles from Washington, and watched the program on test sets supplied by *RCA* and *G-E*. They said that they were extremely impressed with the performance of the broadcast and the receivers' operation.

A SENSITIVE ELECTRONIC device, that is expected to shed some light on the tremendous potential—upwards of 100,000 volts—that exists between our earth and the upper stratosphere, a problem pertinent to long-range communications now, and one that might eventually affect future interplanetary flight, has been developed for the Air Force's Air Research and Development Command.

Weighing but six and one-half pounds, the unit is powered by special batteries and packed with subminiature parts. It is housed in an aluminum case with special insulation which it is expected will minimize the problem of solar radiation and low temperatures found at high altitudes. It was explained that at stratospheric altitudes, although outside air temperatures may be as low as 80 degrees below zero, the sun's rays could generate enough heat inside the instrument to melt some of the parts.

According to one of the research and development engineers on the project, the instrument is so sensitive that it will measure minute flows of electric current—as low as one-million ions per second. (An ion is an atom or group of atoms with an electric charge.)

Carried aloft by huge plastic, free-flying balloons, the instrument instantaneously radios back to a ground-recording station the electrical conductivity, air temperature, and air pressure. By interpreting the temperature and pressure readings, scientists will be able to determine accurately the altitude of the instrument, thus obtaining a record of the variation of the electrical conductivity with the altitude. Upon reaching maximum height, the balloon is mechanically broken and

BLACK BEAUTY® TV TUBULARS

first and still finest... accept no substitutes

Imitation, they say, is the sincerest form of flattery. If so, you who have installed some of the 250,000,000 Black Beauty Telecaps in the past 7 years can be mighty proud. Few Sprague developments have been so closely copied as this capacitor in which you have placed your confidence.

Black Beauty imitations are available in almost every color imaginable . . . including black! But no other molded tubular can equal the unprecedented record set by Sprague TV Tubulars since 1947 when they were first introduced.

Don't be vague — insist on Sprague Black Beauty Telecaps for your TV and radio service needs! There is only one Sprague Black Beauty, *and it has no equal.* Accept no imitations.

Write today for the complete Sprague television and radio service catalog C-609 to Sprague Products Company,* 51 Marshall Street, North Adams, Mass.

There is a Sprague Distributor in every sales area in the United States. Write for the name of your nearest source of supply today.

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dry-assembly phenolic molded paper capacitors offer:

- extra high insulation resistance
- minimum capacitance change with temperature variations
- absence of drift with repeated heating and cooling

Don't Be Vague... Insist on

SPRAGUE

WORLD'S LARGEST CAPACITOR MANUFACTURER

*Sprague Products Company is the Distributors' Division of the Sprague Electric Company

the equipment descends to ground. Additional data is taken on the descent.

The new device, called an *aerial electrometer,* will be carried as high as 100,000 feet. Until now, it has only been possible to collect data on atmospheric electricity from measuring instruments carried by planes reaching a height of 35,000 feet. This ingenious item will make it possible to understand eventually why there is a current of 1800 amperes constantly flowing toward earth; for over fifty years scientists have been trying to discover the source of this tremendous amount of current.

CONELRAD, developed to alert the nation in case of an air attack, can now be activated by over 200 clusters of broadcasters and 500 single stations according to the engineering manager of the National Association of Radio and Television Broadcasters. Should our country ever be attacked, he said, there is no question that the role of the broadcast stations will be equal to that of the defense arm of the military.

Describing the dissemination of the alert signal, he noted that all notifications for alerts and all-clears will be issued by air defense control centers, under the authority of the air division commander or an authorized representative, to all basic key stations. All relay key stations will, in turn, be notified by the basic key stations or other relay key stations. The remaining stations will then be notified by basic key stations or relay key stations. These notifications will be accomplished either by telephone messages or by radio broadcasts. Continuing, the NARTB engineering head said that during the experimental period (midnight to local sunrise) many of the regular key stations may be off the air. All standard, FM, and TV stations have been supplied with the list of *skywave* key stations, at least one of which must be monitored during any period of operation when the regularly-used key station is not on the air.

To receive the alert and all clear, it is mandatory that every standard, FM and TV station has a suitable radio receiver, which should be located at transmitter control. Such a set must be installed regardless of wire-line terminations, such as at the basic key or relay key stations. This ruling was adopted, it was said, to back up any failure that might occur on the wire-line circuits.

In a review of coverage during Conelrad operation, it was pointed out that the system is intended to provide intelligible coverage rather than the usual high type of broadcast quality. This is particularly true, it was emphasized, in areas where the signal intensities are low and where there is rather a wide divergence among the signals of different stations in a sequential cluster. The automatic volume control in the average set can take care of this up to a point, but will not entirely compensate when one signal is considerably weaker and inter-

(*Continued on page* 125)

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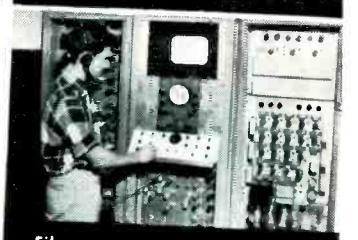
Radio – TV serviceman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Now CTI offers you *MASTER TRAINING* in Electronics, Radio and Television – a combination extension-resident program ACCREDITED by a nationally recognized accrediting agency.

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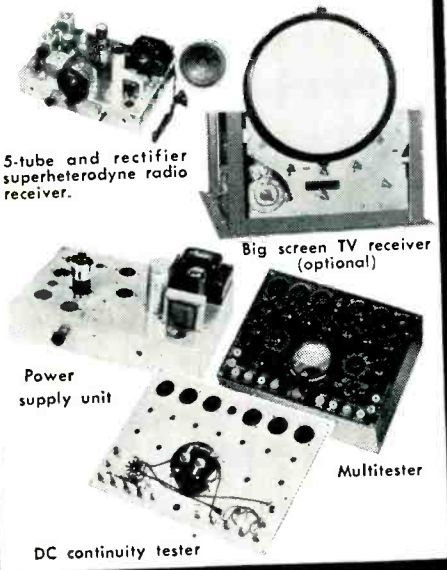
This equipment - and more - - is yours to keep!



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We will send you, FREE, a self-evaluation aptitude guide which will tell you whether you are cut out for this exciting, big-paying profession. Mail coupon at once!

Thousands of highly paid career jobs must be filled in the ever-expanding Electronics Industry. And CTI graduates—men who have sound, thorough training in TV-Radio-Electronics—are the men who fill these important positions!

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With MASTER TRAINING in Electronics-Radio-Television, CTI gives you a PROGRESSIVE TRAINING PLAN. Every CTI lesson you complete . . . every fascinating home-laboratory experiment you perform . . . brings you closer to the Electronics job you want. You PROGRESS from one section to another, and every section you complete qualifies you for a better job, higher earnings. You have something to show—more knowledge of Electronics, more practical skill, greater job qualifications—for every hour you invest in CTI MASTER TRAINING!

- **Approved for Veterans and Non-Veterans**
- **An Approved Technical Institute Offering Accredited Electronic Curricula**

Get in on the Ground Floor!

Don't deny yourself the good pay, the security, the prestige connected with this fascinating industry. The sooner you act, the sooner you can enjoy all benefits of CTI training.

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Ask for information on CTI's accredited resident program leading to Associate of Science (A.S.) Degree. Radio and Electronics training through home study only also available.

FREE – Official monograph on opportunities in Electronics; FREE: "The Electronics Technician" brochure which includes aptitude guide.

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TRIPLETT 630 Volt - Ohm - Mil - Ammeter has many significant advantages and features that make it stand distinctly apart from similar instruments in its price class. Actually in components, in engineering, in minutely accurate performance, Triplett 630 closely approaches laboratory standards.

Since the scales of any VOM comprise the means by which it makes its multiple services most valuable, the legibility and easy-read-ability are of prime importance. Triplett engineers have created in Triplett 630 the longest scales available in this size tester. (The upper arc by actual measurement is four and three-eighth inches.)

This long-scale factor accounts for the ease with which precise readings are easily made. Further legibility is gained by use of black and red scale markings. D.C. and D.B. are black and white. A.C. and Ohm markings are red on white. Ohms from one hundred million to one-tenth ohm mark the range of this amazing scale. On low ohms, center scale reading is 4.5 ohms.

The Single Switch

Futher indication of the practical skill and engineering "know-how" behind Triplett 630 is the Single Switch. Its simplicity of operation assures no burn-outs thru momentary memory lapses. There is instant switching to desired circuit thru a single 2½" knob flush with the face panel. The molded switch itself embodies the most advanced engineering practices. Fully enclosed, the silvered contacts are kept permanently clean. Its rugged construction means stronger performance and longer life.

These two factors are but samples of the many ways in which on-the-job needs have been anticipated and provided for in a beautiful streamlined tester. It provides A.D-D.C. Volts, D.C. Micro-amperes, Milliamperes, Amperes, Ohms, Megohms, Decibel and Out Put readings in a no-short design embodying interior construction with all direct connections; no harness cabling. Its fool-proof unit switch construction houses precision resistors in insulated recesses in direct connection with switch contacts.

Study the following Ranges and descriptions and compare them point by point with *any* similar instrument for conclusive proof that Triplett 630 "speaks" for itself in *any* company.

Ranges

D.C. Volts: 0-3-12-60-300-1200—at 20,000 Ohms/Volt (For Greater Accuracy on TV and other High Resistance Circuits.)
A.C. Volts: 0-3-12-60-300-1200-6000—at 5,000 Ohms/Volt (For Greater Accuracy in Audio and other High Impedance A.C. Circuits.)
Decibels: —30, +4, +16, +30, +44, +56, +70. (For Direct Reading of Output Levels.)
D.C. Microamperes: 0-60—at 250 Millivolts.
D.C. Milliamperes: 0-1.2-12-120—at 250 Millivolts.
D.C. Amperes: 0-12—at 250 Millivolts.
***Ohms:** 0-1,000-10,000—(4,4-44 at center scale).
***Megohms:** 0-1-100—(4,400-440,000 center scale).
Output: Condenser in series with A.C. Volt ranges.

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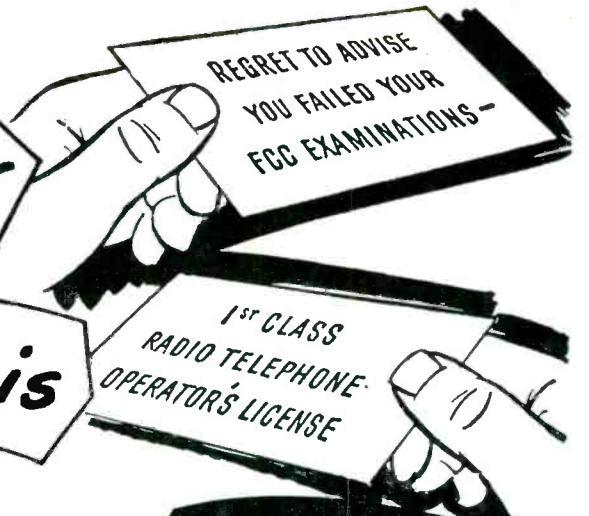

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If you fail to pass your Commercial License exam after completing our course, we guarantee to continue your training without additional cost of any kind until you successfully obtain your Commercial license, provided you first sit for this examination within 90 days after completing your course.

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TO TRAIN AND COACH YOU AT HOME IN SPARE TIME UNTIL YOU GET

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If you have had any practical experience—Amateur, Army, Navy, radio repair, or experimenting.

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Employers make JOB OFFERS Like These to Our Graduates Every Month

Letter from nationally known manufacturer of high quality AM and FM transmitters. "We are very much in need at the present time of radio-electronics technicians and would appreciate any helpful suggestions that you may be able to offer." Salary up to $412 per month to start.

Letter from nationally known airplane manufacturer. "We need men with electronic training or experience in radar maintenance to perform operational check-out of radar and other electronics systems . . . starting salary . . . amounting to $329.33 per month."

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Clifford E. Vogt, Box 1016, Dania, Florida	1st Phone	20
Francis X. Foerch, 38 Beucler Pl., Bergenfield, New Jersey	1st Phone	38
S/Sgt. Ben H. Davis, 317 North Roosevelt, Lebanon, Illinois	1st Phone	38
Albert Schoell, 110 West 11th St., Escondido, California	2nd Phone	23

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"I have obtained my 1st class ticket (thanks to your school) and since receiving same I have held good jobs at all times. I am now Chief Radio Operator with the Kentucky State Police."
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"I wish to thank your Job-Finding Service for the help in securing for me the position of transmitter operator here at WCAE, in Pittsburgh."
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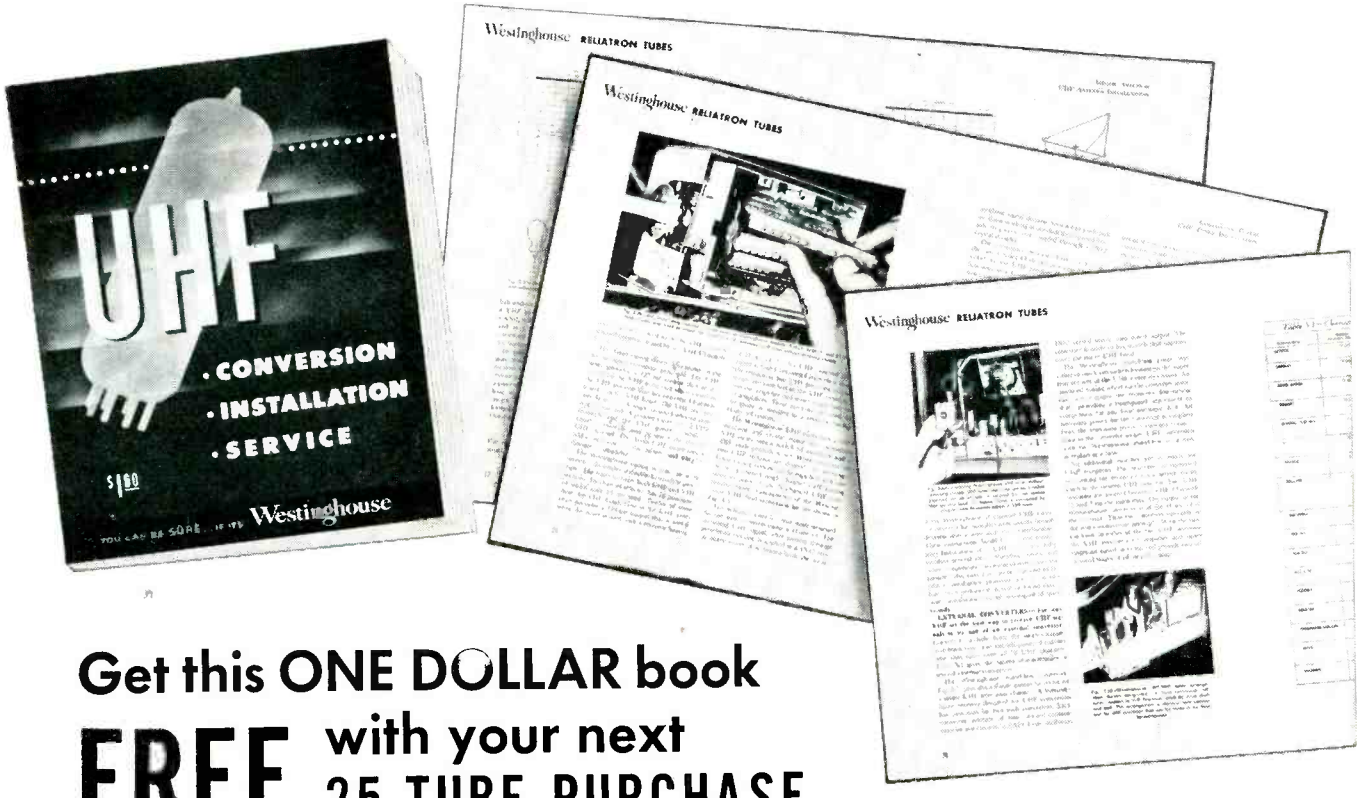

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This newest, most helpful book on UHF conversions is yours free when you buy 25 RELIATRON receiving tubes or one picture tube from your Westinghouse Distributor.

This vital handbook covers conversion data, tuners and converters, antenna installations, channel frequency charts, station coverage, and many other necessary, conveniently arranged facts you will need.

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Get this dollar value for no extra charge with your next order of 25 tubes! See your nearest Westinghouse RELIATRON Tube Distributor for your copy of this new "how to do it" book that will build your profits.

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There is a place for *you* in the great Radio-Television-Electronics industry when you are trained as National Schools will train you at home!

Trained technicians are in growing demand at good pay—in manufacturing, broadcasting, television, communications, radar, research laboratories, home Radio-TV service, and other branches of the field. National Schools Master Shop-Method Home Training, with newly added lessons and equipment, trains you in your spare time, right in your own home, for these fascinating opportunities. OUR METHOD IS PROVED BY THE SUCCESS OF NATIONAL SCHOOLS TRAINED MEN, ALL OVER THE WORLD, SINCE 1905.

EARN WHILE YOU LEARN

Many National students pay for all or part of their training with spare time earnings. We'll show you how you can do the same! Early in your training, you receive "Spare-time Work" Lessons which will enable you to earn extra money servicing neighbors' and friends' Radio and Television receivers, appliances, etc.

MASTER ALL PHASES!

Get Master Shop-Method Home Training from an Established Practical Resident School with its own Training Shops, Laboratories, Studios — almost 50 Years of Successful Experience in Training Ambitious Men.

We Bring National Schools To You!

Superheterodyne Receiver

Signal Generator Audio Oscillator T.R.F. Receiver

LEARN BY DOING

You receive and keep all the modern equipment shown above, including tubes and valuable, professional quality Multitester. *No extra charges.*

FREE! RADIO-TV BOOK AND SAMPLE LESSON!

Send *today* for National Schools' new, illustrated Book of Opportunity in Radio-Television-Electronics, and an actual Sample Lesson. No cost—no obligation. Use the coupon now—we'll answer by return airmail.

This course also offered in Spanish and Portuguese

National Schools Training is All-Embracing

National Schools prepares you for your choice of many job opportunities. Thousands of home, portable, and auto radios are being sold daily—more than ever before. Television is sweeping the country, too. Co-axial cables are now bringing Television to more cities, towns, and farms every day! National Schools' *complete* training program qualifies you in all fields. Read this partial list of opportunities for trained technicians:

Business of Your Own • Broadcasting
Radio Manufacturing, Sales, Service • Telecasting
Television Manufacturing, Sales, Service
Laboratories: Installation, Maintenance of Electronic Equipment
Electrolysis, Call Systems
Garages: Auto Radio Sales, Service
Sound Systems and Telephone Companies, Engineering Firms
Theatre Sound Systems, Police Radio
And scores of other good jobs in many related fields.

APPROVED FOR VETERANS AND NON-VETERANS
Check coupon below

Both Resident and Home Study Courses Offered!

TELEVISION TRAINING

You get a complete series of up-to-the-minute lessons covering all phases of repairing, servicing and construction. The same lesson texts used by resident students in our modern and complete Television broadcast studios, laboratories and classrooms!

NATIONAL SCHOOLS

LOS ANGELES 37, CALIFORNIA • ESTABLISHED 1905
IN CANADA: 811 W. HASTINGS STREET, VANCOUVER, B.C.

GET FACTS FASTEST! MAIL TO OFFICE NEAREST YOU!

(mail in envelope or paste on postal card)

NATIONAL SCHOOLS, Dept. RH-24

4000 S. Figueroa Street, Los Angeles 37, Calif. or **323 West Polk Street, Chicago 7, Ill.**

Send FREE Radio-TV Electronics book and FREE sample lesson. No obligation, no salesman will call.

NAME _____ BIRTHDAY _____ 19___

ADDRESS _____

CITY _____ ZONE ____ STATE _____

☐ Check here if interested in Resident School Training at Los Angeles.
VETERANS: Give Date of Discharge _____

Within the INDUSTRY

LYNN EATON has been appointed vice-president in charge of sales for *National Company, Inc.*, electronic engineering and manufacturing firm of Malden and Melrose, Mass.

Mr. Eaton has, for the past four years, served as general sales manager of another well-known eastern manufacturer of electronic products. Prior to that he was sales manager of *Bendix Home Appliances, Inc.*

In his new post he will supervise all sales activities, both foreign and domestic; advertising and promotion, and market surveys. He will also serve as chairman of the new projects committee of the company.

* * *

RETMA has created an international department and authorized the employment of special counsel for the newly-established Electronics Industry Committee in its continuing program of expansion.

The new international department will be governed by an executive committee representing both radio-TV and electronics interests and will comprise various product sections. An export manager will be employed and stationed at RETMA headquarters in Washington.

The service committee of the association has approved plans to hold a three-week "teacher training seminar" for television service instructors this summer. The seminar will be based on teaching techniques and subject material covered in RETMA's "A" pilot course.

* * *

A. W. KEEN has been named commercial engineering manager for the television picture tube division of *Sylvania Electric Products Inc.* He will make his headquarters at the picture tube division's plant in Seneca Falls, N. Y. . . . The Tube Division of *Westinghouse* has named **JOHN A. CURTIS** to the post of general sales manager . . . **GRANT GRAHAM,** previously in the jobber sales division of *Triad Transformer Corporation,* has been named to fill the newly-created post of product applications engineer . . . *Jerrold Electronics Corporation* has promoted **CAYWOOD C. COOLEY** to the post of vice-president and general manager of the company's service division while **ROBERT J. TARLTON,** who formerly headed the service corporation, has been named manager of the company's new community operations division . . . **C. H. SHARP** has been promoted to the post of general manager of *H. H. Buggie, Inc.* of Toledo. The company also upped **C. R. THORPE** to the post of chief engineer. He was formerly sales manager of the firm . . . **BARNEY EDWARDS** is the new national sales manager for *Recoton Corp.* of New York . . . *CBS-Columbia* has appointed **FRANK R. DAY** production engineer. He has more than thirty years' experience in the radio-television field . . . **W. K. TRUKENBROD** is the new merchandise and sales manager of *Warwick Manufacturing Corporation's* home receiver department. He was formerly with *Raytheon's* distributor division . . . **LINCOLN THOMPSON** has been named a vice-president of *Raymond Engineering Laboratory* of Middletown, Conn. . . . **MYLES SPECTOR** has rejoined *Insuline Corporation of America* after a tour of duty in the Air Force. He is in charge of the company's new product development program . . . *Bellevue Tube Mill, Incorporated,* an affiliate of *Snyder Manufacturing Company,* has appointed **DICK MORRIS** to the post of sales manager . . . **C. G. BARKER,** former vice-president in charge of sales for *Magnecord, Inc.,* has been named distribution manager of the *National Company, Inc.*

* * *

DR. THOMAS T. GOLDSMITH, JR. has been named vice-president-research of the *Allen B. Du Mont Laboratories, Inc.*

One of the country's outstanding electronics and television scientists, Dr. Goldsmith is a member of the company's board of directors and is also president and a director of *Du Mont Television & Electronics, Ltd.* of Canada.

Dr. Goldsmith joined the company in 1936 as director of research. He is active on various committees of RETMA, IRE, SMPTE, NARTB, AIEE, and NTSC.

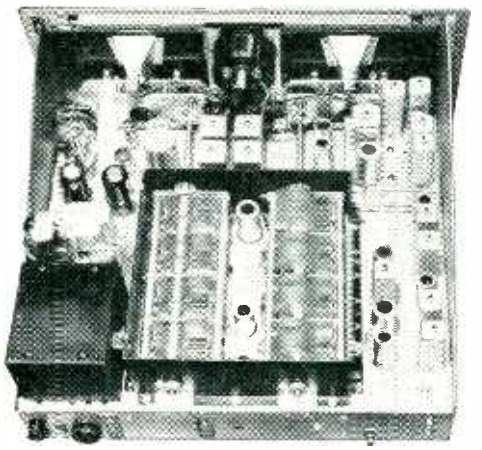
* * *

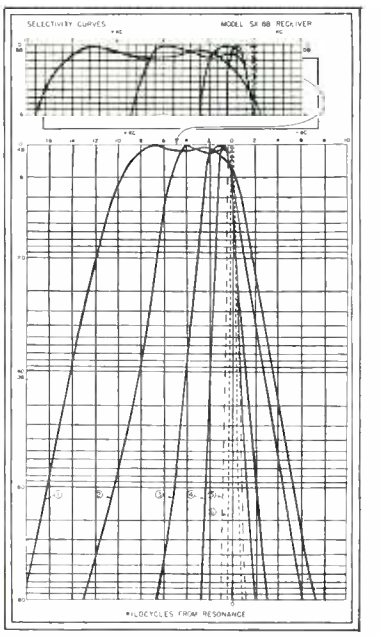
SUPEREX ELECTRONICS CORPORATION of Yonkers, N. Y. is now operating **RAYBURNE CORPORATION** of that city and will market the combined lines of electronic components and equipment under the parent company's name. The new subsidiary makes "Ferri-Loopsticks," "Vari-Loopsticks," TV interference filters, etc. This line will be continued and expanded in the new setup . . . **J. L. CAPPELS & ASSOCIATES** has been formed as a manufacturers representatives firm with headquarters at 800 North Clark Street, Chicago 10. Mr. Cappels, principal in the new firm, was formerly associated with *Hallicrafters, Meissner,* and *Stewart-Warner* . . . **SUPERIOR TUBE**

HERE ARE 31 REASONS WHY THE hallicrafters SX-88 is the hottest ham news in years!

SX-88

SELECTIVITY—
For the first time, selectivity from 10 kc to 250 cycles in six steps. Compare with ANY other receiver!





1. Heavy gauge steel welded chassis for mechanical stability.
2. Full precision gear drive for main and band spread tuning.
3. Six position Band Width Control (selectivity) from 250 cycles to 10 kc.
4. 10 watt inverse feed back and push-pull audio output.
5. Exhalted B.F.O. for tops in single side band reception.
6. Buffer amplifier in B.F.O. circuit.
7. Antenna trimmer.
8. Amplified and delayed A.V.C.
9. Built-in 100 kc calibration crystal.
10. Second conversion oscillators crystal controlled.
11. Inertia tuning (fly wheels both dials).
12. Full frequency coverage from 535 kc. to 33 mc.
13. Calibrated electrical band spread 160, 80, 40, 20, 15, 11, and 10 meters.
14. Logging scales on each tuning shaft.
15. Dial locks on each tuning shaft.
16. Tuning dial indicators resetable from front panel for maximum calibration accuracy.
17. Auxiliary A.C. socket on rear of chassis.
18. Illuminated band-in-use indicator.
19. Illuminated S meter.
20. Dual S meter calibration S units and microvolts.
21. Auxiliary power socket plus .6 amps at 6.3 volts and 10 ma at 150 volts for accessories.
22. Standard 8¾" by 19" panel for rack mounting if desired.
23. 50 kc i.f. output jack via cathode follower for teletype converter, etc.
24. Five position response control (tone control).
25. Two r.f. stages (Bands II to VI).
26. 17 tubes plus voltage regulator, ballast tube and rectifier.
27. Automatic noise limiter circuit.
28. Phono Jack.
29. Audio output transformer for 3.2, 8, 500/600 ohm loads.
30. Fuse for overload protection.
31. Auxiliary sensitivity control permits monitoring of local transmissions in standby position.

hallicrafters

World's Leading Exclusive Manufacturer of Communications and High Fidelity Equipment, Radio and Television

4401 West Fifth Avenue, Chicago 24, Illinois • Hallicrafters Ltd., 51 Camden Street, Toronto, Canada

COMPANY of Norristown, Pa. has purchased a controlling interest in **FINE TUBES LIMITED,** Surbiton, Surrey, England . . . **SERVOMECHANISMS, INC.** has formed a new component division which will be located at 625 Main Street, Westbury, N. Y. The new division will produce miniature servo and instrument motors, etc . . . **RADIO-TECHNICAL SALES COMPANY** has been formed to represent radio-electronic-television manufacturers in the central midwest area. Lew H. Morse, organizer of the firm, advises that the firm will provide technical sales representation in Nebraska, Iowa, Kansas, Missouri, Oklahoma, and Arkansas.

* * *

JOHN R. THOMPSON has been appointed manager of commercial electronic sales for *Hycon Mfg. Company.*

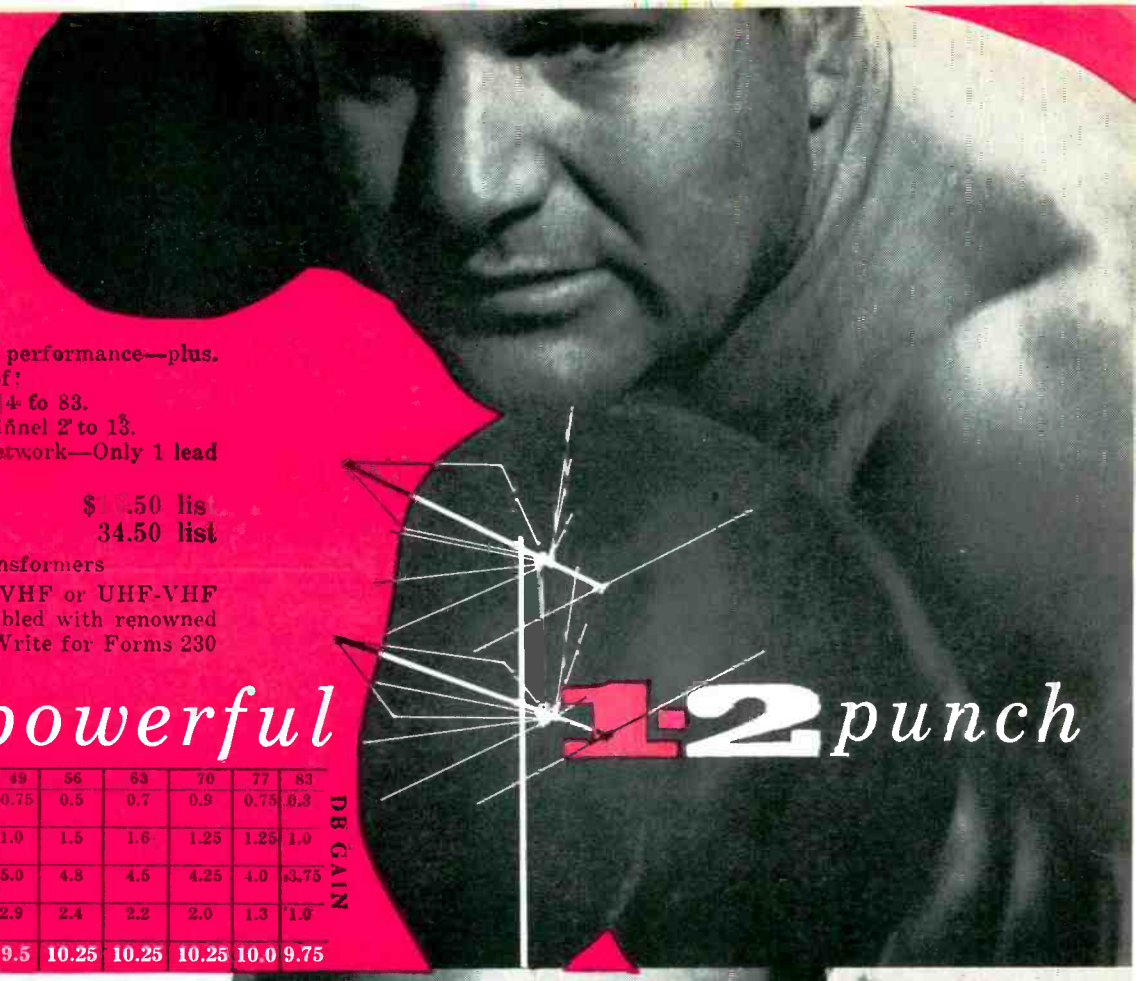
He was formerly manager of electronic sales for the Cincinnati district of *Graybar Electric Company.* As a former electronic engineer for the Navy Department, Mr. Thompson was one of the designers of the underwater submarine and mine detection devices in the field of sonar. He also set up installations and trained personnel in its use.

He is a member of the IRE and was formerly chief engineer for *Stone and Smith Company,* Los Angeles.

* * *

CANNON ELECTRIC COMPANY of Los Angeles has established a third plant in the Lincoln Heights area of Los Angeles at 210 W. Avenue 26 near Barranca Street. The new plant covers approximately 6000 square feet and has a 4000 square foot parking area . . . **ELECTRO PRODUCTS LABORATORIES** of Chicago has expanded its production area at its plant 4501 N. Ravenswood Avenue. Approximately 30 per-cent more floor space has been added to the company's present manufacturing facilities . . . **SUPERIOR INSULATED WIRE COMPANY** has just completed a modern manufacturing plant at Haverstraw, N. Y. The new plant adds over 15,000 square feet to the company's existing facilities for producing electric wires and television transmission lines . . . **PENTRON CORPORATION** of Chicago has leased additional manufacturing facilities at 2355 S. Indiana Avenue and 2441 S. Michigan Avenue in Chicago for assembly operations . . . The newly-occupied 77,000 square foot plant of the electronics division of **THERMADOR ELECTRICAL MANUFACTURING COMPANY,** Los Angeles, is now in full operation . . . The electronics division of **DIAMOND POWER SPECIALTY CORPORATION** has moved into its new electronics laboratory adjacent to its manufacturing plant at Lancaster, Ohio. The new building has approximately 30,000 square feet of floor space and houses the most advanced facilities . . . **ELCO CORPORATION** has added a new plant to its facilities located at

(*Continued on page* 185)



JFD JeTOMIC

Produces brilliant deep fringe UHF performance—plus.
Produces heretofore unachieved gain of:
Stacked* UHF Rhombic on Channels 14 to 83.
Stacked JeT conical on every VHF Channel 2 to 13.
Featuring exclusive no-loss isolation network—Only 1 lead to set.

Model JeT 454 **Single** **$[illegible].50 list**
Model JeT 454 S* **Stacked** **34.50 list**

* complete with stacking transformers

Guaranteed to out-perform any other VHF or UHF-VHF antenna. Both units factory pre-assembled with renowned Jet-action all-aluminum construction. Write for Forms 230 and 241.

the most powerful 1-2 punch

Channels	14	21	28	35	42	49	56	63	70	77	83
Competitor A Conical with Bowtie (2 stack)	4.0	3.25	2.0	1.0	1.0	0.75	0.5	0.7	0.9	0.75	0.3
Competitor B Bedspring with UHF	0.75	0.75	0.9	1.0	0.8	1.0	1.5	1.6	1.25	1.25	1.0
Competitor C Conical with V (2 stack)	3.0	3.3	4.0	4.6	4.9	5.0	4.8	4.5	4.25	4.0	3.75
Competitor D Filter type with attached "V"	2.0	2.0	2.5	2.75	2.9	2.9	2.4	2.2	2.0	1.3	1.0
JFD JeT 454 S	**7.0**	**7.25**	**7.4**	**8.5**	**9.0**	**9.5**	**10.25**	**10.25**	**10.25**	**10.0**	**9.75**

DB GAIN

JFD SUPER-JeT

Delivers Spectacular Deep fringe VHF performance—plus.
Packs Unprecedented gain of:
Single 10-Element VHF Yagi on each channel from 2 to 13.
Stacked UHF Bowtie-Reflector off side lobes on Channels 14 to 83.

Model JeT 213 **Single** **$20.75 list**
Model JeT 213 S* **Stacked** **42.50 list**

* complete with stacking transformers

JFD Electronics

Burton browne advertising

JFD Manufacturing Company
Brooklyn 4, N. Y.

in antenna history!

CHANNELS	2	3	4	5	6	7	8	9	10	11	12	13
Competitor A Mattress (4 Stack)	4.0	5.0	7.0	6.25	5.0	5.25	6.0	5.25	7.25	9.25	6.5	7.0
Competitor B Radar Screen Type A	0.0	3.0	4.0	3.25	3.0	4.5	7 0	7.0	8.0	10.0	10.0	9.0
Competitor C Radar Screen Type B	0.75	3.25	4.5	3.5	3.5	6.0	7.0	6.5	7.75	8.0	7.5	6.0
Competitor D CHS 2-13 YAGI	4.50	5.00	5.75	3.00	2.50	3.50	1.00	0.0	.875	.875	.50	.75
JFD JeT 213 S	6.0	7.5	8.75	7.75	6.75	10.0	9.0	7.0	9.0	10.0	11.0	9.75

DB GAIN

	1" Square Crossarm	Completely Preassembled	LIST PRICE
Competitor A	NO	YES	$55.00
Competitor B	NO	NO	$34.95
Competitor C	NO	NO	$47.50
Competitor D (2 STACK)	NO	NO	$65.90
JFD JeT 213 S	YES	YES	$42.50

World's largest manufacturers of TV antennas and accessories.

This rubber "tire" talks to you

Bell Laboratories engineers have developed a new and highly economical way to record sound magnetically.

Instead of tape or wire they use a mixture of rubber and iron oxides which is formed into a band and mounted on a wheel. This simple and very rugged "talking rubber" can play back messages clearly millions of times.

Talking rubber is already at work for the Bell System announcing weather and answering customers who call vacant or disconnected numbers. It promises to have many other uses. In a new machine, it answers your telephone in your own voice when you are away—and takes a message for you in the voice of your caller.

Many businesses, too, other than telephone, are expected to find a variety of ways to use talking rubber—especially whenever a message must be given quickly to many people.

Talking rubber proves again the downright practicality of Bell Laboratories' research to improve telephone service.

One of a bank of recorder-reproducers operated by the New York Telephone Company for the New York Stock Exchange. They give instant stock quotations to brokers who dial a code number. Recording and pickup heads are shown above wheel.

BELL TELEPHONE LABORATORIES

Improving telephone service for America provides careers for creative men in scientific and technical fields.

No matter where you live
or what you are doing now . . .

I WILL TRAIN YOU FOR A BIG PAY JOB IN TELEVISION

L. C. Lane, B.S., M.A.
President: Radio-Television Training Association.
Executive Director: Pierce School of Radio-Television.

CIVILIANS! VETERANS!

Thousands of new jobs in TV are opening up in every state as new stations go on the air. You too can take your place in America's booming TELEVISION and Electronics industry. enjoy the success and happiness you always wanted out of life! Now . . . prepare for a life-time career as a trained TV TECHNICIAN, often within months . . . using the same successful "learn-by-doing" home study methods that have helped hundreds of men with NO PREVIOUS TRAINING!

NO EXPERIENCE NECESSARY

LEARN TELEVISION AT HOME IN YOUR SPARE TIME!

Giant Screen TV Receiver

GET MORE! LEARN MORE! EARN MORE!

I give you ALL the equipment and training you need to prepare for the BETTER PAY jobs in TV. While training, many of my students make $25.00 a week repairing Radio-TV sets in their spare time . . . start their own profitable service business.

Super-Het Radio Receiver

MORE EQUIPMENT!

You build and keep this professional GIANT SCREEN TV RECEIVER complete with big picture tube (designed and engineered to take any size up to 21-inch). Also all units illustrated, plus additional equipment! Everything supplied complete with all tubes.

C-W Telephone Receiver

FREE FCC COACHING COURSE!

Prepares you at home for your FCC License. The best jobs in TV and radio require an FCC License. My FCC Coaching Course is given to you at NO EXTRA COST after TV Theory and Practice is completed.

Combination Voltmeter-Ammeter-Ohmmeter

NEW! PRACTICAL TV CAMERAMAN & STUDIO COURSE!

For Men With Previous Radio & TV Training

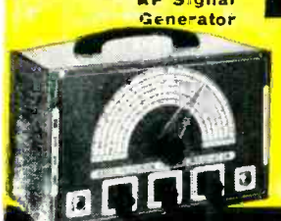
I train you at home for an exciting big pay job as the man behind the TV camera. Work with TV stars in TV studios or "on location" at remote pick-ups! A special one-week course of practical work on TV studio equipment at Pierce School of Radio & TV, our associate resident school in New York City, is offered upon your graduation.

Public Address System

RF Signal Generator

FM-TV TECHNICIAN TRAINING!

My FM-TV Technician Course will save you months of training, if you have previous Armed Forces or civilian radio experience. Complete with kits, BIG SCREEN TV RECEIVER, and FREE FCC Coaching Course.



OPTIONAL: TWO WEEKS TRAINING IN NEW YORK CITY AT NO EXTRA COST

You get two weeks, 50 hours, of intensive Laboratory work on modern electronic equipment at our associated school in New York City—Pierce School of Radio and Television. And I give you all this AT NO EXTRA COST whatsoever, after you finish your home study training in the Radio-FM-TV Technician course and FM-TV Technician Course.

RADIO-TELEVISION TRAINING ASSOCIATION
52 EAST 19th STREET, NEW YORK 3, N. Y.
Licensed by the State of New York Approved by the VA

VETERANS!

MY SCHOOLS FULLY APPROVED TO TRAIN VETERANS UNDER *NEW* G.I. BILL! If discharged after June 27, 1950—CHECK COUPON BELOW! Also approved for RESIDENT TRAINING in New York City . . . qualifies you for full subsistence allowance up to $160 per month. Write for details.

MAIL COUPON TODAY!

MY 4 FREE AIDS SHOW YOU HOW AND WHERE TO GET A BETTER PAY JOB IN TELEVISION!

See for yourself how my simple, practical methods make success easy.

NO SALESMAN WILL CALL!

Dept. T-2B

Mr. Leonard C. Lane, President
RADIO-TELEVISION TRAINING ASSOCIATION
52 East 19th Street, New York 3, N. Y.

Dear Mr. Lane: Mail me your NEW FREE BOOK, FREE SAMPLE LESSON, and FREE aids that will show me how I can make BIG MONEY IN TELEVISION. I understand I am under no obligation and no salesman will call.

(PLEASE PRINT PLAINLY)

NAME_____ AGE_____

ADDRESS_____

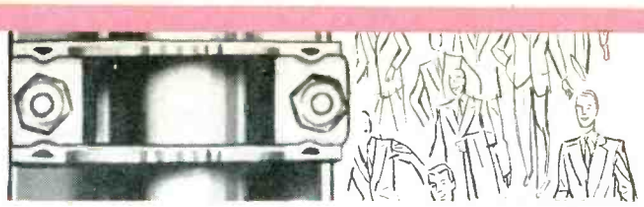
CITY_____ ZONE___ STATE_____

I AM INTERESTED IN:

- ☐ Radio-FM-TV Technician Course
- ☐ FM-TV Technician Course
- ☐ TV Cameraman & Studio Course

VETERANS! Check here for Training under NEW G.I. Bill . . . . . ☐

THE **RADIART** CORPORATION
CLEVELAND 13, OHIO



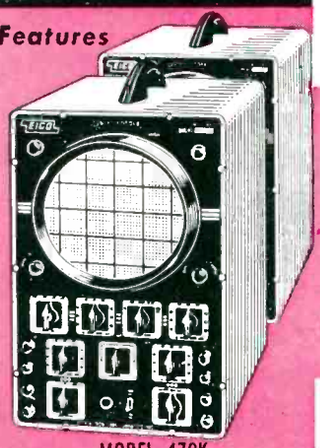
NOW . . . 2 SENSATIONAL EICO SCOPE VALUES!

NEW AMAZING FEATURE PACKED

7" PUSH-PULL OSCILLOSCOPE

Only EICO Has All These Features

- VERTICAL FREQ. RESPONSE: flat ± 2 db 10 cps – 1 mc
- VERTICAL SENS.: .01 volts rms/inch
- HOR. FREQ. RESP.: flat ± 0 db 10 cps – 200 kc, –4 db at 500 kc
- HOR. SENS.: .3 volts rms/inch
- SWEEP RANGE: 15 cps-100 kc
- 3-STEP FREQ.-COMPENSATED ATTENUATOR eliminates freq. distortion, overloading.
- CATHODE FOLLOWER inputs to both amplifiers
- PUSH-PULL outputs in both amplifiers
- RETURN TRACE BLANKING
- INT. VOLTAGE CALIBRATOR
- V & H TRACE EXPANSION & CENTERING: 1.5X full screen without distortion.
- DIRECT CONNECTION to vert. CRT plates.
- PHASING CONTROL of internal 60 cps sine wave sweep.
- AT FRONT PANEL: intensity mod. input; 60 cps, sawtooth outputs.



MODEL 470K
KIT $79.95. WIRED $129.50.

EICO EXCLUSIVE! 5" PUSH-PULL SCOPE, 425K, Amazing feature-packed economy-priced Wired, $79.95. KIT, $44.95.

- PUSH-PULL V & H amplifiers. Sens: 0.5-1 rms v/in. Useful to 2.5 mc.
- SWEEP: 15 cps-76 kc. Z-axis intensity modulation. Dual trace positioning controls.

SCOPE VOLTAGE CALIBRATOR KIT 495K KIT $12.95. WIRED $17.95.
- Sq. wave output at power-line freq. with full-scale readings of .1, 1, 10 or 100 V. peak-to-peak.
- Accuracy ± 5% of full-scale on each range.

6V & 12V BATTERY ELIMINATOR KIT 050K KIT $29.95. WIRED $38.95.
- DC output: 0-8 V or 0-16 V.
- Continuous current rating: 10 A at 6 V, 6 A at 12 V.
- Intermittent current rating: 20 A at 6 V, 12 A at 12 V.
- Separate Voltmeter & Ammeter.

NOW! ONLY EICO KITS & WIRED INSTRUMENTS Gives You LIFETIME SERVICE & CALIBRATION GUARANTEE*

*at less than our cost of handling (See EICO Guarantee Card enclosed with each Kit & Instrument).

221K VTVM KIT $25.95. WIRED $49.95.
- AC & DC volts: 0-5, 10, 100, 500, 1000 V (30 KV with HVP-1 probe).
- 5 ohm ranges from .2 ohm to 1000 megs.
- DC input Z 26 megs.
- 4½" meter movement in can't-burn-out circuit.
- 1% mult. resistors.

HIGH VOLTAGE PROBE $6.95
- Extends range of VTVMs & voltmeters to 30 KV.

PIX TUBE ADAPTER for Tube Testers $4.50. Checks TV picture tubes while in set.

625K TUBE TESTER KIT $34.95. WIRED $49.95.
- Illum. gear-driven "Speed Rollchart."
- New lever-action switches for individual testing of every element.
- Tests all conventional & TV tubes.

COUNTER CABINET for above: add $10.00 to Kit or Wired Prices.

360K SWEEP GEN. KIT $34.95. WIRED $49.95.
- Continuous coverage of all TV & FM freqs. from 500 kc to 228 mc.
- Sweep width variable 0-30 mc.
- Crystal marker oscillator, variable amplitude.

214K VTVM KIT $34.95. WIRED $54.95.
- Large 7½" meter, can't-burn-out circuit.
- AC/DC volts: 0-5, 10, 100, 500, 1000 (30 KV with HV Probe).
- 5 ohms ranges from .2 ohm to 1000 megs.
- DC input Z 26 megs.
- 1% mult. resistors.

950A-K R-C BRIDGE & R-C-L COMP. KIT $19.95. WIRED $29.95.
- Measures & tests all resistors; .5 ohm to 500 megohms.
- Every type condenser, 10 mmf to 5000 mfd.
- 0-500 DC voltage source for capacitor leakage testing.

1171K RES. DECADE BOX KIT $19.95. WIRED $24.95.
- Resistance values from 0 to 99,999 ohms with 0.5% precision.
- All resistors have 0.5% accuracy

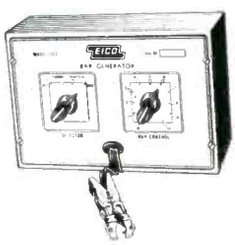
DECADE CONDENSER BOX KIT 1180K KIT $14.95. WIRED $19.95.
- All capacitors precision silver mica, accuracy ± 1%.
- Range from 100 mmf – 0.111 mfd in steps of 100 mmf.
- Smooth-action positive detent ceramic switches.

Prices 5% higher on West Coast. Specifications and prices subject to change without notice.

New! EICO SCOOPS!

CATHODE RAY TUBE CHECKER 630K, WIRED $24.95 KIT, $17.95.
- Checks all types of TV picture and C.R. tubes in the set or carton. Bridge measurement of peak beam current (proportional to screen brightness).
- Detects shorted & open elements.

BAR GENERATOR 352K, WIRED $19.95 KIT, $14.95
- Enabels rapid adjustment of TV picture V & H linearity without hard-to-find station-transmitted test pattern.
- Produces 16 V or 12 H bars. Operates on TV channels 3, 4, or 5.



RTMA RESISTANCE SUBSTITUTION BOX 1100K WIRED $9.95 KIT, $5.50.
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- Covers range of 75 kc to 150 mc.
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- Bandspread vernier tuning.
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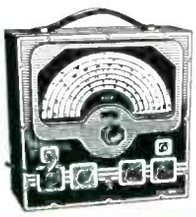

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555K MULTIMETER KIT $29.95 WIRED $34.95. (1% precision resistors)
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- DC/AC/Output volts: 0-2.5, 10, 50, 250, 1000, 5000.
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- Ohms: 0-2K, 200K, 20 meg.

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- 1000 Ω/V; 31 ranges
- DC/AC volts: Zero to 1, 5, 10, 50, 100, 500, 5000.
- DC/AC Current: 0-1, 10 ma; 0.1, 1 A.
- Ohms: 0-500, 100 K, 1 meg.

320K SIG. GEN. KIT $19.95. WIRED $29.95.
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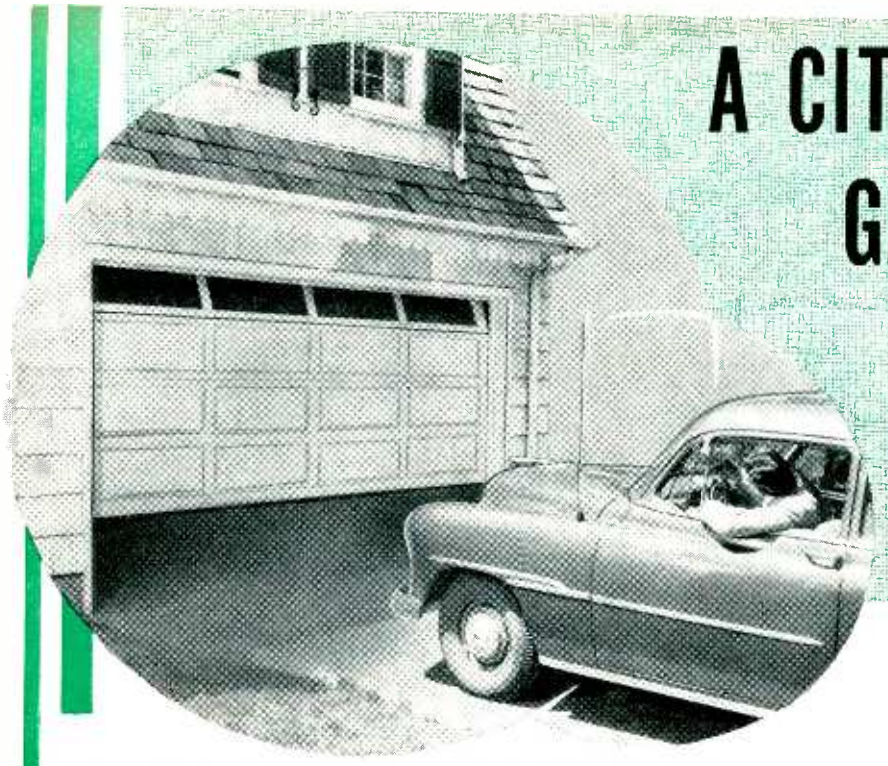
A CITIZENS BAND GARAGE DOOR CONTROL

By
HARTLAND B. SMITH, W8VVD

A TVI-proof unit which operates on the 27 mc. Citizens Band. A station license is required.



An overhead garage door, this one made by Overhead Door Company, Inc., of the type suitable for use with the radio-control unit described.

FEW situations are more disconcerting to a motorist than to arrive home in a pouring rain and find the garage door locked. Although happenings of this nature can be avoided by the simple expedient of leaving the door open while away from home, this practice is not recommended in areas peopled by curious toddlers or borrowing neighbors—at least not if you expect to find the lawn mower and garden spade in their accustomed places when you return from a drive in the country.

Radio control is a practical method for reducing to a minimum the inconvenience of garage door opening and closing. By merely flipping a switch you can open or close the door at will without leaving your car. The Citizens Band radio gear to be described, when used in conjunction with a commercially-built electric door opener, will prove so handy that you'll be the envy of all your non-mechanized acquaintances.

The heart of any radio-control system is the receiver. It must be sensitive enough to respond to its companion transmitter and yet selective enough to reject signals produced by other radio equipment. One way to solve this problem is to use a special modulating circuit which produces a coded signal from the transmitter. A decoding circuit in the receiver will respond only to this signal, rejecting transmissions from all other radio devices.

The complications involved in the construction and adjustment of coding circuits are numerous, however, and so it was decided, for simplicity's sake, to employ a rather insensitive receiver—one which would respond only to a strong signal emanating from a nearby transmitter. The receiving circuit finally evolved, although somewhat unique, has proven both simple and practical. It consists of a voltage tripling crystal detector followed by a d.c. amplifier which, in turn, is followed by a thyratron tube with a sensitive relay in its plate lead.

When a signal from the transmitter in the car is picked up on the receiving antenna, it is rectified by the crystal detector and appears as a negative voltage on the grid of V_1, the d.c. amplifier. This negative voltage reduces the plate current of V_1, thus lowering the voltage drop across R_5. A reduction in the voltage across R_5 cuts the bias of V_2 and, since this tube is a thyratron, its plate current abruptly increases. This large increase in current closes RL_1 and actuates the door opening mechanism.

The crystal detector is in the form of a voltage tripler. Thus, its output is appreciably greater than that provided by the customary half-wave crystal circuit. Use of high back resistance 1N54 germanium diodes, in place of 1N34's, further increases the voltage available at the grid of V_1, a 6AH6 chosen for its very high transconductance.

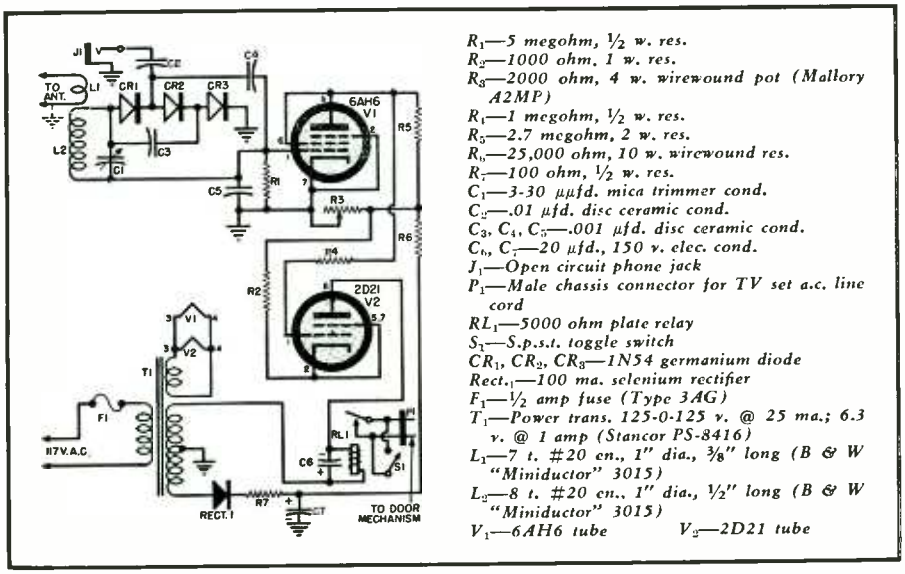
The receiver is constructed in a 6" x 5" x 4" utility cabinet containing a built-in chassis. Although there is plenty of room for mounting the various components, a portion of the front lip of the box must be filed or cut out in order to clear the top of the power transformer as the receiver is placed in the cabinet. The rear lip should be similarly treated, to make way for the antenna terminals and the relay plug on the rear of the chassis. In addition, a 1¼" strip should be cut from the bottom edge of the rear panel to provide easy access to these same terminals.

The receiver's power supply contains a selenium rectifier, and so the reader may wonder why a plate transformer is employed in place of an ordinary a.c.-d.c. circuit. Since the unit is to be installed in a garage, a location with floors that are often damp, the shock hazard of an a.c.-d.c. circuit was felt to be too great. A filament transformer is required for the tubes, anyway. Consequently, the use of a transformer which includes a plate power winding adds little to the cost of the finished receiver.

Once plate current starts to flow in a thyratron, the grid loses control. Current through the tube will stop and the grid can only regain control if plate voltage on the tube is reduced to zero. Since an alternating voltage goes to zero many times per second, a.c. is applied to the plate of V_2, a 2D21. The a.c. is obtained from one half of the transformer high voltage secondary. The d.c. voltage for V_1, the d.c. amplifier, is taken from the other half of this winding.

A half-wave power transformer of the type found in TV boosters should *not* be used. If the plate currents for both tubes are drawn through the same winding, the voltage drop in the transformer, which results from the firing of the 2D21, will cause the plate voltage of the 6AH6 d.c. amplifier to vary. As a result, the receiver will be quite unstable and RL_1 will operate erratically if R_3 is set for maximum sensitivity.

Certain components must be carefully selected if top receiver perform-



R_1—5 megohm, ½ w. res.
R_2—1000 ohm, 1 w. res.
R_3—2000 ohm, 4 w. wirewound pot (Mallory A2MP)
R_4—1 megohm, ½ w. res.
R_5—2.7 megohm, 2 w. res.
R_6—25,000 ohm, 10 w. wirewound res.
R_7—100 ohm, ½ w. res.
C_1—3-30 μμfd. mica trimmer cond.
C_2—.01 μfd. disc ceramic cond.
C_3, C_4, C_5—.001 μfd. disc ceramic cond.
C_6, C_7—20 μfd., 150 v. elec. cond.
J_1—Open circuit phone jack
P_1—Male chassis connector for TV set a.c. line cord
RL_1—5000 ohm plate relay
S_1—S.p.s.t. toggle switch
CR_1, CR_2, CR_3—1N54 germanium diode
$Rect._1$—100 ma. selenium rectifier
F_1—½ amp fuse (Type 3AG)
T_1—Power trans. 125-0-125 v. @ 25 ma.; 6.3 v. @ 1 amp (Stancor PS-8416)
L_1—7 t. #20 en., 1" dia., ⅜" long (B & W "Miniductor" 3015)
L_2—8 t. #20 en., 1" dia., ½" long (B & W "Miniductor" 3015)
V_1—6AH6 tube V_2—2D21 tube

Fig. 1. Schematic and parts list covering the receiver installed in the garage.

ance is to be expected. R_3, R_5, and R_6 should be purchased new and operated well below their maximum ratings. If you rely on the junk box for these particular items, or skimp on their size, the receiver may be so affected by temperature changes that the optimum setting of the sensitivity control will vary constantly.

Despite the low plate current required by the receiver, a 100 ma. selenium rectifier is employed. The large plate area of a 100 ma. rectifier does a good job of heat radiating, a factor which should be kept in mind when constructing a device that must operate reliably, 24 hours a day.

C_6 smooths out the ripples in the plate current of the 2D21 to keep the relay from chattering. It is an electrolytic condenser, and proper polarity, as shown in Fig. 1, should be observed.

No a.c. power switch is required because the receiver operates continuously. A switch on the front panel is provided, however, to bypass the relay and is normally left in the "off" position. It can be used to actuate the door opener for tests, if the receiver becomes inoperative, or when it happens to be inconvenient to provide a signal from the car transmitter. As a safety measure, a ½ amp fuse is wired in series with the primary of the power transformer.

The leads of the 1N54 germanium diodes should be kept long in order to reduce the possibility of damage to the crystals during the soldering process. By gripping the leads tightly with a pair of long nosed pliers, you can make sure that excessive heat from the iron is dissipated before it has a chance to do any harm. Three slightly anemic 1N54's in my junk box offer mute testimony to the dangers of short leads and careless use of a soldering iron.

The transmitter is built into a 5" x 3" x 4" utility box, a smaller version of the type used for the receiver. It contains a 2E30, instant heating beam pentode, with a regenerative crystal oscillator circuit operating in the 27 mc. Citizens Band. Power for the unit is furnished by a commercially-built *Mallory* VP-551 "Vibrapack."

If the transmitter is to be relatively free from TVI producing harmonics, a little care must be exercised during its construction. All paint should be removed from those points where the front and rear covers fasten to the case, thus insuring good electrical contact between adjacent metal parts. A low-pass filter consisting of L_1, C_1, and C_2 in the antenna lead reduces the strength of harmonics attempting to escape along this path, while C_8 and C_9 are needed to filter r.f. from the power leads. These few precautions will keep your televiewing neighbors happy and, at the same time, will insure compliance with the FCC's rule which requires spurious radiations from class C Citizens transmitters to be at least 40 db less than the carrier.

Only a couple of other pointers need be kept in mind while wiring the transmitter. The leads of C_8 and C_9 must be very short. The ground connections to C_3 and C_4 should go to the plates which are directly beneath the adjusting screws. This makes it possible to tune the transmitter without having to use an insulated screwdriver, because the adjustment screws are then almost at ground potential.

A radio-controlled garage door is rather novel and you will probably be kept busy showing yours to friends and neighbors. For this reason you'll want to do a neat construction job. After completing the transmitter and receiver, you can give them a really professional look by lettering the panels with decals. Best results will be obtained if you let the decals dry for at least 24 hours after application. Then, spray them with a light coat of clear lacquer. This procedure,

Fig. 2. Rear view of the receiver unit with the major components identified. Over-all dimensions are 6" x 5" x 4".

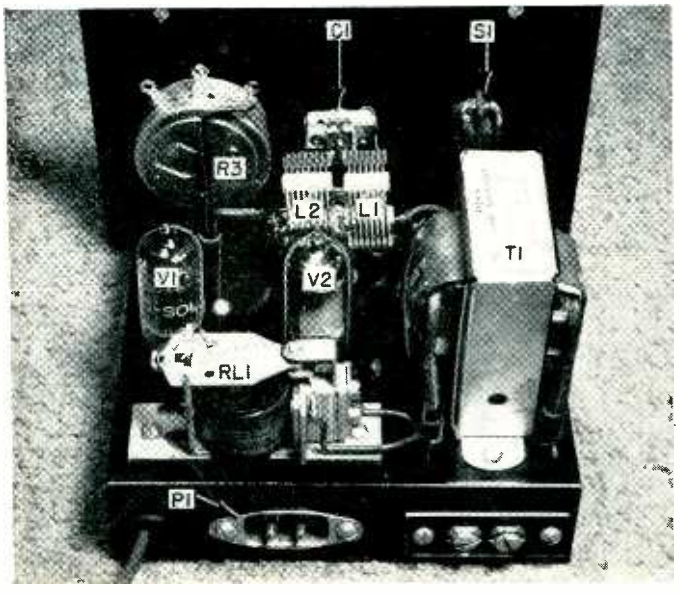


Fig. 3. Bottom view of receiver. Long leads on 1N54 crystal diodes prevent excessive heating while soldering.

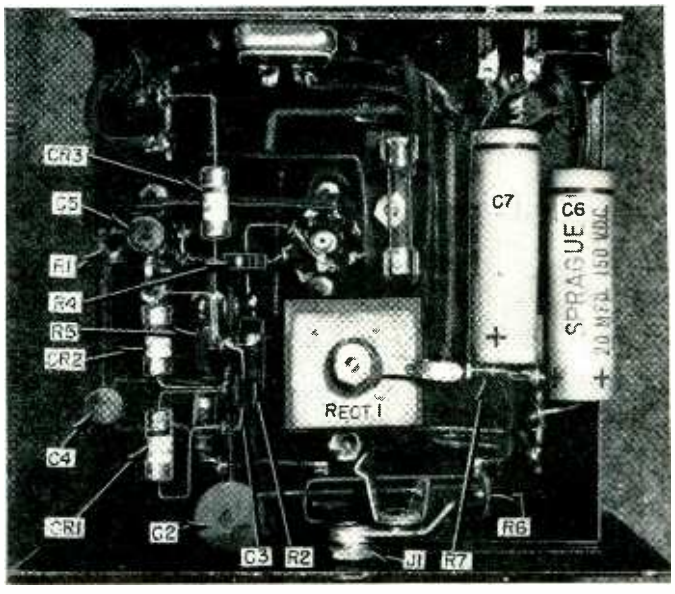


Fig. 4. Front panel view of receiver. Note slot for the screwdriver adjustment cut in shaft of the control, R_3.

Fig. 5. Over-all view of the transmitter. It is built in a 5" x 3" x 4" box and occupies little space in the car.

a trick that I learned from W8GBT, dissolves the transparent backing on which the letters are printed and makes them appear to become part of the panel, not just something that has been stuck on as an afterthought. At the same time, the decals are provided with a protective coating which keeps the letters from rubbing off.

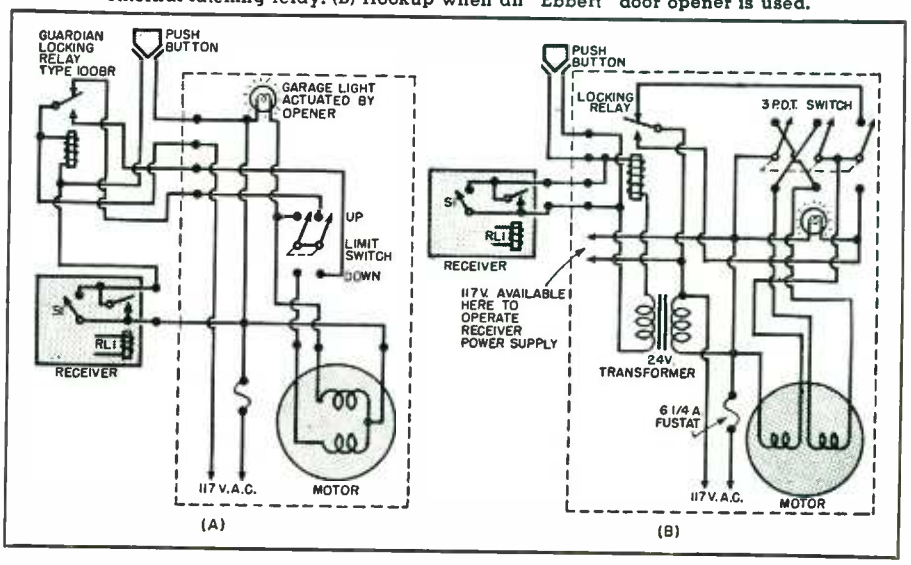
Tuning the transmitter is simple, but the process must be carried out under the direction of someone holding a commercial operator's license issued by the FCC. Preliminary tests may be made with the unit out of its case and with no antenna connected. A milliammeter with a range of approximately 0-100 should be temporarily connected in series with the "B plus" lead. Apply "A" and "B" power and adjust C_4 until the plate current dips sharply, indicating oscillation. Tune a communications receiver to 27.255 mc. to make sure that the transmitter is oscillating at the crystal frequency. If it isn't, try another setting of C_4. A regenerative circuit is employed and if C_4 is incorrectly adjusted, the oscillator may take off on its own without regard for the frequency stamped on the crystal. Once the transmitter is working on the proper frequency, C_3 may be tuned for maximum brightness of PL_1, the output indicator. Since it is wired ahead of the low pass filter, PL_1 will glow even though no antenna is connected to the transmitter.

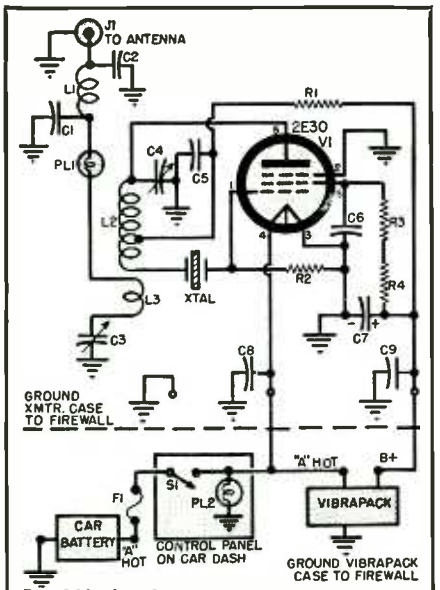
When it is found to be operating satisfactorily, the transmitter may be installed in the car. A handy place to mount it is on the inside of the firewall, as far up under the dash as possible, the "Vibrapack" being placed close to it. A control panel, with switch and pilot bulb, may then be mounted at a convenient spot under the dash and connected as shown in Fig. 7. Only a momentary signal is required to start the door opening mechanism. Thus, after the opener begins to function, the transmitter can be turned off. For this reason, the switch on the control panel may be of the simple push-button variety. I used a toggle switch merely because no suitable push-button could be found in my junk box.

Three different transmitting antenna systems are shown in Fig. 11. Greatest range will be obtained from an eight foot whip of the type used for ham mobile operation. Such an antenna will radiate sufficient energy to actuate the door opening mechanism at distances up to at least 150 feet. If the wife objects to such an arrangement, and she probably will, the next best system is to utilize a receiving-type auto antenna extended as high as possible. The longer it is, the better, but even 4 feet of antenna will produce an adequate signal 100 feet from the garage. Two antennas on a car, one for a broadcast receiver and the other for a radio-control transmitter may appear a bit ridiculous to some folks. Although it is possible to feed power from the transmitter into the antenna used by the car receiver, this procedure is not recommended because it is apt to reduce receiver sensitivity and introduce ignition and other unwanted noises.

A practical substitute for an external transmitting antenna is an 8½ foot insulated wire strung around the engine compartment. One end of this wire can be plugged into J_1 and the remainder fished through a small hole in the firewall. The wire should be kept an inch or so away from the body by supporting it on insulators. The small plastic ones used for TV lead-ins will work very well for the purpose. If possible, a portion of the wire should be placed between the radiator and its protective grille. The engine compartment is far from a perfect shield,

Fig. 6. (A) Method for wiring receiver to typical door opener requiring an external latching relay. (B) Hookup when an "Ebbert" door opener is used.





R_1—200 ohm, 1 w. res.
R_2—68,000 ohm, 1 w. res.
R_3—33,000 ohm, 1 w. res.
R_4—150 ohm, 1 w. res.
C_1, C_2—120 μμfd. tubular ceramic cond.
C_3-C_4—7.5-80 μμfd. dual mica padder (El-Menco Type 50)
C_5—.0047 μfd. disc ceramic cond.
C_6—.001 μfd. disc ceramic cond.
C_7—2 μfd., 450 v. elec. cond.
C_8, C_9—.01 μfd. disc ceramic cond.
J_1—Shielded phono pin jack
PL_1—Pilot light, 6 v. @ 250 ma. (#46)
PL_2—Pilot light, 6 v. @ 150 ma. (#40)
S_1—S.p.s.t. toggle switch
F_1—32 volt automotive fuse (Buss SFE9)
Xtal.—27.255 mc. Citizens Band crystal
Vibrapack—Mallory VP-551 vibrator power supply
L_1—5 t. #18 en., 5/8" dia., 1/2" long (B & W "Miniductor" 3006)
L_2—6 t. #18 en., 1" dia., 5/8" long, tapped 2 1/2 t. from grid end (B & W "Miniductor" 3014)
L_3—4 t. #18 en., 1" dia., 3/8" long (B & W "Miniductor" 3014)
V_1—2E30 tube

Fig. 7. Complete schematic and parts list for the transmitter unit installed in the car. The unit operates on the 27.255 mc. Citizens Band. See text on the FCC rules.

and as the wire is approximately a quarter-wave long, it will do a fairly good job of radiating. A simple arrangement of this kind will produce a usable signal 50 or more feet from the receiving antenna.

Some readers may feel that an operating range of 50 to 150 feet is not great enough. Experience, however, has shown that the door should not be controllable at distances beyond which it can be seen. After all, you wouldn't want to inadvertently close the door on a child or pet that might be sitting under it. While most electrically operated doors will stop automatically before applying enough pressure to kill a person, being pinned under such a device is certainly not an experience one would anticipate with pleasure. For safety's sake, operating range must be restricted.

After the transmitter is installed in the car, only slight retuning of the oscillator and antenna condensers will be required. C_3 and C_1 should both be adjusted for maximum antenna current as indicated by the brilliance of PL_1. It may be necessary to tune C_4 a little off the maximum setting in order to make sure that the crystal starts to oscillate immediately after plate and filament power are applied. The carrier frequency should now be rechecked, to make sure that it is within .04% of 27.255 mc.

With 200 volts from the "Vibrapack," plate current should be in the neighborhood of 25 ma., thus resulting in a power input of 5 watts, the maximum allowed to class C Citizens stations. When calculating input power, the plate current may be found by measuring the total "B" drain of the transmitter. Subtract from this amount the value of the screen current shown by a milliammeter temporarily connected in parallel with R_4. The result, for all practical purposes, will be the total plate current of the 2E30 tube.

The receiver can be installed close to, or even inside, the case of the opening mechanism. A 17-foot antenna, connected to the receiver *via* 75-ohm receiving twin-lead, should be mounted as near the front of the garage as possible. Although most of the antenna should be vertical, many garages are not 17 feet high. Consequently, it may be necessary to run a portion of the antenna horizontally, as shown in Fig. 12.

To tune the receiver, drive the car close to the garage and turn on the transmitter. Plug a pair of headphones into J_1 on the front panel of the receiver and, with an insulated screwdriver, adjust trimmer C_1 until the hum on the transmitter's carrier sounds loudest in the headphones. The capacity of transmitter condenser C_7 is purposely kept low in order that a certain amount of hum will remain on the carrier to aid in the tune-up process. Only enough capacity is used at this point to hold the transmitted bandwidth under 10 kc. C_7 must not be omitted, however, because without it the signal is very broad as a result of the hash kicked up in the "Vibrapack."

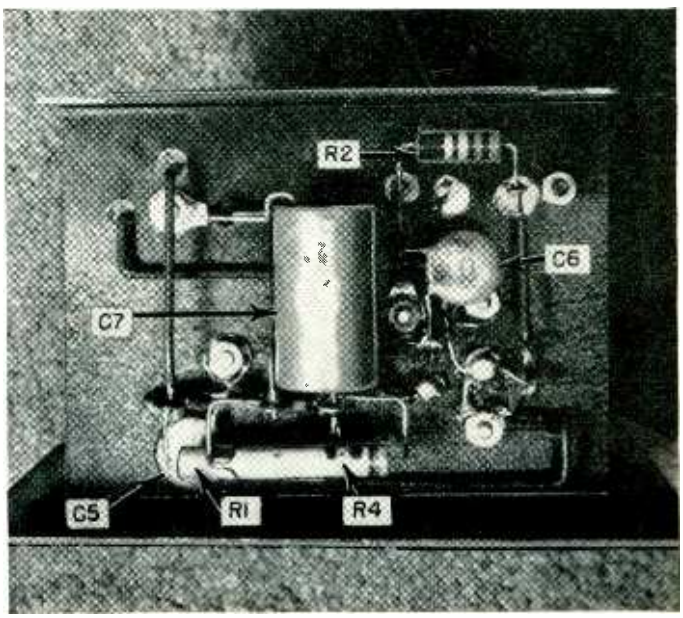
Power may now be applied to the receiver. Allow it to warm up for at least 15 minutes. With the transmitter off, advance the receiver sensitivity control, R_3, until the relay closes. Then, back off on R_3 just enough to let the relay open. When the car transmitter is turned on, the relay should now close. While the transmitter is still running, have someone back the car away until the relay opens. Readjust C_1 until the relay again closes. Back the car farther away, and again retune the trimmer. If you continue this process until the car is at least 50 feet away, the receiver will be peaked for maximum sensitivity.

In Fig. 1 a dotted line is drawn from one side of the antenna coil to the chassis ground. If you are inter-

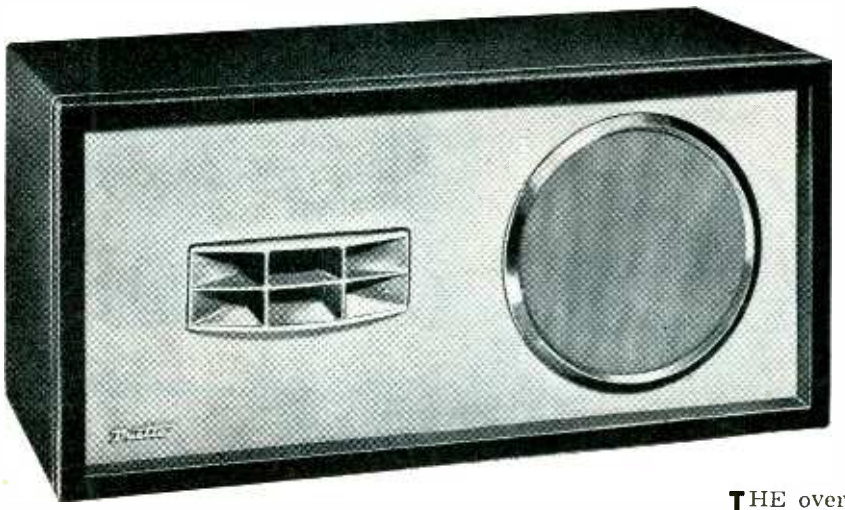
(Continued on page 130)

Fig. 8. Rear view of transmitter with components identified.

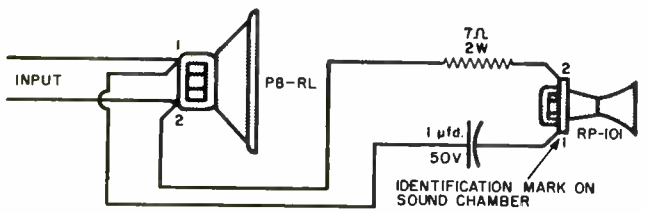
Fig. 9. Bottom view shows simplicity of underchassis wiring.



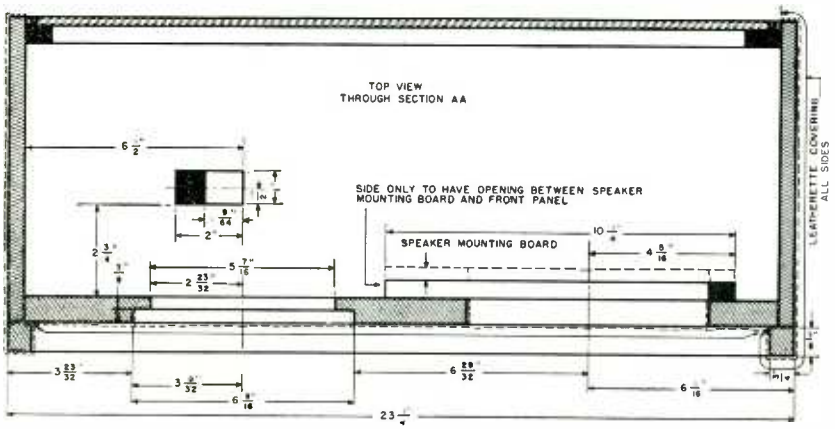
THE DU-201 Duette

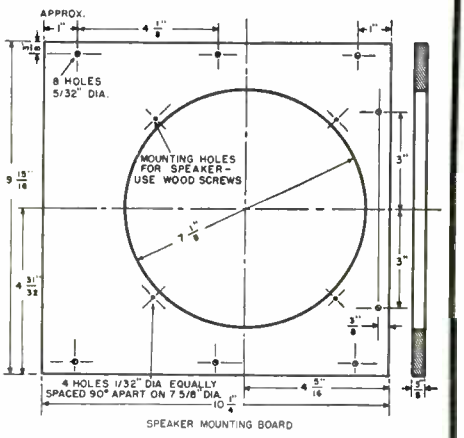


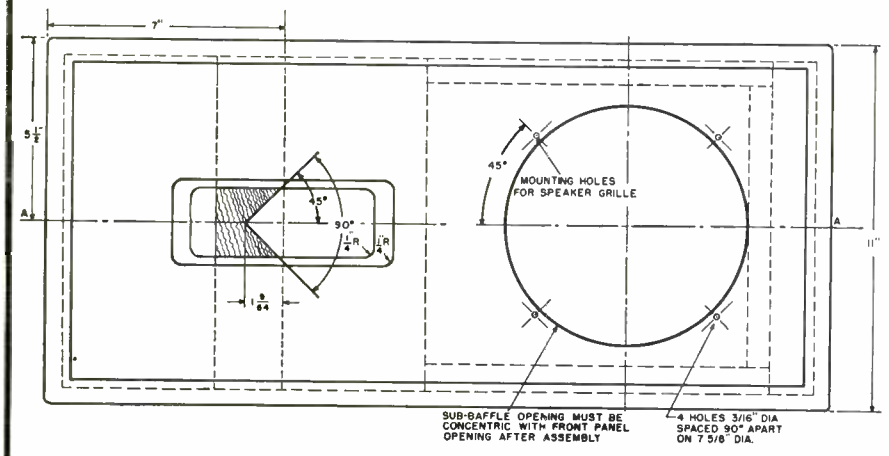
Designed by Jensen Mfg. Co., this unit is compact and easy to build. Its sound reproduction is excellent. Their P8-RL 8 inch speaker and RP-101 horn are used.

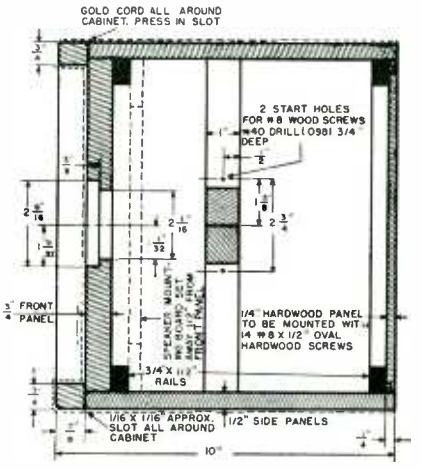


THE over-all construction of this cabinet is relatively simple. All dimensions are clearly indicated. One point that bears specific mention is that its theoretical operation is somewhat similar to that of the *R-J* cabinet in that the waves emanating from the rear of the speaker emerge through a port spaced between the speaker mounting board and the front panel of the cabinet. In this particular design the speaker mounting board is placed ½ inch from the front panel and the left side, looking at the top view of the diagram, is open, providing a port for the sound waves. —30—









A SUBMINIATURE CODE PRACTICE OSCILLATOR

By

LOUIS E. GARNER, JR.

Fig. 1. The tiny code practice oscillator and earphone shown with matchbox and king-sized cigarette.

Although housed in a plastic box measuring just 7/8" x 1 1/8" x 1 1/8", this "watch pocket" unit really works

IN AN earlier article, the author described the construction and use of a compact "pocket" sized code practice oscillator ("A Transistor Code Practice Oscillator, April, 1953, RADIO & TELEVISION NEWS). Although the unit described in the earlier article was quite compact, no real attempt was made to "miniaturize" it . . . except for a hearing aid type battery and the transistor, all components used were standard-sized, and the unit was intended to be used with a regulation hand-key and standard earphones.

Nonetheless, the author received a good deal of good-natured kidding from friends about the size of the oscillator. Such remarks as "why not build a vest-pocket sized oscillator?" and "sure the oscillator is small, but the key and headphone take up too much space" were not uncommon.

Being human, a decision was quickly reached to build a code practice oscillator that was *really small* . . . one in which every part would be so compact that the entire practice set-up, oscillator, power source, key and headphone, could be easily fitted not only in a vest-pocket, *but even in a watch pocket* . . . and yet one which could be used for serious code practice, rather than a tiny "museum piece" destined to collect dust in a forgotten corner. It was also decided to design a unit that could be easily duplicated by any competent technician, using parts available through most of the larger wholesale electronic parts distributors.

The result is shown in Fig. 1 alongside a standard matchbox and a king-sized cigarette. The entire code practice set-up is shown here, including ing the "key," the oscillator, the power source, and the headphone. The key, oscillator, and power supply are all within the small plastic box, with the hearing aid type earphone (and its cord) shown alongside.

As can be seen by reference to the schematic diagram of Fig. 2, the *Raytheon* junction transistor ("*p-n-p*" type) is connected in a modified "tickler" feedback grounded-emitter audio oscillator circuit, with feedback provided by transformer T_1.

In operation, no current flows until the "key" is depressed . . . this eliminates the need for a separate "on-off" switch.

When the key is closed, d.c. can flow over two paths. Part of the current flows over the R_1-base-emitter path, establishing the base "bias" current for the transistor. Another part of the current flows over the path consisting of the primary of T_1 and the collector-emitter circuit of the transistor.

The current drain on the power source depends primarily on the size of R_1, not only because this resistor is in series with the base-emitter current path, but also because the amount of base current flow, in turn, determines the d.c. collector current flow. By keeping R_1 large (10 megohms in the author's model) the current drain is kept small and long battery life is insured. The actual battery life, in normal use, should approach the "shelf" life of the cell.

Variations in the primary current of T_1 are coupled, through magnetic lines of force, to the secondary winding, where they appear as an a.c. voltage. This signal, in turn, is applied through the d.c. blocking condenser C_1 to the base-emitter circuit of the transistor. The step-down turns ratio between the primary and secondary winding of T_1 permits matching the low input impedance of the transistor amplifier stage.

The signal is amplified by the transistor and re-applied to the primary of T_1. In this fashion, the basic condition of signal amplification with positive feedback is set up, and oscillation occurs.

The output audio signal is obtained through coupling condenser C_2 and applied to the *Brush* crystal earphone.

Construction Hints

All the electrical and mechanical components for this unit, except the earphone and its cord, are assembled in a small plastic box measuring 7/8" x 1 1/8" x 1 1/8". A somewhat larger case may be employed, if desired, and will make the wiring easier.

Although a metal case may be used in place of the plastic box, plastic is preferred as it simplifies insulation problems.

The general parts arrangement used by the author is apparent from the exterior and interior views of the oscillator, Figs. 1 and 4, respectively. Layout is not critical, however, and the builder may use any layout that will permit fitting the various parts compactly into the particular case used.

Mounting Parts: Only the two major components, the *"Sub-SubOuncer"* transformer and the *Mallory* RM-1000 mercury cell are actually "mounted." The other parts, *i.e.*, the transistor, the two condensers, and the resistor are allowed to more or less "hang free." Actually, the wiring is sufficiently compact so that the pressure between parts when the case is closed is adequate to hold them immobile.

The transformer is mounted by

cementing it to the case, using either *Duco* cement or general purpose *radio service cement.*

A small "L" bracket is used to hold the mercury cell in place, pressing it against the side of the case. This bracket also serves to make electrical contact to the outer shell (positive terminal) of the cell.

Wiring: Special care must be exercised when wiring the oscillator unit, both to prevent damage to the transistor and to the plastic case. Because so little space is available for components, it was not found practicable to use a socket for the transistor, and soldered connections had to be made directly to the transistor leads.

If the builder uses a somewhat larger case, so that a little "extra" space is available, it is suggested that a socket be used for the transistor, and that the transistor not be installed until all wiring is completed. A standard 5-pin subminiature tube socket is suitable for the CK722 transistor (only three pins are used.)

For best results, a small "pencil" type iron should be used. Keep the iron well-tinned and clean. Tin each wire or component lead prior to making the final connection, and use *quickly* soldered lap joints.

The transformer secondary leads (black) should be arranged so they can be easily interchanged should such a step prove necessary during final testing of the completed unit.

Once the oscillator wiring has been completed, *and the unit tested,* exposed connections may be effectively insulated by applying two or three coats of fingernail polish. Do not coat the negative terminal of the mercury cell, or the contact of the "key," however!

Assembling the "key": The construction of the miniature "key" is clearly visible in the photographs and in the side view sketch given in Fig. 3. Required parts are a small machine screw (preferably one having a smooth head), a small compression spring, and a nut to fit the machine screw used.

A small hole is drilled in the plastic case directly above the location of the mercury cell, and the key assembled so that contact is made with the negative terminal of the cell when the key is depressed.

Contact to the key is made by lap-soldering a wire to the side of the machine nut. This connection should be made *before* assembling the key to avoid melting the plastic case.

For best results the threads of the machine screw above the section where the nut fits on should be filed smooth. Otherwise, there is a certain tendency to catch on either the spring or the sides of the hole (in the case).

The side of the nut facing the battery should be filed smooth to insure good positive contact each time the key is depressed, as well as to reduce the thickness of the nut.

Testing And Adjustment

Once all wiring is completed, *carefully* check each connection to make sure there are no errors in wiring and that all joints are secure. Holding the earphone close to the ear, depress and release the "key" a few times.

If oscillation does not take place, try reversing the secondary (black) leads of the transformer (T_1). It is important that these leads be connected correctly to insure proper phasing of the feedback signal if oscillation is to take place.

Should it still be impossible to obtain operation, it may indicate that good electrical contact to the battery is not made when the "key" is depressed, or that the battery, transistor, transformer, or some other part is defective. Check each part in turn. Since it may prove somewhat difficult to properly check the transistor, all tests may be concentrated on other parts, *including the earphone and cord.*

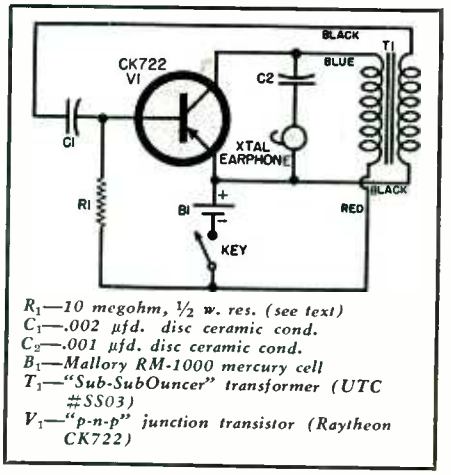
In some instances it may be necessary to change the value of R_1. Should this be the case, temporarily connect a potentiometer or resistance substitution box in place of R_1, adjusting the value until oscillation takes place. Then install a fixed resistor having the appropriate value.

Because of the small size and construction of the "key" used this unit should not be used exclusively in learning the radiotelegraph code. A standard hand-key (which, if desired, may be connected in place of the miniature key) should be used for regular practice sessions in order to develop a good "fist." Use the miniature key only for supplementary practice.

When using the miniature key, try to simulate, as far as is practicable, the normal hand movements used with a standard hand-key. One technique is illustrated in Fig. 5.

The oscillator is held *lightly* between the thumb and middle finger, with the forefinger pressing on the "key." Code is sent using a normal wrist motion, *not the motion of the forefinger alone.* In order to do this, the thumb and middle finger (holding the oscillator) are allowed to flex slightly as the key is depressed.

A little practice will enable almost anyone to acquire this technique.—30—



R_1—10 megohm, ½ w. res. (see text)
C_1—.002 μfd. disc ceramic cond.
C_2—.001 μfd. disc ceramic cond.
B_1—Mallory RM-1000 mercury cell
T_1—"Sub-SubOuncer" transformer (UTC #S503)
V_1—"p-n-p" junction transistor (Raytheon CK722)

Fig. 2. Complete schematic of the subminiature oscillator which uses a transistor.

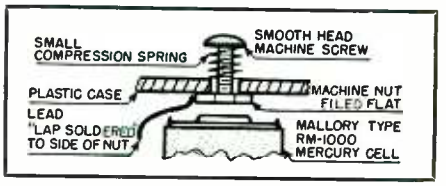


Fig. 3. Mechanical details for building the key to be used with the oscillator.

Fig. 4. Interior view of unit showing parts layout.

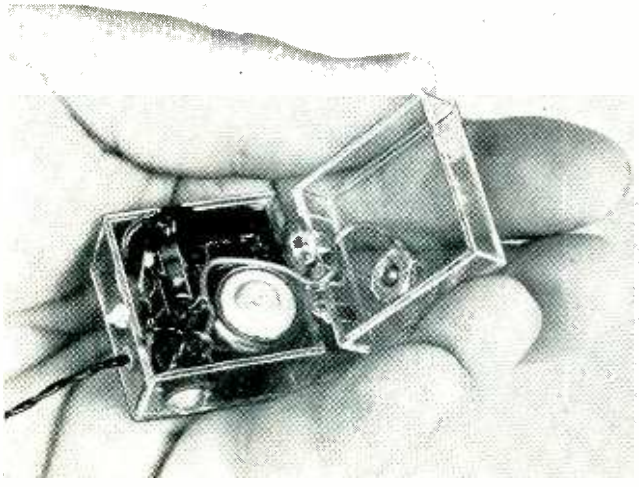
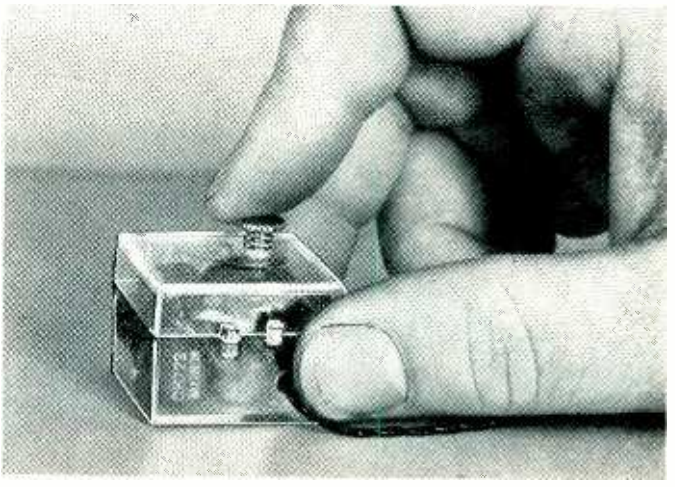
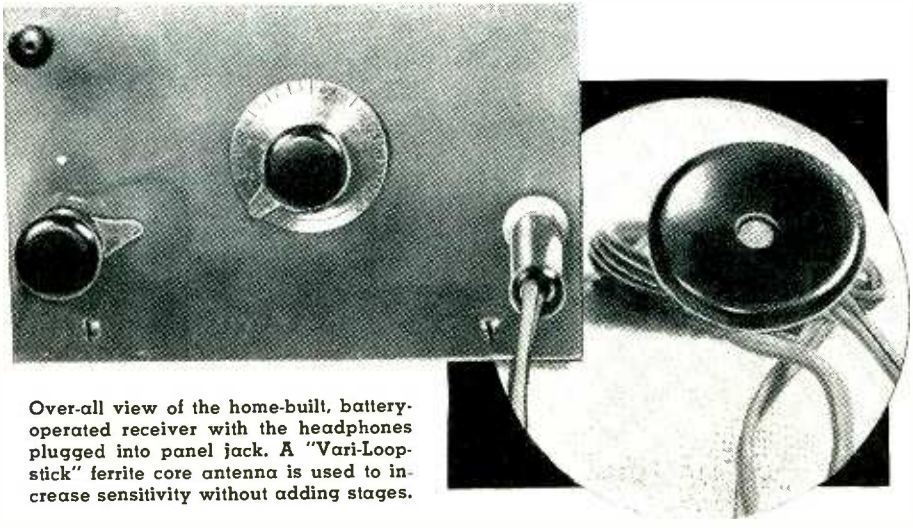


Fig. 5. Correct position for operating oscillator.



HIGH PERFORMANCE HEADPHONE RADIO

By IRVING GOTTLIEB



Over-all view of the home-built, battery-operated receiver with the headphones plugged into panel jack. A "Vari-Loopstick" ferrite core antenna is used to increase sensitivity without adding stages.

Construction details on a simple, compact receiver that uses a ferrite core antenna coil to increase sensitivity.

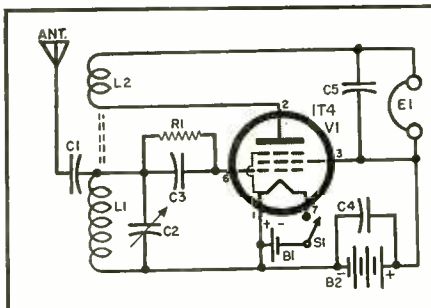
SIMPLE radio receivers which provide reception at headphone level retain a modicum of popularity, for there are occasions when solitary listening is desirable. Such sets are enjoyable as bedside radios in the home or in the hospital. They are welcome as a means of enabling the junior members of the family to tune in their individual program favorites and, in general, whenever others would be disturbed by a blaring speaker. Then too, these sets are often nice to take along on hiking and field trips.

Compromises in the performance of small radio receivers have been accepted as inherent in the simplicity of the circuit arrangement. The common drawbacks have been broad tuning, lack of sensitivity, and weak reception. Additionally, the need for a long and cumbersome antenna has frequently proved an inconvenience. It is not necessary to resort to relatively complex multi-tube circuits in order to achieve a high order of performance. The utilization of a recently developed circuit component in a simple single tube hook-up results in an inexpensive receiver with excellent sensitivity and selectivity. A four-foot vertical rod antenna will bring in about the same number of stations that can be heard with the ordinary four-tube table radio.

This has been made possible by the new high *"Q"* ferrite core antenna coils intended as a substitute for the much bulkier loop antenna commonly used in a.c.-d.c. radios. The higher the *"Q"* of a resonant circuit, the higher the e.m.f. developed across its terminals, other things being equal. The higher *"Q"* likewise implies sharper tuning response. Thus, an appreciable increase in the *"Q"* of the resonant circuit can be expected to pep up performance in much the same manner as the addition of a tuned r.f. amplifier. This is indeed the case and the experimenter who harbors any fixations regarding alleged limitations of simple receivers is due for a pleasant surprise.

The schematic diagram, Fig. 1, is a conventional circuit. From casual inspection one would not deduce anything unusual about it. A small amount of positive feedback is used in

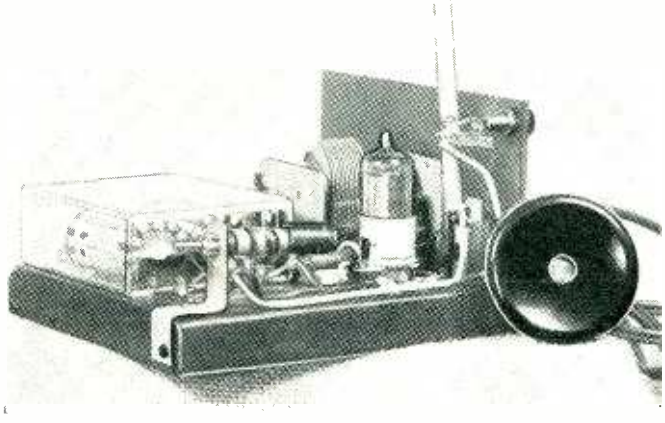
(*Continued on page* 172)



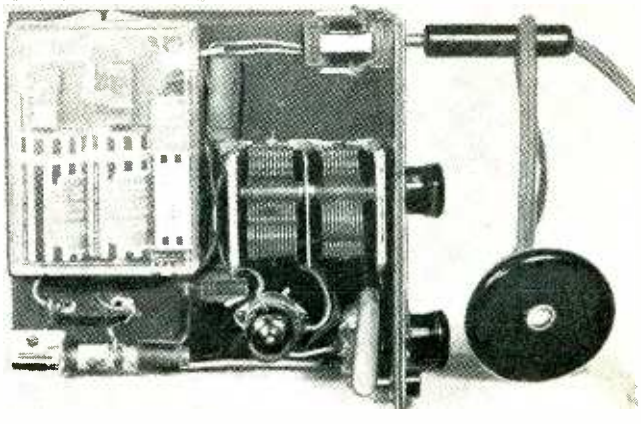
R_1—2.2 megohm, 1 w. res.
C_1—100 μμfd. mica cond.
C_2—350 μμfd. variable cond. (Large section of a dual unit may be used)
C_3—250 μμfd. mica cond.
C_4—.05 μfd., 200 v. cond.
C_5—.002 μfd. mica cond.
S_1—S.p.s.t. switch
B_1—#2 flashlight cell or two #1 cells in parallel
B_2—30 volt battery (Burgess U20)
E_1—Double headphone, 2000 ohm impedance or higher
Ant.—Automobile-type antenna or 1/8" brass rod 4 ft. long. Ant. must be supported in vertical position
L_1—"Vari-Loopstick" ferrite core antenna coil
L_2—7 t. #26 en. wire, spaced about 5/16" from L_1. Wind closespaced in either direction. Fasten with Scotch tape (see text)
V_1—1T4 miniature tube

Fig. 1. Complete circuit diagram of headphone set. A miniature 1T4 tube is used.

Side view of the home-built receiver showing "Vari-Loopstick."



Top chassis view of the set shows how the batteries are mounted.



AMATEUR'S 4-TUBE MINIATURE SUPERHET

By
PAUL POPENOE, JR.
W6IWM

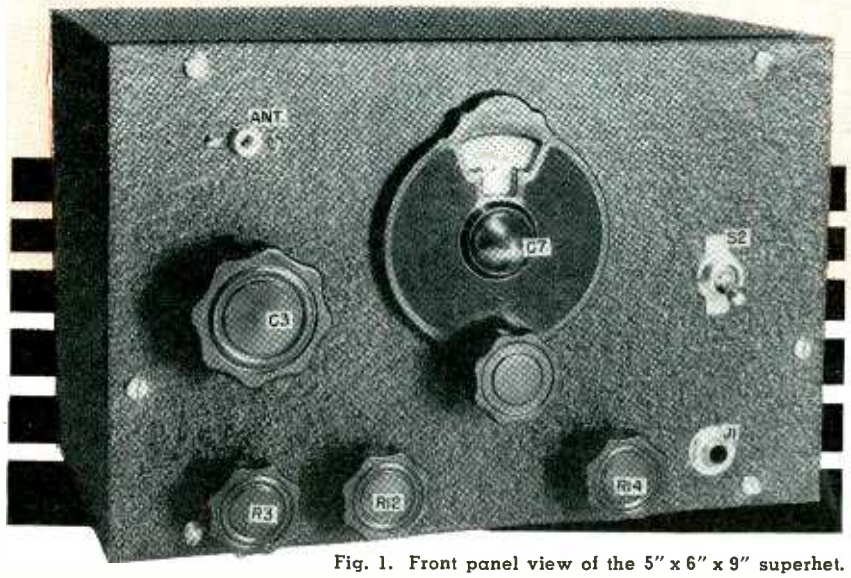


Fig. 1. Front panel view of the 5" x 6" x 9" superhet.

A compact unit which tunes the 40 and 80 meter bands without bandswitching and has its own self-contained power supply.

WHILE articles on the construction of amateur transmitters appear quite frequently in the radio magazines, there is a general dearth of constructional articles on amateur receivers. This is especially true of small portable receivers such as might be desired for use with a midget transmitter. The regenerative receiver is probably still widely used for portable work. However, those amateurs who have spent long hours operating on today's crowded bands realize the importance of a stable receiver with high selectivity, such as is obtainable only in a superhet.

The receiver described in this article was designed specifically with the amateur radio operator in mind and contains no features which are not of use to the ham. Forty and eighty meters are the only bands covered, and no bandswitching or plug-in coils are required. The set uses four dual-purpose tubes in a double conversion superhet circuit with regenerative mixer and detector stages; it is small, being contained in a 5 x 6 x 9-inch steel utility box; and it has a self contained selenium rectifier power supply.

Another factor that should please the ham is the low cost of this receiver. Using first quality components throughout, the cost is approximately $40. At that price many hams could afford this as a second receiver in the shack or as a good little portable to take traveling. On the other hand, some may even find this set desirable for their main receiver since it has performance equivalent to receivers having from eight to ten tubes and costing many times as much.

Is it difficult to build? This is the first question that will come to the mind of many amateurs who have never built a receiver, or at least never a superhet. While this set is not one that should be recommended to a Novice for his first receiver (although it makes a dandy Novice job), any person who has sucessfully constructed several pieces of electronic equipment and who has a fair knowledge of high frequencies should have no difficulty in constructing this set. It is certainly much less complicated in design and circuitry than many of the amateur transmitters published in the radio magazines. Also, it should be pointed out that a lot of specialized test equipment is not required for aligning this set. The only instruments used in the original alignment were a grid-dip meter and a communications receiver. One could probably get by with less.

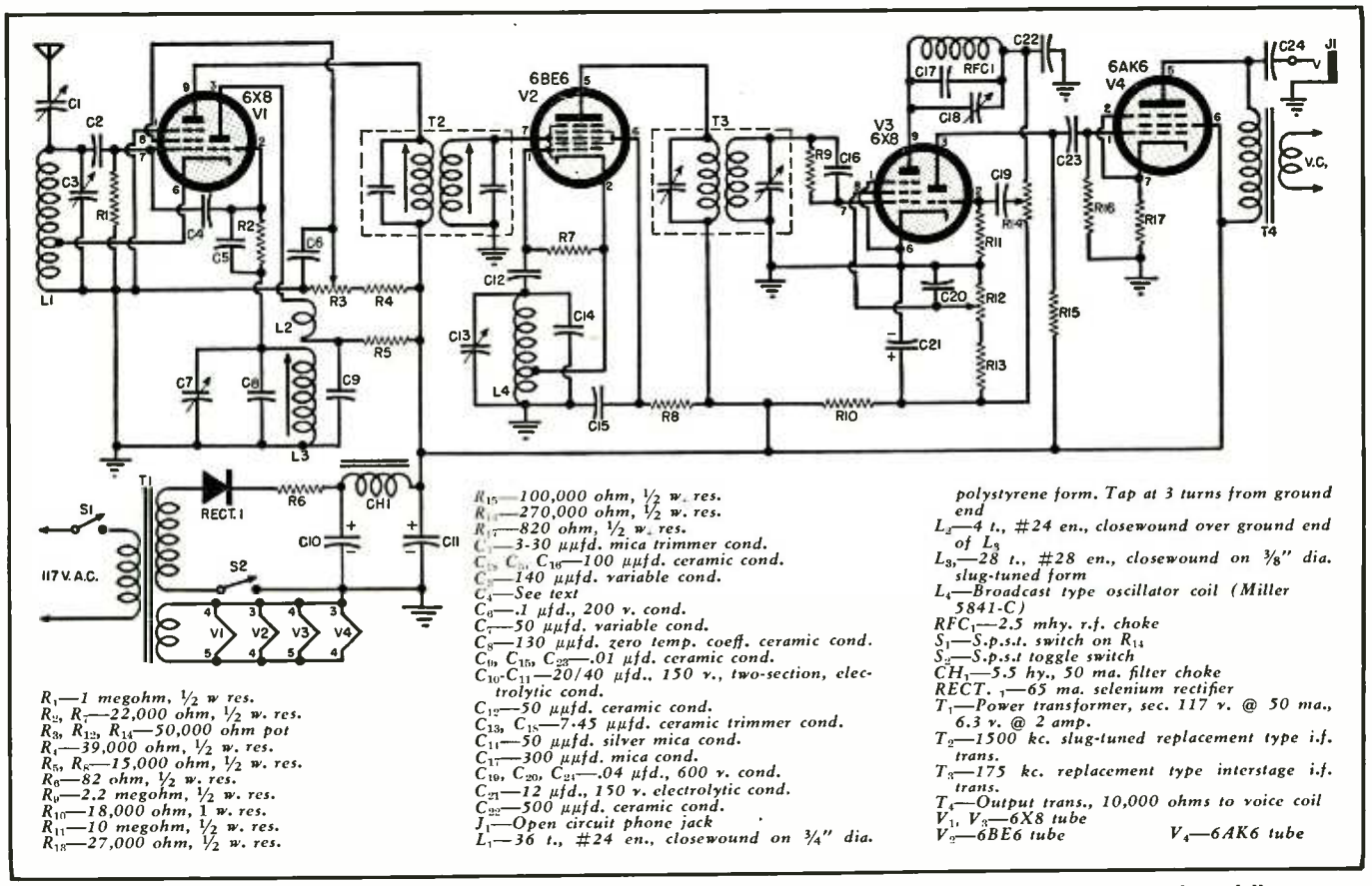
Circuit Description

As shown in the diagram, Fig. 2, the input stage uses a type 6X8 miniature triode-pentode tube as oscillator and mixer. The mixer, using the pentode section of the tube, is regenerative with feedback obtained from a cathode tap on L_1. Regeneration is controlled by screen voltage variation from potentiometer R_4. Tuned circuit L_1-C_3 covers the entire range from 3.5 megacycles to 7.3 megacycles in order to obviate the need for bandswitching in the mixer circuit. A mica compression trimmer condenser is used to couple the antenna directly to the tuned circuit and may be adjusted for different lengths of antenna. The antenna lead is brought out to the front panel in a shielded plug which may be used to connect a fixed tuned converter for coverage of other bands.

The high frequency oscillator, using the triode section of the 6X8, covers a frequency range of 5000 to 5800 kilocycles. The portion of the tuning range from 5000 to 5500 kc. beats with incoming signals in the band 3500 to 4000 kc. to give a mixer output frequency of 1500 kc., the first i.f. frequency. Likewise, the oscillator range from 5500 to 5800 kc. gives an i.f. of 1500 kc. when mixed with signals in the 7000 to 7300 kc. band. The oscillator tuning condenser, C_7, is the main tuning control and is connected to the vernier dial on the panel. The eighty-meter band covers about two thirds of the dial and forty meters, one third. An iron slug-tuned coil, L_3, is used in the oscillator circuit in order that the inductance may be adjusted to allow the tuning condenser to cover the proper range.

Control grid injection of the oscillator signal into the mixer is used. The condenser shown in the diagram as C_1 consists of a length of hookup wire, one end of which is connected to the oscillator grid and the other insulated end is wrapped two times around the wire going to the mixer grid. This arrangement was found to give adequate oscillator injection with no trace of pulling as the mixer tuning condenser was varied. The builder may wish to experiment with this to get greatest conversion efficiency; however, the two turns of wire should prove satisfactory in nearly all cases.

A frequency of 1500 kc. was chosen for the first intermediate frequency for two principal reasons. First of all, 1500 kc. i.f. transformers were readily available at the local radio dealers and secondly this frequency allowed coverage of both the 40- and 80-meter bands without changing oscillator coils. Another advantage is that the



R_1—1 megohm, ½ w res.
R_2, R_7—22,000 ohm, ½ w. res.
R_3, R_{12}, R_{14}—50,000 ohm pot
R_4—39,000 ohm, ½ w. res.
R_5, R_8—15,000 ohm, ½ w. res.
R_6—82 ohm, ½ w. res.
R_9—2.2 megohm, ½ w. res.
R_{10}—18,000 ohm, 1 w. res.
R_{11}—10 megohm, ½ w. res.
R_{13}—27,000 ohm, ½ w. res.
R_{15}—100,000 ohm, ½ w. res.
R_{16}—270,000 ohm, ½ w. res.
R_{17}—820 ohm, ½ w. res.
C_1—3-30 μμfd. mica trimmer cond.
C_{15}, C_{16}—100 μμfd. ceramic cond.
C_2—140 μμfd. variable cond.
C_4—See text
C_6—.1 μfd., 200 v. cond.
C_7—50 μμfd. variable cond.
C_8—130 μμfd. zero temp. coeff. ceramic cond.
C_9, C_{15}, C_{23}—.01 μfd. ceramic cond.
C_{10}-C_{11}—20/40 μfd., 150 v., two-section, electrolytic cond.
C_{12}—50 μμfd. ceramic cond.
C_{13}, C_{18}—7-45 μμfd. ceramic trimmer cond.
C_{14}—50 μμfd. silver mica cond.
C_{17}—300 μμfd. mica cond.
C_{19}, C_{20}, C_{24}—.04 μfd., 600 v. cond.
C_{21}—12 μfd., 150 v. electrolytic cond.
C_{22}—500 μμfd. ceramic cond.
J_1—Open circuit phone jack
L_1—36 t., #24 en., closewound on ¾" dia. polystyrene form. Tap at 3 turns from ground end
L_2—4 t., #24 en., closewound over ground end of L_3
L_3—28 t., #28 en., closewound on ⅜" dia. slug-tuned form
L_4—Broadcast type oscillator coil (Miller 5841-C)
RFC_1—2.5 mhy. r.f. choke
S_1—S.p.s.t. switch on R_{14}
S_2—S.p.s.t toggle switch
CH_1—5.5 hy., 50 ma. filter choke
RECT. 1—65 ma. selenium rectifier
T_1—Power transformer, sec. 117 v. @ 50 ma., 6.3 v. @ 2 amp.
T_2—1500 kc. slug-tuned replacement type i.f. trans.
T_3—175 kc. replacement type interstage i.f. trans.
T_4—Output trans., 10,000 ohms to voice coil
V_1, V_3—6X8 tube
V_2—6BE6 tube
V_4—6AK6 tube

Fig. 2. Complete schematic diagram of the 4-tube ham superhet. It uses standard parts and can be built for about forty dollars.

image frequency is 3000 kc. away from the frequency being tuned. With the high selectivity of the regenerative mixer this means that little or no difficulty should ever be encountered with image interference.

A miniature slug-tuned replacement type i.f. transformer is used at T_2. This couples into a 6BE6 second converter tube which is used in a standard pentagrid circuit. In order to shift the first intermediate frequency to a second intermediate frequency of 175 kc., the oscillator section operates on a frequency of 1675 kc. An ordinary midget broadcast type oscillator coil with tap suitable for use with 6BE6 was used here. While the oscillator could operate on 1325 kc. and still give the required i.f., the higher frequency is preferable since no harmonics of 1675 kc. fall within the bands used. It is essential that the decoupling filter, R_8-C_{15}, be used since without it considerable trouble will be encountered with "birdies."

The second intermediate frequency of 175 kc. was again chosen with the ready availability of components in mind. In this case a miniature i.f. transformer was not available so a regular sized interstage unit was used. The 175 kc. frequency has another advantage in the higher numerical selectivity realized at the lower frequencies.

Regeneration is used in the second detector circuit both to improve overall selectivity of the set and to provide a source of the local oscillations required for beat frequency reception of c.w. signals. The pentode section of a 6X8 tube is employed as a grid leak detector. Feedback is obtained by means of a tuned-plate, tuned-grid oscillator circuit using RFC_1, C_{17}, and C_{18} as tuning elements in the plate of the detector. This tuned circuit requires no special elements as RFC_1 is merely a 2.5 millihenry r.f. choke resonated to the i.f. frequency of 175 kc. by means of the two condensers. Although this arrangement has the disadvantage of causing a slight detuning of the i.f. stage, it has the very important advantage of not requiring any alteration of the i.f. transformer, T_3. Control of regeneration is accomplished by means of screen voltage variation using the 50,000 ohm potentiometer, R_{12}.

After the signal has been demodulated in the pentode section of the 6X8, it is amplified in the triode section. Grid leak bias is used, so it is necessary to have the volume control, R_{14}, in the plate lead of the detector.

The signal is further amplified in the output stage of the set, which uses a 6AK6 tube. For space saving purposes no cathode bypass condenser has been used in this stage. If greater audio gain is required, the constructor may add a 25 microfarad, 25 volt, electrolytic condenser from the cathode of the 6AK6 to ground. The output transformer, T_4, is an ordinary replacement type unit. Since the original thought was to use headphones exclusively, the voice coil winding of the transformer is not shown connected in the diagram. It may be brought out to a jack, however, in case it is desired to use a dynamic speaker.

For reasons of convenience and portability a selenium rectifier power supply has been built into the set. Although this arrangement is quite satisfactory, it is virtually impossible to get rid of all a.c. hum. It is therefore suggested that, where feasible, the power supply be constructed as a separate unit external to the receiver. One precaution that must be taken to insure a low hum level is to make sure that one side of the heater circuit is grounded as shown on the diagram.

The main power switch, S_1, is included on the volume control, R_{14}. Switch S_2 is a standby switch to turn off the high voltage supply during periods of transmission.

Construction

Mechanical construction of the set should be self explanatory from an examination of the photographs. However, certain features will be pointed out. The set is built on a 1½ x 4½ x 8 inch aluminum chassis and contained in a 5 x 6 x 9 inch steel utility box. In order that the chassis may be moved freely in and out of its cabinet, it is necessary to remove the bottom flange of the utility box and make the side flanges slightly narrower. The panel is connected directly to the chassis and is held in place by the three potentiometers and phone jack located underneath the chassis. Mounted on the panel above the chassis are the mixer tuning con-

denser, the oscillator tuning condenser, and the standby switch. The antenna input jack is mounted directly above the mixer tuning condenser. The oscillator tuning condenser, C_7, is the main tuning control and is connected to the vernier dial.

The top view photograph of the set shows the general arrangement of tubes and transformers. All parts have been located to provide for short leads in the r.f. wiring. The audio output transformer is located at the opposite side of the chassis from the power transformer in order to prevent inductive coupling between the two.

The general arrangement of the wiring is shown in the bottom view of the set. It is desirable to employ miniature components as much as possible. Although the chassis size is small, the set is not overcrowded and no difficulty should be encountered in its construction.

Since each constructor will have his own techniques, wiring methods will not be discussed here except to mention the necessity for following good practices, such as making all r.f. leads as short as possible. Because of the design features no difficulty should be encountered with extraneous feedback, which often causes serious difficulty to the home constructor.

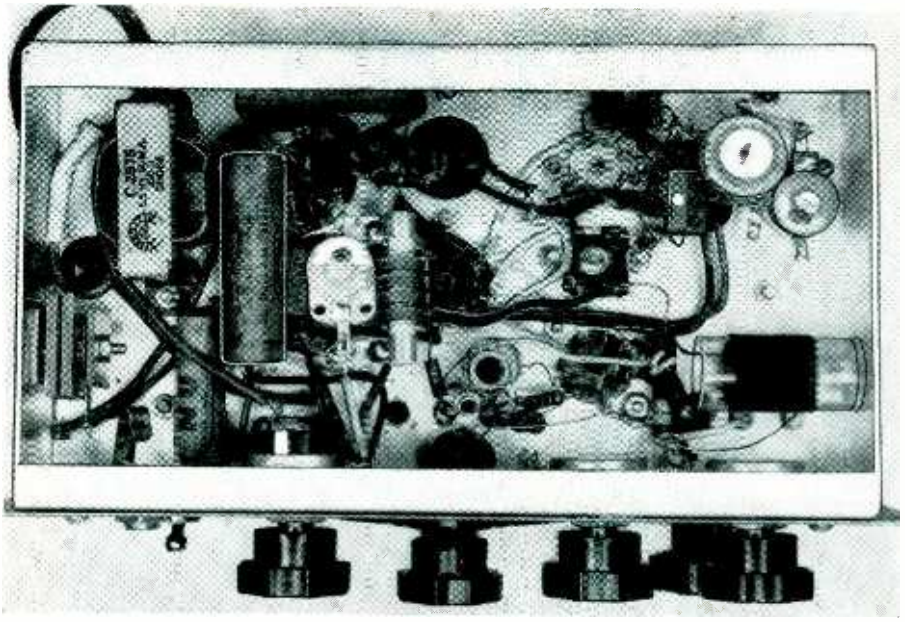


Fig. 3. Under chassis view. Miniature components are used throughout.

Alignment

The first alignment procedure to be suggested here requires the use of a standard modulated signal generator. The first circuit to adjust is the second i.f. transformer. With modulation on, the signal generator should be tuned to 175 kc. and its output coupled to the grid of the 6BE6. With the regeneration control, R_{12}, at a low setting, the transformer, T_3, should be adjusted for maximum output from the set. Next, modulation should be removed from the signal generator and the regeneration control should be advanced to about the half way point. Condenser C_{18} should be adjusted so the detector will oscillate at a point near zero beat with the 175 kc. signal. If no oscillation is obtained, various settings of the regeneration control may be tried. If there is still no oscillation, or if it is not possible to tune close to zero beat, it will be necessary to add or remove capacity from C_{17} until C_{18} will tune RFC$_1$ to 175 kc. This circuit is a sure-fire oscillator, and no trouble should be encountered with inadequate feedback.

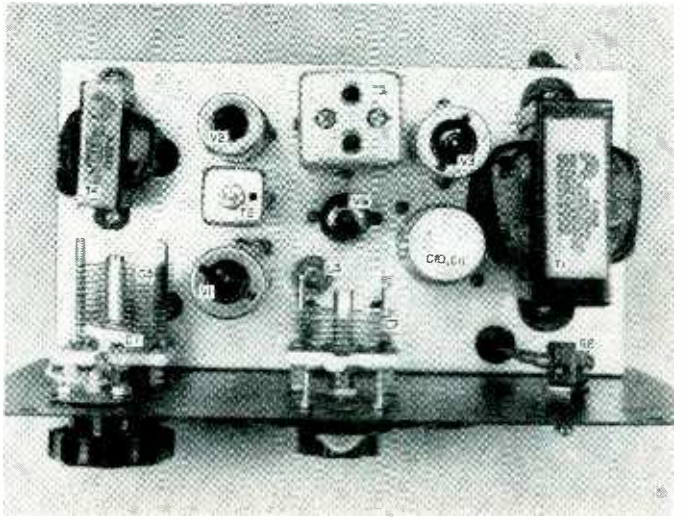
The next step in the alignment is the adjustment of the first i.f. transformer, T_2, and the setting of the frequency of the second oscillator. The signal generator is tuned to 1500 kc. and is connected to the antenna side of the mixer coil. Adjust C_{13} to give a second oscillator frequency of 1675 kc. This may be done by tuning the condenser while listening for the signal. The signal will be heard at two different points. It is essential that the higher frequency point, corresponding to 1675 kc., be selected. Next, the slugs in T_2 should be adjusted to pass maximum signal at 1500 kc.

The final step of alignment consists of adjustment of the mixer and first oscillator. The slug in the first oscillator coil is adjusted to give a range of approximately 5000 to 5800 kc. in the first oscillator tuning control, C_7. With the mixer regeneration control retarded and C_7 set to maximum capacity, tune the signal generator to 3500 kc. and connect it to the antenna terminal. Then adjust the slug in L_3 until a signal is heard; the oscillator should be operating on 5000 kc. With the signal generator set to 4300 kc. the signal should be heard when C_7 is nearly at minimum capacity, corresponding to an oscillator frequency of 5800 kc. If it is not possible to cover the full range, it may be necessary to decrease slightly the size of C_8 and make a corresponding increase in the inductance of L_3. With the signal generator output reduced and loosely coupled to the input of the set, the mixer tuning may be checked. Advance the mixer regeneration control until a slight pop is heard and then retard it to just below this point. It should be possible to peak up signals in the range 3000 to

(Continued on page 114)

Fig. 4. Rear view of receiver with component parts identified.

Fig. 5. Top view of chassis illustrates the uncrowded layout.



QRZ MOBILE

By
LEON A. WORTMAN, W2LJU

Fig. 1. Author holds compact radiotelephone rig. Controls are identified in text.

Bandswitching for 10, 20, and 75 meters, push-to-talk operation, and circuit metering are features of this rig.

"AND DON'T tell me you're only using an 8-foot whip! . . . not with the signal you're putting in here, old man." That's the kind of report that warms a ham's heart, when he's running low power into his home-brewed mobile rig. The mobile-ing aspect of ham-ming has really caught on and the same guy who has concentrated on running a full kilowatt into a rhombic is getting a brand new kick out of an old hobby by discovering that he can "work out" to lots of DX with only 20 or 25 watts and a length of steel rod.

The bug hit me, hard, after giving loads of S9 reports and tape recorded QSL's to mobiles in all states and DX countries. It looked like another way to have fun with the gear and, although the XYL insists I went mobile only because I wouldn't tear myself away from the rig long enough to drive her to market, it has really given us both hours of good fun. I offer the following detailed recipe for my "home-brew" to any ham who is thinking of going mobile, in the hope that some of the ideas employed in this rig may help clarify and simplify some ideas of his own. This rig is a complete and compact radiotelephone transmitter with all the features of a big rig, containing bandswitching for 10, 20, and 75 meters in all stages, push-to-talk operation, circuit metering, and convenient controls.

In planning any installation, one must first attempt to predict many of the problems which may arise, thereby constructing the equipment in such a fashion as to preclude all anticipated difficulties. For example, I was very much concerned about the ability of my automobile generator to maintain the serviceability of the battery after an extended period of mobile operation. Coasting transmitter tube filaments can really "whiff up the juice" during standby . . . 20 to 30 watts of wasted power which, as any one who has left the car radio on overnight will tell you, can stimulate a call for a tow! Not being a traveling salesman and using the car mostly on weekends I couldn't depend on the generator for recharges. Living in an apartment house in the city, I had no power facilities for a battery charger. I didn't want the expense of a "police-type" low cut-in generator. The anticipated difficulty then was dead battery troubles. The solution to this problem seemed to be instant-heating filament type tubes for the rig, tubes which illuminate and draw filament current *only during transmit periods*. So, with the exception of the oscillator tube, all tubes are completely shut off during standby. The oscillator tube is a heater type tube for two reasons: minimization of drift due to sudden heating conditions, and simplicity of harmonic oscillator design.

The r.f. lineup is a 6AQ5 harmonic oscillator capacity coupled to a 5516 final amplifier. The audio modulator is a carbon button mike transformer to push-pull 2E30's. The modulator operates in class "B" for maximum efficiency and minimum plate current drain consistent with good audio quality. It supplies more than sufficient audio power to fully modulate the final r.f. amplifier without making it necessary to shout one's head off. The 30-volt bias for the modulator is obtained from a small hearing aid type "B" battery. The battery is mounted on the underside of the chassis with a clamp such as is used for mounting electrolytic condensers. Because of the exceedingly small and intermittent current drain while transmitting, the battery's life is almost as long as its shelf life.

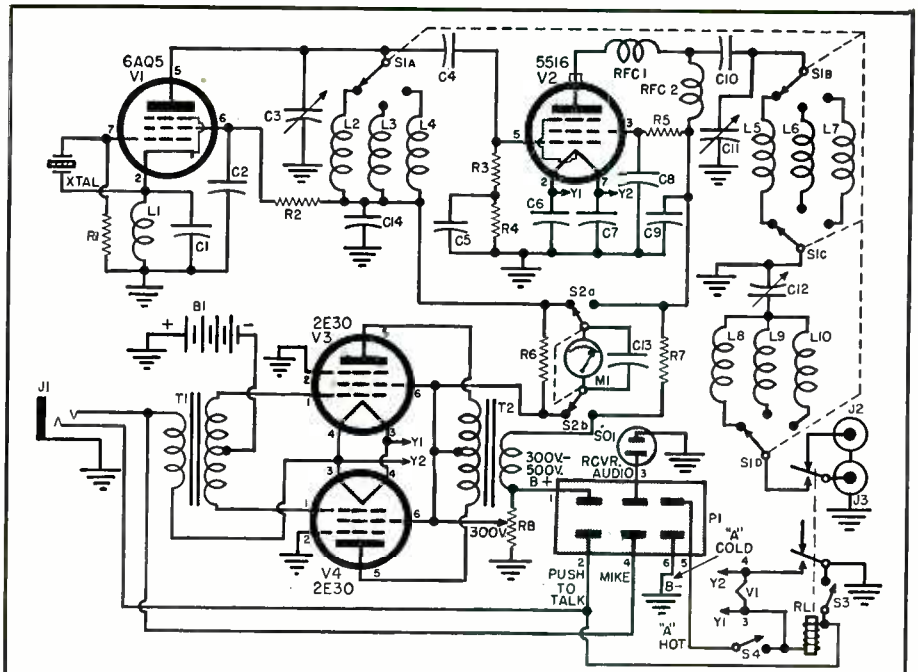
Like nine out of ten hams who "roll their own," I always expect to have to yank out an installation regularly in anticipation of troubleshooting. Whether or not we eventually have to do any troubleshooting isn't important at the moment. What is important is planned accessibility to the rig and its "innards." Therefore, the mechanical layout of this rig and the technique of its installation was decided upon as shown in the accompanying illustrations. The entire rig is built into a grey hammertone finish 5" x 6" x 9" aluminum box with removable top and bottom cover plates. An aluminum chassis was bent, using a vise for the purpose, to fit the inside 6" x 9" dimensions of the box. The chassis is made to be approximately 1" short in its longest dimension, with the short end at the front of the box to make adequate room for mounting the front panel controls. Half-inch flanges on the sides of the chassis enable it to be rigidly mounted. The parts and tube layouts are not critical so an actual template plan is not included here. Simply make certain to use the shield between the oscillator and the final tank coils. This minimizes the mutual coupling between the two circuits, eliminating this possibility as a cause for the final stage to behave as a tuned-

plate, tuned-grid oscillator. The shield for the oscillator tube is included in the mechanical design for the same reason. The modulator tubes should also be shielded to minimize their ability to pick up r.f. energy due to their proximity to the final amplifier. No other shielding was found necessary in the rig. Adequate r.f. bypassing is given by the condensers shown in the diagram. The small antenna changeover and filament power relay should be mounted on the side of the box midway between the coax antenna connectors and the final tank coils to minimize losses and maintain high efficiency.

The bandswitch is assembled from a *Centralab* (or its equivalent) parts kit consisting of an index assembly (Type X). Fig. 3 shows how the wafers are assembled with the switch piercing the vertical shield plate which separates the oscillator coils from the final r.f. coils. The oscillator coils use a solder lug type terminal strip for their common terminus and as a convenient tie point for the .01-μfd. disc-type r.f. bypass condenser C_{14}. The Bakelite wafer section closest to the front panel serves as the band selecting terminus for the oscillator coils L_2, L_3, and L_4. The final tank coils L_5, L_6, and L_7 use two Bakelite wafers for bandswitching. The output coils L_8, L_9, and L_{10} use the stator of C_{12} as their common terminus and the ceramic switch wafer for band selecting. For convenience, neatness, and because of their low cost, all coils are *B & W* "Miniductors." For those who wish to wind their own, data is given in the parts list. RFC_1 is a parasitic choke. RFC_2 is an r.f. choke for shunt feeding the type 5516 tube.

A rather unique feature, which is usually overlooked, was incorporated quite simply. Its inclusion greatly enhances its operability. When making adjustments on the rig, while working a local who is giving you air checks, it's a terrible nuisance to run back and forth from the trunk to the dashboard throwing switches for "transmit-receive" and listening for the comments before running back to the trunk for another adjustment. I obviated that inconvenience by running an extra line in the power cable which interconnects the dashboard mounted remote-control box and the rig itself. That extra line is connected to the "hot" side of the receiver's voice coil. With all "transmit-receive" controls of the remote-

(*Continued on page* 176)



R_1—100,000 ohm, ½ w. res.
R_2—100,000 ohm, 1 w. res.
R_3—18,000 ohm, 1 w. res.
R_4, R_5, R_7—50 ohm, ½ w. res.
R_6—8000 ohm, 2 w. res.
R_8—30,000 ohm, 50 w. variable res.
C_1, C_4—100 μμfd. mica cond.
C_2, C_{14}—.01 μfd. disc ceramic cond.
C_3, C_{11}—100 μμfd. var. cond.
C_5, C_6, C_7, C_8, C_{13}—.005 μfd. mica cond.
C_9, C_{10}—.002 μfd. mica cond.
C_{12}—140 μμfd. var. cond.
S_1—Ganged bandswitch (assembled from Centralab kit—see text)
S_2—D.p.d.t. toggle switch
S_3, S_4—S.p.s.t. toggle switch
J_1—Microphone handset jack
J_2—Coax connector to receiver ant. post
J_3—Coax connector to whip antenna
P_1—6-pin male connector (cable to remote control box and power supply)
SO_1—2-pin female connector (for headset or speaker in car trunk)
Xtal.—Crystal for operating frequency (see text)
T_1—Single-button microphone-to-push-pull grid trans.
T_2—Mod. trans. 10,000 ohms c.t. to 3000 ohms, 10 w. (Thordarson T-21M52 or equiv.)
RL_1—D.p.d.t. miniature, 6 v. d.c. coil relay (Advance Type K1504 RF)
M_1—100 ma. d.c. meter, 1" dia.
L_1—16 t. #22 en., ½" dia., ½" long (or B & W Miniductor #3004—same coil used for all bands)
L_2—8 t. #18 en., ⅜" dia., 1" long (or B & W Miniductor #3006—for 10 m. osc. tank)
L_3—16 t. #18 en., ½" dia., 1" long (or B & W Miniductor #3003—for 20 m. osc. tank)
L_4, L_7—64 t. #22 en., ⅜" dia., 2" long (or B & W Miniductor #3008—for 75 m. osc. tank)
L_5—8 t. #18 en., ⅜" dia., 1" long (or B & W Miniductor #3006—for 10 m. final tank)
L_6—20 t. #22 en., ⅜" dia., 1¼" long (or B & W Miniductor #3007—for 20 m. final tank)
L_8—3 t. insulated wire wound on outside of L_5 (10 m. ant. link)
L_9—4 t. ½" "Miniductor" inserted in L_6 (20 m. ant. link)
L_{10}—10 t. ½" "Miniductor" inserted in L_7 (75 m. ant. link)
RFC_1—1 μhy., 125 ma. parasitic choke
RFC_2—2.5 mhy., 125 ma. r.f. choke
B_1—Hearing-aid battery (see text)
V_1—6AQ5 tube
V_2—5516 tube
V_3, V_4—2E30 tube

Fig. 2. Complete schematic. Coil data is provided for those who "roll their own."

Fig. 3. Top view of rig housed in 5" x 6" x 9" aluminum box.

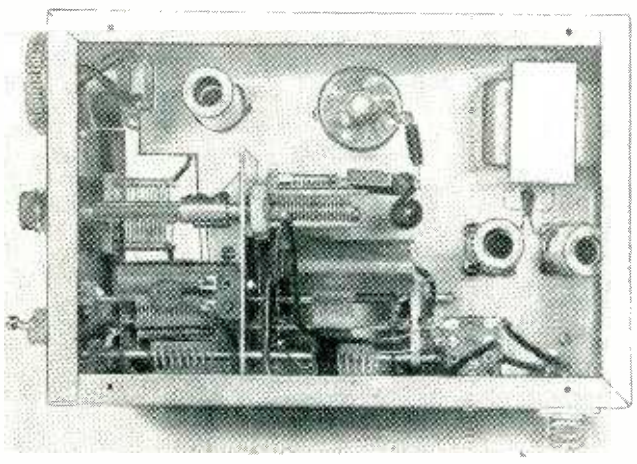


Fig. 4. Roomy layout makes construction and servicing easy.

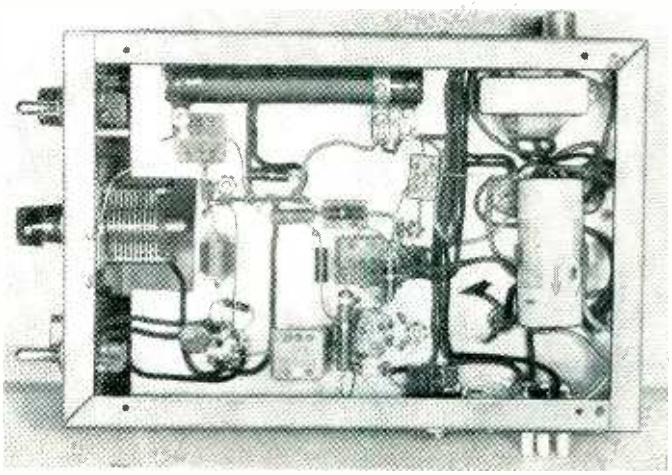
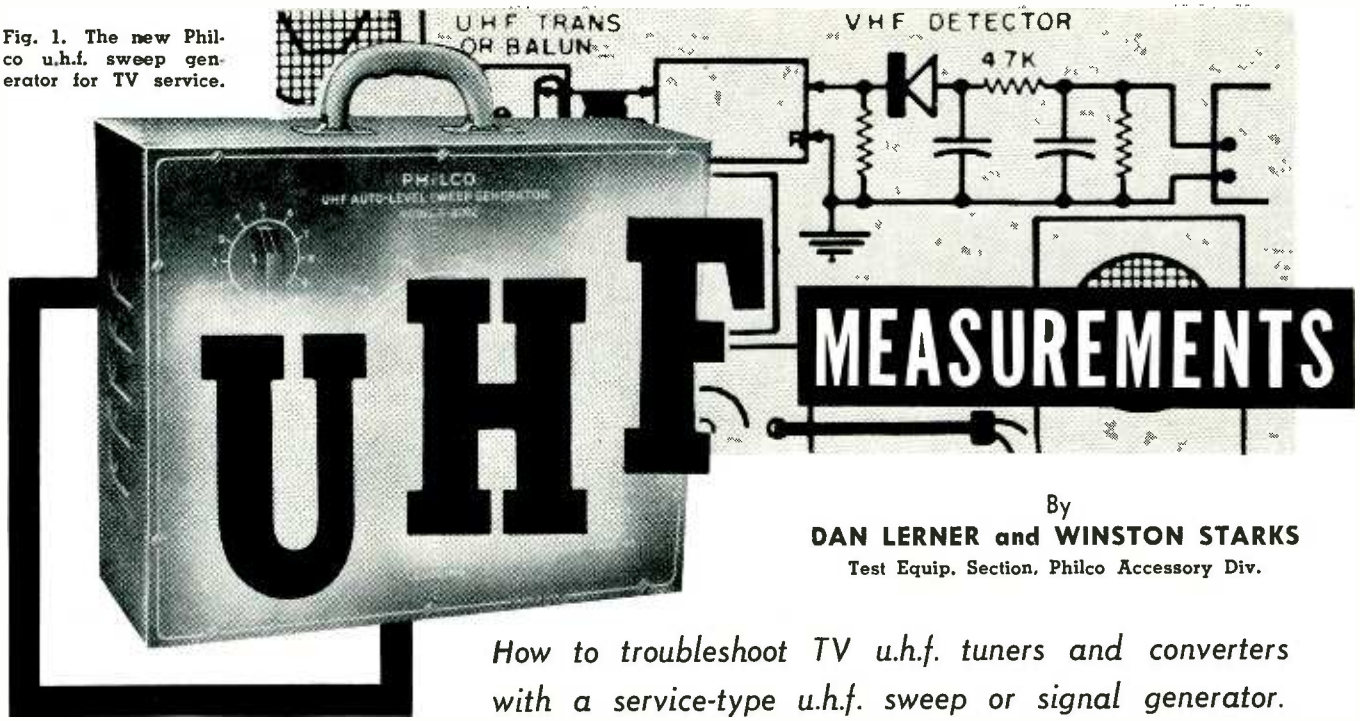


Fig. 1. The new Philco u.h.f. sweep generator for TV service.



U H F MEASUREMENTS

By
DAN LERNER and WINSTON STARKS
Test Equip. Section, Philco Accessory Div.

How to troubleshoot TV u.h.f. tuners and converters with a service-type u.h.f. sweep or signal generator.

THE service technician's need for u.h.f. test equipment has increased rapidly with the speedy expansion of u.h.f. broadcasting. Presently u.h.f. tuners are being used in steadily increasing numbers, with many types requiring repairs or some alignment.

Since the ordinary v.t.v.m., multimeter, oscilloscope, tube tester, etc. can be used for u.h.f. set servicing as well as for v.h.f., the only special piece of equipment needed is a u.h.f. signal or sweep generator.

Until recently, there were no relatively inexpensive u.h.f. signal or sweep generators designed specifically for TV servicing (see "U.H.F. TV Test Equipment," May, 1953, RADIO & TELEVISION NEWS.) However, such equipment is now available (an example is shown in Fig. 1), and the service technician needs to know how to use it for servicing u.h.f. tuners and receivers, as well as for other possible uses.

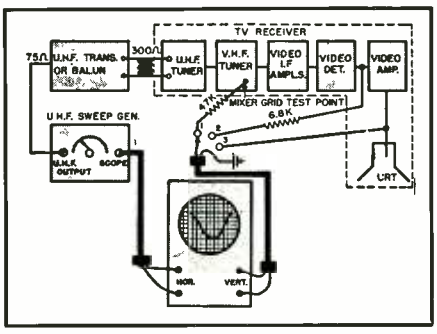


Fig. 2. A u.h.f. test equipment setup for troubleshooting the various sections of a u.h.f.-v.h.f. TV receiver.

Fig. 3. Checking a u.h.f. tuner with a v.h.f. tuner and u.h.f. sweep generator.

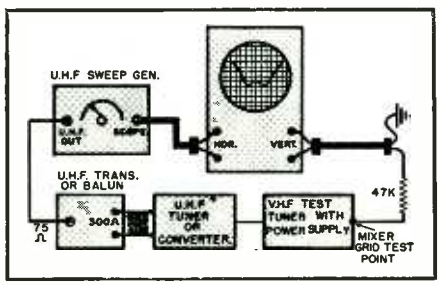
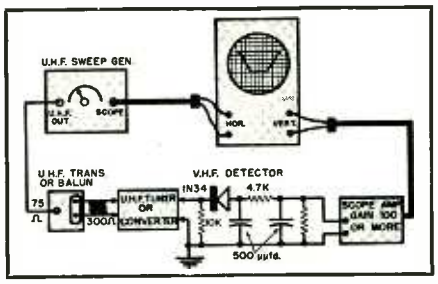


Fig. 4. Checking a u.h.f. TV tuner with a v.h.f. detector and scope.



Troubleshooting a U.H.F. Set

A quick check of the r.f. and i.f. operation of a u.h.f.-v.h.f. TV receiver may be obtained by simply feeding the u.h.f. sweep into the u.h.f. antenna terminals of the set, and observing the response at the check points indicated in Fig. 2. It will be noted that all the response curves taken at these various test points are inverted. This is because the rectified signals at the mixer grid, the video detector, and the picture tube grid are normally of negative polarity. Since this is the case, it is also common practice to make crystal detectors and probes produce an inverted wave in order to be consistent.

The setup shown in Fig. 2 permits checking the r.f. and i.f. over-all response curve and sensitivity at the picture-tube cathode or grid. If the result is below normal, then the scope is moved to the video detector. To avoid loading down the circuit, it is desirable to connect the scope to the video detector through a resistance of about 6800 ohms. If the response is not normal at the video detector output, the scope input is moved to the mixer grid test point on the v.h.f. tuner. Here again, it is important to connect through a resistor—in this case about 47,000 ohms. If we do not get a satisfactory response at this point, the trouble must be in the v.h.f. or the u.h.f. tuner. If a v.h.f. signal from a v.h.f. generator is available, it can be fed in at the v.h.f. terminals, bypassing the u.h.f. tuner. If this gives satisfactory results, the next step is to check the u.h.f. tuner.

Figs. 3 and 4 show test hookups which can be used to check u.h.f. tuners or converters without the use of a television receiver. Although the setup in Fig. 4 could be used to align a u.h.f. tuner or converter, do not attempt alignment unless you have the manufacturer's specific alignment instructions. The basic principles of alignment of tuners at u.h.f. is very much the same as at lower frequencies; however, many u.h.f. tuners incorporate special gimmicks and adjustments whose purpose should be understood before attempting adjustment. There is usually some provision for high and low frequency oscillator tracking. There will sometimes be a gimmick, consisting of two twisted wires, which may be used to adjust the oscillator feedback. There may also be small movable "tabs" or plates which affect oscillator tank balance and feedback. Such adjustments are sometimes used to eliminate "holes" or dips in the tuner curve due to absorption effects and falling off of converter oscillator output. The u.h.f. tuner will usually have some form of tuner r.f. preselection between

the mixer and the antenna. This circuit should have adjustments such as a high-frequency trimmer and perhaps slotted rotor plates, in the case of condenser tuning, which can be "winged" to provide low and midband r.f. tracking.

The setup of Fig. 3 shows how a u.h.f. sweep generator can be used to check the response and relative gain of a u.h.f. tuner or converter. In this case, the output of the u.h.f. tuner goes to a v.h.f. tuner which serves as a test standard. The rectified signal at the mixer grid of the v.h.f. tuner is viewed with an oscilloscope. The response curve is the result of the combined response of the u.h.f. and v.h.f. tuner. Of course, this does not give the true response of the u.h.f. tuner, but does serve as a means of comparison to determine if the u.h.f. tuner is faulty. With the u.h.f. tuner in this setup, crystals and tubes may be changed while observing their effect on the response and relative gain. A tuner known to be of good quality may be placed in the setup, and the generator and oscilloscope settings can be marked and standardized as a means of future comparison and evaluation.

To check the true characteristics of the tuner, it is necessary that the tuner output be detected without going through other circuits. Fig. 4 shows how this can be accomplished by using a detector followed by a scope amplifier of good low-frequency response. The scope amplifier is usually needed in this setup to amplify the detector output to operate the oscilloscope. The value of the detector output resistor should be approximately 100,000 ohms.

Many u.h.f. signal and sweep generators have a 50- or 75-ohm output rather than 300-ohm output. In order to go from the 75-ohm output of the generator to the 300-ohm input of the tuner, a u.h.f. matching transformer must be used as shown in the hookup of Figs. 3 and 4. Such matching transformers are available from some test equipment manufacturers, and one is shown in Fig. 8; its schematic diagram is shown in Fig. 5.

U.H.F. Frequency Calibration

It is possible to mix signals, as shown in Fig. 6, in a way that will permit accurate spot calibration of generator frequencies. A v.h.f. marker generator (using harmonics) or a u.h.f. marker generator may be used to inject a marker or calibration signal into the line as illustrated. It is accepted practice to calibrate sweep generators with the sweep width set at minimum. When the sweep and marker generators are tuned to approximately the same frequency, a beat will be observed on the scope.

A u.h.f. television station can be used to get an accurate frequency calibration point without a calibration standard by tuning the u.h.f. generator for the beat indication on the scope as shown in Fig. 6. This frequency will be the picture carrier frequency of the television station.

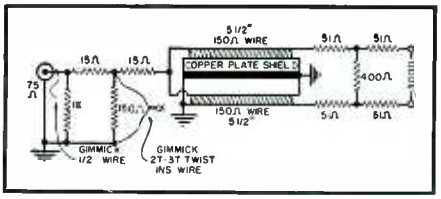


Fig. 5. Schematic diagram of a 75-ohm to 300-ohm matching transformer designed for use at ultra-high frequencies.

In all the u.h.f. setups and measurements which have been discussed, it is necessary that special care be taken to make good connections and to insure that all lines are properly terminated. In cases where a match must be made between a 75-ohm line and a 300-ohm line, a transformer should be used. If 300-ohm lines in a setup are too "hot" (very high standing-wave ratio), they may be cooled off by inserting a 3 or 6 db pad in both ends of the 300-ohm line. The insertion of a 6 db attenuation will cut the available signal in half.

U.H.F. Delay Lines

A u.h.f. sweep generator may be used with a delay line to make numerous tests at u.h.f. The setup shown in Fig. 7 can be used for measuring standing-wave ratios produced by transmission lines or by the terminating device at the end of a line.

The curve on the scope shown in Fig. 7 would be a straight line for a perfect termination of the delay line. If the termination Z is not 75 ohms (for the 75-ohm delay line used) and is not a pure resistance, then there will be ripples on the curve as shown. As might be expected, the SWR is equal to:

$$SWR = \frac{\textit{distance from base line to largest ripple peak}}{\textit{distance from the base line to adj. minimum}} = \frac{Y}{X}$$

It should be remembered that the scope sweep is actually a representation of varying frequency, so that as the generator goes through its sweep, there are points of minimum and maximum SWR. (The termination varies with frequency.) Checking the SWR by this method gives a good approximation only if minimum and maximum points are taken as close together as possible. Obviously, there is some error because the minimum and maximum do not occur at the same frequency. The error can be minimized by using a longer delay line to produce more reflected waves which will be closer together on the scope trace. The limit to making the line longer is the loss which occurs in the line which makes the termination appear better.

The setup in Fig. 7 is also ideally suited for delay line measurement of the velocity of propagation of a transmission line. To measure the velocity of propagation of a line, cut it to a known length (preferably 25 to 100 feet), and substitute it as the delay line. Then, the far end of the line

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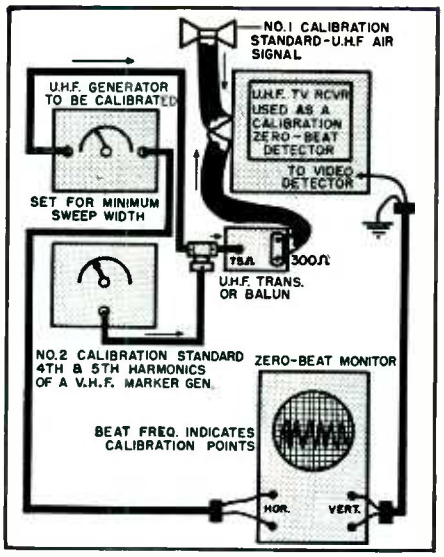


Fig. 6. Shown here is the setup for calibrating a u.h.f. sweep or signal generator using two different standards.

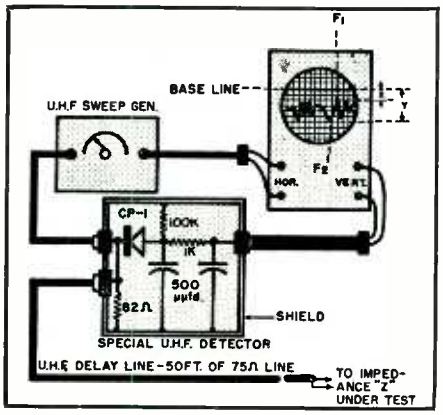


Fig. 7. Test setup for standing-wave ratio measurements with a delay line.

Fig. 8. External appearance of the u.h.f. matching transformer shown in Fig. 5.

PAGES FROM A TAPE EDITOR'S NOTEBOOK

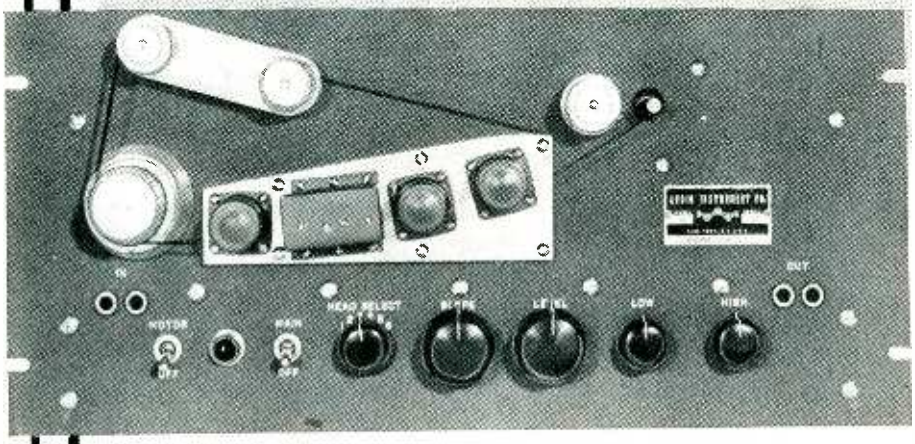


Fig. 1. Audio Instrument's unit permits the use of controlled echo, with audio perspective and reverberation time variable.

Part 4. Concluding article covers a number of "tricks" for which tape is useful and how such effects can be obtained.

By

DONALD C. HOEFLER

THE recording engineer, being equal parts scientist and artist, has never failed to take a new piece of equipment and endow it with even greater virtues than those imagined by its inventor. Never was this truer than in the few years since the advent of magnetic tape. The techniques described here have all been developed since the introduction of tape, although some of them are equally applicable to other media as well.

It has become increasingly common for small U. S. recording companies to buy master tapes from European record companies and radio stations, and to transfer them to commercial LP discs for release in this country. These transactions have enabled tremendous savings in talent costs, but they very often have created equally tremendous headaches for the dubbing engineer, who must translate these foreign tapes into a commercially acceptable LP record for American audiences.

A common problem is the matter of tape width. Our tape is ¼-inch wide, while some European tape is 7 millimeters, just a fraction larger. Some American-made tape machines are equipped with guides which are large enough to permit the 7-mm tape to pass without binding, but for machines which do not, the only cure is to remove the guides and turn them down on a lathe until they fit.

The next big problem is that of overall sound quality. European practice differs widely from American technique in the matter of studio acoustics, microphone placement, equalization, and recording characteristics. Here the engineer and recording director must experiment with equalizing devices until an aural check satisfies them that they have the desired sound.

Finally there is the question of musical pitch. The standard pitch employed almost everywhere in this country is known as the *Stuttgart* pitch, and refers to a middle A pitched at 440 cps. But there have been many other systems of octave nomenclature employed throughout musical history, in which A has varied all the way from 415 to 454.7 cps, and practice among European orchestras still varies widely. This situation is further complicated by the fact that tape speeds will vary somewhat, due to instability of the power frequency supplying the recording equipment.

Thus there has arisen the need for some means of altering the pitch of tape recordings, *i.e.*, of varying the speed of the tape during playback. This can be accomplished by disconnecting the synchronous capstan motor from its usual 60-cycle supply and feeding it instead from a variable-frequency power supply which will operate anywhere between perhaps 55 and 65 cycles. The power pack for the amplifier, of course, remains on the regular power source. The local supply can be a motor-generator set, but a much more satisfactory arrangement consists of a very stable audio oscillator followed by a power amplifier of sufficient output to drive the capstan motor. With this system on a professional machine, it is possible to vary the pitch nearly a half-tone in either direction before the motor falls out of synchronization and begins to hunt. This arrangement is equally applicable to disc reproduction, with the same precaution that the variable supply must feed the turntable motor only.

Another stunt employing tape has made life a little easier for sound-effects men in radio, television, and motion pictures. Most of the brief effects such as gun shots, footsteps, and door slams are produced in the studio as required during a performance. But there are many other background sounds of longer duration such as the noise of a cheering crowd, or of city traffic, or perhaps of the rolling surf which are usually reproduced from recordings. Since these are usually ten-inch records, with a playing time of around three minutes, a scene will often run longer than the record. In such cases, it has been the practice in the past to use two identical records, and to fade from the end of one to the beginning of the other as required. But since most sound-effects setups contain only three turntables, and two of them may be in use for a single background effect, the operator is then severely handicapped.

But none of this is necessary when the sound is recorded on a *continuous tape loop*. Such a loop is made by first dubbing a few seconds of the desired sound from disc to tape. Then the beginning of the tape is spliced to the end of it to form a loop whose length will just permit it to be threaded around the supply reel, past the heads and capstan, around the takeup reel, and then *directly back to the supply reel.* This is illustrated in Fig. 3. A little experimenting will be necessary to determine which tape length works best with a given machine, and it may be necessary to disable the supply and takeup motors to prevent their racing. It is of course possible to record several effects simultaneously on the same tape with this system, thus producing results which would require a very elaborate turntable setup in the studio.

An effective method of noise reduction has been developed by Paul H.

Hickin of the *RCA Victor* studios. It consists simply of reversing the tape and playing it with the plastic base against the head. This results in a reduction in level which discriminates against the higher frequencies, as shown in Fig. 2. A considerable high-frequency roll-off and eventual cut-off is achieved, with the exact shape of the response curve dependent upon the operating speed of the tape. It is important that the tape when played in this fashion have no patch-type splices, as these would raise the oxide further from the head as they passed it, resulting in skip effect. The usual procedure is to make a conventional dub onto tape from the noisy source, and then to make a second dub from the first, playing the first one back with the base in and oxide out. The first tape is then discarded or held for protection, and the second copy edited for ticks and pops.

Numerous other interesting and useful effects may be obtained without any equalizers other than the pre-emphasis and de-emphasis circuits in the tape machines themselves. If a machine has plug-in or switch-in equalizers available for the various speeds at which it operates, it is possible, and sometimes desirable, to use some playback equalization other than the theoretically correct one.

Re-recording at some multiple or fraction of the original recording speed will also alter the response characteristic. If a tape is reproduced at twice the speed at which it was recorded, for example, and a dub made at twice the speed it will be played back, the pre-emphasis and de-emphasis curves are each displaced an octave from their normal positions, and they will no longer be exactly complementary. The differences will depend upon the equipment used and the speeds at which it is operated. A little experimentation along these lines will afford several response curves which are useful for special applications.

The progress of tape recording characteristics has followed a very similar pattern to that of disc and film recording, with each studio having its own concept of the ideal. While standardization would be highly desirable, the recording engineer meanwhile can take advantage of the lack of it. For if he has at his disposal several tape machines of different manufacture, he almost certainly has an equal number of different reproducing characteristics. There again he can give his clients a choice of several variations in sound quality without the additional expense of external equalizers.

There are several methods for the addition of controlled reverberation to recorded material in general commercial use. One of these consists of an electroacoustic drive mechanism, such as that found in a loudspeaker or disc record cutter, which is attached to one end of a set of taut springs made of various gauges of piano wire. The other end of the springs is connected to a reproducer mechanism, such as a contact microphone or phonograph pickup. The vibrations set up in the springs result in a sound which approximates that of an echo.

The method which is most commonly used, when space permits, is the echo chamber. This is essentially a highly reverberant room containing a loudspeaker and a microphone. The amplifier which drives the loudspeaker is bridged across the program source. In live recording this may be a single microphone channel or the output of the entire mixer. In re-recording, the source will be the playback equipment. In either case, the sound from the loudspeaker is reflected many times in the echo chamber and picked up by the microphone, from which it is fed back to the console to be mixed with the original sound in whatever proportion is desired.

The various ways in which an echo chamber can be used to alter the sound of a recording have been thoroughly explored in recent years, and hardly a popular recording is made today which does not make some use of this effect. For many years the reverberation chamber has been standard equipment in motion-picture and broadcasting studios.

But even for this well-known device additional uses have been discovered with the advent of tape. A problem which has often troubled recording companies, when issuing a record of a broadcast or other performance where an audience was present, is how to eliminate the applause at the end of the music. If a slow fade is made, some of the applause will sneak through and prove somewhat annoying to the home listener. With a fast fade, the reverberation on the last note will sound clipped and unnatural. But the combination of tape and an

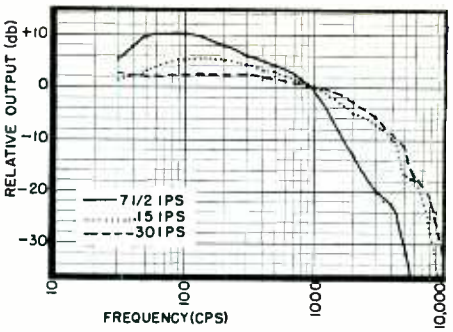


Fig. 2. The effect of frequency response of tape reproduction at various speeds, due to playing back the tape with the base against the reproduce head. See text.

echo chamber has obviated this trouble. The tape is edited so that all of applause is removed and replaced by blank tape. This of course results in a sharply cut off final chord, but the lost reverberation is restored by the echo chamber. A sample of the playback output is bridged to the chamber in the usual manner and returned to a mixer channel. Just as the silent tape approaches the playback head, the return from the echo chamber is faded in to supply the missing reverberation. Often extensive rehearsal is necessary to achieve a natural effect, but when the sound of the echo chamber is equalized to approximate the sound of the original auditorium, and when the cross-fading between the source and the echo are smoothly achieved, the result will be a finely decaying reverberation which will match the music preceding it.

The arrival of LP and EP has caused the use of this trick to become an everyday occurrence. On an EP, for example, there is available a maximum playing time of about eight minutes, while that of a 12-inch standard disc is around five minutes. This means that it is possible to record

(*Continued on page* 98)

Fig. 3. Continuous tape loop permits reproduction of background sound effects for much longer periods than heretofore available on ten-inch recorded discs.

COLOR RECEIVER ALIGNMENT

Fig. 1. Typical color TV chassis.

By

WALTER H. BUCHSBAUM

Television Consultant

RADIO & TELEVISION NEWS

Basic alignment and adjustment information applicable to practically all color TV sets soon to be available

NOW that many TV manufacturers have announced plans for color set production in 1954, the service aspects of color TV are gaining new importance. Actually, there are two distinctly different functions which the service technician performs. One function is the installation and adjustment of the set; the second function is troubleshooting and repairing defects.

Installing and aligning color receivers (see Fig. 1) is much more complex than in monochrome work and each manufacturer will provide detailed instructions with his receiver. Certain adjustments and alignment data, however, apply for almost all sets and will be required with every new color installation. Such data is presented here as it applies to those receiver sections which differ from the monochrome TV circuits. Conventional adjustments such as height, width, horizontal or vertical synchronization, etc., are not covered here.

Fig. 2 shows the essential portions in a color receiver, indicating their sequence and interdependence. The "B+" power supply, heater, and d.c. distribution are omitted here. The typical color receiver requires considerable adjustment and precise alignment in five different sections as listed below:

1. I.F. section. The i.f. response is critical and accurate trap setting is essential to avoid color interference.

2. Color synchronization section. Here the color reference burst must be used to control the phase and frequency of the local color subcarrier oscillator. This section usually uses a.f.c. and is similar to the horizontal oscillator in a monochrome set.

3. Decoding section. In this part of the set the color signals are removed from the subcarrier and transformed from the "I" and "Q" signals into voltages corresponding to the three colors.

4. Chromaticity amplifiers. The color signals are amplified, certain bandpass responses are required, and color intensity adjustments are needed.

5. Picture tube components. For a tri-color tube this is the most complex adjustment of all, requiring both electrical and mechanical settings which affect each other and must be optimized for good color reproduction. The purity coil, field neutralizing coil, deflection yoke, and positioning magnets must be carefully set for correct picture tube operation.

While it is not possible to give a detailed and complete procedure for these five alignment problems as they apply to each individual color receiver, this article does give the technician the data needed to set up a color receiver in the customer's home and get it working right.

I.F. Alignment

Although it may not be obvious, the i.f. section of a color TV set is somewhat different from its monochrome counterpart. The reasons for this are the requirements that the color subcarrier must be amplified along with the video and sound carrier and that there must be a constant phase delay throughout the passband to 500 kc. above the color subcarrier to eliminate the possibility of phase error in the color information. Fig. 3 shows the i.f. response required for a color TV set. Note that the subcarrier is 3.58 mc. lower in i.f. frequency than the video carrier. Also note that the flat portion of the response curve extends at least 0.5 mc. below the color subcarrier. A very sharp dip is needed for the sound carrier to prevent it from interfering with the video signal.

For alignment purposes it is not necessary to know exactly what the i.f. circuit looks like and there are a number of different circuit combinations which will produce a response curve like the one in Fig. 3. The important thing for the alignment procedure is to know the location of the various traps and the prescribed frequencies at which certain coils should resonate. This data is usually contained in manufacturers' service data and sometimes is even given with the tube layout diagram.

Alignment of the color i.f. with the sweep generator and oscilloscope method is the same as for monochrome, with emphasis on accurate markers tuned to the color subcarrier, its sidebands, and the various traps. In monochrome receivers it is usual for some change in i.f. response to occur with varying levels of a.g.c. This is not permissible in color sets since this would mean that a change in signal strength would also result in a change of the actual colors on the screen. Check the i.f. response at maximum and minimum a.g.c. to make sure the shape of the curve remains the same.

Color Sync Adjustment

The color synchronizing section has the function of providing the reference phase of the color subcarrier for the demodulator or synchronous detector circuits. For this purpose the short reference burst transmitted after each horizontal synchronizing pulse must be compared with the frequency of the local color subcarrier oscillator and this oscillator must be locked in-phase to the reference burst. Several different circuits are used by various manufacturers to accomplish this. One

method utilizes the reference burst itself through a crystal ringing circuit to provide a constant amplitude sine-wave signal. Another frequently used circuit employs a phase detector type automatic frequency control to lock the local color oscillator with the reference burst. Since the burst only appears after each horizontal synchronizing pulse, the entire a.f.c. system must be gated so as to operate only during the short burst period. The gating signal is at the horizontal sweep frequency and is usually the horizontal flyback pulse.

Alignment of the color synchronizing section depends, in part, on the gating and cannot be started before the horizontal sweep is locked in correctly. Since the color subcarrier frequency is 3.58 mc., a test signal of this frequency will help greatly in the alignment process. When a color telecast is used as a test signal be sure that the i.f. and second detector, as well as the horizontal and vertical synchronizing sections, are adjusted before the color synchronizing section is tackled.

Fig. 4 is a simplified diagram of a typical gated a.f.c. system. Actual circuits may vary with different manufacturers, but the principal components remain the same. First, align the oscillator output transformer for maximum output signal. Connect a crystal diode probe across the input of the following stage, usually a quadrature phase amplifier, and tune for maximum signal. Similarly, tune the 3.58 mc. takeoff coil which removes the burst from the video section for maximum output. The most critical adjustment is the tuning of the phase detector transformer itself. If this circuit locks on the wrong phase, the colors at the picture tube will be wrong. If the phase detector is misaligned so that the local color oscillator is not locked at all, the colors will vary as the oscillator phase and frequency drifts. In other words, wrong colors which remain consistently wrong can be caused by a slight misadjustment of the phase detector, while shifting colors indicate loss of color synchronization.

The local color oscillator frequency must be quite close to the correct frequency and this depends on the tuning of this oscillator. To check for correct tuning, short out the reference burst going to the phase detector and tune the oscillator carefully until correct colors appear on the screen. It will be difficult to maintain correct colors by manual oscillator tuning for any length of time, but if the manual setting of the oscillator frequency is close enough to produce correct colors for an instant, the a.f.c. system usually can take over full control. After correct phasing is obtained and the local oscillator synchronized firmly, the output transformer and subsequent 3.58 mc. tuned networks should be re-aligned for maximum signal transfer.

Two sine-wave subcarrier signals are required, 90 degrees out-of-phase with each other, to demodulate the "I" and "Q" signals. To obtain the necessary 90-degree phase shift, a quadrature

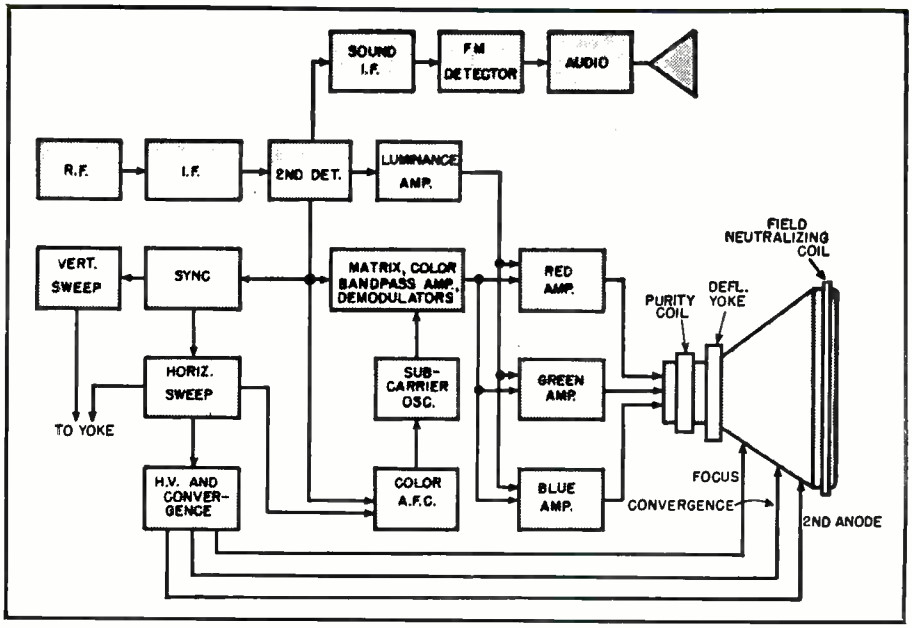


Fig. 2. Partial block diagram of the typical color TV set using tri-color tube.

amplifier is often used. In the system shown in Fig. 4, the 90-degree phase-shift amplifier is also used as a buffer between the oscillator and the phase detector. By adjusting the network marked "phase control," the phase of the feedback signal is shifted to coincide with that of the incoming burst. Needless to say, all 3.58 mc. transformers are tuned for maximum power transfer at the color synchronizing frequency.

Alignment of the crystal ringing system for color synchronizing signals is considerably simpler, since all networks are tuned for maximum and the limiter output transformer is tuned for maximum limiting action. There is no oscillator drift, no trouble of "pull in" limitation, and the only criterion is that the output be a uniform amplitude sine wave free of distortion and harmonics.

Other synchronizing circuits using different a.f.c. systems can usually be aligned in the same manner as the basic circuit of Fig. 4. In some receivers the functions of a crystal ringing circuit and the a.f.c. system of Fig. 4 are combined, but the adjustment problems are essentially the same.

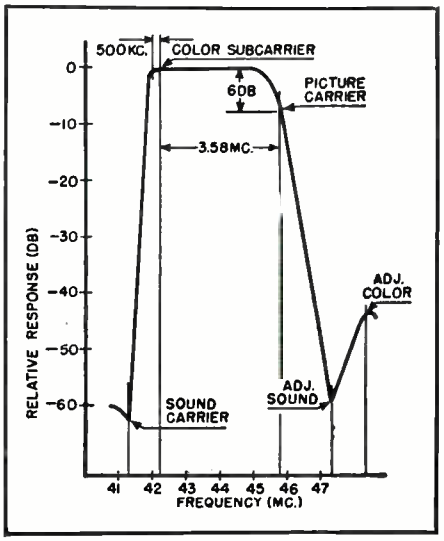


Fig. 3. Color TV set i.f. response.

After the second detector the color signal is separated from the luminance information (monochrome component of the color TV signal) by passing through a bandpass amplifier, often called the chromaticity channel. The frequency response of this stage is such

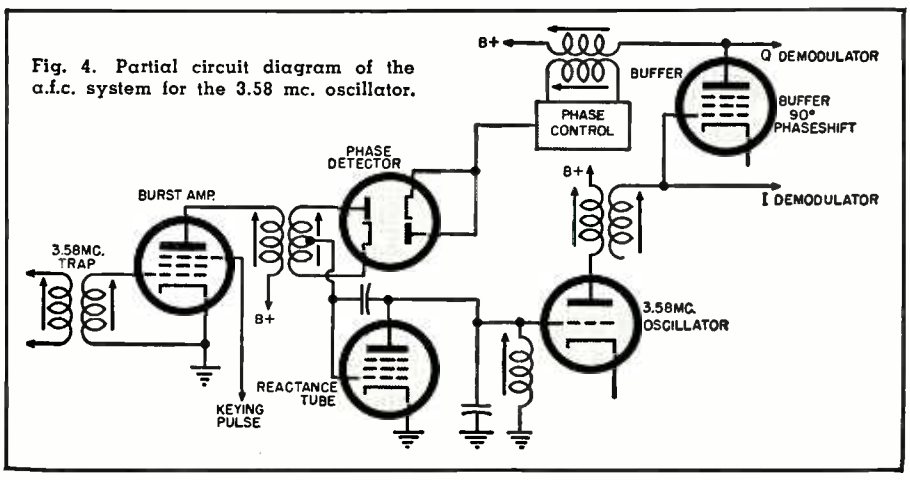


Fig. 4. Partial circuit diagram of the a.f.c. system for the 3.58 mc. oscillator.

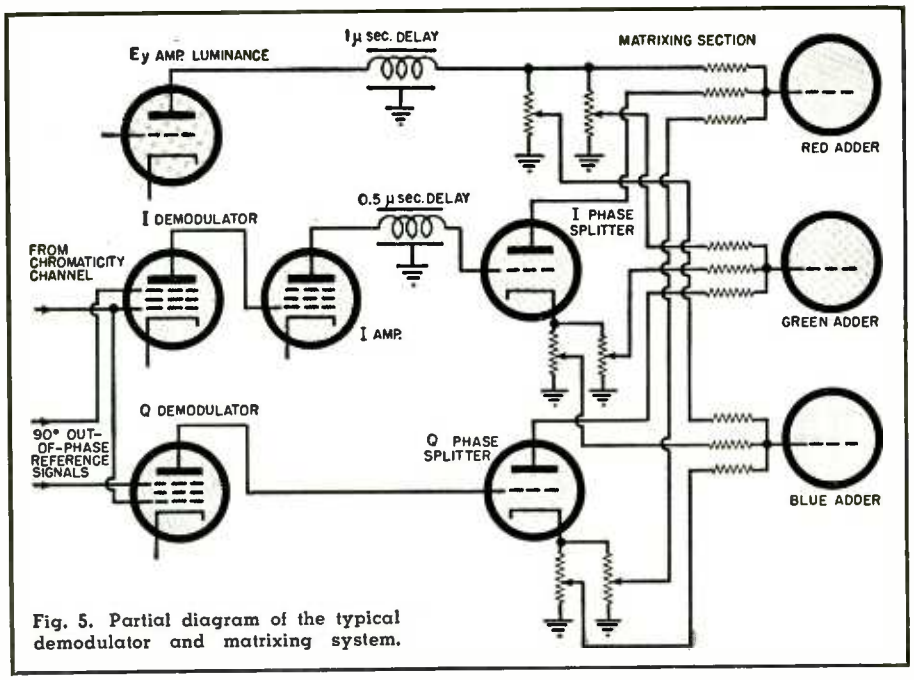
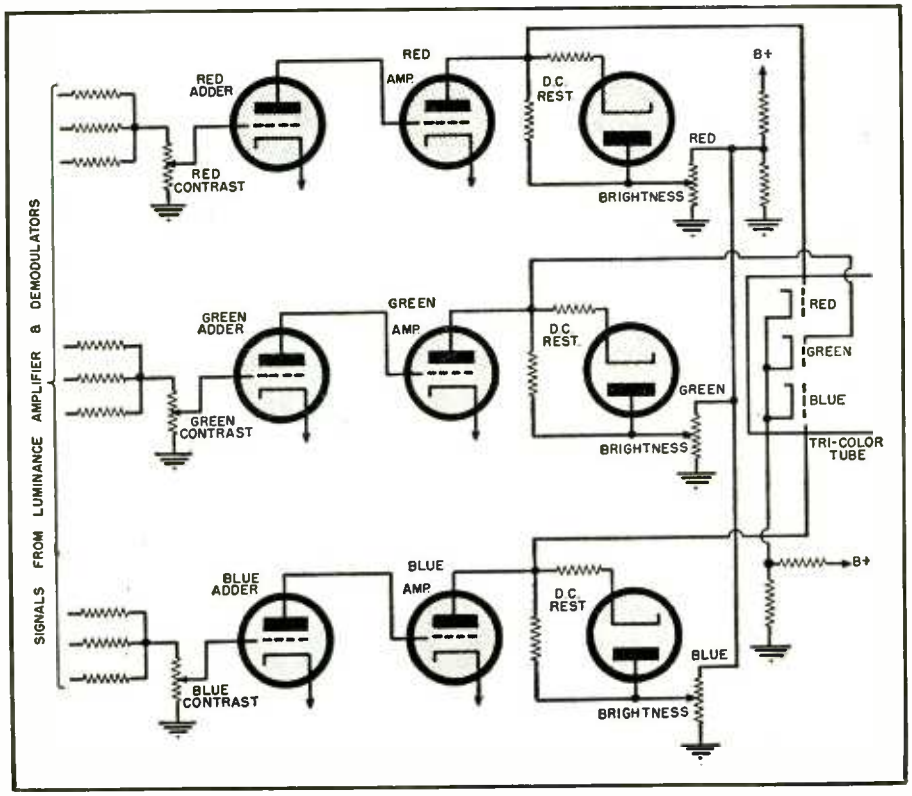


Fig. 5. Partial diagram of the typical demodulator and matrixing system.

that only signals from 2.28 to 3.98 mc. are passed. This frequency spectrum is occupied by the color subcarrier and its two sidebands. After passing through the chromaticity channel, the signal is applied to two demodulators, the "I" and "Q" detectors. As is shown in Fig. 5, these two detectors are controlled by the two color subcarrier reference signals obtained from the color synchronizing section. The two 3.58 mc. sine waves are 90 degrees out-of-phase with each other and 33 and 57 degrees respectively out-of-phase with the reference burst. In order that the "I," "Q," and luminance signals arrive at the combining networks at the same time, a 1 microsecond delay is introduced in the luminance channel and a 0.5 microsecond delay in the "I" channel. A triode is used as phase splitter for each of the two color signals and up to six potentiometers are needed to adjust the amounts of signals to be added. The reason for all these controls is the varying amplification in the three channels requiring adjustments to combine the luminance "E_y," "I," and "Q" signals in the proper amounts to obtain the correct red, green, and blue signals.

In an actual receiver the matrixing section will be adjusted carefully at the factory using special test signals to check for the correct color signal mixing. For the service technician it may be sufficient to touch up some of these controls provided there is reason to believe that wrong colors are not caused by other effects. The adjustment of these matrixing controls requires the presence of a station signal, preferably a test pattern. Only after the picture tube and the other chroma and brightness controls have been carefully adjusted, should the matrixing section be aligned. When one of the three primary colors appears to be off in hue, then the matrixing adjustments can be at fault. Be sure to use each control independently, varying it only slightly and returning to the previous setting if it appears to have no effect on the particular color that is off. In general, matrixing controls should be considered third in line rather than secondary controls.

Fig. 6. Partial schematic diagram of the basic color amplification circuits.



Color Amplifiers

In some receivers the "I" and "Q" signals are not combined with the luminance signal to form the red, green, and blue signals, but instead, are changed over to form three color difference signals with the luminance components added in the picture tube itself. Wherever the luminance signal joins the color information, more gain is needed from the matrixing section to drive the color picture tube. A basic three-channel video system using the final color signals is shown in Fig. 6.

The three color adders each receive some portion of the luminance, "I," and "Q" signals and the total voltages are added at the grid of the tube. A gain control, often the type shown in Fig. 6, controls the gain of each color channel. These controls correspond to the contrast control in the monochrome receiver in that they control the amplitude of the video signal for each color channel. After a stage of amplification, the three color signals are applied to the three control grids of the tri-color picture tube. In the case of a single gun picture tube, some type of sequential keying system is used to apply the three signals to the picture tube grid in the proper sequence.

Similar to some monochrome sets, each video amplifier has a diode d.c. restorer at the output. The d.c. level of each restorer circuit is set by a potentiometer which has the effect of controlling the brightness or background illumination of the screen. In some color receivers a master brightness control is available on the front panel which sets the d.c. level for the separate color brightness controls, designed as secondary adjustments.

A total of six controls is available in a typical color amplifier section. To adjust these controls, a station color signal is helpful, although the brightness controls can be set with a monochrome signal. It is necessary to balance out the three brightness controls to obtain white, and when a color test pattern is

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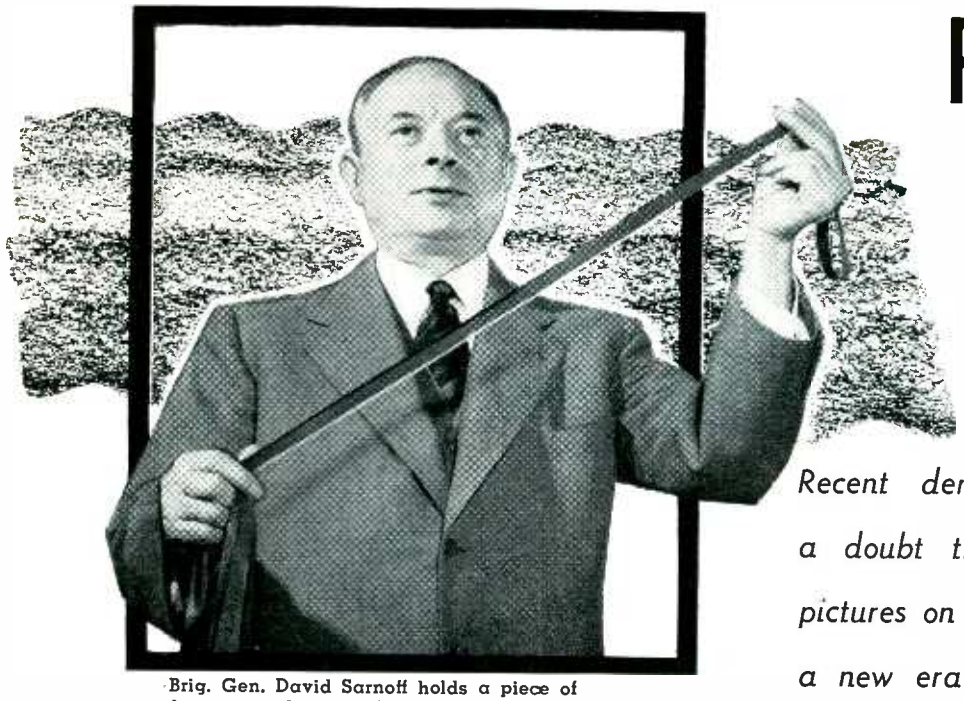


Brig. Gen. David Sarnoff holds a piece of the tape used in the color TV demonstration.

PICTURES ON TAPE

Recent demonstration proved beyond a doubt the feasibility of recording pictures on tape. We saw the dawn of a new era in electronic photography.

RADIO CORPORATION OF AMERICA recently unveiled a new magnetic tape system for television before representatives of the press at Princeton, N. J. The demonstration consisted of several phases. We viewed black-and-white tape recordings on color receivers as well as both live and recorded color programs.

The high point of the demonstration was a live colorcast emanating from the *NBC* studios in New York and microwaved to Princeton. The program was viewed on two color receivers and, at the same time, was being magnetically recorded on tape. Midway in the program one of the color receivers was switched over to receive the taped material. At this point we were actually viewing the same program on two color receivers—one a live telecast and the other a recording of the same program. At a distance of 20 to 30 feet from the receivers, both of the pictures seemed equally good.

In its present state, the quality of video reproduction is better than the poorest kinescope and not quite as good as the best kinescope recording. The bandwidth attained so far is slightly better than 3 mc. with an ultimate goal of nearly 4 mc.

Unlike kinescope recordings, the magnetic tape system stores the electrical signals directly as they come from the station. This system is, to some degree, similar to that used in home tape recording. The tape speed is, however, 30 *feet*-per-second as compared with home recorders which operate at a speed of 3¾ *inches*-per-second or 1/96th the speed of the video tape. Although the demonstration employed a 17-inch diameter reel for showing a four-minute program, plans are being made to record a 15-minute program on a 19-inch reel.

Two sizes of standard plastic-based magnetic tape are employed—a 2-channel, ¼" tape is used for recording the black-and-white telecasts with the video and sync pulses on one channel and the audio on the other; and a 5-channel, ½" tape for color. The video channels comprise the red, blue, and green signals which are recorded separately as is the sync pulse and the audio which make up the 4th and 5th channels.

It is obvious that the cost of magnetic tape recording is considerably lower than that of kinescopes since the kinescope film must be processed before use. It is estimated that the cost of color magnetic tape recordings will run from 5 to 10 per-cent of an equivalent kinescope film. It cannot be denied that this lower cost is important but there is still another feature which will be of equal importance to TV broadcasters and that is the advantage of immediate playback. There is no developing process involved as there is with kinescope films, a worthwhile saving.

The immediate importance of this new system is in the TV broadcasting field but, as pointed out by Brig. Gen. David Sarnoff, it may eventually be used for national defense, motion picture work, industry, schools, and, ultimately, home entertainment. The day may not be too far off when your home movie films will be tape recordings and your projector your television set screen.

RCA estimates that the new system will be ready for commercial use in about two years. While much of the associated equipment needs additional development work, the system, as demonstrated to the press, is technically sound and, with modifications, can be put into production in the not-too-distant future. —30—

Laboratory equipment on which the first public demonstration of tape recording of both black-and-white and color television was made by RCA at Princeton, N.J. Checking the equipment are W. D. Houghton (left) and Dr. Harry F. Olson, director of the company's Acoustical Research Laboratory (right).

By **BERT WHYTE**

SOME months back, I commented on how the manufacturers of some pretty prosaic portable phonographs were labeling their products as "high fidelity." Since then, nearly every manufacturer in the radio field has come out with his particular version of the "Little Jim Dandy High Futility Phonograph." Not content with usurping the true meaning of the term high fidelity, they have ventured further afield with new advertising asininity. Now all the sterling equipment they make is not only "high fidelity," it is "three dimensional" and "stereophonic" as well!

These manufacturers don't bother with such niceties as stating that their unit produces "three dimensional *type*," or "stereophonic-*like*" sound. They brazenly give advertising blurbs exploiting the full meaning of stereosound. That the portables, table-model, and other phonographs they manufacture *do not* and *cannot* reproduce stereophonic sound, goes without saying. There is not the slightest advantage in the sound of these units to condone this assault on the credulity of the lay public. The *only* thing these two and three speaker phonographs can give you is *sound dispersion* and diffusion. This principle of reproduction is as old as the hills and has been used by high-fidelity enthusiasts for many years. (At least by those who could afford the second or third speaker!) There is positively *no directivity* or *perception of depth* in the sound, as in the case of true stereophonic reproduction. O.K. So some jerks are selling the public a bill of goods; why am I so fired up? *Because of the irreparable damage this loose advertising can do to the cause of legitimate stereosound!* Remember, most of the outfits responsible for this lack of discretion are big, corporately and financially. Most honest-to-goodness high-fidelity manufacturers are nickel and dime deals compared with these whoopla merchants. This is most unfortunate, because the little fellow has no spare cash to get a message across to the public that they are being bilked. What can be done about this lamentable situation? Not very much, I'm afraid. This is one time we're really up the creek. You see, the main trouble lies in the very scarcity of "true" stereophonic sound itself.

Since the public has practically no opportunity to hear the real McCoy, they are deluded into thinking these diffuse sounds they hear represent stereophonic reproduction. I don't know how far all this can go; I wish there was some way in which the public could be made aware of the quality difference in true binaural and stereophonic *versus* these "diffuse" sounds issuing from the "high fidelity" and "stereophonic" phonographs. The fact that these "stereophonic" phonographs outnumber the real thing isn't going to make our task any easier.

The only possible solution is for the RETMA to adopt standards by which a unit could truthfully be labeled a high fidelity or stereophonic instrument. The RETMA is a powerful enough organization to police any manufacturer and make certain that the standards they set up are not abused. I have heard a rumor that such a standard is under consideration for adoption at the spring convention of the RETMA. I fervently hope so. I'd hate to see one of the most promising and exciting developments in audio die out by the killing off of public interest by a few greedy and unthinking manufacturers.

Equipment used this month: *Weathers* pickup and arm, *Rek-O-Kut* T12H, *Pickering* preamp-equalizer, *McIntosh* 30-watt amplifier, *Jensen* "Triplex" system in a *Read* "Fold-a-flex."

PROKOFIEV
CLASSICAL SYMPHONY
MOUSSORGSKY
NIGHT ON BARE MOUNTAIN
BORODIN
ON THE STEPPES OF CENTRAL ASIA
GLINKA
RUSSLAN AND LUDMILLA OVERTURE
Orchestre de la Societe des Concerts du Conservatoire de Paris conducted by Ernest Ansermet. London LL864, ffrr curve. Price $5.95.

Here is a tasty potpourri from *London*. To be sure, the works here recorded are nothing new or startling. Nevertheless, these present recordings have some values over the same works in other versions now in the LP catalogue. For one thing, on sound quality alone this disc is quite a few jumps ahead of previous issues. *London* has been turning out some really fine work in the past few months. In the "Classical Symphony" and in Moussorgsky's eerie tale, we have some of the finest *ffrr* sound yet recorded. Beautifully clean, silky strings with none of the harsh steeliness many people accuse *London* records of having. Percussion is crisp and bright without being what you might call "showy." Orchestral balance is excellent in all these works. A very live sounding recording, with just the right amount of reverberation in the hall to enhance this presence. The performance of the "Classical" is beautifully detailed and meticulously wrought. However, you don't have to listen beyond the first few bars to realize that something is very different about this reading. You become aware of very odd tempi, indeed the slowest pace on record. Let me assure you that this choice of tempi was not just a whim of Mr. Ansermet. He predicated this reading on the basis of his friendship with Prokofiev himself and what Prokofiev told him as regards tempi and dynamics, etc. According to Ansermet, the slow pace is just the way Prokofiev intended his "Classical Symphony" should be played. In view of the fact that nearly everyone else who has conducted this work fairly zooms through it, this performance takes a little time to become familiar enough to be comfortable. In a cursory analysis, you find that you rather like this new treatment. It lends the score a stateliness which is in keeping with Prokofiev's original intent. Certainly this dissimilarity with the other available recordings at least makes for renewed interest in this too-often duplicated work. This, plus the superb sound go a long way towards reckoning this version as the best available.

The Moussorgsky, "Night on Bare Mountain" is a real humdinger. This is one of the most superb examples of good acoustical balance extant. The recording is so very much better than that which *London* ordinarily produces (and *London* must be considered among the top rank recording companies) that I am inclined to suspect that something "new" has been added. A better hall? A clever new pickup? A "hotter" and better mike? Or possibly an advance in the type of cutterhead used in transfer from tape to disc? (Any comments, Mr. Farkas?) In any case, this is wonderful sound and we hope to hear more of the same. Performance wise the Moussorgsky receives the usual lavish attention to detail that is characteristic of Mr. Ansermet. His reading is perceptive, and in a score which is obviously programmatic, he manages to evoke the proper emotion. A very good reading, but no one as far as I am concerned, has ever equalled the old Stokowski version on 78 rpm. In spite of the restricted range, dynamic and frequency wise, when he had that

(*Continued on page* 168)

The opinions expressed in this column are those of the reviewer and do not necessarily reflect the views or opinions of the editors or the publisher of this magazine.

KNOW YOUR 1954 ADMIRAL TV RECEIVERS

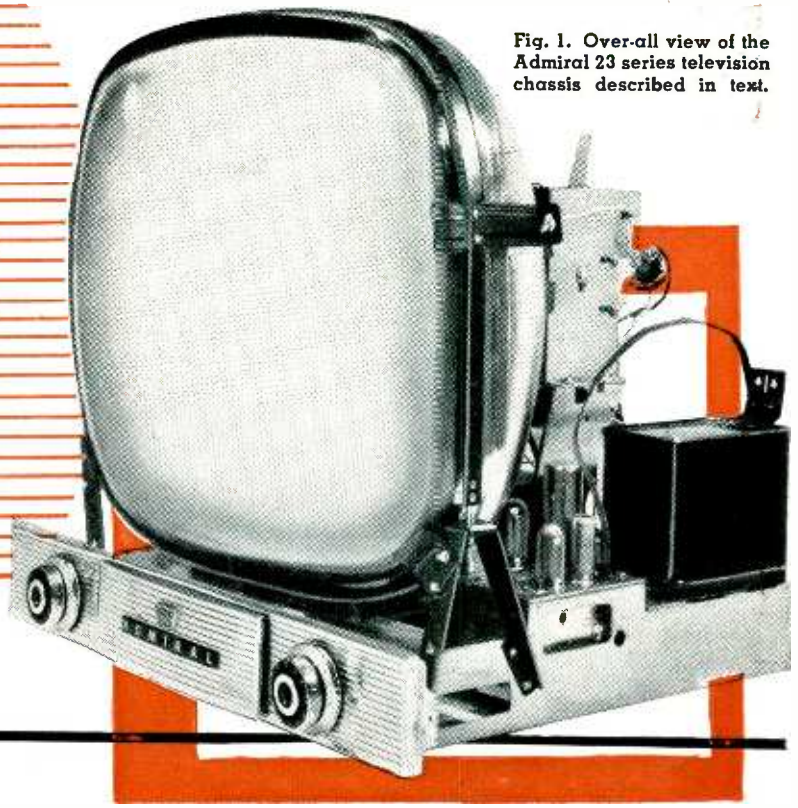


Fig. 1. Over-all view of the Admiral 23 series television chassis described in text.

By

SERVICE DEPT., ADMIRAL CORPORATION

Circuit operation, schematic diagram, alignment data, and other servicing information for 1954 Admiral sets.

AFTER eight years of commercial television transmission and reception, receiver circuitry has reached the stage where more and more time can be devoted to circuit refinement and less and less time to basic circuit changes. This is true for all manufacturers and it is especially true of *Admiral's* 1954 line. The new chassis, for example, contains, among other new features, an improved deflection yoke that provides the 90-degree deflection angle required by the 27-inch picture tube. There is also an improved focusing circuit, a more efficient low-voltage power supply, a sturdier damper tube (6V3), a new vertical output tube (6AV5GT), and a redesigned horizontal output circuit that provides better operation with more flexible control. Each improvement, by itself, is significant; taken together, they represent a considerable advance in the television art from the early days of not-so-long-ago 1946.

Circuit Description

R. F. Section. Circuit-wise, the 1954 *Admiral* 23-series receiver (shown in Fig. 1) follows closely the arrangement established by its predecessor, the *Admiral* 22-series chassis. A low-noise dual-triode 6BZ7 is used in the tuner r.f. amplifier. The circuit (see Fig. 2) is the familiar cascode amplifier which provides higher gain, with reduced noise level, than previous types, and results in a clearer picture in weak-signal areas. Characteristic of the cascode circuit is the direct coupling between the plate of the first triode and the cathode of the second section. Thus, a common current flows through both tubes and a.g.c. bias applied to the first triode grid will be effective for both tubes. Further, since the cathode of the second triode is about 120 volts positive with respect to chassis ground, a voltage divider consisting of resistors R_{111} and R_{112} places the second triode grid at a sufficiently positive potential for proper operating bias with respect to the cathode. R_{110} is a filter resistor.

The oscillator is of the Colpitts type. The tuned circuit consists of L_{102C} and condensers C_{109} and C_{111}, with L_{102C} inductively coupled to mixer grid coil L_{102B} for oscillator injection to the mixer. Condenser C_{109} has a negative temperature coefficient and decreases in capacity with an increase in temperature. Since this action is opposite to that of conventional condensers, it tends to prevent oscillator drift with temperature changes. The fine tuning control is a variable dielectric condenser C_{111}. Further, each channel may be adjusted separately by means of a slug (in L_{102C}) which is accessible from the front of the set.

The oscillator voltage and the incoming signal are combined in the mixer to produce the i.f. signal. Two resistors are used in the mixer grid circuit in order that their junction can be brought out as an alignment test point ("W"). An oscilloscope can then be connected to this point without affecting the operation of the circuit.

Video i.f. System. The output of the r.f. mixer is coupled to the 1st i.f. amplifier V_{301} through two tuned circuits which have a common coupling impedance. L_{103}, C_{112}, and the coupling network combine in a circuit which is tuned to 25.3 mc. by L_{103}. L_{309} and the input capacity of V_{301} combine with the the coupling network to form a circuit which is tuned to 25.3 mc. by L_{309}.

The common coupling impedance includes three tuned circuits. C_{121} and L_{108} form an absorption trap tuned to 19.75 mc. to eliminate the video carrier of the adjacent higher channel. C_{123} couples the output of the r.f. mixer to the 19.75 mc. trap. C_{122} and L_{107} are series resonant at 27.25 mc. to eliminate interference from the sound carrier of the adjacent lower channel. L_{110} is added across these two traps and the entire coupling network becomes parallel resonant at 23.5 mc., which is midway between 19.75 mc. and 27.25 mc.; C_{124} is a d.c. blocking condenser.

The video and sound signals are amplified together in the i.f. system. T_{301} and T_{302} are bifilar-wound transformers that are stagger-tuned to obtain a broad over-all i.f. amplifier response. T_{303} is an impedance coupling between the 3rd i.f. amplifier and the video detector V_{304A}.

The i.f. amplifier response is approximately 3.9 mc. at the 6 db points (50 per-cent down from peak amplitude). L_{310} and C_{321} form an absorption trap for the sound carrier (21.25 mc.) at the input to the 2nd i.f. amplifier, V_{302}. This reduces the sound carrier amplitude to maintain a 10 to 1 ratio between the picture and sound carriers. This is required to prevent sync buzz in strong signal areas. Also, this 21.25 mc. trap, combined with the re-

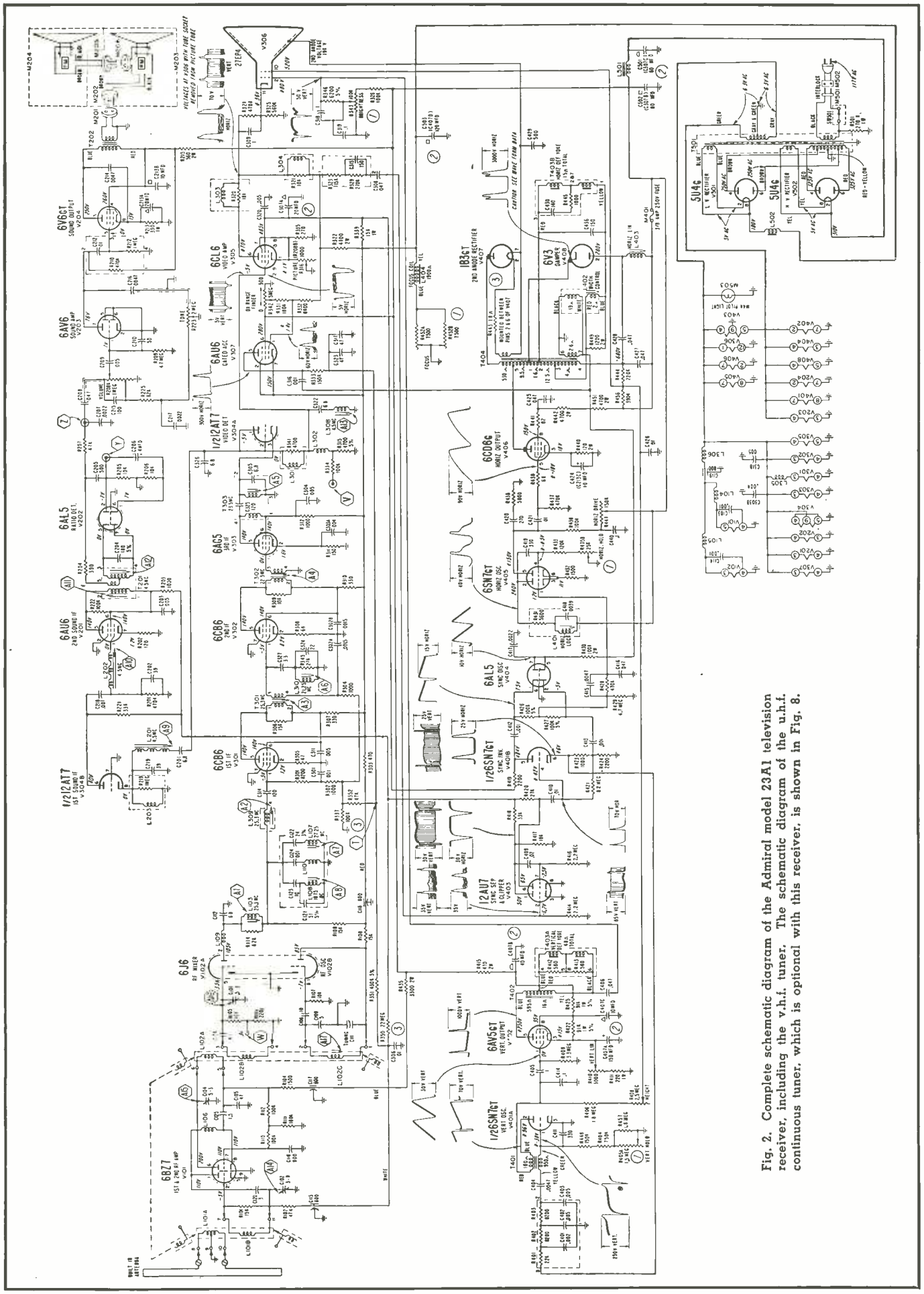


Fig. 2. Complete schematic diagram of the Admiral model 23A1 television receiver, including the v.h.f. tuner. The schematic diagram of the u.h.f. continuous tuner, which is optional with this receiver, is shown in Fig. 8.

sponse characteristics of the coupling network between the output of the r.f. mixer and the 1st i.f. amplifier, results in a "step" or "plateau" on the i.f. amplifier response curve in the region of the 21.25 mc. sound i.f. carrier. This permits adjustment of the fine tuning control over a rather wide range without greatly affecting the sound level. This is of particular importance in fringe areas, where the receiver is often tuned for blackest picture, with the result that the video carrier i.f. frequency of 25.75 mc. falls near the top of the i.f. response curve. Without the "step" or "plateau" for the sound i.f. carrier, the sound level would be so low under these conditions that it would not be possible to achieve satisfactory sound level coincident with maximum picture contrast in weak signal areas.

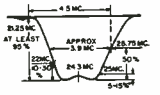
Video Detector and Amplifier. The video detector is conventional, using a diode to demodulate the i.f. signal. Series and shunt peaking coils serve to maintain the response of the circuit to all of the video frequencies.

Direct coupling is utilized between the detector and the 6CL6 video amplifier that follows it. This results in transfer of the d.c. component together with limiting of noise peaks. Picture (contrast) control R_{316} is a degeneration control in the cathode return circuit. It provides video amplifier gain control by placing a variable opposing signal voltage in series with the input signal voltage applied between grid and cathode of video amplifier V_{305}.

The screen voltage for the video amplifier (and the plate supply for sync inverter V_{401B}) is supplied through dropping resistor R_{339}. Electrolytic condenser C_{307A} does the major portion of the filtering here, although C_{320} is added for more effective bypassing of the higher video frequencies. In the plate circuit, over-all response is again given careful consideration by the use

Table 1. Alignment procedure for the video and sound i.f. systems of the Admiral 23 series chassis.

VIDEO I. F. ALIGNMENT

STEP	SIGNAL GENERATOR		OUTPUT INDICATOR	CONNECT TO	ADJUST	REMARKS
	FREQUENCY	CONNECT TO				
1	25.3 mc. unmodulated	Tube shield of 6J6 (V_{102}). (Insulate shield from chassis.) Low side to chassis near 6J6 tube base	V.T.V.M.	Test point "V" and chassis	"A_1," "A_2," and "A_3" for maximum	Connect minus side of a 3-volt bias battery to the a.g.c. bus at test point "T." Use lowest scale on V.T.V.M. Set channel switch to channel 12 or other unassigned high channel. When peaking, reduce generator output to give 1-volt maximum reading. See Fig. 4 for test points.
2	22.3 mc. unmodulated	Same as above	V.T.V.M.	Same as above	"A_4" for maximum	
3	23.5 mc. unmodulated	Same as above	V.T.V.M.	Same as above	"A_5" for maximum	
4	21.25 mc. unmodulated	Same as above	V.T.V.M.	Same as above	"A_6" for minimum	
5	27.25 mc. unmodulated	Same as above	V.T.V.M.	Same as above	"A_7" for minimum	Connect minus side of 1½-volt bias battery to a.g.c. bus. Set channel switch between channels.
6	19.75 mc. unmodulated	Same as above	V.T.V.M.	Same as above	"A_8" for minimum	
7	25.3 mc. unmodulated	Same as above	V.T.V.M.	Same as above	"A_1" and "A_2" for maximum	Use 3-volt bias battery. Set channel switch as for step 1.
8	23 mc. center frequency. 7 mc. sweep	Same as above	Oscilloscope	Test point "V" through decoupling network (10,000-ohm series resistor, 330-$\mu\mu$fd. shunt condenser to ground)	All i.f. slugs for curve below 	

SOUND I. F. AND 4.5 MC. TRAP ALIGNMENT

9	4.5 mc. unmodulated	Test point "V" through .01-μfd. condenser	V.T.V.M.	Test point "Y"	"A_9," "A_{10}," and "A_{11}" for maximum	Use lowest d.c. V.T.V.M. scale
	or					
10	Tune in local TV station.		V.T.V.M.	Test point "Z"	"A_{12}" for zero reading. (Between positive and negative maximums.)	Use zero-center scale on V.T.V.M. If "A_{12}" was far off, repeat step 9
11			V.T.V.M.	Test point "Y"	"A_{13}" for minimum	Use lowest d.c. V.T.V.M. scale. Connect a 10-$\mu\mu$fd. condenser from pin 6 of V_{305} (6CL6) to pin 8 of V_{304} (12AT7)

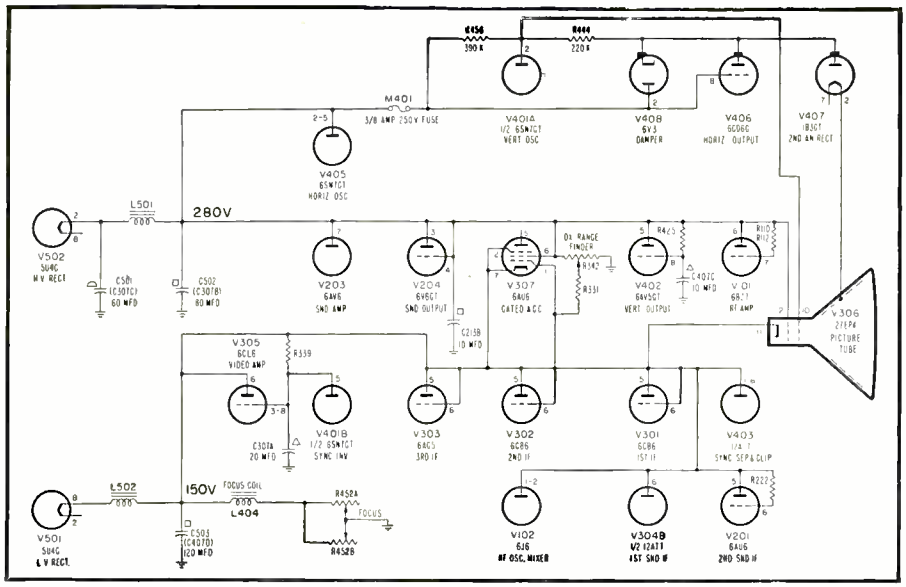


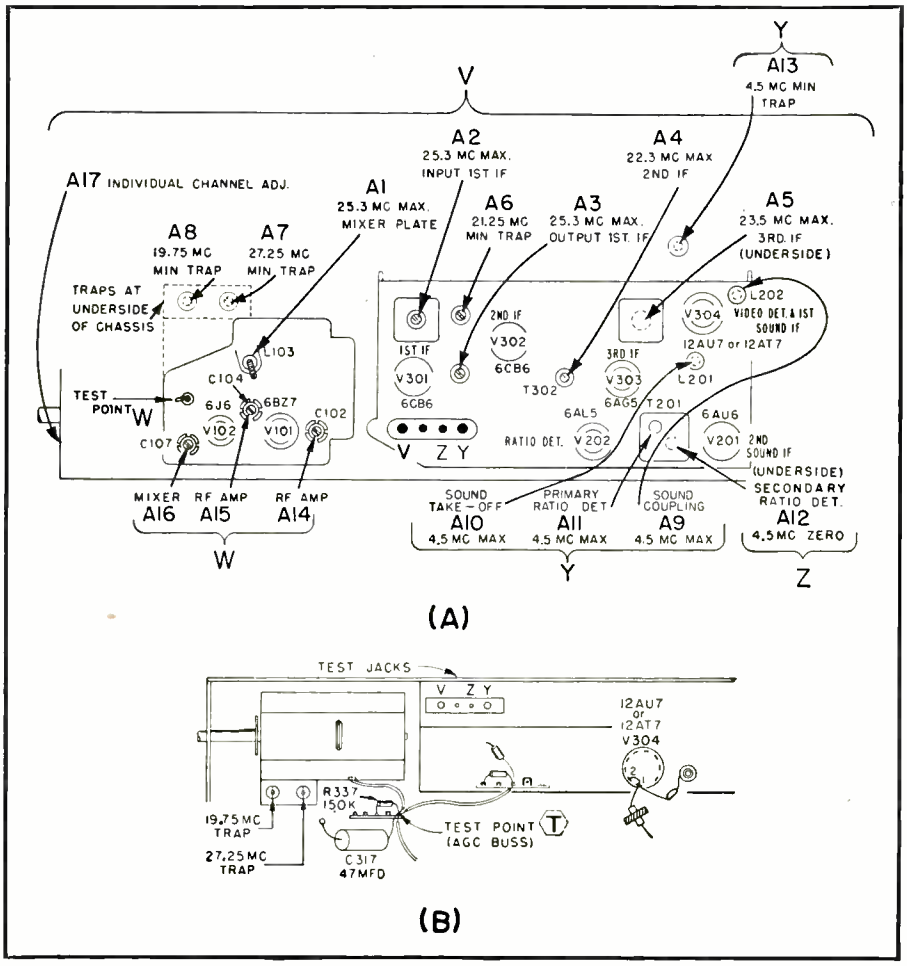
Fig. 3. Simplified diagram of the "B+" distribution in the Admiral 23A1 TV chassis, stamped "Run 2" or higher. Note the two "low-voltage" power supplies.

of two peaking coils (L_{303} and L_{304}) and a low-value load resistor (R_{322}).

As a final step in this chain, the video signal is coupled to the cathode of the picture tube by C_{309}, R_{324}, and R_{325}. Picture brightness is varied by R_{313}.

Sound System. Returning to the video second detector, it will be seen that a portion of the total signal is coupled through C_{201} and L_{201} to the cathode of V_{304B}, the first sound i.f. stage. The sound signal frequency is 4.5 mc. and C_{201} is purposely chosen small in value so that it offers a higher impedance to the video signals which are lower in frequency. The cathode connection of L_{201} is employed to eliminate oscillation that often occurs in a tuned-grid, tuned-plate amplifier circuit. L_{203} provides a d.c. path for the cathode current of V_{304B}. C_{219} and L_{203} form a high impedance for the 4.5 mc. sound i.f. voltage applied to the cathode.

Fig. 4. (A) Top view of chassis showing alignment points and test points used with particular adjustments. (B) Bottom view with test points located.



A.G.C. System. Automatic control of the receiver gain is exercised by a gated a.g.c. circuit. As is usual in such arrangements, the grid of the a.g.c. tube (V_{307}) is supplied with the composite video signal voltage (by direct coupling through R_{332}) from the output of the video amplifier V_{305}. Pulsed voltages, developed during the horizontal retrace time, are coupled to the plate of V_{307} through C_{316}. Thus, the a.g.c. tube conducts only during the horizontal sync pulse interval and the level of the control voltage developed is established by the level of the received sync pulses.

The amount of a.g.c. voltage developed is also controlled by the "DX Range Finder" (R_{342}), a potentiometer located in the control grid circuit of the a.g.c. tube. The center tap of the control is connected to the grid of V_{307} through R_{331}. This provides a variable means of setting the bias on the control grid of V_{307}. The "DX Range Finder" also provides for higher gain in fringe areas resulting in more contrast, increased sync stability, and reduction of "flashing."

Caution must be exercised in setting the "DX Range Finder." The control is calibrated from 0 to 300, but the numbers themselves have only a relative meaning. At the "0" setting, maximum a.g.c. is developed. As the control is advanced toward "300," less and less a.g.c. is developed until, at maximum setting of the control, minimum a.g.c. is produced and the gain is greatest. Since the control determines the amount of a.g.c. voltage reaching the controlled tubes, and consequently the gain of the receiver, a too-high setting of this control can result in

(*Continued on page* 140)

THE *Music Probe* FOR FASTER SERVICING

By
STAN JOHNSON, WØLBV

Over-all view of the "Music Probe" showing the compact size of this versatile service test instrument.

This tiny "crystal receiver" unit provides a broadcast station program which can be used for signal tracing.

NINE times out of ten trouble in the audio end of a TV set lies in the ratio detector or associated circuits. But unless you have an "Ouija" board ear—you may be *very* wrong on the tenth set—and spend a lot of time looking for trouble in the r.f. section of the receiver when actually the grief is simpler: plain old audio distortion.

Obviously what is needed is some sort of simple audio generator—small enough to tuck into the service kit along with tools, tubes, and small parts. To provide such a device, the "Music Probe" was designed. It is very little larger than the r.f. probe for the *"Voltohmyst."* But it actually generates music (or voice) with sufficient output to swing the speaker on the business end of any TV set with only one stage of amplification.

The "Music Probe" has some other highly useful qualities, too. Enough so that it has become a permanent part of the writer's test gear.

For example, it is highly useful for running a quick check on the video amplifier. And it is very helpful in servicing AM (including a.c.-d.c.) sets, too, thus providing a 10 second way to isolate trouble to "before" or "after" the volume control on a superhet.

The circuit diagram reveals the "secret" of the music. Actually the unit is a hot little crystal set, using a germanium crystal diode. It is built around the familiar *"Loopstick"*—which gives the crystal set a new lease on life. The *"Loopstick"* tunes the unit to the strongest AM broadcasting station in the area. The signal from this station is made available on the prod end of the probe for applying as an audio signal generator wherever desired in the set under test.

You will notice on the diagram that the unit uses an antenna coil. This was done so that the *"Loopstick"* could be set once and left alone—applying the antenna directly to the end of the coil would result in detuning with different lengths of antennas.

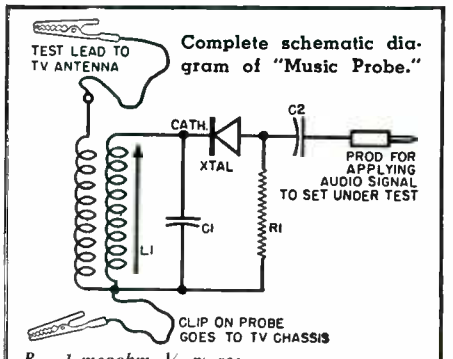
In using the probe, one of the test leads is borrowed from the v.t.v.m. and plugged into the jack on the end of the probe. *The other end is connected to the TV antenna lead-in,* which is disconnected from the TV set. The average TV antenna installation provides a lot of signal on the AM bands as well—which accounts for the good output from the probe. (If the TV set uses rabbit ears, clip the test lead to the finger stop on a dial phone, hot air register, etc. to provide an "antenna.")

Now—for using the "Music Probe."

First, suppose there is distortion in the sound of a TV set and replacing the ratio detector tube and other tubes has not helped.

Pull out the ratio detector—to silence TV sound signal. Then clip the lead on the probe to the chassis near

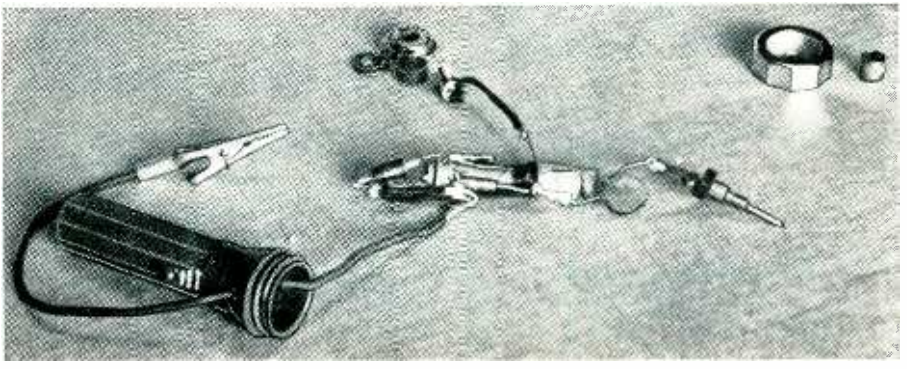
(*Continued on page* 172)



Complete schematic diagram of "Music Probe."

R_1—*1 megohm, ½ w. res.*
C_1—*100 μμfd., or larger, ceramic cond. (Value chosen to provide strongest AM signal in area when slug in coil is adjusted)*
C_2—*.01 μfd. ceramic cond.*
Xtal.—1N34A or similar crystal diode
L_1—*"Ferri-Loopstick" with 30 t. #30 en. wire closewound at bottom end to provide antenna coil*

The "Music Probe" disassembled to show the various component parts of the unit.



POSITIVE GRID CIRCUITS IN TV RECEIVERS

By
MILTON S. KIVER
Pres., Television Communications Institute

A positive grid does not always indicate a defective circuit; here are some that are normally positive.

THE television technician is frequently confronted with indications in television receivers which appear, at first glance, to run counter to the normal behavior of electronic circuits. One specific situation along these lines which is encountered with increasing frequency is a positive grid circuit, that is, tubes in which the grid is positive with respect to the chassis.

Now, one of the first lessons the beginner learns is that the grid potential should be negative. A positive grid, he is told, can lead to such dire consequences as circuit loading, distortion, and rectification and should be avoided like the plague. So you can imagine his shock when, in the course of taking voltage measurements in a receiver, he comes across a positive grid voltage. Here obviously is something wrong—or so he believes—and thereby wastes good servicing time on a circuit that is often operating perfectly.

Positive grid circuits can be divided into two categories—those which are positive with respect to chassis and cathode, and those which are positive with respect to the chassis only. In the latter group it will be found that the control grid is actually negative with respect to cathode, that is, the cathode has a higher positive voltage than the grid.

In view of the technician's previous instruction and the fact that all things bad are associated with positive grid circuits, why would any one want to utilize them at all? The answer is to be found in (*a*) certain effects which are obtained when the grid is made positive and (*b*) from the voltage distribution within a television receiver.

Let us consider proposition (*a*) first. We know that normally the grid is negative with respect to the cathode and under these circumstances electrons do not flow in the grid circuit. It is also generally accepted that under the same conditions the impedance between grid and cathode is very large. Actually, as we all know, the input impedance depends upon frequency, decreasing as the latter rises. However, for the purpose of this discussion, we will consider the grid-to-cathode impedance high if the grid is negative with respect to the cathode.

Now let us see what happens when the grid becomes positive with respect to the cathode. The grid wires attract electrons from the cathode and current flows in the grid circuit. To be exact, electrons flow from the grid, through whatever resistance exists in the grid circuit, back to the cathode again. As far as the cathode is concerned, the grid has become an element similar to the plate.

Fig. 1. (A) Simplified positive grid circuit showing the rectification (C) resulting from an input sine wave (B).

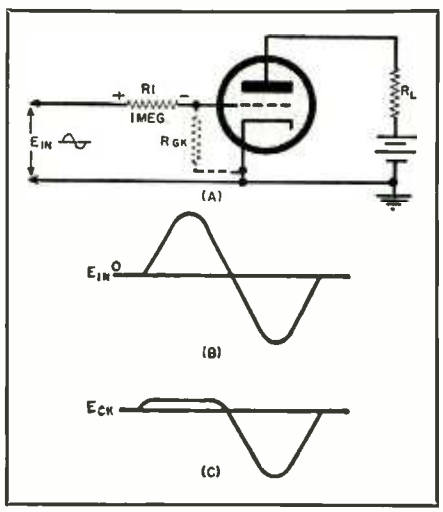
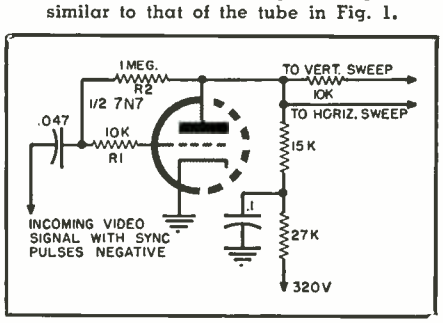


Fig. 2. Sync separator stage used by Philco operates with a positive grid similar to that of the tube in Fig. 1.



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With the flow of current from cathode to grid, the resistance between these two elements has decreased. Thus, if 1 volt is applied between grid and cathode, and a current of .25 milliampere flows, then the external circuit sees a resistance of 4000 ohms. This is because:

$$E = IR$$
$$1 = .00025\,R$$
$$R = \frac{1}{.00025} = 4000 \text{ ohms}$$

Applying a larger positive voltage between grid and cathode will cause a larger current to flow and it will be found that the resistance decreases still further. Eventually it may drop below 1000 ohms.

With this behavior in mind, let us insert a resistance in series with the grid as shown in Fig. 1A. If a value of 1 megohm is used, this resistance will be considerably greater than the grid-to-cathode impedance when grid current flows. Now apply a signal, in the form of a sine wave, to the grid. See Fig. 1B. On the positive half cycle, the grid will be driven positive and grid current will flow. The current, flowing through R_1, will develop a voltage having a polarity opposite to that of the applied positive voltage. This voltage, subtracted from the applied voltage, represents what the tube receives. Thus, as R_1 is made larger, its voltage drop will approach that of the applied voltage. This will leave very little voltage between grid and cathode (Fig. 1C), with the result that very little will appear in the plate circuit. In other words, by this arrangement we have effectively suppressed the positive half cycle of the applied sine wave.

Throughout the negative half cycle, the grid is negative with respect to the cathode, no grid current flows and the full value of the applied negative voltage appears between grid and cathode. This is amplified and appears in the plate circuit.

We have here a form of limiter circuit and variations of this have appeared in television receiver sync separator circuits. Thus, *Philco* uses the circuit in Fig. 2 in its sync separator stages. A 10,000-ohm resistor is placed in series with the grid and then a 1-megohm resistor is connected between the end of the 10,000-ohm grid

resistor and the positive plate. This places a positive voltage on the grid and causes grid current to flow through R_1 and R_2. The combined resistance of R_1 and R_2 greatly exceeds the grid-to-cathode impedance so that the grid voltage is essentially zero with respect to ground.

Now, the video signal with the sync pulses negative is applied to this stage. The negative sync pulses drive the grid negative, forcing the tube current down and raising the plate voltage. Positive sync pulses are developed in the plate circuit by this action. The rest of the video signal, being more positive than the applied sync pulses, is unable to affect the grid-to-cathode voltage. This is because driving the grid more positive increases the grid current which increases the voltage drop across R_1. This increase, in turn, counterbalances the greater positive voltage. Result: the positive video signal portions of the applied signal are effectively suppressed, which is the desired action.

A situation which is somewhat similar to the foregoing is employed in a number of receivers to minimize the effects of noise. Such a circuit is shown in Fig. 5 and utilizes a 6BE6 sync clipper. The cathode of the tube is grounded, which places grid 3 at zero potential, initially. The video signal fed to this grid is obtained from the plate circuit of the first video amplifier and at this point the sync pulses extend upward, in the positive direction. The positive sync pulse tips drive grid 3 positive, current flows in this circuit and condenser C_1 charges up to the peak value of the sync pulses. Between pulses, C_1 discharges somewhat through R_1 but the amount of voltage lost is small and is replenished when the next pulse arrives. At this same instant, amplified pulses also appear in the plate circuit of the 6BE6. These are transferred to the succeeding sweep systems.

The average potential of grid 3 is negative. Consider, however, grid 1. It is tied into the video detector circuit and receives the full video signal with the sync pulses negative. At the same time, enough positive voltage is applied to grid 1 to offset the average negative voltage of the video signal. The resulting d.c. voltage at grid 1 thus hovers about zero, being slightly positive or slightly negative depending upon the average value of the incoming video signal and the setting of the "Fringe Lock" control. The positive portions of the applied video signal at grid 1 do not materially increase the voltage at this element because making grid 1 more positive draws more grid current and this, in turn, increases the voltage drop across R_2 and R_3.

The conditions are thus set so that with normal signals grid 1 permits electrons to flow through the tube.

Consider, now, what happens when a strong noise pulse arrives. At grid 1 it will extend in the negative direction and drive the tube into cut-off, shutting off the flow of electrons. This prevents the noise pulse, which is also at grid 3, from drawing grid current and consequently appearing in the output of the 6BE6 where it could disrupt sweep circuit operation.

The second class of positive grid circuits contains grids which are positive with respect to ground (or chassis) but actually less positive (*i.e.*, negative) with respect to the cathode. The technician runs into trouble with these circuits because voltage measurements are frequently made with respect to chassis and when a positive grid is uncovered in one of these voltage checks, the unwary service technician feels that here is the seat of his trouble.

Positive grid circuits of this second type appear in a variety of stages. Take, for example, the keyed a.g.c. tube shown in Fig. 3. Note that the control grid of the 6AU6 is tied directly into the plate circuit of the 12AT7 video amplifier and therefore it has a positive voltage on it. To offset this, the cathode is returned to the 125-volt terminal of the power supply. Since the grid is positive by 115 volts, the difference between these elments is 10 volts, which is more than enough to keep the tube biased to cut-off.

The reason for this particular arrangement stems from the fact that the video signal applied to the grid of the keyed a.g.c. tube must have all the sync pulses aligned to the same level. To insure this, there is a d.c. path (here) from the video detector to the 12AT7 video amplifier and from the video amplifier to the 6AU6 a.g.c. tube. Inserting capacitive coupling between any of these points would remove the d.c. component of the signal and the level of the sync pulses would no longer be the same for all pulses.

In this same keyed a.g.c. system, the d.c. potential of the plate (with respect to ground or any of the other tube elements) is negative. This is because the plate is triggered by a positive pulse of voltage obtained from the horizontal output transformer. This pulse is several hundred volts in amplitude and it appears during the horizontal retrace interval at the end of every line. At this same instant, strong, positive horizontal sync pulses appear at the control grid of the 6AU6, overcome the 10 volts bias here, and drive the tube into conduction. The flow of current in the plate circuit develops a

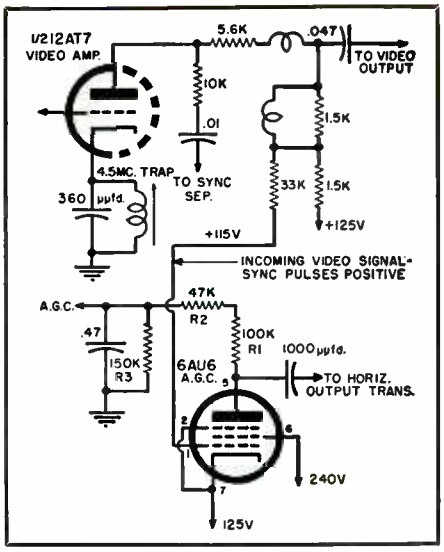


Fig. 3. A keyed a.g.c. stage in which the control grid is positive with respect to ground. The grid is, however, negative with respect to the cathode.

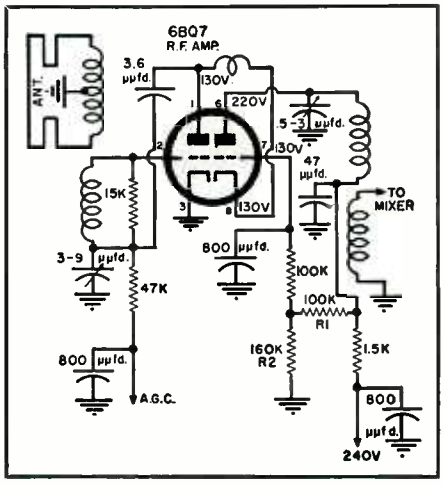


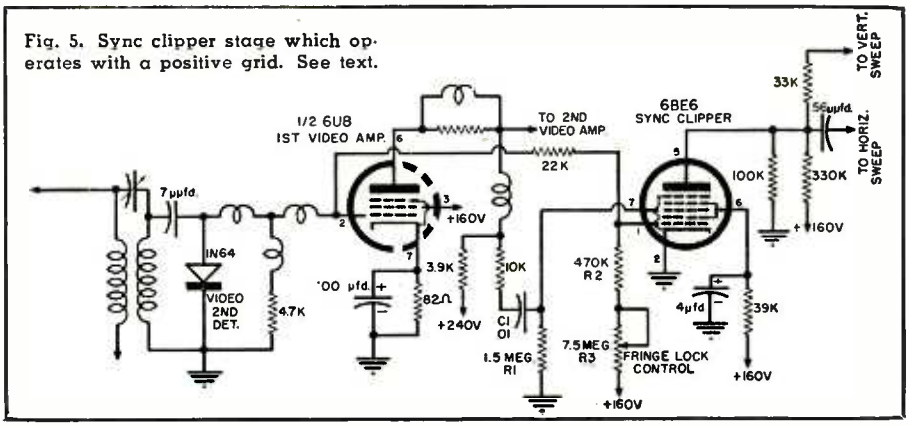
Fig. 4. Cascode amplifier circuit with the second tube section grid positive.

negative voltage across R_1, R_2, and R_3, and this negative voltage is fed, in part, to the r.f. and video i.f. stages as an a.g.c. voltage.

The introduction of the cascode r.f. amplifier also brought with it a positive grid circuit. This is shown in Fig. 4 where it can be seen that the plate of the first r.f. amplifier is tied directly to the cathode of the second r.f. ampli-

(*Continued on page* 116)

Fig. 5. Sync clipper stage which operates with a positive grid. See text.



WAVEFORM TRACING AID

By **LOUIS E. GARNER, JR.**

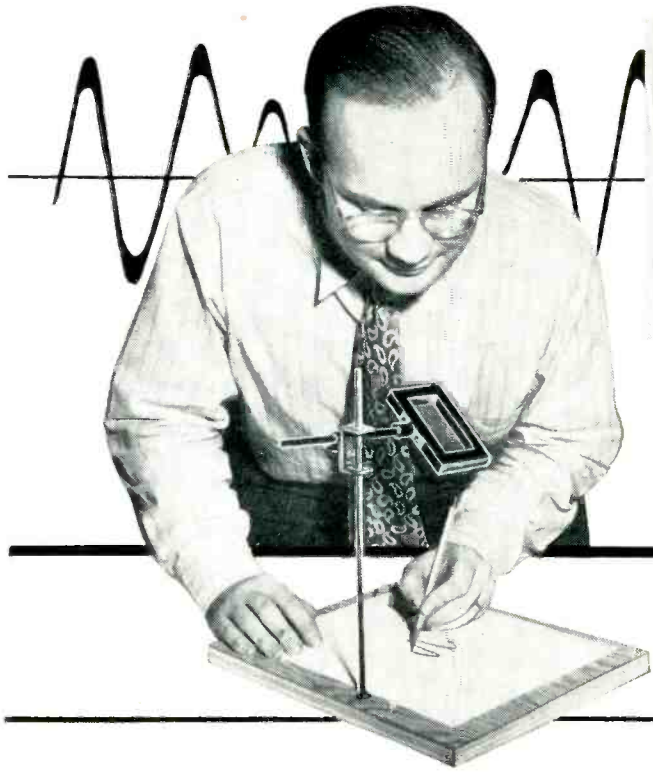


Fig. 1. The author using the Tracing Aid. Since he is left-handed the rod is mounted at right, but should be reversed for right-handers.

A handy device for experimenters and service technicians which permits scope traces to be recorded permanently.

DESIGN and development engineers often have occasion to record oscilloscope waveforms in new circuits. But recording waveforms for future reference may be of value to almost any worker in the technical side of radio, electronics, radar, or television.

The home experimenter, working with unfamiliar circuits, may wish to keep a record of the different waveforms obtained as circuit parameters are changed. The student finds an immediate need for some method of preserving the waveforms of circuits he studies. Even the technician, working on a new TV receiver, may wish to record "normal" waveforms in critical circuits for which service data is not yet available.

Several methods of recording scope patterns have been tried, and all have certain limitations. Free-hand sketching, for example, requires skill, and also makes it difficult to maintain accurate proportions in complex waves, as well as including the finer details. Direct tracing cannot generally be used, for even thin tracing paper diffuses the light too much and prevents a sharp image. Photography requires waiting until the film can be developed and printed, and thus is not suitable for immediate comparison when changes are made in the circuit.

An easily built and quite simple device, shown in use by the author in Fig. 1, permits oscilloscope waveforms to be recorded easily and quickly. The patterns obtained may be used immediately, as for comparing the input and output waveforms of a circuit, or for checking for variations in waveform with circuit changes. The patterns are full size and accurate as to detail.

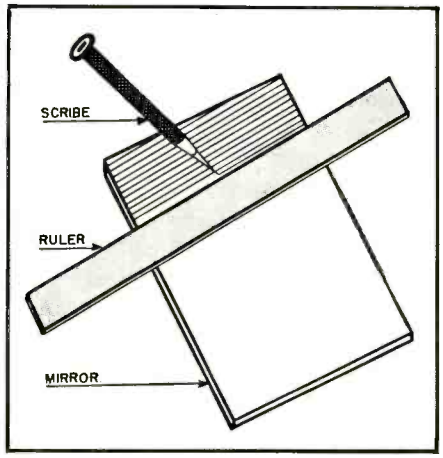
Theory of Operation

Basically, the device consists of a special mirror (Fig. 6) which has about 50% reflectivity and 50% transparency. Thus, when the mirror is adjusted at a 45° angle (as shown in the sketch), the scope image is reflected over path *A-B-C* to the eye at the same time that the note pad can be seen over path *D-B-C*. The scope image, therefore, appears superimposed upon the note pad, and a direct tracing may be easily made, even by a comparatively unskilled operator.

The note pad may be graph paper, if desired, and thus the traced image will appear as on the scope screen.

Although a special mirror is indicated, this is obtained by a simple modification of a dimestore pocket mirror.

Fig. 2. How to prepare a dimestore mirror so that it can be used in setup. See text.



Preparing the Mirror

An ordinary dimestore pocket mirror may be changed to give about 50% reflectivity by removing approximately half the silver backing. This must be done by removing the silver in thin lines, so that the remaining silver is evenly distributed over the mirror.

To do this, lay the mirror face down on a table and use a ruler and a sharp instrument (scribe, sharp nail, icepick, knife, or similar tool) to scratch a series of parallel lines on the back as shown in Fig. 2. The lines should be fairly close (about 3/64") and enough pressure should be exerted on the scratching tool to remove the silver but not to scratch the glass.

Scratch four sets of lines in the silver backing . . . one set parallel to each side and two sets at a 45° angle, forming the pattern shown in Fig. 3. This pattern "breaks-up" the mirror and avoids the effect of lines. A soft cloth should be used to remove the dust formed as the silver backing is scratched off.

After completing this job, test the mirror by holding it at a 45° angle to make sure you can both see through it, and see a reflected image of objects in front of the mirror.

Mounting the Mirror

Use your own ingenuity in mounting the mirror. The scheme used by the author is shown in Fig. 4.

A block of ½" thick wood was cut out about ⅝" larger than the mirror used (all around). A rectangular hole was cut in the center of the block about 3/16" smaller than the mirror, and then a recess carved into one side in which the mirror could be fitted.

Mount a ¼" dowel (wood, plastic, or metal) in one side of the wooden block. The length may be anything from 5 to 8 inches.

Finally, the mirror is placed in the recess and held in place with tape. The author used black *Scotch* elec-

trical tape, completely covering the block and giving the final product the appearance of having been molded from plastic.

If preferred, a small metal plate may be cut out and used to hold the mirror in place. For that matter, the whole mounting may be made of metal, if desired, and if metal working facilities are available to the builder.

The next step is to prepare the clamp which holds the mirror at the proper height and at the correct angle. A simple clamp may be made from a small piece of sheet metal, a ¼" shaft coupler and a few small screws as shown in Fig. 5. The brass shaft coupler may be soldered to the sheet metal if steel is used, or screwed in place if aluminum sheet is employed.

Should the constructor have solid metal stock and metal-working facilities available, the clamp shown in Fig. 5 may be made in one solid piece, and the shaft coupler eliminated.

The dowel mounted on the mirror frame fits into the hole in the shaft coupler and set screw *"A"* used to lock it in place. Set screw *"A"* thus serves to adjust the angle of the mirror and to lock it.

A base plate is made by mounting a 3/16" rod on a piece of ½" plywood or board as shown in Fig. 7, and the clamp fitted over the rod. Set screw *"B"* serves to lock the clamp in position along the rod and thus serves as a height adjustment.

The 10" x 13" base plate serves as a "desk" for the note pad on which the patterns are traced. This size is adequate for a standard 8½" by 11" pad. If a smaller or larger pad is used, the size of the base may be changed accordingly. Too small a base will result in instability of mounting, however.

The author is left-handed, and therefore mounted the rod on the right side of the base, for ease in making sketches. If the user is right-handed, mount the rod on the left side of the base.

Finally, the mirror, clamp, base, and rod are assembled into the complete unit shown in Fig. 7. Once this is done, the device is ready for use.

Adjustment and Use

To use the Tracing Aid, first adjust the mirror to a 45° angle and lock it in place with set screw *"A"*. Place the device in front of the scope and adjust the height of the mirror until its center lines up with the center of the scope screen, locking it in place along the vertical rod with set screw *"B"*.

The eye is placed directly above the mirror, as shown in Fig. 6, and the device moved back and forth until distance *A-B* equals distance *B-D*. This is necessary so that the superimposed scope image will appear to fall on the surface of the pad and not above or below it. A check on this may be made by moving the eye forward and back. With the distance properly adjusted, the image stays in place on the

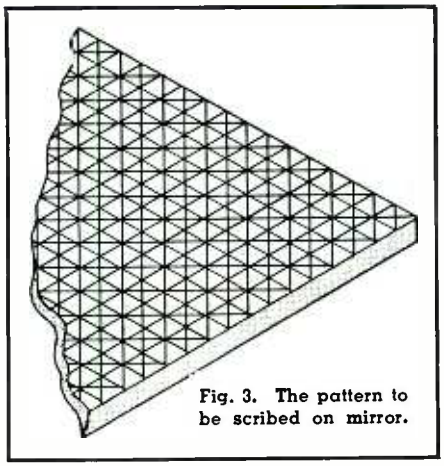


Fig. 3. The pattern to be scribed on mirror.

pad. If the distances are wrong, the image will appear to move over the surface of the pad.

Normal room lighting should be used so that the pad is well-illuminated. If sufficient light is not available, a desk lamp may used to light the pad directly.

The image on the screen of the CRO will appear superimposed on the pad, full size, and not distorted. It will be perfectly clear and sharp, and may be easily traced with a pencil or pen. A little practice is necessary at first, but the proper technique is soon acquired.

Since a reflected image is seen, it is inverted with respect to the pattern on the scope. If, for any reason, a "right side up" tracing is required, simply reverse the connections to the vertical deflection plates of the scope. These connections will generally be found on a plate on the back or side of the scope. Some scopes are provided with an "image reversing" switch in the front panel.

Application

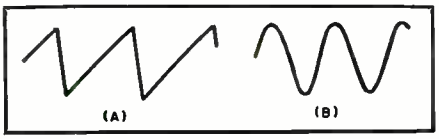
Two typical patterns traced with this device are shown in Fig. 8. In 8A a saw-tooth is shown, and in 8B a sine-wave is illustrated. Note how sharp the peaks of the saw-tooth are and how clean the sine-wave is.

Probably the chief use to which the Tracing Aid will be put is for simply recording waveforms in circuits for future reference. It is ideally suited for this, since the tracings are full size and may be made on graph paper. If copies are desired, as in making reports, simply replace the pad with additional sheets with carbon paper between each sheet. Use a harder pencil, or a ball point pen, and apply somewhat greater pressure when making the tracing.

Another valuable application is in comparing the input and output wave-

(*Continued on page* 119)

Fig. 8. Patterns traced with the Tracing Aid. (A) a saw-tooth and (B) a sine wave.



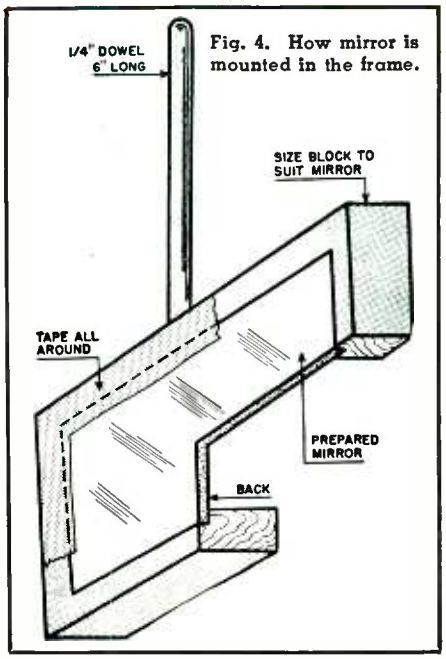


Fig. 4. How mirror is mounted in the frame.

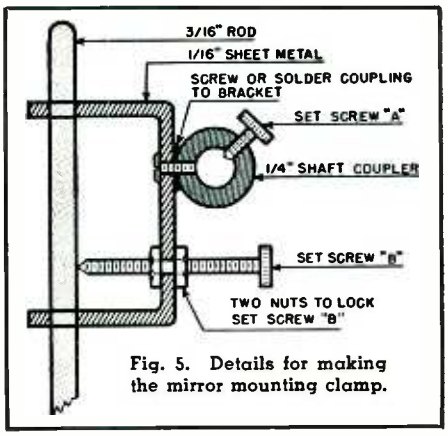


Fig. 5. Details for making the mirror mounting clamp.

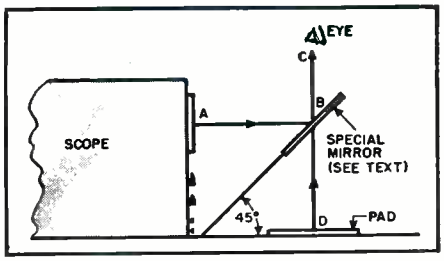
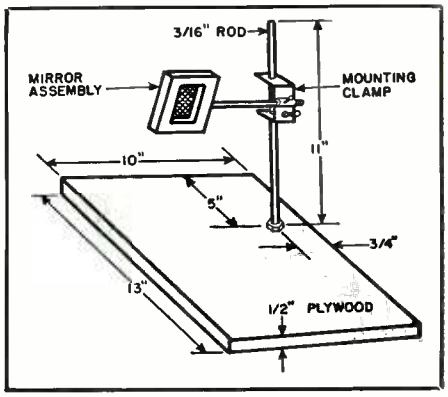


Fig. 6. Setup for tracing waveforms using the easily-built reflecting mirror device.

Fig. 7. Mounting rod on the plywood base. The mirror, clamp, base, and rod can then be assembled into complete tracing unit.



THE SCOTT 99-A AMPLIFIER

By

VICTOR H. POMPER

Hermon Hosmer Scott, Inc.

Fig. 1. Front panel view of the 99-A transcription amplifier. This 10-watt unit is self-contained.

Technical details on a 10-watt amplifier which includes a power supply, equalizer, and preamp on a single chassis.

THE new *Scott* 99-A transcription amplifier appears, at first glance, to be a "front end" or equalizer-preamp, yet actually it is a complete 10-watt amplifier, power supply, and equalizer-preamp—all packaged in a single cabinet measuring 13¼" x 3¾" x 9¾". See Fig. 1.

Since heat dissipation as well as the size were important, engineering studies made at the time this amplifier was being designed showed that a 10-watt power output would be most feasible. Higher power outputs would add considerably and undesirably to the size and would also dissipate too much heat to be radiated comfortably from a sheet metal cover. The 10-watt output proved satisfactory for reasons to be discussed shortly.

Beam power tetrode output stages were chosen for several reasons. The greater efficiency of the beam power tetrode meant less power lost in heat and more developed in sound output. This efficiency also allowed use of fewer driving stages which further decreased over-all heat and bulk. Considering all factors, use of beam power tetrodes meant a reduction in generated heat by almost two-to-one. The final system does not overheat, in fact, the metal cover becomes only moderately warm to the touch. The heat generated is conducted through, and radiated from, the plane surfaces of the all-aluminum chassis. Scientifically designed slots in the case, located directly above the output tubes, aid heat dissipation by the convection of heated air rising through these slots.

The reliable 6V6 output tubes were chosen because they produced the 10-watt output with less heat and less distortion than any other tubes tested. With carefully engineered inverse feedback, it is possible to achieve extremely low levels of distortion. At 10 watts, harmonic distortion is less than .8 per-cent. At full rated output the first order difference tone intermodulation distortion is less than .3 per-cent. This latter type of distortion is closely allied to that harsh, discordant growling most noticeable and offensive to the human ear. This distortion component measurement then represents the best criterion for determining over-all quality of a power output system.

Also engineered into the output system were the self-balancing phase inverter circuits which have been standard on *H. H. Scott* amplifiers for six years. These circuits automatically balance the output tubes, reducing distortion and making unnecessary any readjustments after replacement of output tubes in use.

Another factor of output systems receiving careful attention was the often overlooked requirement of clean, symmetrical clipping. On sudden peaks of music and sound, any amplifier will clip to some extent. Some amplifiers may indicate extremely low distortion levels up to their rated undistorted output, and yet above these ratings the clipping may not be clean and symmetrical. Ragged clipping causes extraneous damped transient effects, which sound very harsh and discordant, to be introduced. This was avoided in the 99 by careful engineering to insure that any clipping would be both clean and symmetrical. As long as this requirement is met, the human ear is unable to detect substantial amounts of clipping, and the over-all result is an output system which, though rated at 10 watts, gives performance audibly equal to much higher formal power ratings.

That a 10-watt power amplifier with associated power supply is incorporated into so compact an enclosure while still including sensitive low-level preamplifying and equalizing circuits, seemed to make the hum problem important. Since d.c. heater operation was not feasible because of space considerations, an all-aluminum chassis was used to minimize circulating and ground currents which, in

Table 1. Suggested equalizer settings for a variety of record labels.

33⅓ AND 45 RPM RECORDS

MAKE	TURNOVER	ROLL-OFF	MAKE	TURNOVER	ROLL-OFF
Atlantic	NARTB	LP	London	LP	AES
Bartok	AES	LP	Lyrichord (new)	AES	LP
Blue Note Jazz	AES	AES	Mercury	AES	AES
Caedmon	AES	AES	M-G-M	NARTB	AES
Canyon	AES	AES	Oceanic	LP	LP
Capitol	AES	AES	Philharmonia	AES	AES
Capital-Cetra	AES	AES	Polymusic	NARTB	LP
Cetra-Soria	LP	LP	RCA Victor	RCA	RCA
Columbia	COL	COL	Remington	NARTB	LP
Cook Laboratories[1]	NARTB	AES	Tempo	NARTB	AES
Decca	LP	LP	Urania (most)	NARTB	NARTB
EMS	AES	AES	Urania (some)	LP	LP
Elektra	AES	LP	Vanguard—Bach Guild	LP	LP
Esoteric	NARTB	AES	Vox	LP	LP
Haydn Society	LP	LP	Westminster	NARTB	LP

[1] For inside band of binaural records roll-off should be set at "Flat"

78 RPM

European recordings and old American recordings	EUR	EUR
Columbia	EUR	COL
London	LON	LON
Victor	RCA	RCA or FLAT

a steel chassis, would contribute to hum pickup. Positive bias on the heaters, together with an adjustable center-tapped, hum-bucking potentiometer, reduced hum still further, as did careful engineering of parts placement (Fig. 2) and shielding of all low level circuits. This attention to detail brought over-all hum to the unusually low level of better than 80 db below full output, a level comparable to that generally achieved only by d.c. on the heaters. See Fig. 4 for the schematic of the amplifier.

The over-all frequency response is flat from 20 cps to 30,000 cps. Above 30,000 cps the response is rolled off in order to prevent possible ultrasonic oscillation. Such oscillation is often caused by unavoidable stray coupling between external input and output connections when amplifiers have unnecessarily extended frequency response. While such oscillation is, in itself, inaudible to the ear, it overloads the amplifier, causing noise and distortion in the audible range.

Another feature, usually found only in higher priced amplifiers, is the sharp-cut-off rumble filter which prevents sub-audible overload below 20 cps. Unless the low-frequency response is limited sharply below the lowest audible notes, sub-audible signals may be generated by eccentricity of the record center hole and by turntable rumble. These sub-audible signals often are sufficiently large to cause amplifiers to operate in almost continuous states of overload. Acoustical feedback from the loudspeaker to the pickup cartridge is also decreased considerably by eliminating sub-audible, but high power, low-frequency signals.

For record equalization, separate three-position bass turnover and treble roll-off controls are provided. These separate controls are patterned after those first announced in the *H. H. Scott* 212-A amplifier which was catalogued in 1950 but only few made because of Korea and parts shortages. While two controls must be adjusted for equalization, this type of control is inherently a simpler and less costly means of equalization than the somewhat simpler-to-operate single control giving the complete equalization curve.

In order to give maximum equalization flexibility, a study was made of

(*Continued on page* 122)

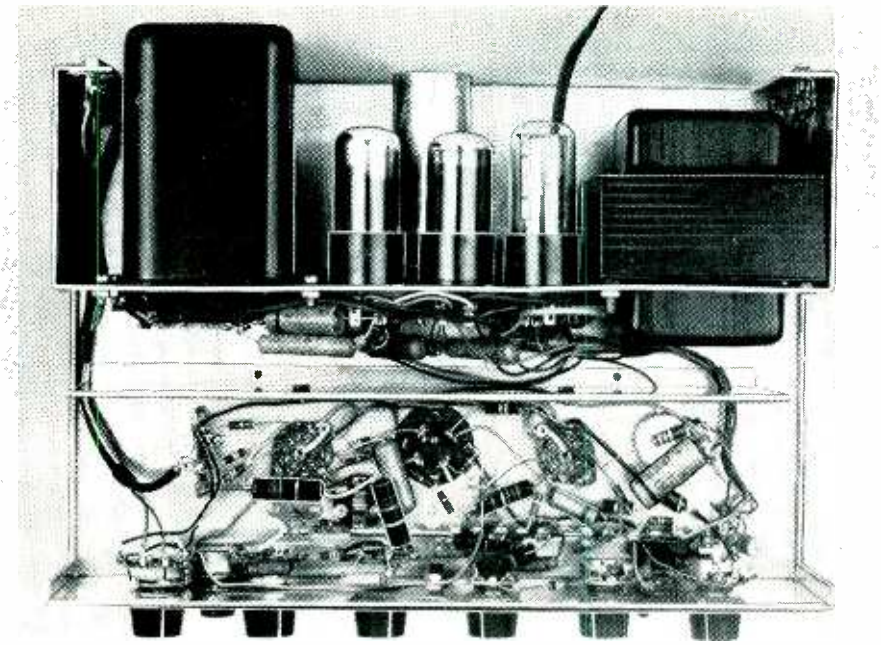


Fig. 2. Top view of the 99-A, showing major assemblies and parts placement.

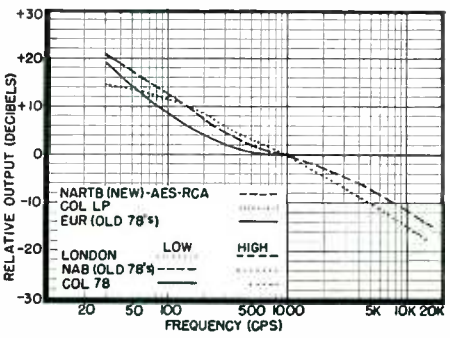
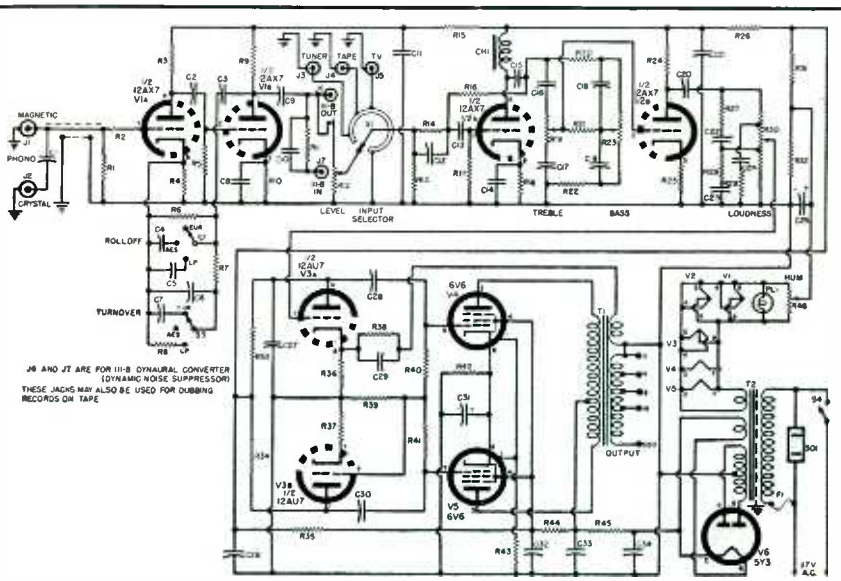


Fig. 3. Equalization curves for the 99-A. Data on other records is given in Table 1.

Fig. 4. Complete schematic diagram of the 99-A. The power supply and equalizer-preamp are housed on the same aluminum chassis.

R_1, R_{15}, R_{28}, R_{39}—47,000 ohm, ½ w. res.
R_2, R_{26}, R_{38}—15,000 ohm, ½ w. res.
R_3, R_7, R_9, R_{41}—270,000 ohm, ½ w. res.
R_4, R_{10}, R_{43}—2700 ohm, ½ w. res.
R_5, R_{11}, R_{13}—1 megohm, ½ w. res.
R_6, R_{22}—22,000 ohm, ½ w. res.
R_8—1.8 megohm, ½ w. res.
R_{12}—500,000 ohm pot
R_{14}, R_{31}—470,000 ohm, ½ w. res.
R_{16}—2.7 megohm, ½ w. res.
R_{17}—2.2 megohm, ½ w. res.
R_{18}—1000 ohm, ½ w. res.
R_{19}, R_{23}—1 megohm pot
R_{20}, R_{40}—220,000 ohm, ½ w. res.
R_{21}, R_{24}, R_{33}, R_{34}—100,000 ohm, ½ w. res.
R_{25}, R_{36}, R_{37}—1500 ohm, ½ w. res.
R_{27}—330,000 ohm, ½ w. res.
R_{29}—68,000 ohm, ½ w. res.
R_{30}—500,000 ohm pot (special Scott control)
R_{32}—33,000 ohm, ½ w. res.
R_{35}—4700 ohm, ½ w. res.
R_{42}—250 ohm, 10 w. wirewound res.
R_{44}—2000 ohm, 2 w. res.
R_{45}—400 ohm, 2 w. res.
R_{46}—500 ohm wirewound pot
C_1, C_{16}—100 μμfd. mica cond.
C_2, C_3, C_{18}—.022 μfd., 600 v. cond.
C_4—180 μμfd. mica cond.
C_5, C_{27}—470 μμfd. mica cond.
C_6—.0015 μfd., 600 v. cond.
C_7—680 μμfd. mica cond.
C_8-C_{14}-C_{11}-C_{21}—Single-can elec. cond. C_8, C_{14}—25/25 μfd. @ 25 v., C_{11}, C_{21}—10/10 μfd. @ 450 v.
C_9, C_{28}, C_{30}—.047 μfd., 600 v. cond.
C_{10}, C_{20}—220 μμfd. mica cond.
C_{12}—33 μμfd. mica cond.



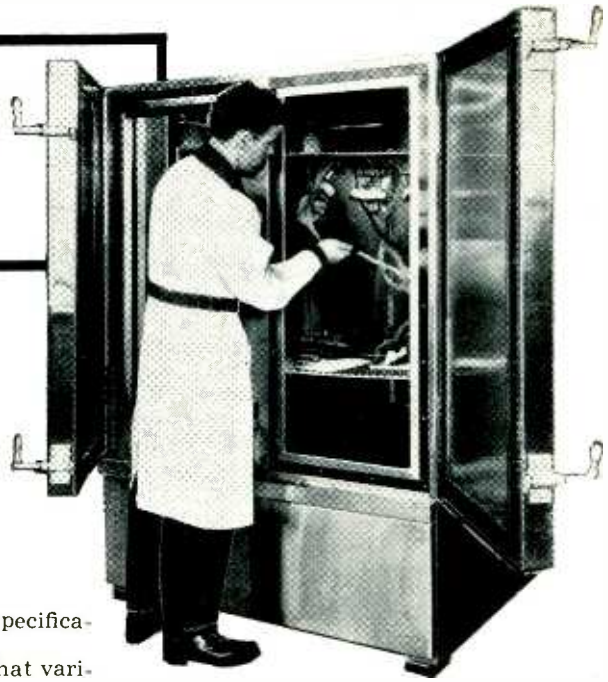
C_{15}, C_{19}, C_{20}, C_{24}—.01 μfd., 600 v. cond.
C_{17}—.0022 μfd., 600 v. cond.
C_{18}—.001 μfd., 600 v. cond.
C_{22}—47 μμfd. mica cond.
C_{23}—.0047 μfd., 600 v. cond.
C_{25}, C_{31}—25 μfd., 25 v. elec. cond.
C_{26}-C_{32}-C_{33}-C_{34}—20/20/20/20 μfd., 475 v. elec. cond.

S_1—Special switch (Scott)
S_2, S_3—S.p. 3-pos. switch
S_4—S.p.s.t. switch
CH_1—250 hy. choke
PL_1—6.3 volt pilot light
J_1, J_2, J_3, J_4, J_5, J_6, J_7—Phono jack
T_1—Output trans. (special Scott unit)
T_2—Power trans. (special Scott unit)

RESISTOR TRIAL BY TEST

By **GUY B. ENTREKIN**
Chief Product Eng., International Resistance Company

Extensive laboratory tests insure reliable service from the components used in electronic equipment.



Moisture cycling box which can dup'icate any humidity conditions called for by MIL specifications for testing resistors.

WE HAVE become so used to taking the reliability of electronic components for granted that we often forget "how they got that way." Since the performance of even the most elaborate equipment depends on many small and relatively inexpensive parts, the reliability of a 10-cent resistor is just as important as the most complicated tube.

One example of the lengths to which manufacturers go to insure the reliability of even small components is typified by the resistor testing program at *International Resistance Company,* Philadelphia. Its laboratory checks approximately a half-million resistors a year—putting them through a wide variety of tests to insure uniformity, quality, and performance.

For example, MIL specifications for all types of resistors require tests under load. These tests are made under conditions of various applied voltages and ambient temperatures. *IRC* utilizes several massive load-life ovens, like that pictured on this month's cover and on this page, to perform these load-life tests. Each of these precision-engineered ovens can test approximately 1200 resistors at a time and is uniquely designed to meet the variety of conditions necessary to fulfill military and customer specifications for load-life testing.

The ovens are designed so that various voltages can be applied to produce whatever wattages are specified in the test of a particular resistor. The resistors are supported in such a way that the heat dissipated by one resistor does not affect another unit being tested. "Still air," rather than circulating air, is maintained within the ovens as an added safeguard to guarantee conformity.

Another interesting aspect of MIL specifications for load-life testing is the requirement that ovens be equipped to feed loads intermittently to the resistors. During test, loads are normally applied for 1½ hours, then cut off for ½ hour, then applied for 1½ hours, alternating on and off for the full test period.

This intermittent application of the load produces a temperature cycling effect—important because continuing heating and cooling of any resistor introduces stresses similar to those obtained when equipment is turned on and off.

The actual voltages applied to resistors during test depend on their resistance range and ambient temperature of the test. These load-life ovens have a test voltage range of 0 to 750 volts—more than adequate for standard testing since the majority of all resistors test at 500 volts or less. For tests requiring the application of higher voltages, a specially designed oven in the test section is used.

Since the load-life ovens operate 24 hours a day, 7 days a week, automatic recording equipment and built-in safety devices of many types are used to give tight control over testing. In every test run, intermittent readings are taken to trace the pattern of resistance change with time. MIL specifications usually require at least four readings per thousand hours of test. More frequent readings are taken if tests require them.

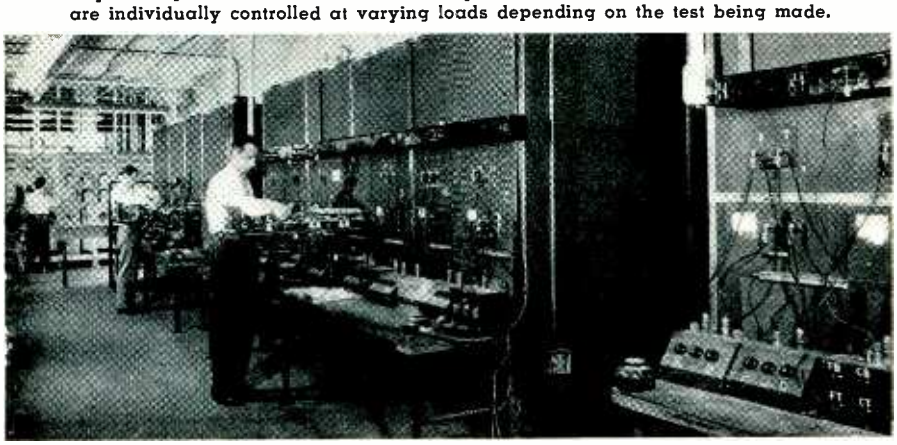
Testing a single group of resistors may take six weeks or longer depending on the number and type of tests they must undergo. Where a shelf-life test is indicated, resistors are stored under the same or more severe conditions than they would encounter in a distributor's stock or in a local service shop, and are periodically tested for as long as three years. This test insures that resistors will not deteriorate in stock while awaiting use.

Resistor testing is an involved, lengthy, often laborious undertaking but it has made an invaluable contribution to the development of new and better electrical equipment and the amazing reliability of such gear under all conditions.

This is just one example of the infinite pains manufacturers take to insure uniform, inexpensive, and reliable components.

It is because of such painstaking procedures that U. S.-built electronic equipment has earned a reputation for excellent performance that is second to none in the world. —30—

These massive load-life ovens in IRC's resistor test section operate 24 hours a day, testing hundreds of resistors of every kind. Resistors hang in trays which are individually controlled at varying loads depending on the test being made.



A NEW LINE OF HI-FI SPEAKERS

By
HARRY F. OLSON and **JOHN PRESTON**
RCA Laboratories, Princeton, N. J.

Fig. 1. (left) The RCA Type SL-8, 8-inch speaker. Fig. 2 (center) The Type SL-12, 12-inch unit. Fig. 3 (right) The 15-inch "Duo Cone" loudspeaker, the Type LC-1A.

Direct-radiator loudspeakers—RCA's final results of five years of research and development work

BEGINNING with the advent of radio, the direct-radiator, dynamic loudspeaker has been exclusively used with the electronically amplified disc phonograph, magnetic tape reproducer, and television in turn. Its use in home-type sound reproducing systems is due to the simplicity of construction, small space requirements, and the fundamental relationship between the acoustical resistance load and the total accoustical impedance of the vibrating system. In a properly designed loudspeaker, this fundamental relationship leads to a uniform response frequency characteristic. Extensive research and development during the past five years have resulted in many outstanding improvements in the performance of direct-radiator loudspeakers, including smoother response frequency characteristics, broader directivity patterns, improved transient response, and lower nonlinear distortion.

It is the purpose of this article to describe the results of these developments which have culminated in a new line of high-fidelity, direct-radiator loudspeakers.

High-Fidelity Loudspeakers

The *RCA* Types SL-8 and SL-12, shown in Figs. 1 and 2, are extended-frequency range, 8- and 12-inch, single cone speakers developed and designed for high-fidelity applications. Particular efforts were made to obtain a uniform response frequency characteristic. A loudspeaker without this characteristic will introduce frequency discrimination, will not exhibit good transient response, and will tend to accentuate noise. The smooth response characteristic exhibited by these loudspeakers was obtained by employing a particular shape of the curvilinear cone, a specially developed pulp for the material of the cone, and a damping ring in the outer suspension of the cone, which provides a matched terminating acoustical impedance for the cone.

The transient response is related to the response frequency characteristic. This relationship shows that a loudspeaker with a uniform response frequency characteristic will exhibit good transient response. In wide frequency range loudspeakers, it is important that the directivity pattern be broad and uniform in order to reduce frequency discrimination for observation points removed from the axis.

The shape and material of the cone play important roles in determining the directivity pattern of the loudspeaker and were selected experimentally.

Nonlinearity in a speaker occurs when the force *vs* displacement characteristic deviates from a straight line. In a lightweight cone this deviation occurs at a relatively small input, therefore, it is important that the cone be strong enough to handle the vibratory forces without producing distortion. These precautions were observed in this design.

The physical specifications for the *RCA* Type SL-8 are as follows: over-all diameter, 8½ inches; depth, 4¼ inches; magnet weight, 6.8 ounces; and electrical impedance, 8 ohms. The physical specifications for the *RCA* Type SL-12 are: over-all diameter, 12¼ inches; depth, 6⅛ inches; magnet weight, 14.5 ounces; and impedance, 8 ohms.

The Type LC-1A, shown in Fig. 3, is a "Duo Cone" loudspeaker. Every known acoustical principle, both theoretical and experimental, that would result in an improved loudspeaker, has been employed in the research, development, and design of this unit. The Type LC-1A[1] was first announced and demonstrated[2] at Tanglewood, Massachusetts, in July 1947. Since that time, it has been sold to broadcast and television stations, recording studios, and other users of high-quality sound installations.

One of the outstanding features of the original LC-1A speaker was its broad directivity pattern. This has been broadened even further in the new design and the response frequency characteristic made more uniform. These characteristics have been obtained by the use of the following new features: a series of conical domes placed upon the surface of the large cone; a damping ring in the outer suspension of the large cone, which provides a matched terminating acoustical impedance for the large cone; and a multiple vane deflector in front of the high-frequency cone. The series of cones breaks up the symmetry of the unit and thereby eliminates interference which normally characterizes a symmetrical shape. The high-frequency efficiency is improved because the solid angle into which the high-frequency cone operates is reduced, thereby increasing the acoustical load imposed upon the small cone. At the same time, the conical diffusers increase the distribution angle due to a reduction of the propagation velocity in the low-frequency cone and due to

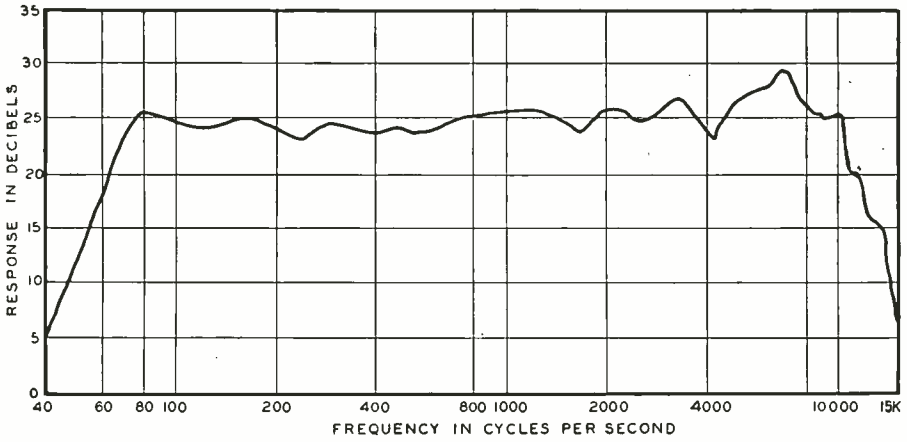


Fig. 4. Response frequency characteristic of the RCA Type SL-8 loudspeaker.

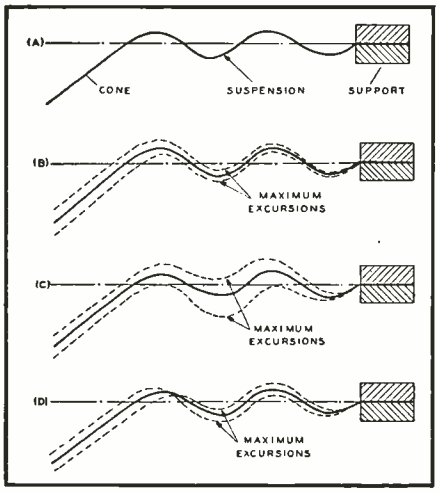


Fig. 5. (A) Outer suspension for a direct-radiator speaker. (B) normal vibration of the suspension. (C) resonant vibration of the suspension in-phase with the cone. (D) resonant vibration of the suspension out-of-phase with the cone of the speaker.

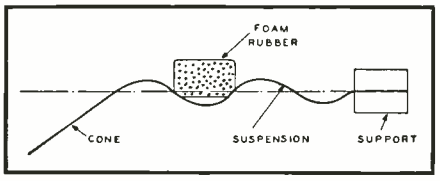


Fig. 6. Suspension with a rubber damper.

diffraction of the sound emitted by the high-frequency cone. The purpose of the two-vane deflector is to increase the radiation angle in the frequency range above 10,000 cycles to conform to the directivity pattern of the remainder of the frequency range. The damping ring in the outer suspension of the low-frequency cone eliminates mid-frequency resonance of the suspension. It also provides a terminating acoustical impedance for the large cone, thereby eliminating standing waves in the cone. The final result is a very smooth response frequency characteristic, a broad directivity pattern, and low nonlinear distortion.

The physical specifications of the Type LC-1A are as follows: over-all diameter, 17 inches; depth, 7 7/16 inches; magnet weight, 2½ pounds; and impedance, 16 ohms.

Performance Characteristics

Response Frequency Characteristics: The response frequency characteristic depicts the sound pressure output of the loudspeaker at some specified observation point, usually on the axis, as a function of the frequency. Of all the performance characteristics of a speaker, the response frequency characteristic is the most useful and important because it conveys the most information. The response frequency characteristic of the *RCA* Type SL-8 is shown in Fig. 4. It will be seen that response covers a very wide frequency range for a loudspeaker of this size.

This uniform characteristic was obtained by employing a particular shape of the curvilinear cone, a special pulp for the material of the cone, and a damping ring in the outside suspension of the cone. The material and shape of the cone were determined from tests made to obtain a smooth response frequency characteristic and a broad directivity pattern. The internal damping in the pulp of the cone plays an important role in the shape of the response frequency characteristic. The shape of the cone influences the high-frequency response and the directivity of the cone. After the shape and material of the cone had been determined it was found that additional damping was required in the suspension system to smooth out the response.

The outside suspension of the cone consists of a corrugated disc which provides a flexible connecting means between the cone and the fixed support, as shown in Fig. 5A. The normal mode of vibration of the cone and suspension is shown in Fig. 5B. The maximum excursions of each part of the suspension and cone are shown by the dotted lines. It will be seen that the amplitude falls off gradually in the suspension from the edge of the cone to the fixed outside edge. Unfortunately, a suspension does not behave in this manner throughout the frequency range, but breaks into resonance in the mid-frequency range. The amplitude of the suspension is thus greater than that of the cone, as shown in Figs. 5C and 5D. The vibration of the suspension is in phase with the cone, as shown in Fig. 5C, and out-of-phase, as shown in Fig. 5D.

In the past, the procedure has been to coat the suspension with some highly viscous material, such as viscoloid, thereby providing damping which reduces the amplitude at resonance. In this way, the response is smooth and free from the peak and the dip. The objection to the use of viscous materials is that these materials tend to dry out, with the result that the damping efficiency is lost. The vibration can be controlled and the effects of any resonance reduced to a negligible amount by means of a special rubber damping ring, as shown in Fig. 6. The curve of Fig. 7, taken without the damping ring, can be compared with that of Fig. 4 taken with the damping ring. It will be seen that the response frequency characteristic without the damping ring exhibits a peak and a dip at 850 and 1050 cycles respectively. Furthermore, the high-frequency response is not as smooth as that with the damping ring. This shows that the damping ring provides a better acoustical impedance termination for the cone. High-frequency vibrations started at the voice coil flow out in the cone, then from the cone into the suspension and damping ring, and are absorbed in this system. As a consequence, standing waves in the cone, which would lead to a ragged response frequency characteristic, are reduced to a negligible quantity.

Fig. 7. Response frequency characteristic of a Type SL-8 without suspension damper.

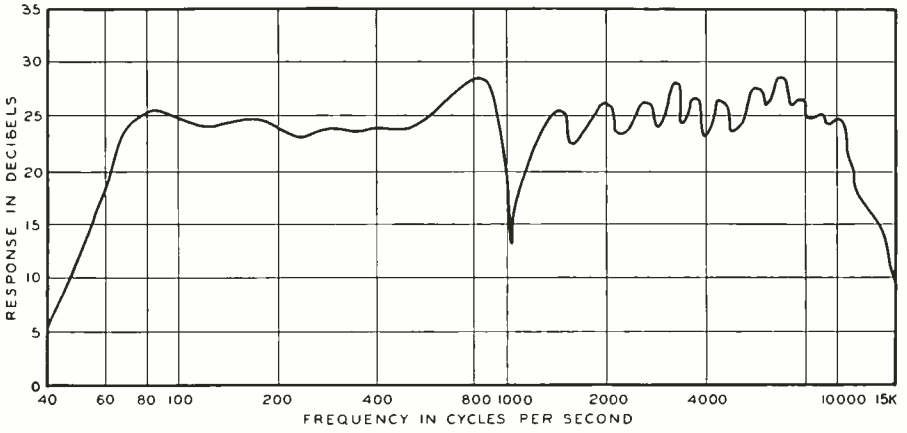


Fig. 8. Response frequency characteristic of the Type SL-12 speaker.

The response frequency characteristic of the Type SL-12, taken in the *RCA* Type SC-8 cabinet, is shown in Fig. 8. This loudspeaker covers the frequency range from 50 to 15,000 cycles with very uniform output. The same features were used in the Type SL-12 as in Type SL-8 to obtain uniform response.

The response frequency characteristic of the Type LC-1A is shown in Fig. 9. The new features which have resulted in the improved performance are as follows: a series of conical domes or cones placed on the surface of the large cone, a damping ring in the outer suspension of the large cone which provides a matched terminating acoustical impedance for the large cone, and a multiple vane deflector in front of the high-frequency cone.

The action of the damping ring in the outer suspension of the cone is the same as that of the Type SL-8 and need not be discussed further.

It was considered desirable to increase the response of the LC-1A loudspeaker in the frequency range from 2500 to 8000 cycles. The output in this range is supplied by the high-frequency unit. The output of any direct radiator loudspeaker can be increased by reducing the solid angle into which the loudspeaker radiates. In this case, it would necessitate a reduction of the angle of the low-frequency cone. By cementing small cones to the large cone, as shown in Fig. 3, the radiation angle into which the high-frequency cone operates is reduced without affecting the effective angle of the large cone. As a matter of fact, the radiation angle of the large cone is increased as will be shown in a later section.

The two-vane deflector operates in the region above 10,000 cps to smooth the response and broaden the directivity. Since the purpose of the deflector is related to the directivity, the action will be explained in the next section.

Directional Characteristics[3]: The directional characteristic depicts the sound pressure output of the loudspeaker as a function of the angle with respect to some reference axis of the system. In general, the reference axis is the symmetrical axis of the loudspeaker.

The directivity pattern of a direct radiator loudspeaker is a function of the ratio of the effective radiation dimensions of the cone to the wavelength, the velocity of sound in the material of the cone, and the geometrical configuration of the cone. Thus there are three ways to establish the directional characteristic of a direct radiator loudspeaker. This will now be illustrated.

Fig. 10 illustrates the role of the shape[4] and material of the cone in determining the directivity pattern. The cone angle in Fig. 10A is 90 degrees. The velocity of wave propagation, V_C, in the cone is 1.4 times the velocity of wave propagation, V_A, in air. Under these conditions, the cone emits practically a plane wavefront in the high-frequency region, which is manifested as a very narrow directivity pattern. The directivity pattern can

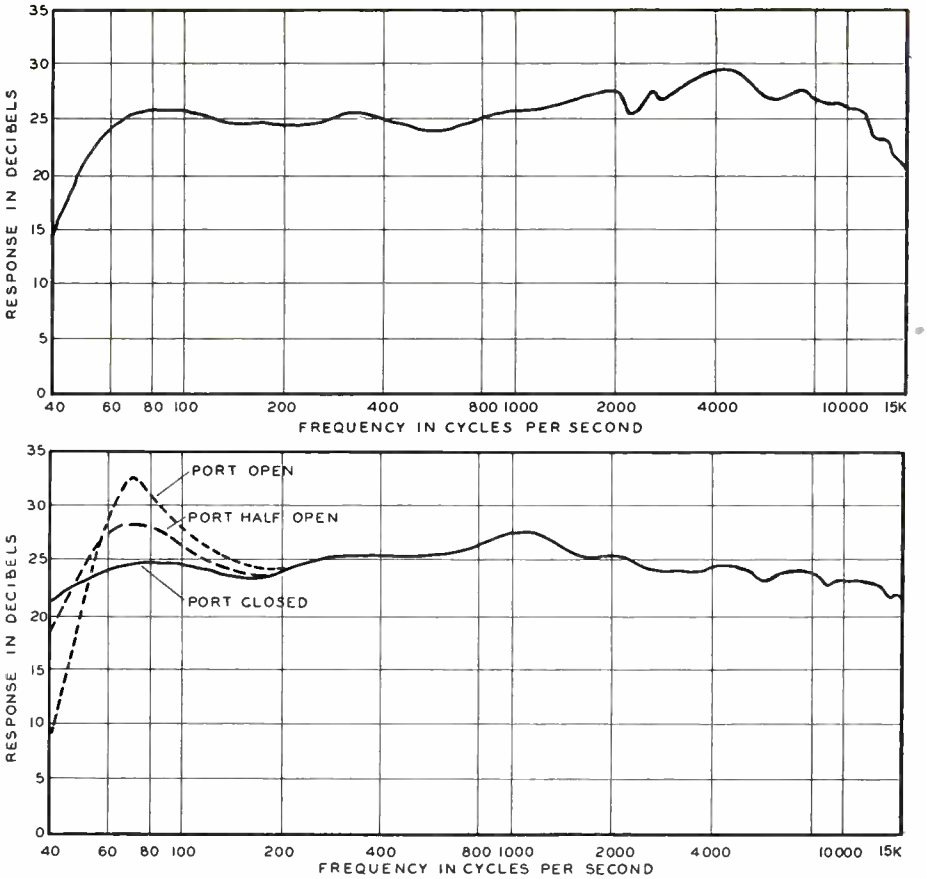


Fig. 9. Response frequency characteristic of the Type LC-1A loudspeaker.

Fig. 10. Wavefronts emitted by various cones. (A) cone with an angle of 90 degrees, (B) cone with angle of 135 degrees, (C) cone with angle of 135 degrees and a very slow propagation velocity of the speaker cone.

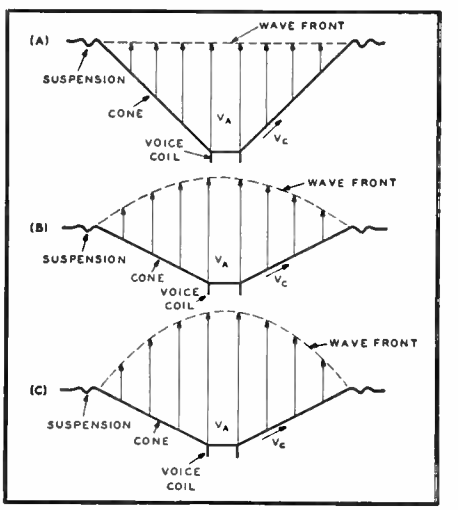
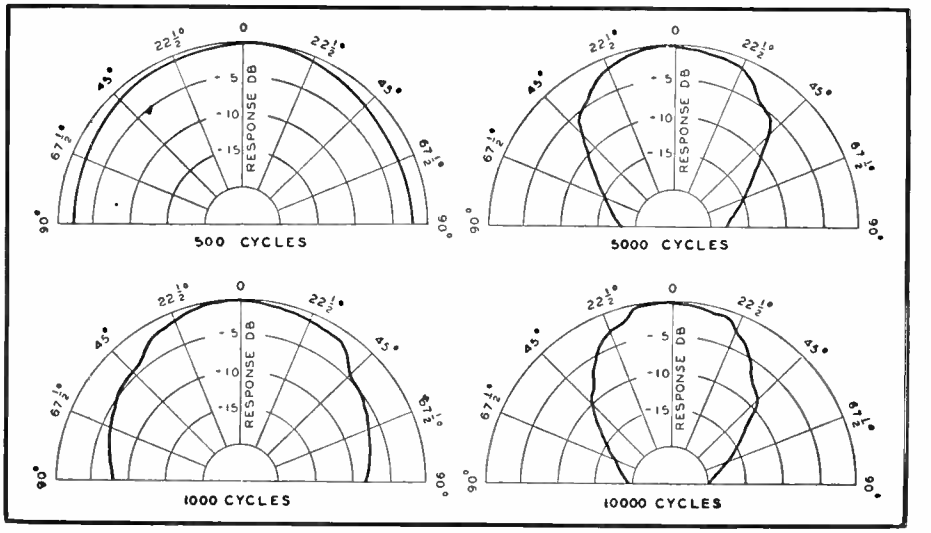


Fig. 11. Directional characteristics of the RCA Type SL-8 speaker.



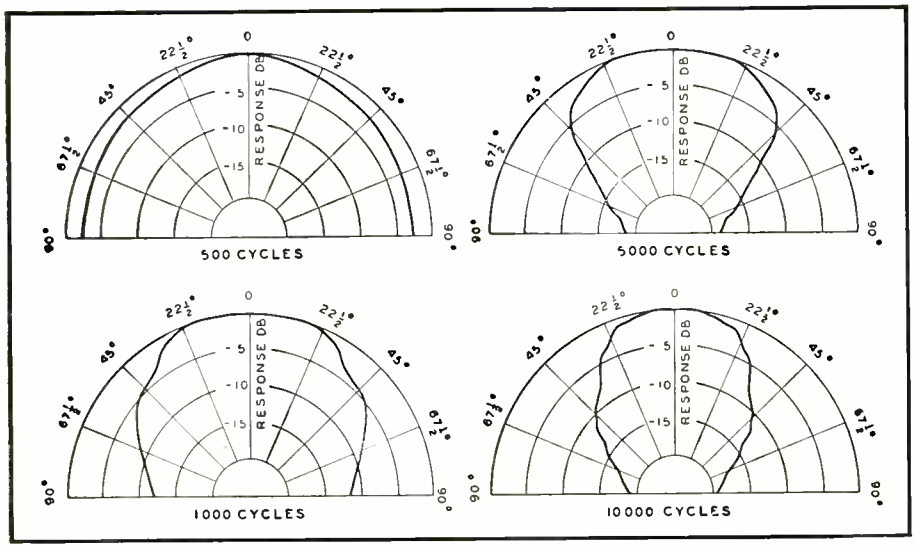


Fig. 12. Directional characteristics of the RCA Type SL-12 loudspeaker.

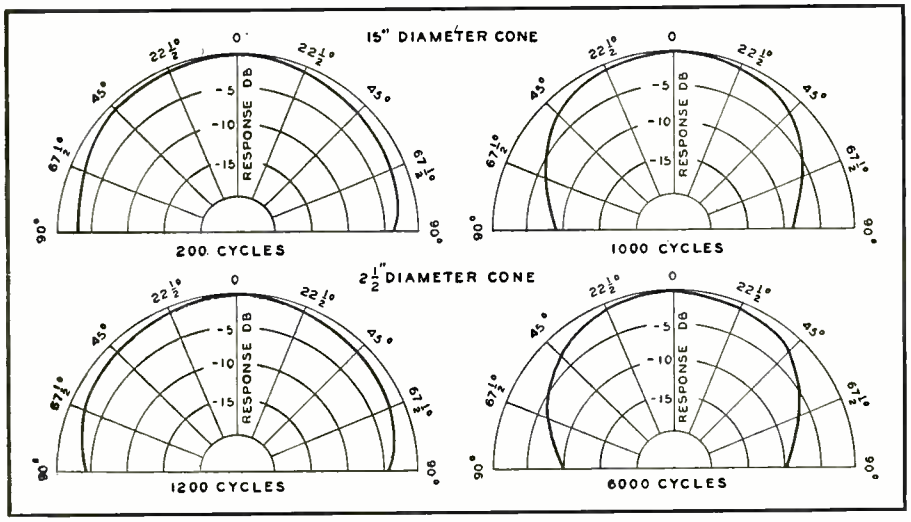


Fig. 13. Directional characteristics of a 15" and 2½" speaker. See text.

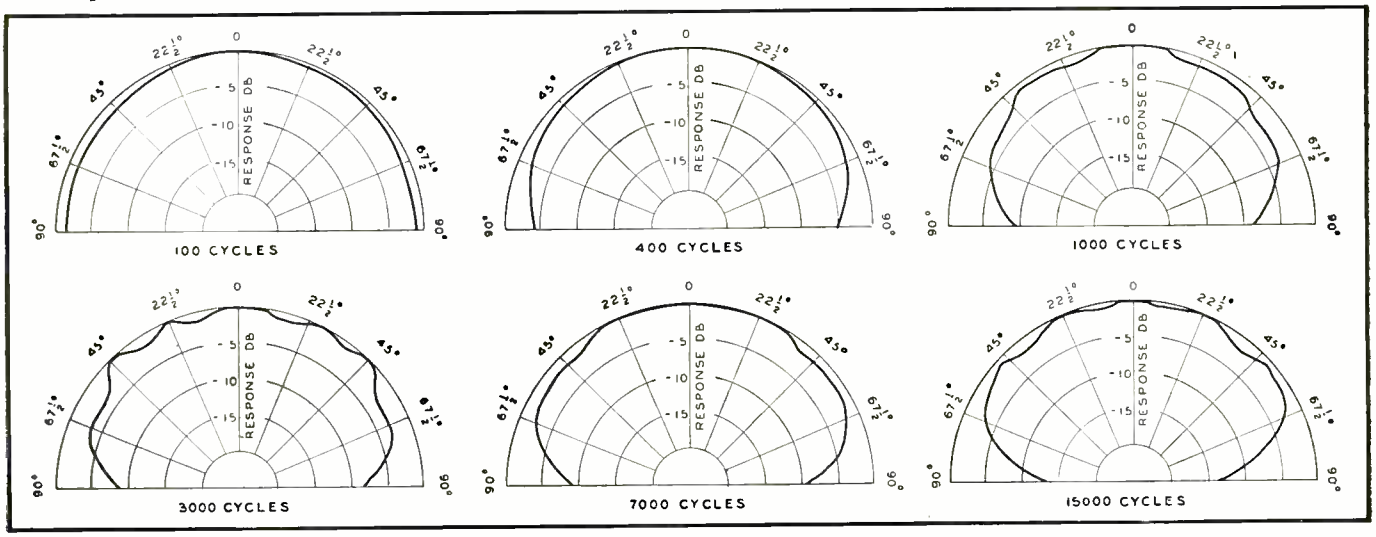
be broadened by using a cone with a wider angle. The cone angle in Fig. 10B is 135 degrees. The velocity of wave propagation in the cone is the same as in Fig. 10A. The emitted wavefront is convex, and as the radius of curvature of the wavefront decreases, the directivity pattern becomes broader. Therefore, the directivity pattern of the cone of Fig. 10B will be broader than that of the cone of Fig. 10A. The radius of curvature of the wavefront can be decreased further by reducing the velocity of wave propagation in the cone. In Fig. 10C, the velocity wave propagation, V_c, in the cone is equal to the velocity of sound propagation, V_A, in air. The radius of curvature is reduced and, as a result, the directivity pattern is broadened.

The shape and material of the cone in the Types SL-8 and SL-12 loudspeakers, have been determined from these principles. They give as broad and uniform directivity patterns as possible and still retain uniform response, low distortion, and adequate power handling capacity. The directional characteristics of the Types SL-8 and SL-12 are shown in Figs. 11 and 12. The directivity patterns are exceptionally broad and uniform, with respect to frequency, for single cone loudspeakers.

In a two-unit loudspeaker employing a large cone for the reproduction of the low-frequency range and a small cone for the reproduction of the high-frequency range, a uniform directivity pattern can be obtained over the entire audio frequency range. This is because the ratio of wavelength to linear dimensions can be employed in addition to the expedients used in the cone of the loudspeakers, Types SL-8 and SL-12. This is illustrated in Fig. 13 in which the directivity patterns of 15-inch and 2½-inch loudspeakers are compared for a six to one ratio of frequency, that is, for a constant ratio of diameter to wavelength. Fig. 13 shows that the directivity pattern of a 15-inch loudspeaker at 200 and 1000 cycles corresponds to that of a 2½ inch loudspeaker at 1200 and 6000 cycles. These relationships were used in designing the two units of the LC-1A.

In addition, in the Type LC-1A loudspeaker, the small cones which are attached to the wide-angle cone reduce the velocity of wave propagation in the large cone. This broadens the directivity pattern of the low-frequency cone. In the high-frequency range, the sound emitted by the high-frequency cone is diffracted by the cones attached to the large cone which broadens the directivity pattern of the

Fig. 14. Directional characteristics of the RCA Type LC-1A loudspeaker. See text for a full discussion of these characteristics.



high-frequency cone. Then, in the region around 10,000 cycles, small deflectors are used to broaden the directivity pattern of the small cone to conform with the directivity pattern of the remainder of the frequency range.

The directional characteristics of the Type LC-1A are shown in Fig. 14. It will be seen that uniform directivity is obtained over a total angle of 140 degrees for the entire audio frequency range. These patterns are obtained by the use of the principles relating to directivity outlined in this section.

Nonlinear Distortion Characteristics: This characteristic depicts the total r.m.s. nonlinear distortion in percent of the fundamental as a function of the frequency for a specified input. The ones shown were obtained by means of an automatic nonlinear distortion analyzer[5].

The nonlinear distortion frequency characteristics of the Type SL-8 for inputs of one-half and one watt are shown in Fig. 15. This speaker will deliver a sound level of 93 decibels in the average living room for an input of one watt. Fig. 15 shows that the distortion is exceedingly low except for the low-frequency range. However, if a correction is made for the power distribution with respect to frequency for the average orchestra, the distortion for one watt input will be as shown in Fig. 16. Now the distortion is under one-third per-cent over the entire audio frequency range.

These same characteristics for the Type SL-12, for inputs of one-half and one watt, are shown in Fig. 17. The essential difference between the distortion characteristics of the Types SL-8 and and SL-12, is that the distortion in the 12-inch loudspeaker is less than that of the 8-inch loudspeaker in the low-frequency range.

The nonlinear distortion frequency characteristics of the Type LC-1A, for inputs of 1, 2, and 5 watts, are shown in Fig. 18. The nonlinear distortion due to the suspension can be reduced to a negligible quantity by placing the fundamental resonant frequency of the loudspeaker at the lower limit of reproduction. Above the fundamental resonant frequency, the velocity of the cone is not appreciably affected by the suspension. This is because the mechanical reactance due to the compliance of the suspension is small compared to the mechanical impedance of the remainder of the system. In this speaker, the fundamental resonant frequency of the low-frequency unit was placed at 30 cycles.

Another source of nonlinear distortion is the cone. Since the frequency range from 100 to 800 cycles contains the maximum power in both speech and music, it is important that the distortion be reduced to a minimum in this range. This was done by employing a very rigid cone of high strength. In order to obtain sufficient rigidity and strength to insure low distortion, the thickness of the cone

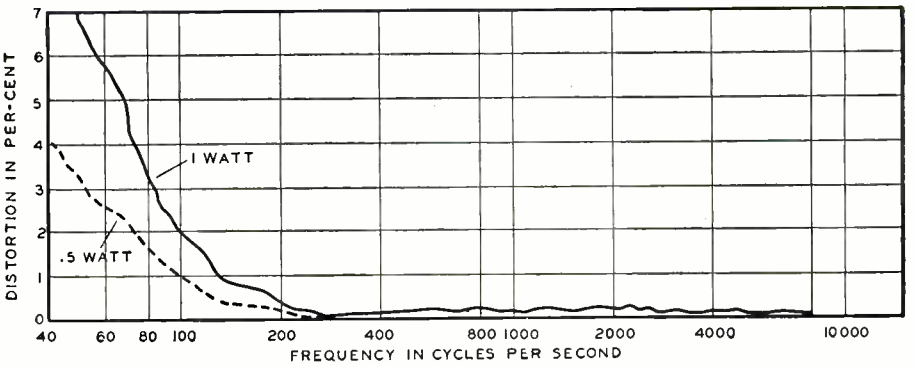


Fig. 15. Distortion frequency curve of the Type SL-8 for ½ and 1 watt inputs.

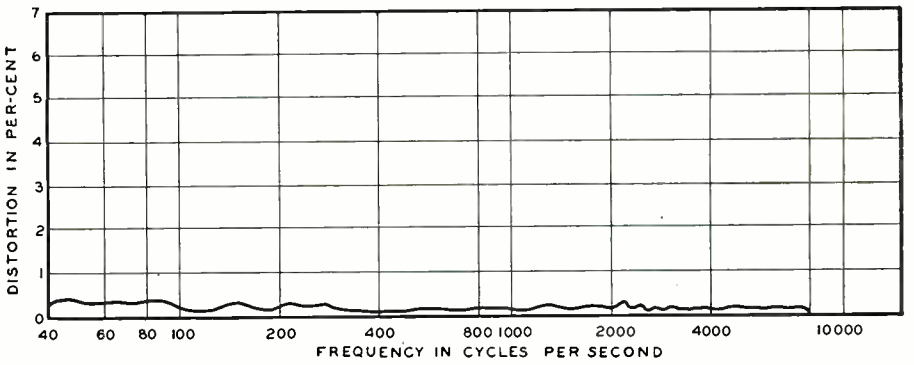


Fig. 16. Distortion frequency characteristic of the RCA Type SL-8 for an input of one watt having the frequency distribution of orchestral music.

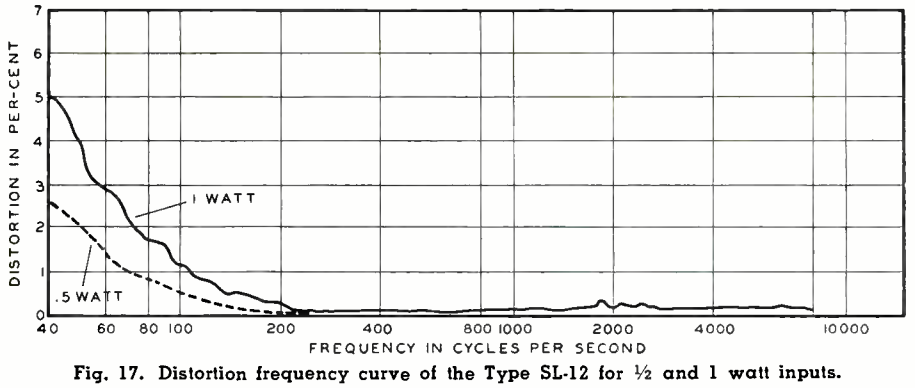
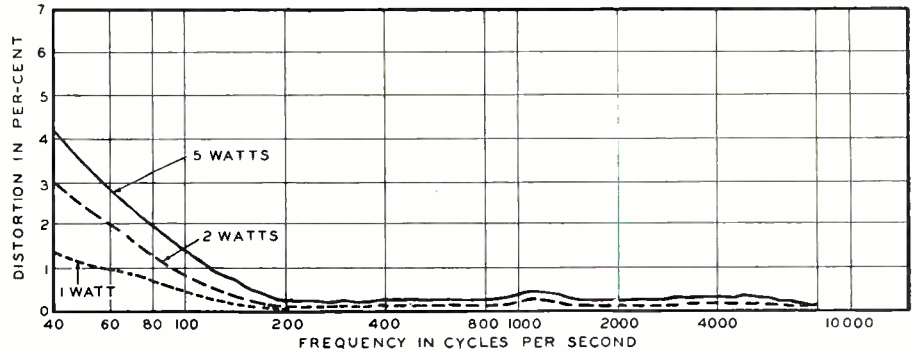


Fig. 17. Distortion frequency curve of the Type SL-12 for ½ and 1 watt inputs.

was made two and one-half times that of a conventional cone. This increased the rigidity by a factor of 15 times and the strength by more than two and one-half times.

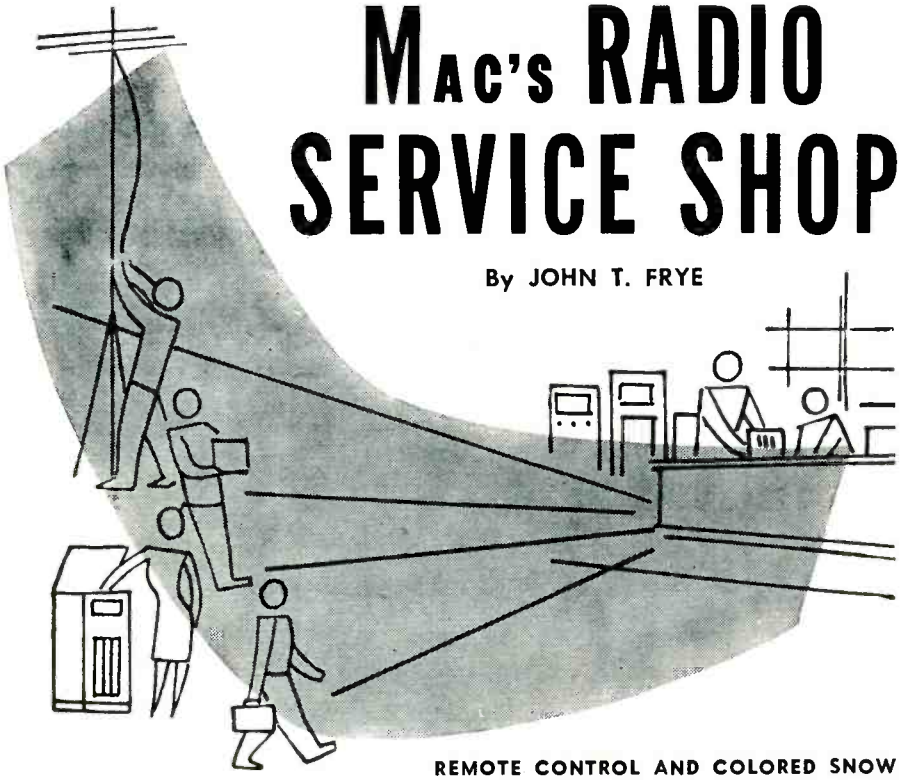
Inhomogeneity of the flux density through which the voice coil moves is another source of distortion. This can be eliminated by making the summation of the product of each turn, and the flux density associated with that turn, independent of the amplitude. This requirement was satisfied by making the voice coil large and slightly longer than the air gap. A heavy voice coil must be used to obtain reasonable efficiency with the heavy cone. A voice coil of 25 grams was used in this loudspeaker. This is about 25 times the mass of tne voice coil used in conventional console type radio loudspeakers. (*Continued on page* 173)

Fig. 18. Distortion frequency curve of the Type LC-1A for 1, 2, and 5 watt inputs.



MAC'S RADIO SERVICE SHOP

By JOHN T. FRYE



REMOTE CONTROL AND COLORED SNOW

A SUDDEN warm-up during the night had left the entire city wrapped in a thick blanket of fog. As Barney entered the service shop that February morning, he thought to himself that this would probably be a "hot" television reception day in the ultra-fringe area. The moisture-saturated air on the ground with drier air above it usually produced a condition in the troposphere favorable for bending TV signals back to earth.

When he opened the door of the service department, he saw his hunch had been right. A chassis on the trial-run bench was displaying a steady, crystal-clear picture. As Barney watched, another channel was switched on and then another and another until five different pictures were revealed. When the program carried by each channel came into view, the fine tuning was adjusted and the volume was cut down to zero and then brought back up. Yet the only other person in the room was Mac, and he was sitting on a stool clear across the room from the set.

"Hey!" Barney exclaimed, "what's going on here? How are you doing that?"

"Now calm down, Buster, or you'll flip your lid," Mac admonished. "It's being done with this new *Regency* remote TV tuner," he explained as he tapped a small mahogany cabinet resting in his lap. Watching closely, Barney saw the picture and sound were being manipulated by two large dual-dials on the face of this cabinet; and he also noticed the unit was connected to the set by a cable about the size of a pencil.

"How does it work?" Barney asked.

"Inside the cabinet is a complete cascode tuner with its own power supply. These concentric dials on the right select the channel and adjust the fine tuning in the usual manner. The output of the tuner feeds through that small coaxial line to the input of the set's i.f. system. Another connection is made to the receiver's audio system so that this outside dial on the left can adjust the volume. Finally, the remote control unit generates a d.c. voltage, either positive- or negative-going, the amplitude of which is controlled by the inside dial on the left; and this voltage is fed to the set for varying the contrast of the picture. A 'local-distance' switch on the back of the unit permits placing proper bias on the tuner for extremes of signal strength."

"Now let me get this straight," Barney interrupted. "If I understand you correctly, that same little concentric cable is carrying an i.f. signal from the remote control unit to the set, an audio signal from the set to the unit, and a d.c. voltage from the unit back to the set. Why that little old chunk of coax must be busier than a party line the night the banker's wife left town with the traveling salesman! How do all those signals keep from getting into each other's hair?"

"A good question," Mac said with a chuckle. "It is all done with an arrangement of chokes, blocking condensers, and filters inside a small potted unit mounted inside the set chassis. The coax line goes to this potted unit, and then leads go from it to the various sections of the receiver controlled. Here," he said as he tossed a yellow-covered instruction book across to the boy. "Take that home with you tonight and see if you can figure how it is done by looking at the diagram."

"Can you hook that outfit on to any receiver?" Barney wanted to know.

"Just about any. It comes in two models: one for sets with an i.f. around 21 megacycles and another for sets with an i.f. near 41 megacycles. A set with an odd i.f. too far removed from these standard frequencies could not use the remote tuner. Neither could the remote control be applied to an old set using manual gain control without a.g.c. But outside of such rare cases, the device will work on any set. It functions equally well with split i.f. and intercarrier systems. When you want to use it for u.h.f. reception, you simply install u.h.f. strips in the remote control tuner. If you want to employ a booster in conjunction with the remote control tuner, there is an a.c. outlet on the rear of the cabinet into which the booster can be plugged."

"How about using the unit in a weak-signal area? Can you get as good reception with the remote unit as you do with the set's own tuner?"

"If you hook it on to a set employing a less-efficient type of tuner, you will actually get better reception when the modern cascode circuit of the remote unit is in use. In general, you should be able to use this remote control unit in any area in which the set alone will receive a watchable picture."

"Whose set is this you are using?"

"The wife and I were visiting friends at Big City over the weekend. They have a little boy with rheumatic fever who must spend the next few months in bed. Television is the best thing they have found to keep him entertained; but, like most kids, he likes to do a lot of channel hopping. That means his mother has to dash in from the kitchen, laundry, or upstairs dozens of times a day to adjust the set. I was telling them about this remote control gadget, and they insisted I bring their set home and install the unit. We are going to take it back to them tonight."

"That will certainly be a fine thing for him and his mother, and I can see where it could be used to great advantage in a public place where the set must be up high so everyone can see it but yet you want to control it from a convenient location. Also, I can understand how elderly people will like not having to jump up and down every time they want to change programs, touch up the tuning, or adjust the volume; but I wonder if many other people—young and able-bodied people, I mean—will buy them."

"I am sure they will," Mac said emphatically. "I remember that when automatic gear shifts were first introduced a lot of people thought that they would only be used by women and 'other' inept drivers. As soon as drivers in general found out how convenient they were, though, everybody wanted them.

"Remote control of TV sets is not a brand-new idea, for we have had some novel electrical-mechanical systems

(*Continued on page* 148)

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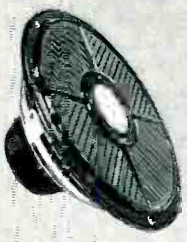

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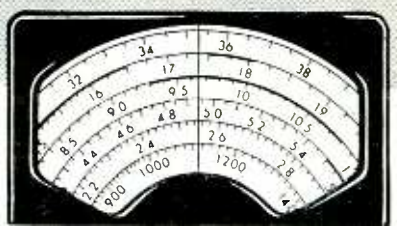


Compiled by KENNETH R. BOORD

AFGHANISTAN—*Kabul Radio,* 9.972A, noted with *English* 1050-1100, fair level in England. (Catch)

Albania—Radio Tirana, 6.570, 7.850A, has *English* 1340-1400, 1600-1630; French 1230-1300, 1630-1700. *(WHR)*

Alaska — Alaska Communications System, 5.980, Juneau, noted *testing* 0055-0110. (Kary, Va.)

Algeria—Radio Algerie, 6.160, heard closing 1658 with "La Marseillaise."

Anglo-Egyptian Sudan—Radio Omdurman, 7.085A, noted at good level ending Arabic session 2345. (Kary, Va.; Cox, Dela.) With news in *English* 1115 on *Sun.* (Pearce, England)

Angola — CR6RA, 11.862, now announces simply as *"Radio Angola;"* is heard 1330-1730. (ISWC, London) Luanda is using a *new* channel of 6.355; *Radio Clube de Benguela* signs on 1200 on 9.502. (Radio Sweden) Luanda's 11.862 channel is audible most days 1322A-1330 with interval signal of steady native drum beats preceding 1330 sign-on. (Niblack, Ind.) And closing 1730 with "A Portuguesa." (Christie, Calif.) CR6AA, Lobito, is heard in Sweden on 5.033 at 0530-0600. *(Nattuggian,* Sweden) *Etervsep,* Sweden, lists CR6RD, *Radio Clube do Huambo,* Nova Lisboa, on 11.928, heard 1120-1140.

Argentina — SIRA is using LRA, 15.345, for Latin American session 2030 - 0100. (Morgan, Balbi, Calif.) Heard occasionally in Tokyo near 0100 closedown. (Takemi) Still uses LRU, 15.29, for *English* to Western North America from 2300. (Ferguson, N. C.) Announces *English* for 1500-1600 on LRS, 11.880. (Kahan, Calif.) *Radio Splendid,* 9.310A, is good from 0145.

Azores — CSA93, 4.865, Ponta Delgada, heard 1615 in Spanish. (Dahlgren, Sweden)

Bechuanaland—Shapiro, Ireland, has heard ZNB, 8.240, Mafeking, *after* 1330 with music, in heavy CWQRM. (ISWL, England)

Belgian Congo—OTM4, *Radio Congo Belge,* Leopoldville, has *moved* from 6.295 to 6.290, closes 1600. (ISWC, London) OTM, 9.380A, noted 1515 at good level, closed 1557 with National Anthem. (Ferguson, N. C.) Heard opening 0000 in French, Flemish. (Morris, Pa.)

Bolivia — CP38, 9.444A, La Paz, is heard in Chile at very weak level, bad QRM. (Bush)

Brazil—PRL7, 9.270, Rio de Janeiro, has *English* announcements in musical session 2200 *Sat.* (Zerosh, Pa.) Has varied announcement in this session to "Radio Nacional, the Voice of Brazil." (Niblack, Ind.) ZYS8, 4.805, Manaus, noted 2036 in Portuguese; Recife, 6.085, is heard in Sweden around 1835; ZYB8, 11.765, relaying *Radio Tupi,* noted 1630. (Dahlgren) *Radio Relogio,* 4.905, noted 1900-2300, good level. (Bush, Chile)

British Guiana—ZFY, Georgetown, is currently being heard on *new* 3.255A signing off 2115. (West, Va.; URDXC)

Bulgaria—The European Service of *Radio Sofia* is now 1045-1445, 6.070, 7.670; 1500-1730, *new* 7.256, 7.670; *English* 1500-1515, 1615-1645, 1715-1730. *(WRH)*

Burma—Radio Rangoon is scheduled 2000-2130, 9.542, 955 kc.; 0030-0230, 9.542, 6.035, 955 kc.; 0700-1015, 9.542, 4.774, 955 kc.; news 2020, 0130, 1000. *(Radio Times of India)*

Canada — CFRX, 6.070, Toronto, Ont., noted 1830-1900 with news, sports. (Karrer, Pa.) CJCX, 6.010, Sydney, N. S., heard 2225-2235 with news; CBNX, 5.970, St. John's, Newfoundland, heard 0605-0615 with music, time checks. (Morris, Pa.) CHNX, 6.130, Halifax, N. S., is good level around 0740. (Hall, Que.)

Cape Verde Islands — Praia noted near 7.398 with news in Portuguese 1942, closing 1700A. (Pearce, England) Recently *listed* channels of 3.950, 400 watts, 6.350, 3 kw., scheduled 1530-1700. (Radio Sweden)

Ceylon — Radio Ceylon, 9.520, noted 1730 with music; 15.120 at 2100 with news. (Sanderson, Australia) On 11.975 at 1015-1115 or later, good level. (Kroll, N. Y., others)

Chile — Radio Yungay, 7.60086 *(measured),* noted 2013 tune-in to 2326 tune-out, fair level but with severe QRM. (Rastorfer, N. Y.)

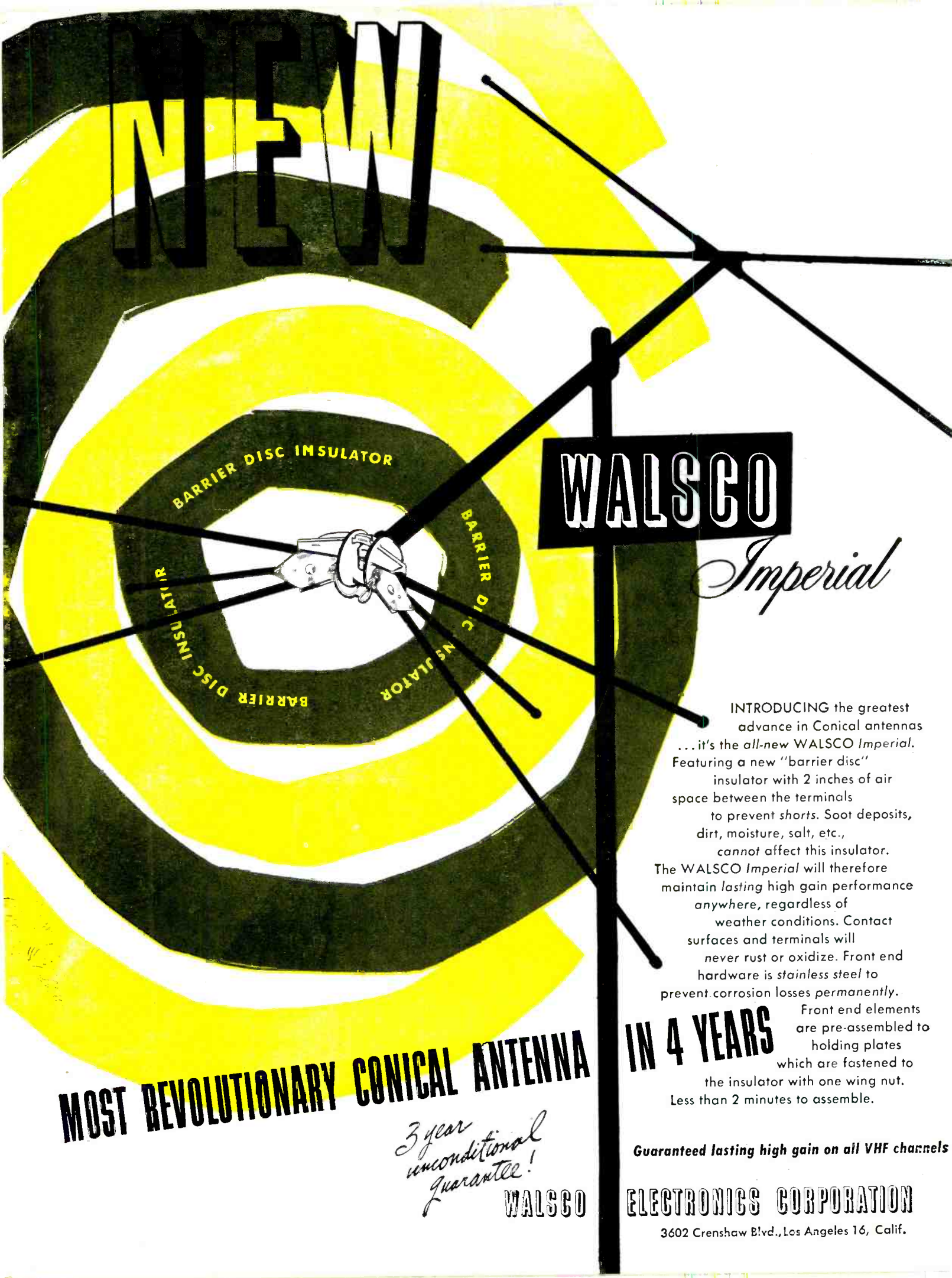
China—Radio Peking usually comes in with news 0400 on 6.105, 6.200AV, and less often on 7.500; noted with *English* 2200 on *new* 11.96 parallel 15.06. (Morgan, Balbi, Calif.) Fair level on occasion on 9.040A at 0810. (Kary, Va.) Heard on *measured* 15.084 at 1827; on *measured* 15.060 at 1900, still on at 2316. (Ferguson, N. C.)

Colombia—HJKH, 5.070, noted signing on weekdays 1830 with soft organ music and chimes; HJDE, 6.145, Medellin, is good quality lately; HJKD, 6.000, Bogota, noted 2030-2100 with *English* feature "American Melodies," evidently by tape recording. (Niblack, Ind.) *Radio Maria,* located in what seems to be Pasto (in southwestern part of country) is noted with call of HJHO

(Note: Unless otherwise indicated, all time is expressed in American EST; add 5 hours for GCT. "News" refers to newscasts in the English language. In order to avoid confusion, the 24 hour clock has been used in designating the times of broadcasts. The hours from midnight until noon are shown as 0000 to 1200 while from 1 p.m. to midnight are shown as 1300 to 2400.) The symbol "V" following a listed frequency indicates "varying." The station may operate either above or below the frequency given. "A" means frequency is approximate

The cheery voice of Marianna Linard, English announcer for "The Voice of Denmark," Copenhagen, is well-known to SWL's around the world. This picture of Marianna was made during a visit to the United States. Shown with Marianna is Albert K. Saylor, Quantico, Va., ISW Department monitor, whom she visited en route to California for a stay with relatives. Her English broadcasts are heard to North America over 9.52 between the hours of 2100 and 2230 Eastern Standard Time.

NEW



WALSCO *Imperial*

INTRODUCING the greatest advance in Conical antennas ... it's the *all-new* WALSCO *Imperial*. Featuring a new "barrier disc" insulator with 2 inches of air space between the terminals to prevent *shorts*. Soot deposits, dirt, moisture, salt, etc., *cannot* affect this insulator. The WALSCO *Imperial* will therefore maintain *lasting* high gain performance *anywhere*, regardless of weather conditions. Contact surfaces and terminals will *never* rust or oxidize. Front end hardware is *stainless steel* to prevent corrosion losses *permanently*.

MOST REVOLUTIONARY CONICAL ANTENNA IN 4 YEARS

Front end elements are pre-assembled to holding plates which are fastened to the insulator with one wing nut. Less than 2 minutes to assemble.

3 year unconditional guarantee!

Guaranteed lasting high gain on all VHF channels

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3602 Crenshaw Blvd., Los Angeles 16, Calif.

on 4.825 to *past* 2230. The one on 4.747 to 2100A sign-off is probably *Radiodifusora Militar de Colombia.* (Stark, Texas) HJCH, 4.895, Bogota, noted 1700 in Spanish. (Dahlgren, Sweden) HJBE, *Radio Libertad,* 5.979A, noted with music 1800-1900. (Sutton, Ohio)

Cuba — Radio Reporta del Hora, 6.314A, noted 2335-0015, frequent time checks. (Roberts, Conn.)

Czechoslovakia — Prague, 9.504, noted with *English* 0715-0740; announced further *English* for 1400 on this channel and 1700 on *only* 233 meters, medium-wave. (Pearce, England) Heard on 9.550 at 2300 with *English* to North America. (Barnard, Calif.) And 1930-2000 on 7.255. (Morris, Pa., others)

Denmark—Copenhagen, 9.520, noted at good level opening to North America 2030. (Barnard, Calif.) And again 2200.

Dominican Republic — "La Voz Dominicana," lists HI2T, 9.735, 7.5 kw.; HI4T, 5.970, 7.5 kw. Latter noted 2315-2330 with music, good level in Iowa. (Shear) *Radio Caribe,* 4.996, Santiago de Los Caballeros, is noted to 2100. (Stark, Texas)

Ecuador — Radio Mundo, Guayaquil, is noted on 4.743, up from 4.675A, goes *past* 2030. (Stark, Texas) *"La Voz de Democracia."* 6.060A, is good level around 1000-2200. (Sawyer, Ont.)

Egypt—Cairo uses 17.725 to Indonesia, India, Pakistan 0700-1000; news 0830. (ISWC, London; *WRH:* Ferguson, N. C.) Is strong daily on 11.965 with Arabic 1000-1100. (Morgan, Balbi, Calif.) Still noted on 9.475, 11.815 to 1700 closedown. (Rastorfer, N. Y., others) The Home Service in Arabic is radiated on 6.085, 11.965, 2345-0205,

(*Continued on page* 101)

PHILCO'S "SURFACE-BARRIER" TRANSISTOR

RADICALLY new production techniques have been employed by the Philco Corporation in the development of a new type of transistor which is said to outperform all transistors currently in use. The new unit is called a "surface-barrier" transistor because advantage is taken of a "surface-barrier" effect discovered by Philco engineers. It is basically a "p-n-p" junction type.

Major operating characteristics include a gain-bandwidth product of over 50 mc., reliable operation at 70 mc. and above, and a noise figure of 4 to 8 db at 10 mc. Power gain is on the order of 1000. These characteristics are achieved by depositing a suitable material, such as indium, on each side of a very thin section of germanium. The thickness of the germanium can be accurately controlled to within 10 millionths of an inch, and actual thickness is about 2 ten-thousandths of an inch.

In manufacturing this device, the germanium is first purified to 1 part in 10 billion. A suitable impurity is then introduced in the proportion of 1 part in 10 million, forming "n" type germanium. Small wafers are cut for additional processing. These wafers are about .050 x .100 inch and are lapped to a thickness of .006 inch. Chemical etching further reduces the thickness to .003 inch.

A process called "jet electrolytic etching" was developed to produce the desired final thickness. Two small jets of a salt solution are directed against the sides of the germanium wafer and current is passed through the solution, resulting in the etching of the germanium. When the desired thickness (thinness!) is reached, the current is reversed and the process becomes one of electroplating rather than etching. The electroplating is continued until electrodes of suitable thickness are plated on the germanium. Leads are then soldered to these electrodes and the complete unit is hermetically sealed.

Fig. 1 is a cross-sectional view of the transistor. The collector electrode is made slightly larger than the emitter by using a slightly larger jet during the etching process. Although indium was used as the electrode material in experimental units, many other materials are satisfactory.

A major advantage of this manufacturing process is the uniformity that can be obtained. When mass production equipment is in use, it is expected that the uniformity will be better than that of vacuum tubes.

Pilot plant operation is being set up for the manufacture of this unit but it is expected that the military will absorb all production for some time to come. Because of its high efficiency and the low operating voltage required, the "surface-barrier" transistor is ideally suited for battery-operated or airborne military electronic equipment. An experimental military receiver has been built, using "surface-barrier" transistors, which requires only 5 to 10 milliwatts of battery power. A reduction in power requirements of 1000 to 10,000 times is anticipated in airborne equipment. —30—

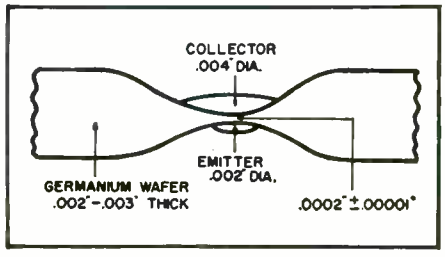
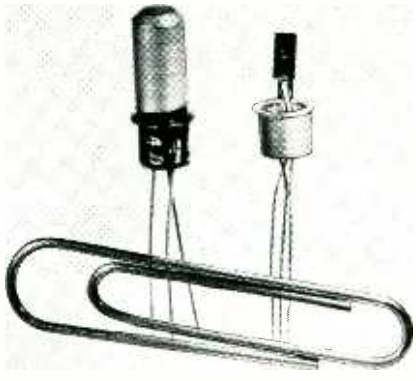
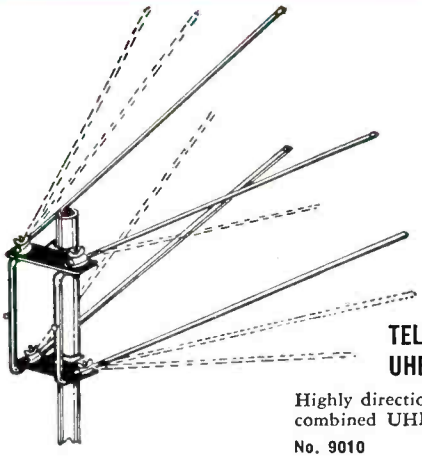


Fig. 1. Cross-sectional view of the new Philco "surface-barrier" transistor.

Philco's "surface-barrier" transistor compared with a standard paper clip. The new units are capable of operating at higher frequencies and lower power consumption than currently-available transistors. The transistor at left is enclosed in a hermetically-sealed metal case while the one at right is complete except for case.



THE "TELCO TEN"



NEW!

TELCO "DOUBLE V" UHF-VHF ANTENNA

Highly directional...adjustable for combined UHF-VHF 50°-70°-90°.

No. 9010 List $6.95

...the "T" formation line—T for Top Quality and T for Ten Antenna Styles. Insist on TELCO ...the best TV antennas for the greatest "show" on earth.

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...exclusive with TELCO, is a free air insulator that prevents shorting out under any condition ... found only on TELCO UHF Antennas.

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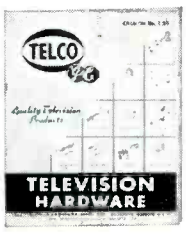

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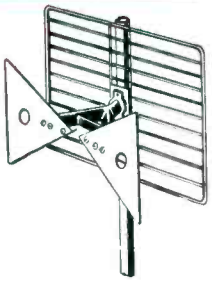
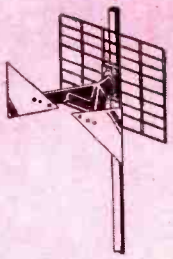
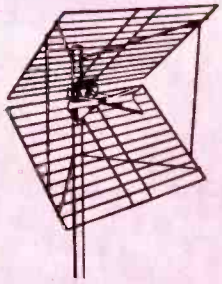
DIVISION OF GENERAL CEMENT MFG. CO.
904 Taylor Street Rockford, Illinois



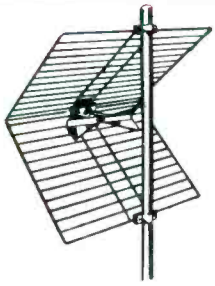
TELCO UHF "GOLDEN GRID" SUPER DELUXE BUTTERFLY ANTENNA
No. 8965 List $5.95



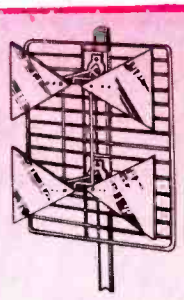
TELCO UHF "GOLDEN GRID" STANDARD BUTTERFLY ANTENNA
No. 9001 List $3.95



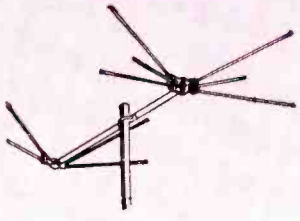
TELCO UHF "GOLDEN GRID" DELUXE CORNER REFLECTOR ANTENNA
No. 8984 List $11.25



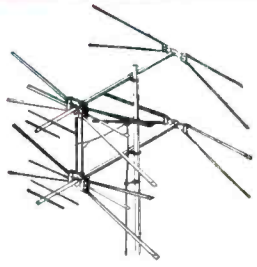
TELCO UHF "GOLDEN GRID" STANDARD CORNER REFLECTOR ANTENNA
No. 9002 List $11.25



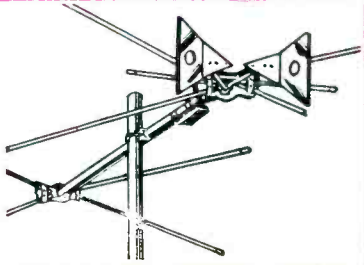
TELCO UHF "GOLDEN GRID" 2-STACK DOUBLE TIE ANTENNA
No. 9004 List $7.50 less mast



TELCO VHF CONICAL ANTENNA
No. 8700 List $9.25



TELCO VHF SUPER CONICAL ANTENNA
No. 8902 List $19.85



TELCO UHF-VHF UNIVERSAL CONICAL ANTENNA
No. 8981 List $16.25

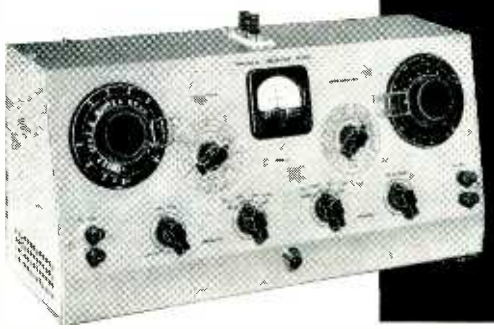
TELCO UHF-VHF "GOLDEN HALO" INDOOR ANTENNA
No. 9000 List $4.95

Heathkit
IMPEDANCE BRIDGE KIT

MODEL IB-2

$59.50

SHIPPING WT. 15 LBS.



Features

- Simpson 100-0-100 microampere meter.
- Completely AC operated.
- Built-in phase shift generator and amplifier.
- Battery type tubes, no warm-up required.
- Newly designed two section CRL dial.
- Single knob D, Q, and DQ functions.
- Special impedance matching transformer.
- New modern cabinet styling.
- ½% precision resistors and silver mica condensers.

Another new, outstanding instrument design so typically characteristic of Heathkit operation in producing high quality instrument kits at the lowest possible price. A new, improved model Impedance Bridge kit featuring modern cabinet styling, with slanted panel for convenience of operation and interpretation of scales at a $10.00 price reduction over the preceding model. Built-in adjustable phase shift oscillator and amplifier with all tubes of the battery operated type completely eliminates warm-up time. The instrument is entirely AC line operated. No bothersome battery replacements.

The Heathkit IB-2 Impedance Bridge Kit actually represents four instruments in one compact unit. The Wheatstone Bridge for resistance measurements, the Capacity Comparison Bridge for capacity measurements, Maxwell Bridge for low Q, and Hay Bridge for high Q inductance measurements. Read Q, D, DQ all on one dial thereby eliminating possible confusion due to the incorrect dial reference or adjustment. Only one set of instrument terminals necessary for any measurement function. Panel provisions provided for external generator use.

A newly designed two section CRL dial provides ten separate "units" switch settings with an accuracy of .5%. Fractions of units are read on a continuously variable calibrated wire-wound control. A special minimum capacity, shielded, balanced impedance matching transformer between the generator and the bridge. The correct impedance match is automatically switch selected to provide constant load operation of the generator circuit. The instrument uses ½% precision resistors and condensers in all measurement circuits.

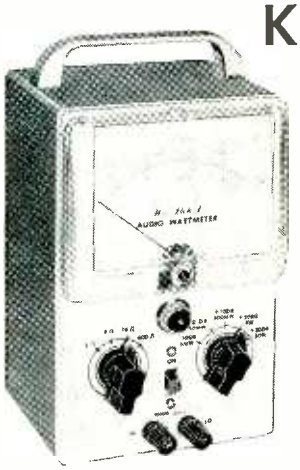
The new Heathkit IB-2 provides outstanding design features not found in any other kit instrument. The single low price includes the power supply, generator, and amplifier stages. No need to purchase separate instrument accessories in order to obtain the type of operation desired.

Heathkit
AUDIO WATTMETER KIT

MODEL AW-1

$29.50

SHIPPING WT. 6 LBS.



A new Heathkit design for the audio engineer, serious hi fi enthusiast, recording studio, or broadcast station; the Heathkit Audio Wattmeter Kit. This specialized instrument instantly indicates the output level of the equipment under test without requiring the use of external load resistors. All readings are taken directly from the calibrated scales of a 4½" 200 microampere Simpson meter.

The Heathkit Audio Wattmeter features five full scale power measurement ranges from 5 milliwatts up to 50 watts with db ranges of −15 db to +48 db. The instrument has a power measurement rating of 25 watts continuous and 50 watts maximum for intermittent operation. Non-inductive resistance load impedances of 4, 8, 16, and 600 ohms are provided through a panel impedance selector switch. Frequency effect is negligible from 10 cycles to 250 kc. A conventional VTVM circuit utilizes a 12AU7 twin triode tube. The meter bridge circuit uses four germanium diodes for good linearity.

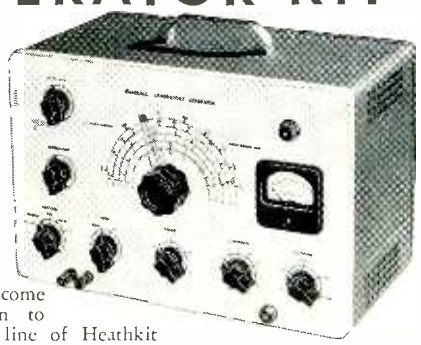
With the Heathkit AW-1 desired information can be obtained instantly and conveniently without bothering with the irksome setups and calculations usually required. Useful for power curve measurements, frequency response checks, monitoring indicator, etc. Convenient calibration directly from 110 volt AC line source. This new instrument will help to supply the answers to your audio operating or power output problems.

Heathkit
LABORATORY GENERATOR KIT

MODEL LG-1

$39.50

SHIP. WT. 16 LBS.



Another welcome new addition to the popular line of Heathkit instruments, the Heathkit Laboratory Generator. Specifically designed for flexibility of operation, accuracy and versatility beyond the performance level provided by the conventional service type generator. Frequency coverage of the Colpitts oscillator is 150kc to 30mc in five convenient ranges with provisions for internal or external modulation up to 50%, and .1 volt RF output throughout the frequency range. Panel mounted 200 microampere Simpson meter for RF "set reference level" to provide relative indication of RF output. Individually shielded oscillator and shielded variable and step attenuator provide flexible control of RF output.

The circuit features a 6AF4 high frequency oscillator, a 6AV5 amplifier with grid modulation, 12AU7 400 cycle oscillator and modulator, OB2 voltage regulator tube, and a selenium rectifier for the transformer operated power supply. The smart professional instrument appearance and over-all flexibility of operation will prove a decided asset to any industrial or educational laboratory. The Heathkit Laboratory Generator sets a new level of operation, far superior to any instrument in this price classification.

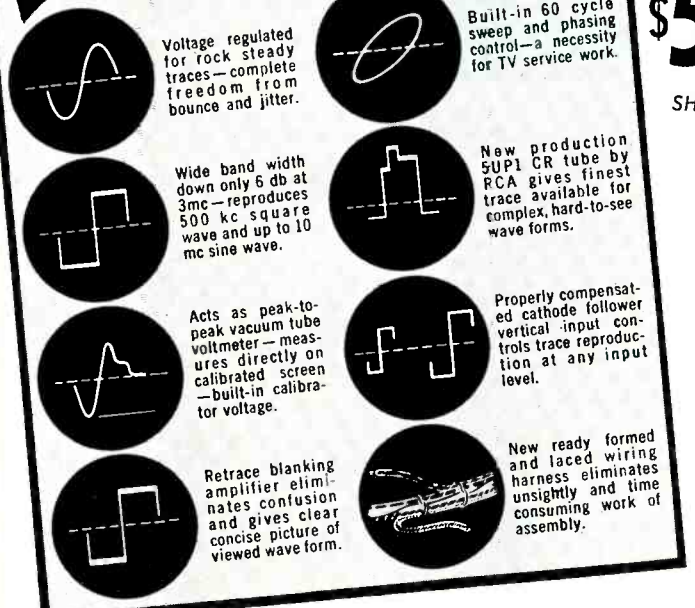
HEATH COMPANY • Benton Harbor 15, Mich.

THE MOST *Outstanding* OSCILLOSCOPE IN HEATHKIT HISTORY

NEW MODEL O-9

OSCILLOSCOPE KIT

Check THESE FEATURES



MODEL O-9

$59.50

SHIPPING WT. 28 LBS.

Announcing the newest addition to a brilliant series of Heathkit Oscilloscopes, the outstanding new model O-9 instrument. This Oscilloscope features a brand new 5UP1 cathode ray tube for really fine hairline focusing, good intensity and freedom from halation.

NEW FEATURES

Efficient voltage regulation system maintains rock steady trace stabilization. New retrace blanking amplifier circuit—amplifier band width further extended through efficient circuitry. Calibrated 1 volt peak-to-peak reference — wiring simplified by ready laced and formed wiring harness—new phasing control.

GOOD DESIGN

Terminal board for quick access to deflection plates—provisions for Z axis input—astigmatism control—balanced push-pull deflection amplifiers—internal sync on either positive or negative peaks.

VERTICAL AMPLIFIER

High impedance input with 6AB4 cathode follower, twin triode 12AT7 Cascade amplifier, 6C4 phase splitter and 12AT7 push-pull high gain deflection amplifier. Sensitivity .025 volts per inch.

HORIZONTAL AMPLIFIER

Five position input switch for choice of external input—line sweep—line sync—internal sync and external sync. Uses 12AU7 input stage, half as triode phase splitter driving 12AT7 push-pull high gain deflection amplifier. The remaining half of the 12AU7 used as retrace blanking amplifier.

POWER SUPPLY

New heavy duty internally shielded 100 milliampere power transformer. Efficient high voltage filtering system—voltage regulation completely eliminates trace bounce or jitter.

The Heathkit O-9 is the ideal general purpose oscilloscope for educational and industrial use. Radio and TV servicing and any other application requiring the instantaneous reproduction and observation of actual wave forms.

Heathkit LOW CAPACITY PROBE KIT

No. 342

$3.50

SHIP. WT. 1 LB.

Oscilloscope investigation of high frequency, high impedance or broad band width circuits requires the use of a low capacity probe. The Heathkit Low Capacity Probe features a variable capacitor to provide the necessary degree of instrument impedance matching.

Heathkit SCOPE DEMODULATOR PROBE KIT

No. 337-B

$3.50

SHIP. WT. 1 LB.

In applications such as trouble shooting TV, RF, IF and video stages, the frequency ranges encountered require the demodulation of signals before oscilloscope presentation. The Heathkit Demodulator Probe will fulfill this function and readily prove its value as a service accessory.

Heathkit VOLTAGE CALIBRATOR KIT

MODEL VC-2

$11.50

SHIP. WT. 4 LBS.

The Heathkit Voltage Calibrator provides a convenient method of making peak-to-peak voltage measurements with an oscilloscope. Peak-to-peak voltages are read directly on the calibrated panel scales in the range of .01 to 100 volts peak-to-peak. A convenient "signal" position on the panel switch can be used to by-pass the calibrator and apply the signal directly to the scope input.

Heathkit ELECTRONIC SWITCH KIT

The basic function of the Heathkit S-2 Electronic Switch kit is to permit simultaneous oscilloscope observation of two separate traces which can be either separated or super-imposed for individual study. Continuously variable switching rates in three ranges from less than 10 cps to over 2000 cps. Individual gain controls for each input channel and a positioning control.

MODEL S-2

$23.50

SHIP. WT. 11 LBS.

Heathkit VACUUM TUBE VOLTMETER KIT

MODEL V-6

$24.50

SHIPPING WT. 6 LBS.

Features

- New 1½ volt full scale low range
- 1,500 volt upper limit DC range
- Increased accuracy through 50% greater scale coverage
- High impedance 11 megohm input
- Center scale zero adjust
- Polarity reversal switch
- 1% precision resistors
- Clearly marked db scales

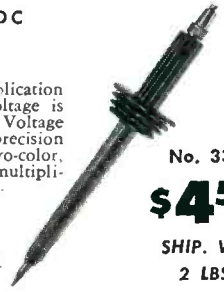
The beautiful Heathkit Model V-6 VTVM, the world's largest selling kit instrument, now offers many outstanding new features in addition to retaining all of the refinements developed and proven in the production of over 100,000 VTVM's. This is the basic measuring instrument for every branch of electronics. Easily meets all requirements for accuracy, stability, sensitivity, convenience of ranges, meter readability, and modern styling. It will accurately measure DC voltages, AC voltages, offers tremendous ohmmeter range coverage, and a complete db scale for a total of 35 meter ranges.

New 1½ volt full scale low range provides well over 2¼" of scale length per volt. Upper DC scale limit 1,500 volts. DC ranges 0-1.5, 5, 15, 50, 150, 500, 1,500 volts full scale. AC ranges 0-1.5, 5, 15, 50, 150, 500, 1,500 (1,000 volts maximum). Seven ohmmeter ranges from .1 ohm to 1,000 megohms. For added convenience a DC polarity reversing switch and a center scale zero adjustment for FM alignment.

The smartly styled, compact, sturdy, formed aluminum cabinet is finished in an attractive gray crackle exterior. The beautiful two-color, durable, infra-red, baked enamel panel further adds to the over-all professional appearance.

Top quality components used throughout. 1% precision resistors — silver contact range and selector switches — selenium rectifier — transformer operated power supply. Individual calibration on both AC and DC for maximum accuracy. DB scale printed in red for easy identification, all other scales a sharp, crisp black for easy reading. A variety of accessory probes shown on this page still add further to over-all instrument usefulness.

Heathkit 30,000 VOLT DC PROBE KIT



No. 336

$4.50

SHIP. WT. 2 LBS.

For TV service work or any similar application where the measurement of high DC voltage is required, the Heathkit Model 336 High Voltage Probe Kit will prove invaluable. A precision multiplier resistor mounted inside the two-color, sleek, plastic probe body provides a multiplication factor of 100 on the DC ranges of the Heathkit 11 megohm VTVM. The entire kit includes precision resistor, two-color plastic probe, tip connector spring, test lead, phone plug panel connector, and complete assembly instructions

No. 338-B

$5.50

SHIP. WT. 2 LBS.

Heathkit PEAK-TO-PEAK PROBE KIT

Now read peak-to-peak voltages on the DC scales of the Heathkit 11 megohm VTVM. Readings can be directly made from the VTVM scale without involved calculations. Measurements over the frequency range of 5 kc to 5 mc. Use this probe to extend the usefulness of your VTVM in radio and TV service work. The Peak-to-Peak Probe Kit features the new polished aluminum housing with two-color polystyrene probe ends. Detailed assembly sheet including instructions for probe operation.

Heathkit RF PROBE KIT

The Heathkit RF Probe used in conjunction with any 11 megohm VTVM will permit RF measurements up to 250 mc, ± 10%. A useful, convenient accessory for those occasions when RF measurements are desired. The RF probe body is housed in the new, smartly-styled polished aluminum probe body featuring two-color polystyrene probe ends and a low capacity flexible shielded test lead. The kit is complete with all necessary material and a detailed assembly sheet as well as instructions for probe operation.

No. 309-B

$3.50

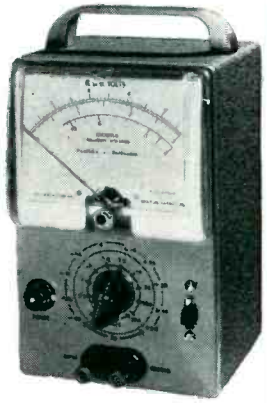
SHIP. WT. 2 LBS.

Heathkit AC VACUUM TUBE VOLTMETER KIT

MODEL AV-2

$29.50

SHIPPING WT. 5 LBS.



The new Heathkit AC VTVM that makes possible those sensitive AC measurements required by laboratories, audio enthusiasts, and experimenters. Especially useful for hum investigation, sensitive null detection, phono pick-up output measurements, making frequency response runs, gain measurements, ripple voltage checks, etc. Low level measurements are easy to make because of the complete voltage coverage of the instrument and the one knob operation.

The large 200 microampere Simpson meter has clearly marked and easy to read meter scales. Ten voltage ranges covering from .01 rms full scale to 300 volts rms full scale, with frequency response ± 1 db from 20 cycles to 50,000 cycles. Instrument input impedance 1 megohm, ten db ranges from −52 db to +52 db. For stability and good linearity characteristics the meter bridge circuit features 4 germanium diodes. Attractive instrument styling, a companion piece for the popular Heathkit VTVM and the new AW-1 Audio Wattmeter.

HEATH COMPANY • Benton Harbor 15, Mich.

CHECK THESE *Features*

- 20,000 ohms per volt DC sensitivity, 5,000 ohms per volt on AC
- Polarity reversal switch
- 1% precision multiplier resistors
- 50 microampere 4½" Simpson meter
- Meter ranges for service convenience
- New resistor ring-switch assembly
- Total of 35 meter ranges
- New Modern cabinet styling

NEW *Heathkit*

MULTIMETER KIT

MODEL MM-1

$26.50

SHIPPING WT. 6 LBS.

The most important Heathkit announcement of the year, the new 20,000 ohms per volt Heathkit Multimeter, Model MM-1. The universal service measuring instrument, accurate, sensitive, portable, and completely independent of AC line supply. Particularly designed for service use incorporating many desirable features for the convenience of the service man. Full 20,000 ohms per volt sensitivity on DC ranges — 5,000 ohms per volt sensitivity on AC — polarity reversal switch, no bothersome transferring of test leads — 1% precision multiplier resistors — large 4½" recessed non-glare 50 microampre Simpson meter — conveniently slanted control panel — recessed safety type banana jacks — standard universally available batteries — rugged practical sized cabinet with plastic carrying handle, and a total of 35 calibrated meter ranges.

RANGES

Voltage ranges selected entirely for service convenience. For example 1½ volt full scale low range for measuring portable radio filament voltages, bias voltages, etc., 150 volt full scale range for AC-DC service work, 500 volt full scale range for conventional transformer operated power supply systems. Complete voltage ranges AC and DC, 0-1.5—5—50—150—500—1,500—5,000 volts. DC current ranges, 0-150 microamperes—15 milliamperes—150 milliamperes—500 milliamperes—15 amperes. Resistance measurements from .2 ohms to 20 megohms x 1 x 1,000 x 10,000. DB coverage from —10 db to +65 db.

CONSTRUCTION

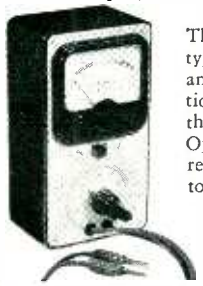
Entirely new design permits assembly, mounting and wiring of precision resistors on a ring-switch assembly unit. The major portion of instrument wiring is completed before mounting the ring-switch assembly to the panel. No calibration procedure is required, all precision resistors readily accessible in event of replacement.

CABINET

Strikingly modern cabinet styling featuring two piece construction, durable black Bakelite cabinet, with easy to read panel designations. Cabinet size 5½" wide x 4" deep x 7½" high. Good cabinet physical stability when operated in vertical position.

The Heathkit MM-1 represents a terrific instrument value for a high quality 20,000 ohms per volt unit using all 1% deposited carbon type precision resistors. Here is quality, performance, functional design, and attractive appearance, all combined in one low priced package.

Heathkit BATTERY TESTER KIT



MODEL BT-1

$8.50

SHIP. WT. 2 LBS.

The Heathkit Battery Tester measures all types of dry batteries between 1½ volts and 150 volts under actual load conditions. Readings are made directly on a three color Good-Weak-Replace scale. Operation is extremely simple and merely requires that the test leads be connected to the battery under test. Only one control to adjust in addition to a panel switch for "A" or "B" battery types. The Heathkit Battery Tester features compact assembly, accurate meter movement, and a three deck wire-wound control, all mounted in a portable rugged plastic cabinet. Checks portable radio batteries, hearing aid batteries, lantern batteries, etc.

Heathkit HANDITESTER KIT

MODEL M-1

$14.50

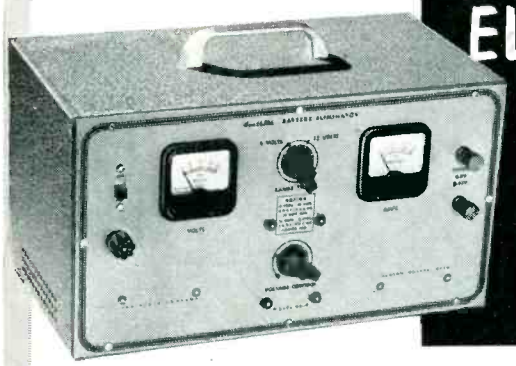
SHIPPING WT. 3 LBS.

The Heathkit Model M-1 Handitester readily fulfills major requirements for a compact, portable volt ohm milliammeter. Despite its compact size, the Handitester is packed with every desirable feature required in an instrument of this type. AC or DC voltage ranges full scale, 0-10—30—300—1,000—5,000 volts. Two ohmmeter ranges, 0-3,000 and 0-300,000. Two DC current measurement ranges, 0-10 milliamperes and 0-100 milliamperes. The instrument uses a Simpson 400 microampere meter movement, which is shunted with resistors to provide a uniform 1 milliampere load on both AC and DC ranges. Special type, easily accessible, battery mounting bracket — 1% deposited carbon type precision resistors — hearing aid type ohms adjust control. The Handitester is easily assembled from complete instructions and pictorial diagrams. Necessary test leads are included in the price of this popular kit.

HEATH COMPANY • Benton Harbor 15, Mich.

New *Heathkit* 12 Volt

BATTERY ELIMINATOR KIT



MODEL BE-4

$31.50

SHIPPING WT. 18 LBS.

CHECK THESE *Features*

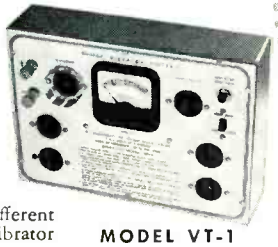
- Either 6 or 12 volt operation
- Continuously variable voltage output
- Constant ammeter and voltmeter monitoring
- Automatic overload relay — self-resetting
- Two 10,000 mf condensers
- New 18 disc split type heavy duty rectifier unit
- Fuse protection

Here is the new Heathkit Battery Eliminator necessary for modern, up-to-date operation of your service shop. The Heathkit Model BE-4 furnishes either 6 volts or 12 volts output which can be selected at the flick of a panel switch. Use the BE-4 to service the new 12 volt car radios in addition to the conventional 6 volt radios.

This new Battery Eliminator provides two continuously variable output ranges, 0-8 volts DC at 10 amperes continuously, or 15 amperes maximum intermittent; 0-16 volts DC at 5 amperes continuously or 7.5 amperes maximum intermittent. The output voltage is clean and well filtered as the circuit uses two 10,000 mf condensers. The continuously variable voltage output feature is a definite aid in determining the starting point of vibrators, the voltage operating range of oscillator circuits, etc. Panel mounted meters constantly monitor voltage and current output and will quickly indicate the presence of a major circuit fault in the equipment under test. The power transformer primary winding is fuse protected and for additional safety an automatic relay of the self-resetting type is incorporated in the DC output circuit. The heavy duty rectifier is a split type 18 plate magnesium copper sulfide unit used either as a full wave rectifier or voltage doubler according to the position of the panel range switch.

Here is the ideal battery eliminator for all of your service problems and as an additional feature, it can also be used as a battery charger. Another new application for the Heathkit Battery Eliminator is a variable source of DC filament supply in audio development and research. More than adequate variable voltage and current range for normal applications.

Heathkit VIBRATOR TESTER KIT



Your repair time is valuable, and service use of the Heathkit Vibrator Tester will save you many hours of work. This tester will instantly tell you the condition of the vibrator being checked. Checks vibrators for proper starting and the easy to read meter indicates quality of output on a large Bad-?-Good scale. The Heathkit VT-1 checks both interrupter and self rectifier types of vibrators. Five different sockets for checking hundreds of vibrator types.

The Heathkit Vibrator Tester operates from any battery eliminator capable of delivering continuously variable voltage from 4 to 6 volts DC at 4 amperes. The new Heathkit Model BE-4 Battery Eliminator would be an ideal source of supply.

MODEL VT-1

$14.50

SHIPPING WT. 6 LBS.

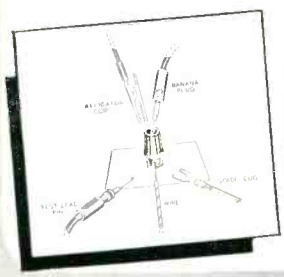
NEW *Heathkit* VARIABLE VOLTAGE ISOLATION TRANSFORMER KIT

The new Heathkit Isolation Transformer Kit provides line isolation for AC-DC radios (not an auto transformer), thereby eliminating shock hazard, hum problems, alignment difficulties, etc. The output voltage is variable from 90 to 130 volts AC and is constantly monitored by a panel mounted AC volt meter. Use it to increase AC supply voltage in order to induce breakdown of faulty components in circuits thereby saving service time. Use it also to simulate varying line voltage conditions and to determine the line voltage level at which oscillator circuits cease functioning, particularly in three-way portable radios. Rated at 100 watts continuous operation and up to 200 watts maximum intermittent operation. A useful radio and TV service tool.

MODEL IT-1

$16.50

SHIP. WT. 9 LBS.



Heathkit BINDING POST

Binding post kit now available so that standardization of all instrument connectors is possible. This new, five-way binding post will accommodate an alligator clip, banana plug, test lead pin, spade lug, or hook-up wire. Sold in units of 20 binding post assemblies. Each assembly includes binding post, flat and shoulder fiber washers, solder lug, and nut. 120 pieces in all. Kit 362, $4.00.

Heathkit TECHNICAL APPLICATION BULLETINS

An exclusive Heathkit service. Technical application bulletins prepared by recognized instrument authorities outlining various combinations of instrument applications. Available now with 40 four-page illustrated bulletins and an attractive flexible loose-leaf binder. Only $2.00. (No c.o.d. on this item, please.)

HEATH COMPANY • Benton Harbor 15, Mich.

NEW *Heathkit*

TV ALIGNMENT GENERATOR KIT

MODEL TS-3

$44.50

SHIPPING WEIGHT 18 POUNDS

CHECK THESE *Features*

- INCREDUCTOR controllable inductor sweep
- TV and IF sweep deviation 12-30 mc
- 4 mc- 220 mc continuous frequency coverage
- Oscillator operation entirely on fundamentals
- Output in excess of 100,000 microvolts
- Automatic amplitude circuit
- Voltage regulation
- Simplified operation

Proudly announcing an entirely new, advanced model TV and FM Sweep Generator, the Heathkit Model TS-3. This new design provides features and combinations of functions not found in any other service type instrument. Every design consideration has been given to the requirements of the TV service man to provide a flexible, variable sweep source with more than adequate RF output and complete frequency coverage throughout the TV and FM spectrum.

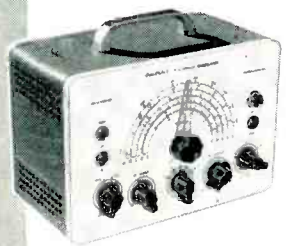
The frequency range of the TS-3 is from 4 mc to 220 mc in four switch selected ranges. All frequency ranges are overlapping for complete coverage. A particularly important feature of the instrument is that the oscillator operates entirely on fundamentals, thereby providing complete freedom from spurious oscillation and parasitics normally encountered in beat frequency type oscillators. This circuity assures a much higher total RF output level and simplifies attenuation problems.

The new TS-3 features an entirely new principle of sweep operation. Sweep action is entirely electronic with no moving parts or electro-mechanical devices so commonly used. The heart of the sweep system is a newly-developed INCREDUCTOR controllable inductor. With this system, the value of inductance of each oscillator coil is electrically varied with an AC control current, and the inductance variation is achieved by a change in the magnetic state of the core on which the oscillator coils are wound. This system provides a sweep deviation of not less than 12 mc on all TV frequencies, and up to a maximum of 30 mc on TV IF frequencies. The high RF output level throughout the instrument frequency range overcomes the most common complaint of the older type sweep generators. A new, automatic amplitude control circuit maintains the output level flat to ± 2 db throughout the instrument range. For convenience of operation a low impedance 50 ohm output is used.

Operation of the instrument has been simplified through the reduction of panel controls and separate panel terminals provide for external synchronization if desired. The circuit uses a voltage regulator tube to maintain stable instrument operation. A built-in variable oscillator marker further adds to flexibility of instrument operation. Provisions are also made for the use of an external marker, such as your service type signal generator, if desired. Use the Heathkit TS-3 for rapid, accurate TV alignment work, and let it help you solve those time consuming, irksome problems so frequently encountered.

NEW *Heathkit*

SIGNAL GENERATOR KIT



MODEL SG-8

$19.50

SHIPPING WEIGHT 8 POUNDS

Announcing the new Heathkit Model SG-8 service type Signal Generator, incorporating many design features not usually found in an instrument in this price range. The RF output is from 160 kc to 100 mc in five ranges, all on fundamentals, with useful harmonics up to 200 mc. The RF output level is in excess of 100,000 microvolts throughout the frequency range.

The oscillator circuit consists of a 12AT7 twin triode tube. One half is used as a Colpitts oscillator, and the other half as a cathode follower output which acts as a buffer between the oscillator and external load. This circuity eliminates oscillator frequency shift usually caused by external circuit loading.

All coils are factory wound and adjusted, thereby completely eliminating the need for calibration and the use of additional calibrating equipment. The stable low impedance output features a step and variable attenuator for complete control of RF level. A 6C4 triode acts as a 400 cycle sine wave oscillator and a panel switching system permits a choice of either external or internal modulation.

The transformer operated circuit is easy to assemble, requires no calibration, and meets every service requirement for an adjustable level variable frequency signal source, either modulated or un-modulated.

NEW *Heathkit*

BAR GENERATOR KIT

MODEL BG-1

$14.50

SHIPPING WEIGHT 6 POUNDS

The Heathkit BG-1 Bar Generator represents another welcome addition to the fast growing line of popular Heathkits. The station transmitted test pattern is rapidly disappearing, and the bar generator is the logical answer to the TV service man's problem in obtaining quick, accurate adjustment information without waiting for test patterns.

The Heathkit BG-1 produces a series of horizontal or vertical bars on a TV screen. Since these bars are equally spaced, they will quickly indicate picture linearity of the receiver under test. Panel switch provides "stand-by position" — "horizontal position" — "vertical position." The oscillator unit utilizes a 12AT7 twin triode for the RF oscillator and video carrier frequencies. A neon relaxation oscillator provides low frequency for vertical linearity tests. The instrument will not only produce bar patterns but will also provide an indication of horizontal and vertical sync circuit stability, as well as overall picture size.

Instrument operation is extremely simple, and merely requires connection to the TV receiver antenna terminal. The unit is transformer operated for safety when used in conjunction with universal or transformerless type TV circuits.

HEATH COMPANY • Benton Harbor 15, Mich.

NEW *Heathkit* TUBE CHECKER KIT

MODEL TC-2

$29.50

SHIP. WT. 12 LBS.

CHECK THESE NEW *Features*

- Simplified harness wiring
- Improved, smooth, anti-backlash roll chart action
- Optional roll chart illumination
- Individual element switches
- Portable or counter style cabinet
- Spare blank socket
- Contact type pilot light test socket
- Simplified test set-up procedure
- Line adjust control
- 4½" three-color meter

The new Model TC-2 Heathkit Tube Checker features many circuit improvements, simplified wiring, new roll chart drive and illumination of roll chart. The instrument is primarily designed for the convenience of the radio and TV service man and will check the operating quality of tubes commonly encountered in this type of work. Test set-up procedure is simplified, rapid, and flexible. Panel sockets accommodate 4, 5, 6, and 7 pin tubes, octal and loctal, 7 and 9 pin miniatures, 5 pin Hytron and a blank socket for new tubes. Built-in neon short indicator, individual three-position lever switch for each tube element, spring return test switch, 14 filament voltage ranges, and line set control to compensate for supply voltage variations, all represent important design features of the TC-2. Results of tube tests are read directly from a large 4½" Simpson three-color meter, calibrated in terms of Bad-?-Good. Information that your customer can readily understand. Checks emission, shorted elements, open elements, and continuity.

The use of closer tolerance resistors in critical circuits assures correct test information and eliminates the possibility of inaccurate test interpretation. Improvement has been made in the mechanical roll chart drive system, completely eliminating diagonal running, erratic operation, and backlash. The thumb wheel gear driven action is smooth, positive, and free running. As an additional feature, the roll chart is illuminated for easier reading, particularly when the tube checker is used on radio or TV home service calls.

Wiring procedure has been simplified through the extended use of multicable, color coded wires, providing a harness type installation between tube sockets and lever switches. This procedure insures standard assembly and imparts that "factory built" appearance to instrument construction. Completely detailed information is furnished in the new step-by-step construction manual, regarding the set-up procedure for testing of new or unlisted tube types. No delay necessary for release of factory data.

The new Heathkit Tube Checker will prove its value in building service prestige through usefulness — simplified operation — attractive professional appearance. Don't overlook the fact that the kit price represents a savings of $40.00 to $50.00 over the price of a comparable commercially built instrument. At this low price, no service man need be without the advantages offered by the Heathkit Tube Checker.

New HEATHKIT PORTABLE TUBE CHECKER KIT

MODEL TC-2P

$34.50

SHIP. WT. 14 LBS.

The portable model is supplied with a strikingly attractive two-tone cabinet finished in rich maroon, proxylin impregnated, fabric covering with a contrasting gray on the inside cover. Detachable cover, brass-plated hardware, sturdy plastic handle help to impart a truly professional appearance to the instrument.

PORTABLE TUBE CHECKER CABINET as described above will fit all earlier Heathkit TC-1 Tube Checkers. Shipping weight 7 lbs. Cabinet only, 91-8, $7.50.

No. 355
Ship. Wt. 1 Lb.
$4.50

Heathkit TV PICTURE TUBE TEST ADAPTER

The Heathkit TV Picture Tube Test Adapter used with the Heathkit Tube Checker will quickly check for emission, shorts, etc., and determine picture tube quality. Consists of standard 12 pin TV tube socket, four feet of cable, octal socket connector, and data sheet.

Heathkit POWER SUPPLY KIT

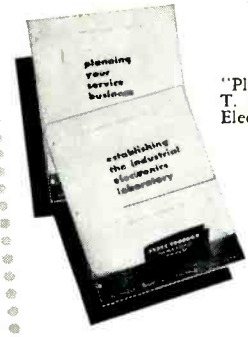
MODEL PS-2

$33.50

SHIPPING WT. 17 LBS.

The Heathkit Laboratory Power Supply features continuously variable, regulated voltage output with good stability under wide load variations. A 4½" Simpson plastic enclosed panel mounted meter provides accurate meter output information of voltage or current. All panel terminals completely isolated from the cabinet. Separate 6.3 volt AC supply at 4 amperes for filament requirements. Ripple component exceptionally low, stand-by switch provided to eliminate warm-up time of the five tube circuit.

LABORATORY AND SERVICE SHOP BOOKLETS



"Planning Your Service Business" by John T. Frye, and "Establishing the Industrial Electronics Laboratory" by Louis B. Garner, Jr., are booklets available to Heathkit customers at no charge. These booklets, written by nationally recognized authorities, outline the various requirements and considerations for establishing your own service business or for setting up an industrial electronics laboratory. Full attention is given to various details that are frequently overlooked when projects of this nature are undertaken. Just write in to the Heath Company requesting your free copy, or attach a memo to your next order.

HEATH COMPANY • Benton Harbor 15, Mich.

CHECK THESE *Features*

- Visual and aural signal tracing
- Two channel input
- High RF sensitivity
- Unique noise locater circuit
- Calibrated wattmeter
- Substitution test speaker
- Utility amplifier
- RF, audio probes and test leads included

Heathkit VISUAL-AURAL SIGNAL TRACER KIT

MODEL T-3

$23.50

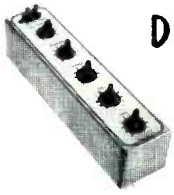
SHIPPING WEIGHT 10 POUNDS

An entirely new type of signal tracer incorporating a combination of features nor found in any other instrument. Designed expressly for the radio and TV service man, particularly for the servicing of AM, FM, and TV circuits. Here in a five tube, transformer operated instrument are all of the useful functions so necessary for speedy, accurate isolation of service difficulty.

This new signal tracer features a special high gain RF input channel, used in conjunction with a newly-designed wide frequency range demodulator probe. High RF sensitivity permits signal tracing at the receiver antenna input. A separate low gain channel and probe available for audio circuit exploration. Both input channels are constantly monitored by an electron ray beam indicator, so that visual as well as aural signal indications may be observed. The instrument can also be used for comparative estimation of gain per stage.

A decidedly unusual feature is a noise localizer circuit in conjunction with the audio probe. With this system, a DC potential is applied to a suspected circuit component and the action of the voltage in the component can be seen as well as heard. Invaluable for ferreting out noisy or intermittent condensers, noisy resistors, controls, coils, IF and power transformers, etc. A built-in calibrated wattmeter circuit is very useful for a quick preliminary check of the total wattage consumption of the equipment under test. Separate panel terminals provide external use of the speaker or output transformer for substitution purposes. Saves valuable service time by eliminating the necessity for speaker removal on every service job. The terminals also permit the utilization of other shop equipment, such as your oscilloscope or VTVM. The T-3 Signal Tracer can be used as a high gain amplifier for checking tuners, record changers, microphones, phono crystals, etc.

Don't overlook the interesting service possibilities provided through the use of this new instrument and let it work for you by saving time and money. The kit is supplied complete with all tubes, circuit components, demodulator probe, audio probe, and additional test leads.



Heathkit DECADE RESISTANCE KIT

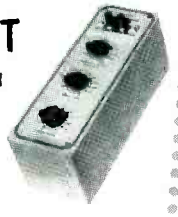
MODEL DR-1

$19.50

SHIP. WT. 4 LBS.

The Decade Resistance Kit provides individual switch selection of resistance values using twenty 1% resistors providing a choice of 1 to 99,999 ohms in 1 ohm steps. Ceramic wafer switches, silver-plated contacts, smooth, positive detent action, baked enamel panel, and handsome, polished birch cabinet.

Heathkit DECADE CONDENSER KIT



The Heathkit Decade Condenser Kit features silver mica, precision condensers with a rated accuracy of ± 1%. Capacity values are arranged in three decades from 100 mmf to .111 mf in steps of 100 mmf. Ceramic wafer switches with silver-plated contacts and smooth detent action. Useful in laboratory work, for circuit development.

MODEL DC-1

$16.50

SHIP WT 4 LBS.

Heathkit RESISTANCE SUBSTITUTION BOX KIT

MODEL RS-1

$5.50

SHIP. WT. 2 LBS.

The Heathkit Resistance Substitution Box provides individual switch selection of any one of 36 RTMA 1 watt 10% standard value resistors, ranging from 15 ohms to 10 meghoms. Many applications in circuit development work, and also in radio and TV service work. Ideal for experimentally determining resistance values and for quickly altering circuit operating characteristics. Entire unit housed in attractive Bakelite cabinet, featuring the new universal type Heathkit binding posts to simplify circuit connections.

Heathkit CONDENSER CHECKER KIT

MODEL C-3

$19.50

SHIPPING WT. 8 POUNDS

Use the Heathkit C-3 Condenser Checker to quickly and accurately measure those unknown condenser and resistor values. All readings are taken directly from the calibrated panel scales without requiring any involved calculation. Capacity measurements in four ranges from .00001 mf to 1,000 mf. Checks paper, mica, ceramic, and electrolytic condensers. A power factor control is available for accurate indication of electrolytic condenser measurements. A leakage test switch with switch selection of five polarizing voltages, 25 volts to 450 volts DC, will indicate condenser operating quality under actual load condition. The spring return leakage test switch automatically discharges the condenser under test and eliminates shock hazard to the operator.

Resistance measurements can be made in the range from 100 ohms to 5 megohms. Here again all values are read directly on the calibrated scale. Increased circuit sensitivity coupled with an electron beam null indicator increases overall instrument usefulness.

For safety of operation the circuit is entirely transformer operated and the instrument is housed in the attractive, newly-styled Heathkit cabinet, featuring rounded corners, and drawn aluminum panel. The outstanding low kit price for this surprisingly accurate instrument includes necessary test leads. Good service shop operation requires the use of this specialized instrument, designed for the express purpose of determining unknown condenser values and operating characteristics.

HEATH COMPANY • Benton Harbor 15, Mich.

Heathkit AMATEUR TRANSMITTER KIT

MODEL AT-1

$29.50

SHIPPING WEIGHT 16 POUNDS

CHECK THESE NEW *Features*

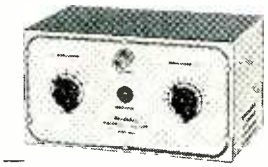
- Single knob band switching
- Pre-wound coils
- Metered operation
- 52 ohm coaxial output
- Crystal or VFO excitation
- Built-in power supply
- Rugged, clean construction

Here is the latest Heathkit addition to the ham radio field, the AT-1 Transmitter Kit, incorporating many desirable design features at the lowest possible dollar-per-watts price. Panel mounted crystal socket, stand-by switch, key click filter, AC line filtering, good shielding, etc. VFO or crystal excitation — up to 35 watts input. Built-in power supply provides 425 volts at 100 ma.

This kit features pre-wound coils, single knob band switching, 52 ohm coaxial output, plug in chassis provisions for VFO or modulator and rugged clean construction. Frequency range 80, 40, 20, 15, 11, and 10 meters. Tube line-up 6AG7 oscillator-multiplier, 6L6 amplifier-doubler, 5U4G rectifier. Physical dimensions 8⅛" high x 13⅛" wide x 7" deep.

This amazingly low kit price includes all circuit components, tubes, cabinet, punched chassis, and detailed construction manual. The ideal kit for the novice just breaking into ham radio. It can be used later on as a stand-by rig or an all band exciter for higher powered transmitter.

NEW Heathkit ANTENNA COUPLER KIT

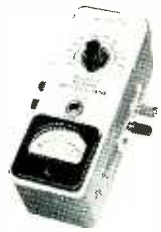


New Heathkit Antenna Coupler, specially designed for the Heathkit AT-1 Transmitter. The Antenna Coupler can be used with any 52 ohm coaxial input — up to 75 watts power. Low pass filter with cut-off frequency of approximately 36 mc — L section tuning network — neon tuning indicator — rugged, compact construction — transmitter type variable condenser, and high Q coil are all outstanding features. The AC-1 has both inductance and capacity tuning for maximum operating versatility. Dimensions 8⅛" wide x 4⅜" high x 4⅞" deep.

MODEL AC-1

$14.50 SHIP. WT. 3 LBS.

Heathkit ANTENNA IMPEDANCE METER



Use the Heathkit Antenna Impedance Meter for measuring antenna impedance for line matching purposes — adjustment of beam antennas — phone monitor, etc. It will determine antenna resistance at resonance, match transmission line for minimum SWR, determine receiver input impedance, and provide a rough indication of SWR. Precision resistors, germanium diode, 100 microampere Simpson meter. Dial calibrated from 0-500 ohms. Shielded aluminum cabinet. 7" long x 2½" wide x 3¼" deep.

$14.50 SHIP. WT. 3 LBS.

MODEL AM-1

Heathkit COMMUNICATIONS RECEIVER KIT

MODEL AR-2

$25.50 SHIP. WT. 12 LBS.

Here is the new receiver kit you have repeatedly asked for, the Heathkit Communications Receiver. The perfect companion piece for the AT-1 Transmitter kit. Many outstandingly desirable features have been incorporated in the design of the AR-2; such as, electrical bandspread for logging and tuning convenience — high gain miniature tubes — IF transformers for high sensitivity and good signal to noise ratio — separate RF gain control with optional automatic volume control or manual volume control, in addition to the conventional audio gain control. Noise limiter — stand-by switch — stable BFO oscillator circuit — headphone jack — transformer operation, etc., all contribute to a high performance standard.

Frequency coverage is continuous from 535 kc to 35 mc in four ranges. For added convenience, various ham bands have been separately identified in respect to their relative placement on the slide rule tuning scale. A chassis mounted, 5½" PM speaker is included with this kit. Tube line up 12BE6 mixer oscillator, 12BA6 IF amplifier, 12AV6 detector AVC audio, 12BA6 BFO oscillator, 12A6 beam power output, 5Y3GT rectifier.

RECEIVER CABINET

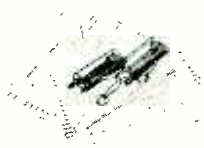
Proxylin impregnated, fabric covered, plywood cabinet with aluminum panel designed expressly for the AR-2 Receiver. Part 91-10, shipping weight 5 lbs., $4.50.

IMPROVED Heathkit GRID DIP METER KIT

$19.50 SHIP. WT. 4 LBS.

MODEL GD-1B

The invaluable instrument for service men, hams, and experimenters. Useful in TV service work for alignment of traps, filters, IF stages, peaking compensation networks, etc. Locates spurious oscillation, provides a relative indication of power in transmitter stages, use it for neutralization, locating parasitics, correcting TVI, measuring C, L, and Q of components, and determining RF circuit resonant frequencies. With oscillator energized, useful for finding resonant frequency of tuned circuits. With the oscillator not energized, the instrument acts as an absorption wave meter. Variable meter sensitivity control, head phone jack, 500 microampere Simpson meter. Continuous frequency coverage from 2 mc. to 250 mc. Pre-wound coil kit and rack, new three prong coil mounting, 6AF4 high frequency triode.



Two additional plug-in coils are available and provide continuous extension of low frequency coverage down to 355 kc. Dial correlation curves included. Shipping weight 1 lb., kit 341, $3.00.

HEATH COMPANY · Benton Harbor 15, Mich.

CHECK THESE *Features*

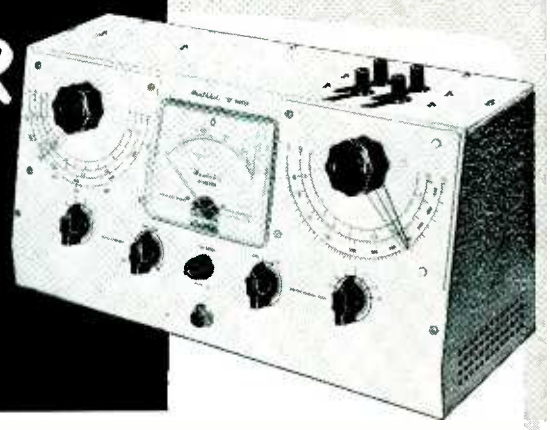
- First popular priced Q Meter
- Reads Q directly on calibrated scale
- Oscillator supplies RF frequencies of 150 kc to 18 mc
- Calibrate capacitor with range of 40 mmf to 450 mmf with vernier of ± 3 mmf
- Measures Q of condensers, RF resistance, and distributed capacity of coils
- Many applications in design and development work
- Useful in TV service work for checking deflection yokes, coils, chokes, etc.

Heathkit "Q" METER KIT

MODEL QM-1

$44.50

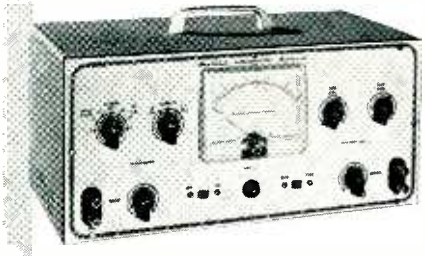
SHIPPING WT. 14 POUNDS



Another outstanding example of successful Heathkit engineering effort in producing a Q Meter Kit within the price range of TV service men, schools, laboratories, and experimenters. This Q Meter meets RF design requirements for rapid, accurate measurement of capacity, inductance, and Q at the operating frequency and all indications of value can be read directly on the meter calibrated scales. Oscillator section supplies RF frequencies of 150 kc to 18 mc. Calibrate capacitor with range of 40 mmf to 450 mmf, with vernier of ± 3 mmf.

Particularly useful in TV service work for checking peaking coils, wave traps, chokes, deflection coils, width and linearity coils, etc. At this low kit price research laboratory facilities are within the range of service shops, schools, and experimenters.

Heathkit INTERMODULATION ANALYZER KIT



MODEL IM-1

$39.50

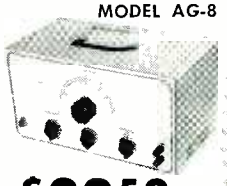
SHIPPING WT. 17 POUNDS

The Heathkit IM-1 is an extremely versatile instrument specifically designed for measuring the degree of inter-action between two signals in any portion of an audio chain. It is primarily intended for making tests of audio amplifiers, but may be used in other applications, such as checking microphones, records, recording equipment, phonograph pick-ups, and loud-speakers. High and low test frequency source, intermodulation unit, power supply, and AC vacuum tube volt meter all in one complete instrument. Per cent intermodulation is directly read on the calibrated scales, 30%, 10%, and 3% full scale. Both 4:1 and 1:1 ratios of low to high frequency easily set up. With this instrument the performance level of present equipment, or newly developed equipment can be easily and accurately checked. At this low price, you can now enjoy the benefits of intermodulation analysis for accurate audio interpretation.

Heathkit AUDIO GENERATOR KIT

A Heathkit Audio Generator with frequency coverage from 20 cycles to 1 mc. Response flat ± 1 db from 20 cycles to 400 kc, down 3 db at 600 kc, and down only 8 db at 1 mc. Calibrated, continuously variable, and step attenuator output controls provide convenient reference output level. Distortion is less than .4% from 100 cps through the audible range. The ideal controllable extended frequency sine wave source for audio circuit investigation and development.

MODEL AG-8

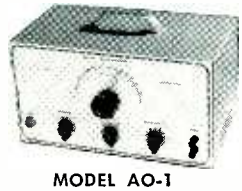


$29.50

SHIP. WT. 11 LBS.

Heathkit AUDIO OSCILLATOR KIT

Sine or square wave coverage from 20 to 20,000 cycles in three ranges at a controllable output level up to 10 volts. Low distortion, 1% precision resistors in multiplier circuits, high level output across entire frequency range, etc., readily qualify this instrument for audio experimentation and development work. Special circuit design consideration features thermistor operation for good control of linearity.

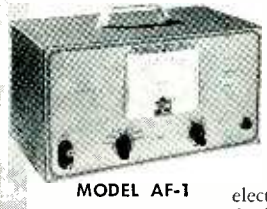


MODEL AO-1

$24.50

SHIP. WT. 11 LBS.

Heathkit AUDIO FREQUENCY METER KIT



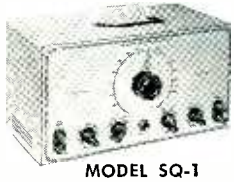
MODEL AF-1

$34.50

SHIP. WT. 12 LBS.

The Heathkit Audio Frequency Meter provides a simple and convenient means of checking unknown audio frequencies from 10 cycles to 100 kc at any voltage level between 3 and 300 volts rms with any non-critical wave shape. Instrument operation is entirely electronic. Just set the range switch, feed an unknown frequency into the instrument, and read the frequency directly on the calibrated scale of the Simpson 4½" meter.

Heathkit SQUARE WAVE GENERATOR KIT



MODEL SQ-1

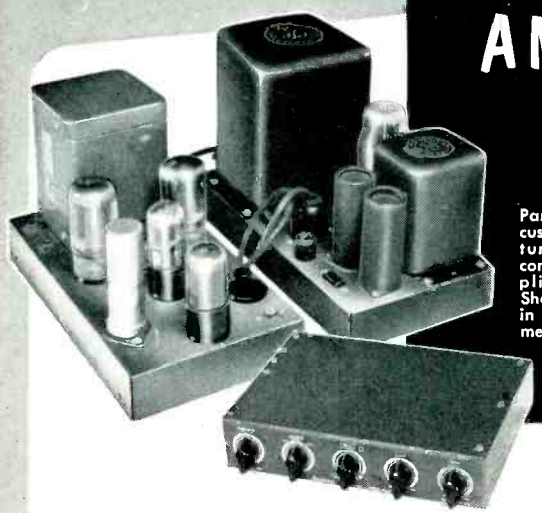
$29.50

SHIP. WT. 12 LBS.

The Heathkit Square Wave Generator provides an excellent square wave frequency source with completely variable coverage from 10 cycles to 100 kc. This generator features low output impedance of 600 ohms and the output voltage is continuously variable between 0 and 20 volts, thereby providing the necessary degree of operating flexibility. An invaluable instrument for those specialized circuit investigations requiring a good, stable, variable square wave source.

HEATH COMPANY • Benton Harbor 15, Mich.

Heathkit
WILLIAMSON TYPE
AMPLIFIER KIT
MODEL W-2



Particularly designed for custom installations, featuring separate cable connected units for simplicity of installation. Sheet metal work finished in attractive gray hammertone for smart appearance. All control shafts of the adjustable length break-off type.

$69.50

When selecting an amplifier for the heart of your high fidelity audio system, investigate the outstanding advantages offered by the Heathkit Williamson Type Amplifier. Meets every high fidelity audio requirement and makes listening to recorded music a thrilling new experience.

This outstanding amplifier is offered with optional output transformer operation, providing either the conventional triode output circuit or the new extended power circuity in which the screen supply voltage is obtained from separate transformer primary taps. Frequency response within ± 1 db from 10 cycles to 100 kc. Tube complement — 6SN7 cascade amplifier and phase splitter, 6SN7 push pull driver, two 5881 push pull power amplifiers, one 5V4G cathode type rectifier.

Matching preamplifier available providing three switch selected inputs, correct compensation, and individual bass and treble tone controls. Uses 12AY7 (or 12AX7) preamplifier — 12AU7 tone control amplifier.

Particularly designed for the novice kit builder and requires no specialized knowledge or equipment for successful assembly and operation.

PRICES OF COMBINATIONS

W-2 Amplifier Kit including main amplifier, power supply, and WA-P1 Preamplifier Kit. Shipping Weight 37 lbs. Shipped Express only. **$69.50**

W-2M Amplifier Kit includes main amplifier and power supply. Shipping Weight 29 lbs. Shipped Express only. **$49.75**

WA-P1 Preamplifier Kit only. Shipping Weight 6 lbs. Shipped Express or Parcel Post. **$19.75**

NEW *Heathkit* 20 WATT
High Fidelity AMPLIFIER KIT
MODEL A-9A

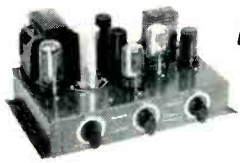
$35.50

SHIP. WT. 18 LBS.

A new 20 watt high fidelity amplifier, designed especially for custom audio installations demanding clean reproduction, adequate power, and flexibility to meet individual requirements. Separate treble and bass tone controls provide up to 15 db boost or cut. Four switch selected inputs, each with the necessary compensation for the service desired. Output transformer impedances of 4, 8, and 16 ohms.

Preamplifier, tone control, and phase splitter circuits utilize 9 pin twin triode miniature tubes for low hum and noise level. Two 6L6 push pull power output tubes provide full 20 watts power. Frequency response ± 1 db, 20-20,000 cycles. Total harmonic distortion 1% (at 3 db below rated output). Tube line-up: 12AX7 preamplifier, 12AU7 voltage amplifier and tone control, 12AU7 voltage amplifier and phase splitter, two 6L6 push pull pentode power output, 5U4G rectifier. Truly outstanding amplifier performance coupled with low cost.

Heathkit ECONOMY 6 WATT
AMPLIFIER KIT



MODEL A-7B

$15.50

SHIP. WT. 10 LBS.

The new Heathkit Model A-7B Amplifier offers many unusually fine features not normally expected in this low price range. Either of the two input circuits may be individually switch selected for phono or tuner operation. Separate bass and treble tone controls. Output impedances of 4, 8, and 15 ohms. Push pull beam power output stage for balanced reproduction. Excellent voltage gain characteristics, good frequency response, and full 6 watts power output. 12J5 amplifier, 12SL7 second amplifier and phase splitter, two 12A6 beam power output, one 5Y5 GT rectifier.

A-7C incorporates preamplifier stage with special compensated network to provide necessary gain for operation with variable reluctance or low output level phono cartridge. Circuit is properly compensated for microphone operation. $17.50.

NEW *Heathkit*
BROADCAST BAND
RECEIVER KIT

MODEL BR-2

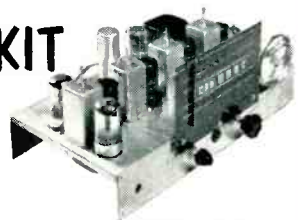
$17.50 *SHIP. WT. 11 LBS.*

Another new Heathkit for the student, beginner, or hobbyist. If you have ever had the urge to build your own radio receiver, this kit warrants your attention.

New high gain miniature tubes and IF transformers provide excellent sensitivity and good signal to noise ratio. A built-in ferrite core rod type antenna has been provided. A chassis mounted 5½" PM speaker provides excellent tone and volume. Convenient phono input. Can be operated either as a receiver or tuner. Simplified construction manual outlines circuit theory. Ideal for students. Tube line-up: 12BE6 mixer oscillator, 12BA6 IF amplifier, 12AV6 detector-AVC-first audio, 12A6 beam power output, 5Y3GT rectifier.

CABINET — Proxylin impregnated fabric covered plywood cabinet. Shipping weight 5 lbs. Part number 91-9, $4.50.

Heathkit
FM TUNER KIT



MODEL FM-2

$22.50

SHIP. WT. 9 LBS.

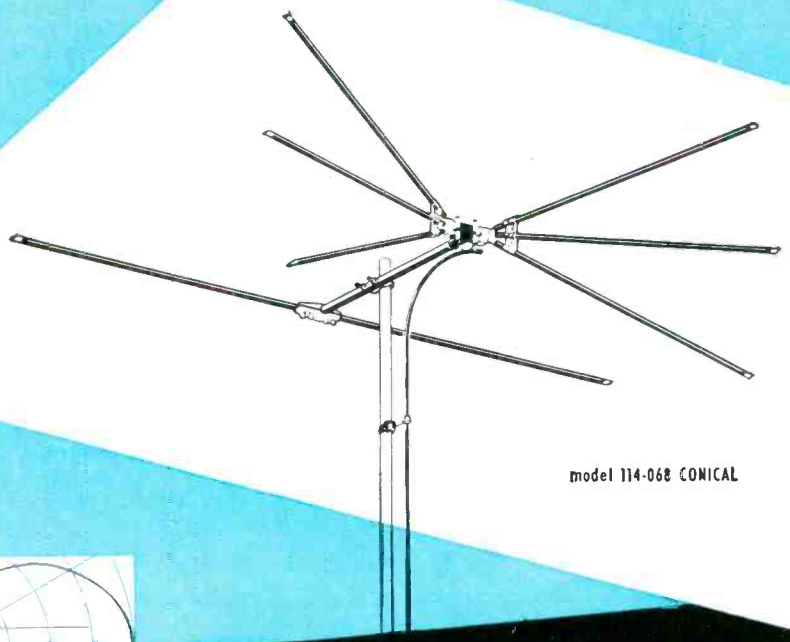
The Heathkit FM-2 Tuner was specifically designed for simplified kit construction. Can be operated through the "phono" portion of your radio or with a separate amplifier. The kit features a pre-assembled and adjusted tuning unit, three double tuned IF transformers, and a discriminator transformer in an 8 tube AC operated circuit. Frequency coverage 88 to 108 mc. Experience the thrill of building your own FM tuner and at the same time enjoy all of the advantages of true FM reception.

Free CATALOG

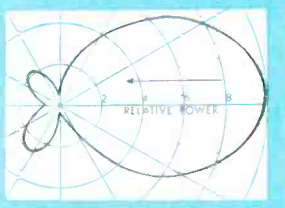
Write for free catalog containing latest price information, schematics, specifications, and descriptions of all Heathkits.

HEATH COMPANY • Benton Harbor 15, Mich.

now!



model 114-068 CONICAL



69 mc—channel 4

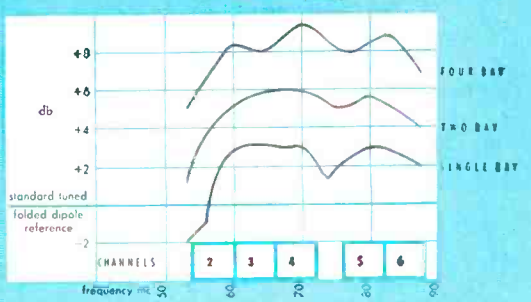
a VHF CONICAL antenna built to the Quality Standards of AMPHENOL

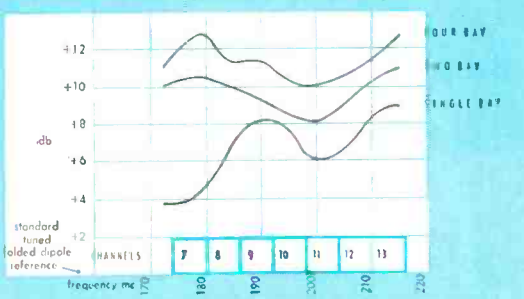
...est-growing and fastest-selling anten-
...ates is a new AMPHENOL VHF antenna.
...ent the fabulous INLINE* for VHF recep-
CONICAL antenna will give true-picture recep-
y VHF signal area: major, fringe and long-distance.
directivity have been engineered to the high AMPHENOL
...ds that have set the quality goal for the entire industry;
...anship attention to the small but important details make
ONICAL another example of AMPHENOL's fine antenna

AMPHENOL CONICALs are available in single, two and four ... models. The stacked models use unique phasing harnesses ... extra gain. The CONICAL may be obtained in packaging ...at contains all the necessary stacking equipment or else the individual antenna may be purchased one or two to a carton. In addition, the single bay CONICAL is available in a complete antenna installation kit.

All elements of the CONICAL are constructed of sturdy, long-lasting seamless aluminum tubing — assuring rust-free years of top performance.

*Reissue U. S. Patent 23,273





High gain of the CONICAL is illustrated in the gain charts for single, two bay and four bay models. Measured in accordance with proposed RETMA standards, the charts also show the desirable flatness of the gain.

AMPHENOL AMERICAN PHENOLIC CORPORATION • *chicago 50, illinois*

available for 20, 40, and 75 meter operation, incorporate several unusual features. They are compactly designed,

rugged, and lightweight. They have a special coated air-spaced coil winding to insure improved transmission and reception quality.

The 20-meter coil measures 3½" x 2⅜" in diameter and weighs 7½ ounces, the 40-meter unit measures 6½" x 2⅜" in diameter and weighs 11 ounces, while the 75-meter coil measures 7½" x 2⅜" in diameter and weighs 12 ounces.

SMALL TRANSISTORS

Texas Instruments Incorporated has announced a size reduction in its junction transistor cases for even greater usefulness in miniature equipment.

The over-all length of the case has been reduced from .500 to .300 inch. Connections are made to the transistor case through three leads, supplied already tinned and 1½ inches long, suitable for soldering into the circuit or clipping to desired length and plugging into a subminiature socket.

Three types of these "n-p-n" tran-

(*Continued on page* 166)

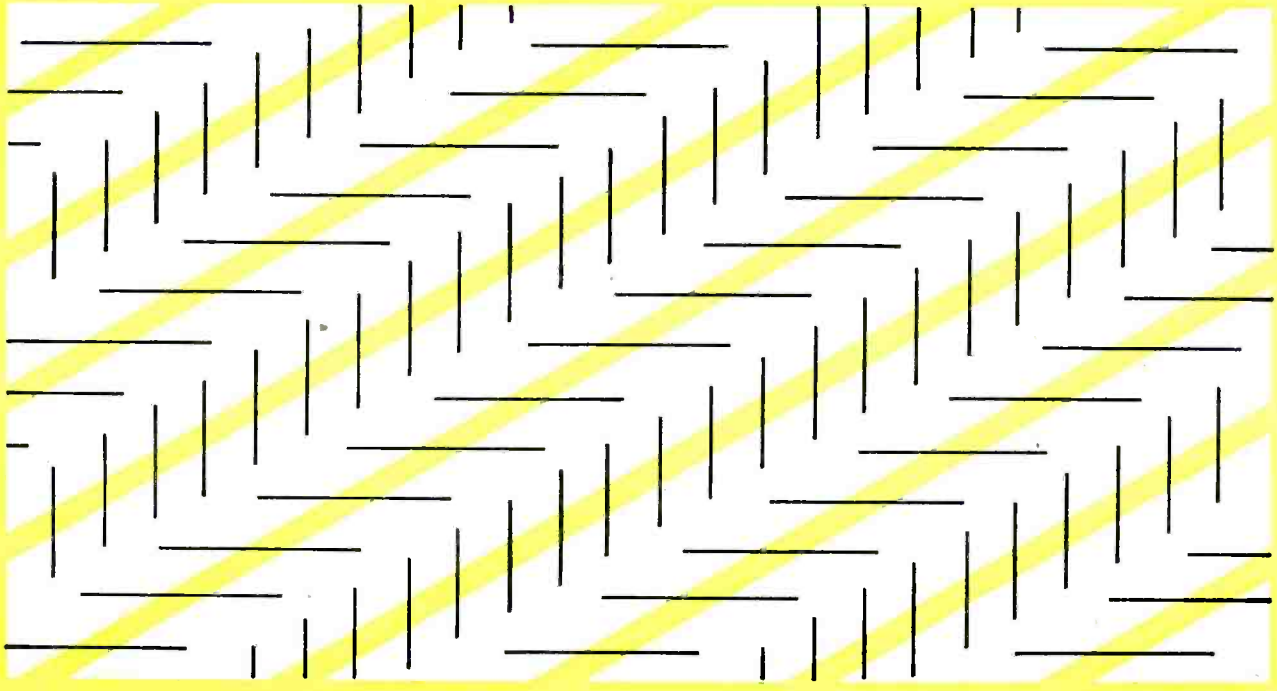
NEW TV STATIONS ON THE AIR

(As of January 25, 1954)

The following new stations bring the list published in the January, 1954 issue up to date.

STATE, CITY	STATION	CHANNEL	FREQUENCY RANGE (IN MC.)	VIDEO WAVELENGTH (IN FT.)	VIDEO POWER* (IN KW.)
Arkansas					
Pine Bluff	KATV	7	174-180	5.61	24.5
California					
Stockton	KTVU	36	602-608	1.63	525
Colorado					
Denver	KOA-TV	4	66-72	14.61	100
Florida					
Fort Lauderdale	WITV	17	488-494	2.01	43
Idaho					
Idaho Falls	KID-TV	3	60-66	16.06	100
Illinois					
Bloomington	WBLN	15	476-482	2.06	16
Danville	WDAN-TV	24	530-536	1.85	1
Indiana					
Princeton	WRAY-TV	52	698-704	1.41	95
Iowa					
Waterloo	KWWL-TV	7	174-180	5.61	30
Kansas					
Pittsburgh	KOAM-TV	7	174-180	5.61	98
Louisiana					
Shreveport	KSLA	12	204-210	4.79	13
Maine					
Lewiston	WLAM-TV	17	488-494	2.01	1
Portland	WCSH-TV	6	82-88	11.8	100
Massachusetts					
Adams-Pittsfield	WMGT	74	830-836	1.18	300
Mississippi					
Jackson	WJDT	3	60-66	16.06	15.9
Missouri					
Columbia	KOMU-TV	8	180-186	5.43	60
Festus-St. Louis	KACY	14	470-476	2.09	500
Nebraska					
Kearney-Holdrege	KHOL-TV	13	210-216	4.65	56.2
New Jersey					
Asbury Park	WRTV	58	734-740	1.34	100
North Dakota					
Bismarck	KFYR-TV	5	76-82	12.74	100
Oklahoma					
Oklahoma City	KWTV	9	186-192	5.25	55
Pennsylvania					
Scranton	WARM-TV	16	482-488	2.04	252
South Carolina					
Greenville	WFBC-TV	4	66-72	14.61	100
Texas					
Midland	KMID-TV	2	54-60	17.8	26.3
Weslaco	KRGV-TV	5	76-82	12.74	28.8
Washington					
Seattle	KOMO-TV	4	66-72	14.61	100
West Virginia					
Fairmont	WJPB-TV	35	596-602	1.65	20
Wisconsin					
Eau Claire	WEAU-TV	13	210-216	4.65	52
Neenah	WNAM-TV	42	638-644	1.54	15.5

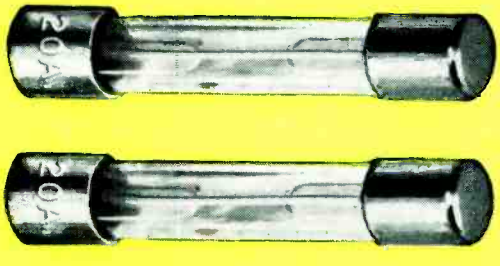
*From Station CP application. The frequency of the video carrier = 1.25 + channel lower freq. limit. Total number of television stations now on the air: 351 (123 of which are u.h.f.)

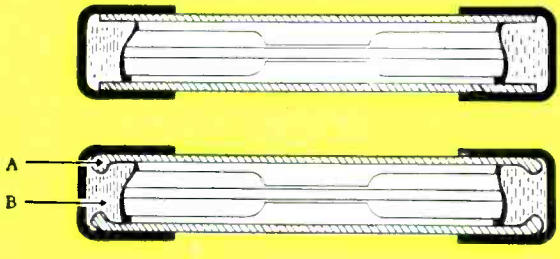


THINGS ARE NOT AS THEY SEEM...

The long lines are strictly parallel—
that they appear otherwise is an optical illusion.

This fuse merely has the metal caps cemented to the glass.





The difference between these two fuses is no illusion . . .

This Littelfuse has the caps locked to glass like this.

The ends of the glass are formed[A]. The solder which is bonded in a separate operation to the cap reflows through the small aperture and spreads out to form a permanent collar-button lock[B] between cap and glass—impervious to moisture and vibration. The exclusive Littelfuse feature eliminates fuse failure due to loose caps.

Littelfuse leads all other fuse manufacturers in design patents on fuses. ***Lock-cap assembly patent no. 1922642***

LITTELFUSE

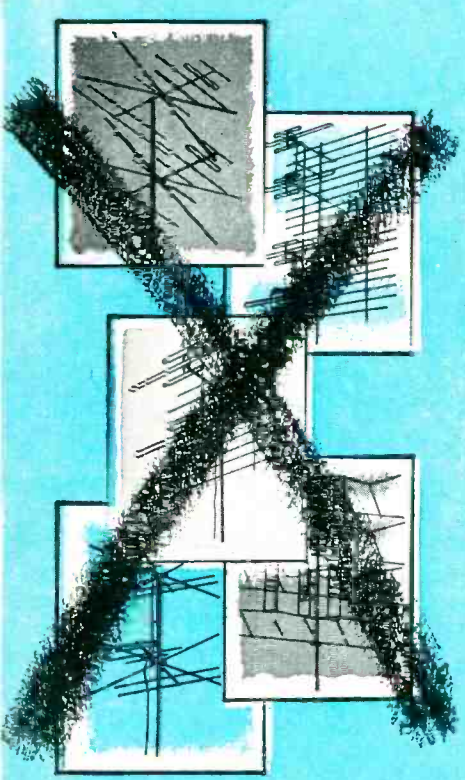
DES PLAINES, ILLINOIS

KAY-TOWNES Announces

the new Super "KATYS"

(PATENTS PENDING)

Highest Gain ALL-CHANNEL VHF ANTENNAS EVER DESIGNED!



GUARANTEED

TO *OUT-PERFORM* ANY OTHER ALL-CHANNEL VHF ANTENNA ON THE MARKET

Practically every TV Antenna maker in America has made just such statements as these . . . *but, there is a big difference in making these broad claims and then being able to back them up!*

WE CAN! We are prepared to run a PERFORMANCE TEST with *anyone . . . anywhere . . . anytime . . .* to prove the vast superiority of the new SUPER "KATYS" *over all other all-channel VHF antennas* . . . regardless of manufacture, design, type or number of bays!

IN FACT, WE WILL POSITIVELY AND ABSOLUTELY GUARANTEE THAT OUR SINGLE-BAY SUPER KATY WILL OUTPERFORM ANY VHF 4-BAY ANTENNA MADE TODAY!

Our 2-Bay SUPER KATY is designed for *extremely difficult* reception areas. It has been tested in many practically impossible locations . . . *AND HAS NEVER FAILED TO BRING IN A PICTURE RATED EITHER "VERY GOOD" OR "EXCELLENT"!*

4½ Years IN DEVELOPMENT...

THE AMAZING SUPER KATY DESIGN MAKES OTHER VHF ALL-CHANNEL ANTENNA DESIGNS AS OBSOLETE AS THE HORSE AND BUGGY! WE CHALLENGE YOU TO TEST IT . . . *ANYWHERE!*

Super KATY-2

2-BAY

Super KATY-1

SINGLE-BAY

Now THE WORLD'S FINEST ALL-CHANNEL VHF RECEPTION!

The SUPER KATY all-channel VHF antennas feature a twin-driven aray with a combination of special cut elements for a close 300 OHM impedance across the entire VHF Band. This feature in conjunction with the long, accumulative fan dipoles, with directors and reflectors properly cut and spaced, results in performance never before obtained by any antenna design . . . *including our own "BIG JACK", whose design has been so widely "hijacked".*

Actual tests show that the Single-Bay KATY-1 will outperform any 10-element Yagi on every channel, 7 through 13 . . . and will perform as well as any 10-element Yagi on every channel, 2 through 6.

	List Price
SUPER KATY-1 Single-Bay	$25.00
SUPER KATY-2 2-Bay	$50.00

K-T Antennas are sold through selected distributors only . . . write for name of your nearest jobber.

KAY-TOWNES

ANTENNA COMPANY

ROME, GEORGIA

Recognized leaders in the field of fringe area antenna design

Tape Editor's Notebook

(*Continued from page* 51)

only the length of about one and a half 78-rpm sides on one EP side. Thus a cut must be made somewhere in the middle of the second 78-rpm side in order to stay within the EP time limit. If there is a pause or long rest in the music at the right time, the cutting is simple. But when this fortunate coincidence doesn't occur, then it is necessary to cut into continuous music and the echo chamber must be brought into play. The tape is cut at a point which is most feasible musically as well as technically, and several seconds of blank tape is spliced between the ends. The ending is then re-recorded and reverberation faded in as before.

The characteristics of tape have made the medium itself very adaptable to methods of simulating reverberation. A commercially-available unit, designed by Lewis Goodfriend, comprises a continuous loop of tape moving past a record and several reproduce heads, whose outputs can be adjusted to give the effect of various degrees of multiple reflections. Such a unit is illustrated in Fig. 1. An approximation of this effect is possible with any tape recorder having separate record and playback heads. If a small portion of the recorder output is fed back into the input, it will be recorded again, a fraction of a second behind the original, and then the combination will be recorded again, the entire process being repeated continuously until the system losses cause the sound to decay to inaudibility. As in the case of the reverberation chamber, it is advisable to insert a variable equalizer in the feedback loop, so that the quality of reverberation may be controlled. The delay time will be dependent upon the rate of speed at which the tape travels and the distance between the playback and record heads. On most commercial machines, 15 inches-per-second seems to be the best speed for usual applications, but the other speeds are often useful for special effects.

Thus we have seen a few of the tremendous advances in technique which have been made in the recording art in the few short years since the introduction of tape. At the present rate, who can possibly foresee what wonders the future holds? —30—

"Rex, here Rex. Junior's on the TV quiz program!"

I Will Train You at Home
for Good Pay Jobs, Success in
RADIO-TELEVISION

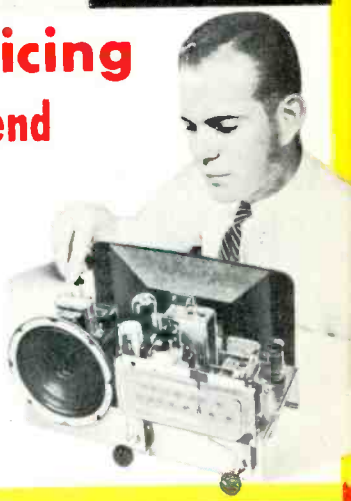
J. E. SMITH
President
National Radio
Institute
Washington, D.C.
40 years of success
training men at
home in spare time.

Practice Broadcasting
with Equipment I Send

As part of my Communications Course I send you kits of parts to build the low-power Broadcasting Transmitter shown at the left. You use it to get practical experience putting a station "on the air," performing procedures demanded of Broadcasting Station Operators. An FCC Commercial Operator's License can be your ticket to a better job and a bright future; my Communications Course gives you the training you need to get your license. Mail card below and see in my book other valuable equipment you build.

Practice Servicing
with Equipment I Send

Nothing takes the place of PRACTICAL EXPERIENCE. That's why NRI training is based on LEARNING BY DOING. You use parts I furnish to build many circuits common to Radio and Television. With my Servicing Course you build a modern Radio (shown at right). You build a Multitester which you use to help fix sets while training. Many students make $10, $15 a week extra fixing sets in spare time starting a few months after enrolling. All equipment is yours to keep. Card below will bring book showing other equipment you build.



Television is Growing Fast
Making New Jobs, Prosperity

More than 25 million homes now have Television sets and thousands more are being sold every week. Well trained men are needed to make, install, service TV sets. About 200 television stations on the air with hundreds more being built. Think of the good job opportunities here for qualified technicians, operators, etc. If you're looking for opportunity get started now learning Radio-Television at home in spare time. Cut out and mail postage free card. J. E. Smith, President, National Radio Institute, Washington, D. C. OUR 40TH YEAR.

AVAILABLE TO VETERANS UNDER G.I. BILL

Good Jobs, Good Pay, Success in Radio-TV! *SEE OTHER SIDE*

CUT OUT AND MAIL THIS CARD NOW

Sample Lesson & 64-Page Book
Both FREE

This card entitles you to Actual Lesson on Servicing, shows how you learn Radio-Television at home. You'll also receive my 64-Page Book, "How to Be a Success in Radio-Television." Mail card now!

NO STAMP NEEDED! WE PAY POSTAGE

Mr. J. E. SMITH, President,
National Radio Institute, Washington 9, D.C.

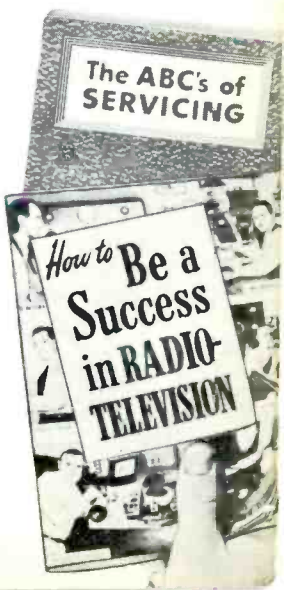
Mail me Lesson and Book, "How to Be a Success in Radio-Television." (No Salesman will call. Please write plainly.)

NAME ..... AGE .....

ADDRESS .....

CITY ..... ZONE ..... STATE .....

VETS write in date of discharge .....
B C



Train at Home to Jump Your Pay as a RADIO-TV Technician

Get a Better Job—Be Ready for a Brighter Future in America's Fast Growing Industry

Training PLUS opportunity is the PERFECT COMBINATION for job security, good pay, advancement. When times are good, the trained man makes the BETTER PAY, GETS PROMOTED. When jobs are scarce, the trained man enjoys GREATER SECURITY. NRI training can help assure you and your family more of the better things of life.

Radio-Television is today's opportunity field. Even without Television, Radio is bigger than ever before. Over 3,000 Radio Broadcasting Stations on the air; more than 115 million home and Automobile Radios are in use. Then add Television. Television Broadcast Stations extend from coast to coast now with over 25 million Television sets already in use. There are channels for 1,800 more Television Stations. Use of Aviation and Police Radio, Micro-Wave Relay, Two-way Radio communication for buses, taxis, trucks, etc. is expanding. New uses for Radio-Television principles coming in Industry, Government, Communications and Homes.

NRI Training Leads to Jobs Like These

BROADCASTING
Chief Technician
Chief Operator
Power Monitor
Recording Operator
Remote Control Operator

SERVICING
Home and Auto Radios
P. A. Systems
Television Receivers
Electronic Controls
FM Radios

IN RADIO PLANTS
Design Assistant
Transmitter Design Technician
Service Manager
Tester
Serviceman
Research Assistant

SHIP AND HARBOR RADIO
Chief Operator
Assistant Operator
Radiotelephone Operator

GOVERNMENT RADIO
Operator in Army, Navy, Marine Corps, Coast Guard
Forestry Service Dispatcher
Airways Radio Operator

AVIATION RADIO
Plane Radio Operator
Transmitter Technician
Receiver Technician
Airport Transmitter Operator

TELEVISION
Pick-up Operator
Voice Transmitter Operator
Television Technician
Remote Control Operator
Service and Maintenance Technician

POLICE RADIO
Transmitter Operator
Receiver Serviceman

My Training is Up-to-Date You Learn by Practicing

Get the benefit of my 40 years experience training men. My well-illustrated lessons give you the basic principles you must have to assure continued success. Skillfully developed kits of parts I furnish "bring to life" the principles you learn from my lessons. Read more about equipment you get on other side of this page.

Naturally, my training includes Television. I have, over the years, added more and more Television information to my courses. The equipment I furnish students gives experience on circuits common to BOTH Radio and Television.

Find Out About the Tested Way to Better Pay

Read at the right how just a few of my students made out who acted to get the better things of life. Read how NRI students earn $10, $15 a week extra fixing Radios in spare time starting soon after enrolling. Read how my graduates start their own businesses. Then take the next step—mail card below.

You take absolutely no risk. I even pay postage. I want to put an Actual Lesson in your hands to prove NRI home training is practical, thorough. I want you to see my 64-page book, "How to Be a Success in Radio-Television" because it tells you about my 40 years of training men and important facts about present and future Radio-Television job opportunities. You can take NRI training for as little as $5 a month. Many graduates make more than the total cost of my training in two weeks. Mailing postage free card can be an important step in making your future successful. J. E. Smith, President, National Radio Institute, Washington 9, D. C. OUR 40TH YEAR.

J. E. Smith, *President*
National Radio Institute

The men whose messages are published below were not born successful. Not so long ago they were doing exactly as you are now . . . reading my ad! They decided they should KNOW MORE . . . so they could EARN MORE . . . so they acted! Mail card below now.

I TRAINED THESE MEN

Handicapped but Successful

"I am now Chief Engineer at WHAW. My left hand is off at the wrist. A man can do . . . if he wants to." R. J. Bailey, Weston, W. Va.

$10 a Week In Spare Time

"Before finishing, I earned as much as $10 a week in Radio servicing, in my spare time. I recommend NRI". S. J. Petruff, Miami, Fla.

Control Operator, Station WEAN

"I received my license and worked on ships. Now with WEAN as control operator. NRI course is complete." R. Arnold, Rumford, R. I.

Has Own Radio-Television Shop

"Doing Radio and Television servicing full time. Have my own shop. I owe my success to NRI." Curtis Stath, Fort Madison, Iowa.

Has Growing Business

"Am becoming expert Teletrician as well as Radiotrician. Without your course this would be Impossible." P. Brogan, Louisville, Ky.

Got First Job Thru NRI

"My first job was with KDLR. Now Chief Engr. of Radio Equipment for Police and Fire Dept." T. Norton, Hamilton, Ohio.

Find Out What RADIO-TV Offers You

SAMPLE LESSON and 64-PAGE BOOK Both FREE

Cut out and mail postage-free card today!

FIRST CLASS
Permit No. 20-R
(Sec. 34.9, P.L.& R.)
Washington, D.C.

BUSINESS REPLY CARD
No Postage Stamp Necessary If Mailed In The United States

POSTAGE WILL BE PAID BY

NATIONAL RADIO INSTITUTE

16th and U Sts., N.W.

Washington 9, D. C.

Start Soon to Make $10, $15 a Week Extra Fixing Sets

Keep your job while training. Many NRI students make $10, $15 and more a week extra fixing neighbors' Radios in spare time starting a few months after enrolling. I start sending you special booklets that show you how to fix sets the day you enroll. The multitester you build with parts I furnish helps discover and correct troubles.

Do You Want Your Own Business?

Many NRI trained men start their own successful Radio-Television sales and service business with capital earned fixing Radios in spare time. My book tells how you can be your own boss. Joe Travers, a graduate of mine, in Asbury Park, N.J., writes: "I've come a long way in Radio and Television since graduating. Have my own business on Main Street."

International Short-Wave

(*Continued from page 78*)

0700 - 0800, 1200 - 1700; Middle East Service 0800 - 0830, 1000 - 1200, same channels. (Bluman, Israel, via Radio Sweden)

El Salvador—Radio Nacional 9.55A, is noted in Spanish to 2300 closedown. (Bush, Chile; Zerosh, Pa.)

Fiji Islands — Suva's Post Office transmitter is now on 4.880. (Fox, N. Z., via Radio Australia) Station officials inform Scheiner, N. J., that it looks like they will settle down on ZJV3, 3.980, and ZJV, 930 kc., with ZJV3 serving outlying islands with 500 watts while ZJV will serve the main island of Viti Levu with 2 kw.; hours of transmission are 1400-1600, 1900-2100, 0030-0530, mostly in *English* although some vernacular programs are given in Fijian and Hindi.

Finland—Helsinki, 15.19, noted signing on 0640; has *English* 0700 weekdays *only*. (Pearce, England) News for North America is heard 1430-1445, good level in N. Y. (Steinberg)

France — Paris, 7.105, noted 1400-1500 in Czech, Slovak; bad QRM. (Zerosh, Pa.) Heard on 9.765 in Portuguese 1410 tune-in. (Bellington, N. Y.) Noted opening 0230 with "La Marseillaise" in beam to New Caledonia in French. (Takemi, Japan) Is good level on 11.70, 9.685 at 1800-1815; strong on 15.35 to Canada 1030-1045. (Sawyer, Ont.)

French Equatorial Africa — Radio Brazzaville noted on 15.595 at 1400, good level in French; left air *abruptly* 1409. (Ferguson, N. C.) Heard with news 1745 on 9.44. (McGrath, Iowa, Parson, Va.) And on 11.970. (Kroll, N. Y.; Granrose, Fla.; Frazier, Texas) With *English* 1550 on 11.97. (Hall, Que.)

French Guiana — Radio Cayenne, 6.210A, seems to be on the air *irregularly,* around 1745 - 1830 closedown. (Kary, Va.)

French Morocco—Rabat, 6.006, noted 1745 with Arabic vocal music; closed with "La Marseillaise" 1759. (Pearce, England)

French West Africa — Radio Dakar, 9.560, noted with French identification 1500. (Ferguson, N. C.) Good level 0300 with news in French. (Sawyer, Ont.)

Germany—American Committee for Liberation from Bolshevism, Inc., Munich, sent letter verification for reports on 7.130, 6.175 outlets; asked for further reports "regarding jamming noises," and said presently uses 6.055, 6.175, 7.130, 9.585, 11.720, 11.785. Heard on 6.055 at 0155 at good level in Russian dialects; 6.175 noted parallel 0200. (Pearce, England) *Sudwestfunk,* 6.320, noted from 1845-2000 closedown on *Sat.,* may close earlier other days; mostly music. (Huttemeyer, N. J.) RIAS, 6.005, Berlin, heard with dance music 2035. (Cox, Dela.)

Gold Coast—Accra, 4.915, noted 1240 with recordings; 1245 call in *English,* then news, weather forecast; closed

John Jerry Bartko, Masaryktown (Brooksville), Florida, 15-year-old sophomore at Hernando High School, won the top Class A prize in the first radio listening contest sponsored by "Boys' Life," national Boy Scout journal, and a Hallicrafters HT-20 transmitter. During the contest months of January-February 1953, young Bartko spent 400 hours at the controls and logged 4000 stations. He totaled 7145 points. All continents, all states, and all call areas, plus 105 countries, were logged.

1300; weak with CWQRM. (Pearce, England)

Greece — Armed Forces Station, 7.420A, is heard to 1700A sign-off, also from around 0030 *past* 0200; on *Sun.* has Orthodox religious service 0100 to *past* 0200. (Kary, Va.)

Greenland — Radio Angmagssalik sent letter verification; said operates on 7.570 as a part of the local Greenlandic News Service on 5.700 and 1500 kc., primarily for Danish and Greenlandic listeners in Greenland; listed power as 2 kw., using a dipole antenna directed SW-NE, 42 meters high, transmitter is suppressor-grid modulated; maintenance of the station—staffed by 16 Danes, 13 Greenlanders—is partly to collect weather observations from all Greenlandic stations, and to relay these to Denmark and to others who might be interested, and partly for local telegraph service *via Lynfby Radio,* Copenhagen, as well as serving as a common coast station for civil navigation; 1 kw. telegraphy-telephony transmitters are used on 500 kc., 2500; schedule for 7.570 and 1500 kc. is weekdays 0900-0950. (Pearce, England)

Guatemala — TGWA, 9.760, noted back on air around 1330. (Zerosh, Pa.) Heard 2130 tune-in. (Bellington, N. Y.) TGNB, 9.668, noted daily 2200-2345 closedown in *English,* fair to good level. (Brown, Wyo.)

Haiti—Radio Commerce noted *moved* to 6.090 from 6.140, good level to 2300 closedown. (Morgan, Balbi, Calif.) 4VEH, 9.69, heard in *English* 0830-0900. (Grace, Conn.) 4VC is good on 9.485 at 0800 in French. (Morrison, R. I.) *Radio Tropices* (formerly *Radio Fides*), 6.405, Port-au-Prince, is usually good level in French 1900, although at times has bad CWQRM. (Niblack, Ind.) 4VRW, 10.074A, noted 1400, an unusual time to hear this one in N. Z. (Collett)

Honduras—HRTL, *Radio Tela,* sent airmail letter verification for 6.035; relays 980 kc., 0900-2300 daily *except* Sun., has American music and songs daily 2120-2200. (Pearce, England; Bellington, N. Y.)

Hong-Kong—ZBW3, 9.525, Victoria,

noted 0615 at good level with music, news. (Sanderson, Australia) Has news daily 0900. (United 49'ers Radio Society)

Hungary — Budapest, 6.248A, noted with *English* from 2300. (Saylor, Va.) And 1930-2000. (Zerosh, Pa.) Announces *English* for North America as 1930-2000, 2300-2330, over 9.833, 7.220, 6.248. (Parrish, Ga.)

India—AIR, Delhi, noted opening to Southeast Asia and Far East 0830 on 9.565, 11.790; at 0945 close said next *English* for Southeast Asia would be 1930 on 9.755, 7.170; heard signing on *English* for Europe 0230 on 17.740, 15.380, closed 0330. (Pearce, Catch, England) Heard on 15.350 at 0245 with classical music; on 11.950A at 1945 with Home Service; on 21.510 at 0235 with news and music in Home Service; on 7.210 at 0715 with weather reports, local and general news; VUM, 7.260, Madras, noted 0600 with musical program and news. (Sanderson, Australia) Heard on 7.155 opening 0700 in Asiatic languages. Closes on 9.750 at 0815 after a program in Kouyu. (Kary, Va.) Opens in French on 3.950 at 1445, also on 7.170; news noted 1030-1045 on 4.760A. (Pearce)

Indo-China (Vietnam) — Radio France-Asie, Saigon, noted using 9.750A to Europe again 1035-1130A when closes with "La Marseillaise;" uses French and *English,* with news around 1100A. (Pearce, England; Balbi, Calif., others) Noted on 6.225A with identification in French 1800. (Stark, Texas) Heard on 11.925A with French news, then *English* program 2100; on 6.235A at 0525 with strong signal in French session; on 15.420 at 0405 with *English* program of news, music; on 9.745A at 2330 good level in French news, music. (Sanderson, Australia) Noted with French news 0300 on 6.116A. (Saylor, Va.) *"Voice of Vietnam,"* 9.62, Saigon, is fairly good in Tokyo 0500-0600. (Ishikawa) And with world news in *English* 0940. (Navarro, Philippines)

Israel — Tel Aviv some weeks ago was noted *testing* on 9.745 at 1500 parallel 9.010A and asking for comparison reports on the *experimental* 9.745 channel. (Pearce, England) Noted on 9.010A with news 1515-1530. (Zerosh, Pa.) And with "Voice of Zion" session in *English* 1615-1700 closedown. (Chapman, Pa,; Morrison, R. I.) Was heard earlier *testing* on 7.190 (Pearce)

Italy—Rome, *measured* 6.214, noted opening to Brazil in Portuguese 1915; Spanish 1935; Italian 2000. (Ferguson, N. C.) Heard with news 0400 for Australia on 15.300, 11.800A; asked for reports. (Pearce, England) Noted with news to North America 1920 on 7.29, 9.57. (Crowell, Zerosh, Pa.)

Jamaica — Radio Jamaica, 3.360, is fair level 0600-0715. (Parsons, Va.)

Japan — Sanderson, Australia, reports Far East Network on 3.975A at 0515 with variety program; JOB6, 11.725, at 0400 with news and music, good level; JOB3, 9.695, at 0410 with news.

(*Continued on page* 156)

THE TRI-POLE ANTENNA

By

DR. YUEN T. LO

Development Engr., Channel Master Corp.

Explaining the operation of a new TV antenna covering the low and high v.h.f. bands.

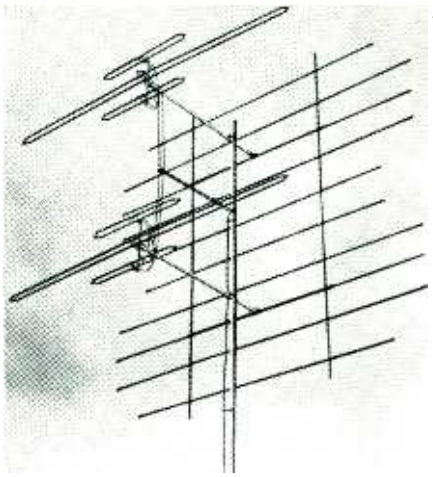


Fig. 1. Two-bay array of the twelve-channel v.h.f. antenna described here.

AMONG antenna manufacturers, there has been a steady trend toward the production of twelve-channel v.h.f. antennas to accommodate the many new TV stations on the air. This article will describe the development of a new type of antenna—the "Tri-pole"—used for TV reception of the entire v.h.f. band. (See Fig. 1.) The design of this antenna is based upon a study of the half-wave dipole antenna.

The current distribution along a half-wave dipole is shown in Fig. 2A. Since the size of the dipole varies inversely with frequency, and since the voltage that a dipole picks up is proportional to its length, a high-band dipole will pick up only about one-third the energy of a low-band dipole. (The frequency ratio of the middle of the high band to the middle of the low band is approximately 3:1.) If we attempt to use a low-band dipole for high-band reception, the current distribution is as shown in Fig. 2C. The dipole is then said to be working on its third harmonic. This current distribution results in the horizontal polar pattern shown in Fig. 2B. The low-band dipole can be considered to be three half-wave, high-band dipoles tied together. The lobe-splitting shown in Fig. 2B is due to the fact that the center dipole is 180° out-of-phase with the two outside dipoles which are in-phase.

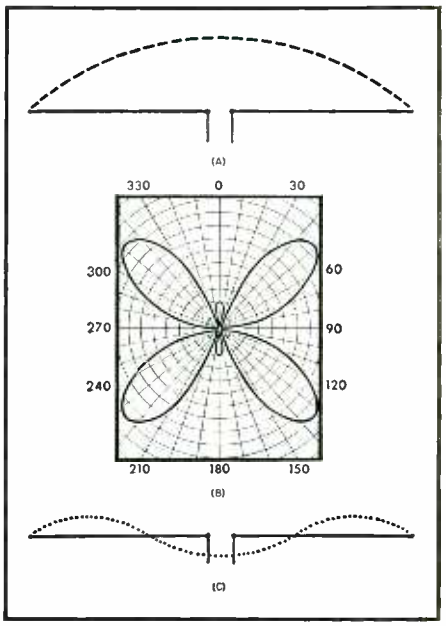


Fig. 2. Current distribution along: (A) a half-wave dipole, and (C) a dipole three half-wavelengths long. (B) Horizontal polar diagram for dipole shown in (C).

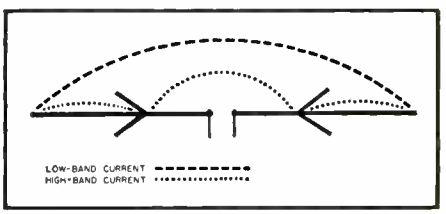


Fig. 3. Low-band and high-band current distribution along a "bat wing" antenna.

The desirable goal would be to have the three dipoles in-phase. A half-wave dipole, having the current distribution shown in Fig. 2A has, by definition, a gain of 0 db. Theoretically, the gain of three half-wave dipoles, side-by-side in-phase, is about 3.2 db. It must always be borne in mind that the same three half-wave, high-band dipoles must also function as one half-wave, low-band dipole.

One of the early attempts to achieve an all-v.h.f. dipole was the so-called "bat wing." Fig. 3 shows the current distribution for both high-band and low-band operation. The dipole structure acts as a half-wave dipole on the low band, but on the high band the "bat wings" form electrical discontinuities in the dipole and effectively isolate the outer third of the dipole on each side. This means that from apex-to-apex of the "bat wings" on the dipole, there is one half-wave on the high band. However, the full length of the antenna is not utilized on the high band.

Probably the most familiar types of broadband antennas are the conical or fan types. The total length of the elements equals one half-wave on the low band, and three half-waves on the high band. (See Fig. 4.) The current

WARD TELE-VANES

styled for **NEW BEAUTY on the housetops**

INCREASED SALES of TV antennas

Sell the antennas that are "selling" for you. Ward is promoting their new line of Tele-vane Antennas right to the consumer with national advertisements in:

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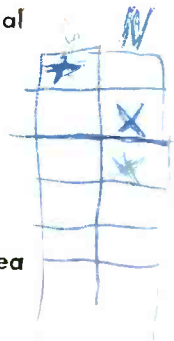
Write today for the giant Tele-vane Sales Kit that gives you the complete schedule plus many, many more selling aids. Tie-in with this gigantic selling campaign for the newest, most revolutionary idea in TV antennas yet.



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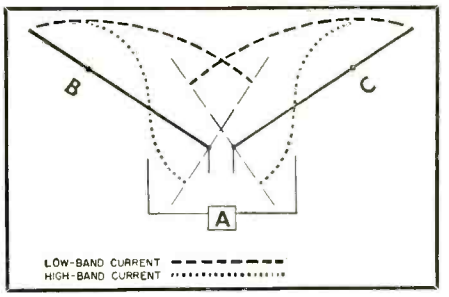


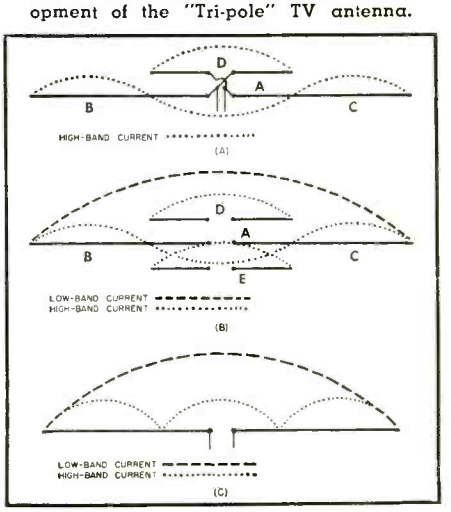
Fig. 4. Current distribution along a conical antenna cut for the low v.h.f. band.

distribution on the high band is the same as for an ordinary low-band dipole, with the outer two sections being out-of-phase with the center section. The normal split-lobe pattern is overcome by tilting the dipole forward from the apex. In this case, points "B" and "C," which are the electrical centers of the outer dipoles, are moved forward in space with respect to point "A," the electrical center of the inner dipole. Therefore, an overlapping of lobes occurs and, in this manner, a significant amount of the cancellation from the center dipole is overcome. However, this pattern still produces side lobes on the high band.

The problem in essence, therefore, is how to get the low-band dipole to act normally on its own band, and as three effective dipoles in-phase on the high band. The approach used in the "Tri-pole" is to reverse the phase of the center dipole during high-band operation. This is shown simplified in Fig. 5A. This configuration effectively produces another high-band, half-wave dipole immediately adjacent to the out-of-phase section in the low-band dipole, when operating on the third harmonic.

It is seen from Fig. 5A that, since dipoles "A" and "D" occupy almost the same point in space with relation to a received signal, they cancel one another, so that high-band operation is achieved through the use of dipoles "B" and "C." However, this approach produces only two half-wave dipoles on the high band. Low-band operation remains unimpaired. The next step,

Fig. 5. Progressive stages in the development of the "Tri-pole" TV antenna.



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MONEY BACK GUARANTEED TO RECEIVE *All* CHANNELS 2-83 FROM *All* DIRECTIONS AND POSITIVELY OUTPERFORM *All* OTHER ANTENNAS *WITH* OR *WITHOUT* A ROTORMOTOR

UP TO **10 TIMES MORE POWERFUL THAN ALL OTHER ANTENNAS**

Solves Your Problem in Your Area

Yes, we said YOUR area. With the FCC allocating over 2,000 new TV Stations covering 12 VHF and 70 UHF channels, your area is due to change and you will require an antenna able to receive both UHF and VHF channels from all directions. All Channel Antenna Corp. has just the antenna to fill your needs and money back guaranteed to positively bring you at your location, clearer, sharper, pictures than any combination of present day antennas using expensive rotor motors, boosters, etc. With a flick of the 9 position electronic beam selector switch, any station in any area is instantly brought in on any TV set clearer and sharper.

LIST PRICE **$36.75** SEE YOUR JOBBER

The Super 60 is the general purpose model for conditions prevailing in most communities today. Within a short time 15 to 20 UHF-VHF stations will be on the air within a 60 mile radius of every fair sized community. With the installation of the Super 60, you are improving your present reception in all directions and you are ready for the future.

LIST PRICE **$24.50** SEE YOUR JOBBER

The Suburban 40 has been developed for suburban areas where the stations are closer and trouble with distance is less of a problem — but the advantage of all direction all channel reception is necessary. A low priced high quality antenna for the present and the future.

LIST PRICE **$43.50** SEE YOUR JOBBER

Here is the real go-getter of the All Channel family. The Ultra 150 reaches out at long distances on VHF and gives you a bright, clear picture 150 miles and more. This antenna has solved the problem for thousands throughout the country where long range reception was otherwise impossible.

9 POSITION ELECTRONIC ORIENTATION SWITCH

PRICE INCLUDES

Antenna arrays - necessary stacking bars - 9 position switch - switch-to-set coupler - necessary hook-up harness - 7½" stand-offs Individually boxed in mailable carton.

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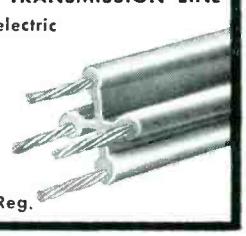

While antenna reception is guaranteed as specified, perfect pictures have been consistantly received from 2 to 3 times these distances.

ALL CHANNEL ANTENNA CORP.
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then, is to tie another high-band, half-wave dipole to these same feed points. (See Fig. 5B.) Fig. 5C shows the resulting current distribution of this system. As in the previous case, dipoles "A" and "D" can be considered to cancel each other out; but now dipole "E" fills the gap since this new dipole is in the same phase relationship as dipoles "B" and "C."

Adding all the currents together, dipoles "A" and "D" cancel each other out, and dipoles "B," "C," and "E" are in-phase. This system achieves in-phase operation of the three sections on the high band, and also functions as a half-wave dipole on the low band. However, due to low-impedance characteristics, it has limited bandwidth.

To obtain higher impedance for the configuration shown in Fig. 5B, folded dipoles are used. In addition, special quarter-wave transformer lines produce a total impedance of 300 ohms for the three dipoles in parallel. The screen-type reflector used with this antenna gives an optimum gain of about 7 db and is nonresonant. This means that the reflector itself is not frequency-sensitive. This was chosen in preference to a straight-bar reflector whose maximum potential gain is somewhat over 3 db which is achieved only at one frequency. —30—

ALUMINUM CHASSIS

By ARTHUR TRAUFFER

MANUFACTURERS of aluminum kitchenware are now putting out a complete line of small seamless aluminum utensils for little girls who want to learn how to bake and cook.

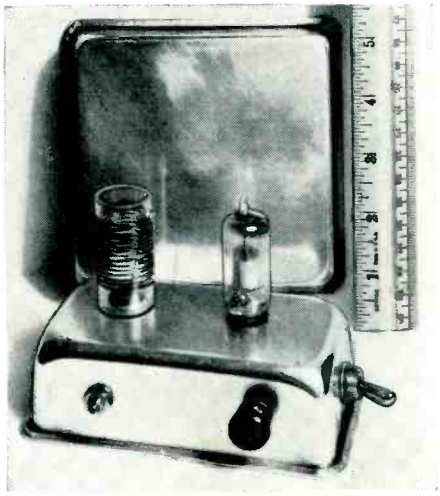
The photograph shows two of the little pans, selling for about 15 cents each, that are of interest to radio and electronic experimenters and gadgeteers.

Made of seamless aluminum, the loaf pan measures 5" long, 2½" wide, and 1½" deep, while the square pan measures 5" x 5" x 1⅛".

The photograph shows a fixed frequency r.f. amplifier built into the loaf pan while the square pan is propped behind it.

It's fun to work with these little pans; the aluminum is so soft and thin you can punch it and cut it with the small blade of a pocket knife. However, the metal is plenty stiff enough for radio construction projects. —30—

How toy aluminum pots and pans can be used as inexpensive, easily-worked radio chassis.



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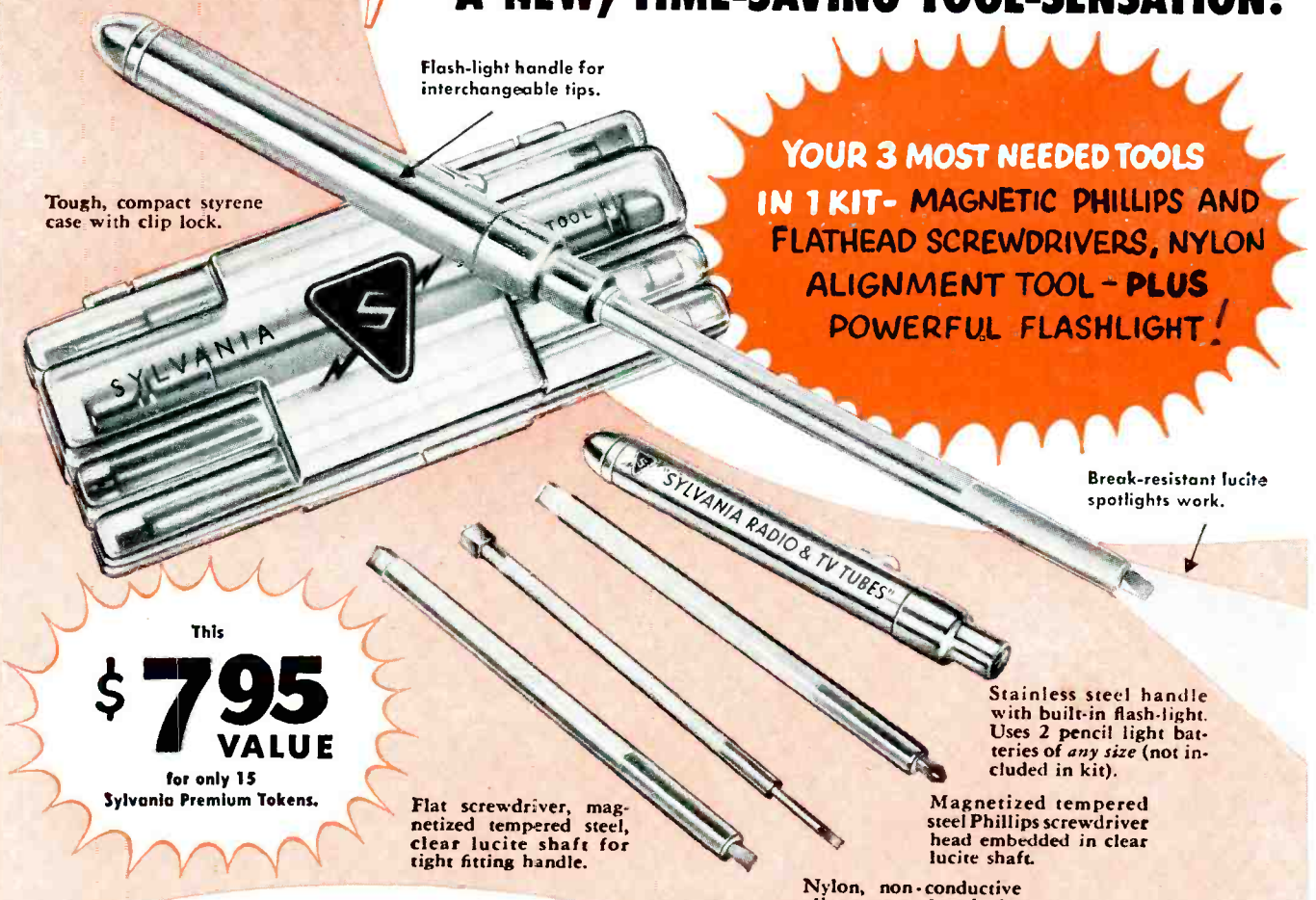

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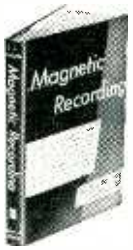

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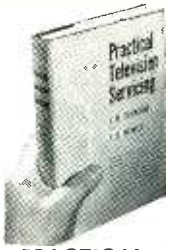

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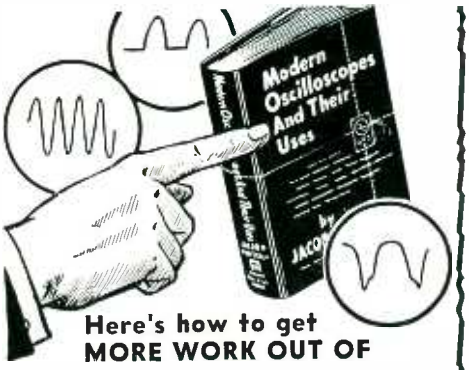

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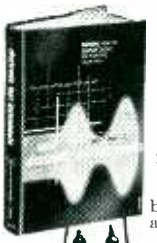

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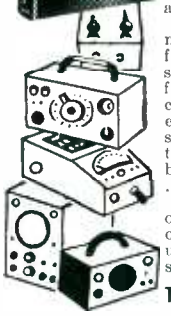

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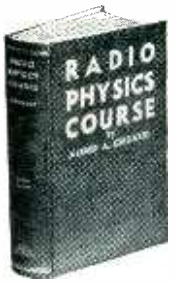

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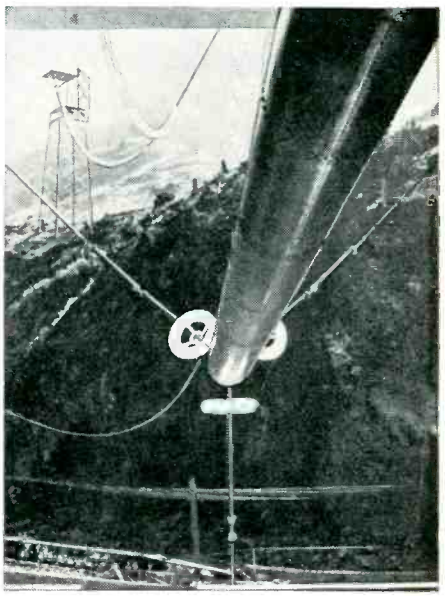


View from transmitter building along the antenna lead-in trunk, shows 145 foot bus tower halfway up mountain, one of thirteen which support transmission line. The "doughnuts" are corona shields guarding the trunk from damage by corona discharge.

THE world's most powerful radio transmitter has been put into operation by the U.S. Navy at Jim Creek Valley, Washington, in the heart of the Cascade mountains.

The new 1,200,000-watt radio-telegraph transmitter can send messages to Navy forces operating in any of the seven seas and its signals will penetrate to submarines cruising below the surface as well as to arctic outposts despite frequent magnetic storms and ionospheric disturbances.

The megawatt transmitter has been designed around the special *RCA* Type 5831, 500 kw. high-vacuum triode. Each of the two power amplifiers employs three 5831's, two in the push-pull circuit with the third available as a spare.

The transmitter also features microsecond fault protection developed especially for this equipment. This electronic device relieves overload faults in the super-power amplifier tubes in seven-millionths of a second and prevents the build-up of currents that could damage the tubes.

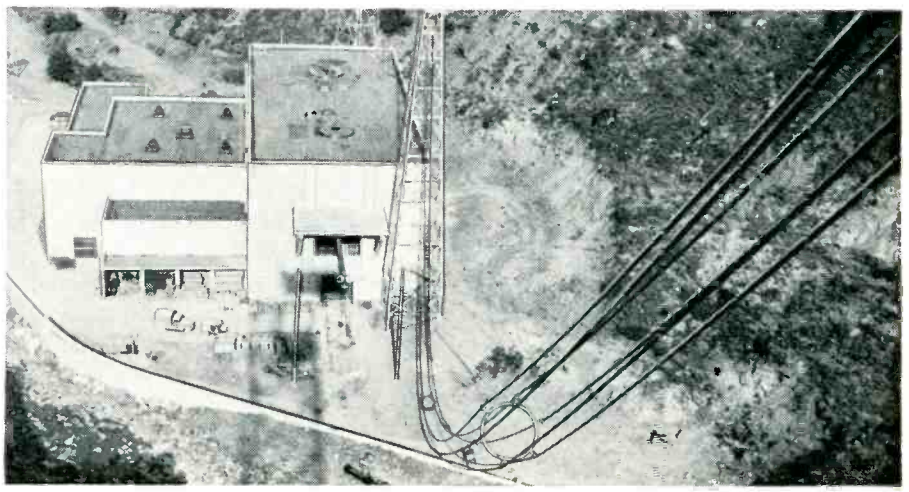
Tuning adjustments have been confined to remote push-button control of the antenna and power amplifier tuning. This is accomplished by special broadband amplifiers developed by *RCA* and used in its standard b.c. transmitters.

The antenna is a highly-efficient catenary-type with ten catenary spans, representing the largest antenna ever erected.

The transmitter itself is contained in an enclosure 80 feet wide by 50 feet deep. The transmitter is arranged in "U" shape with the supervisory control console and the operator's desk located between the wings of the "U."

The windowless transmitter station is several stories high and is shielded against the intense electromagnetic field. The structure also includes a machine, electrical, sheet metal, and other servicing shops as well as storage space. —30—

Bird's-eye view through steel framework of 200-foot summit ridge tower shows transmitter building nestling in valley between 3000-foot mountains.



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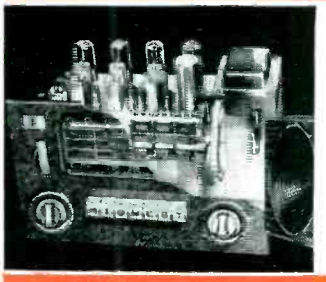

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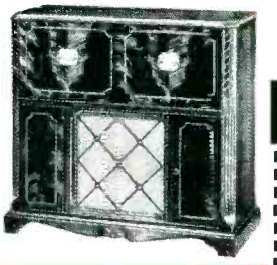

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Amateur's Superhet

(*Continued from page* 45)

3500 kc. with the mixer tuning condenser, C_3, set at nearly maximum capacity. Likewise, the range 7000 to 7300 kc. should peak up with a low capacity setting of C_3. If it is not possible to peak up both bands, it will be necessary to prune the coil L_1. With the cathode tap at three turns from the ground end of L_1, as specified in the coil data, no difficulty should be encountered in getting the mixer to regenerate. If the mixer will not regenerate after connecting an antenna, it probably indicates too close a coupling in condenser C_1. The antenna trimmer condenser, C_1, should be increased in capacity for a short antenna and decreased for a long antenna.

For those not possessing a calibrated signal generator, an alternative method of alignment will be suggested. This method requires the use of a grid dip meter and a calibrated communications receiver, both of which are more generally available than the required test gear.

Under this method the two local oscillators are first set to their proper operating frequencies. This may be done by getting an approximate setting with the grid dip meter and then an exact setting by listening to the signal of the given oscillator in the communications receiver. With the proper setting of the second oscillator, a 1500 kc. signal applied to the grid of V_2 is converted to 175 kc. in the output. Using an unmodulated 1500 kc. signal from the grid dip meter in this manner, it is necessary to adjust the regeneration circuit along with transformer T_3 in order to obtain an audible signal in the headphones. After this is accomplished, the remainder of the alignment may be performed using the signal from the dip meter in much the same manner as the signal generator was used.

After completion of alignment, an antenna may be connected and the set is ready for many pleasant hours of operation. Almost any single-wire antenna may be used from a three-foot whip to a half-wave on eighty. The longer antenna, in addition to providing greater signal pickup, has the advantage of causing the mixer tuning to be quite broad. This means that it is not necessary to readjust the mixer tuning every few kilocycles as is necessary when using a short antenna. The adjustment of the antenna trimmer condenser, C_1, is not critical but, in general, it is desirable to have the maximum coupling that will allow the mixer to regenerate at all settings of its tuning control.

In operation the second detector may be operated in an oscillating or non-oscillating condition depending on whether c.w. or phone is to be received. The second detector regeneration control is operated in the same manner as the control in a simple re-

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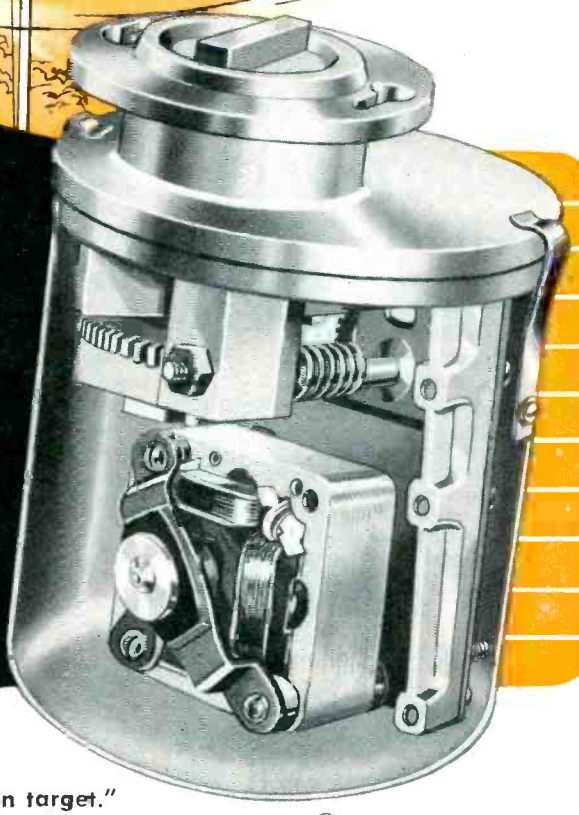
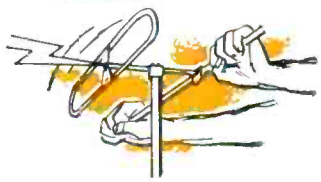


At last! — an antenna rotator that really **stays "on target."** With **Superotor** there's no jumping up to make adjustments, because it locks in place **two** ways, instead of one. First, a motor brake eliminates "coasting"; second, a worm gear lock prevents "drifting." This exclusive double lock also permits rotation in increments of **less than ½-degree**, enabling razor-sharp tuning for top UHF reception!



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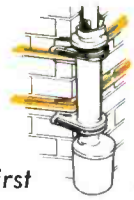

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generative receiver. There is, however, no detuning effect from operation of the main tuning control. Those who have operated a simple regenerative receiver will find the regeneration control on this set very smooth indeed.

The mixer regeneration control is always adjusted so that the mixer will be non-oscillating. Allowing the mixer to oscillate will cause spurious signals to be heard due to autodyne action. Maximum gain and selectivity are realized with the regeneration set just below the point of oscillation. This may have to be readjusted slightly from time to time in tuning across the band or upon changing bands.

With the mixer tuning control peaked up at its low frequency end, the main dial should cover the range 3500 to 4300 kc. and with a high frequency setting of the mixer the range should be 6500 to 7300 kc. In practice, operation of the receiver may be done with one hand and only an occasional trimming of the mixer.

From the foregoing description the operation may sound a bit formidable. Actually that is not so. If the set has been well constructed. using good quality components, the result will be a first class communications receiver with excellent stability, selectivity, and sensitivity, but with coverage of limited bands. -30-

Positive Grid Circuits

(*Continued from page* 63)

fier. This direct connection places cathode 8 at about the same d.c. potential as plate 1 and necessitates that grid 7 receive an offsetting positive voltage. This is supplied by the voltage divider R_1 and R_2 and from this network grid 7 is given the proper operating voltage to provide the correct bias for the second r.f. amplifier.

It is interesting to note that both tube sections are in series with each other so that the same current flows through both sections. Also, a.g.c. bias is applied only to the first triode but its effect is felt by both stages because of the series connection.

This trend toward placing tubes in series is being adopted by a number of television manufacturers and is not confined only to the cascode amplifiers mentioned. A popular practice is to string one or more tubes in series-parallel arrangement across the power supply, as shown in Fig. 6. Here, between the power supply terminals of 360 volts and ground, we find the audio output amplifier, a 6V6GT, in series with a number of stages, all of which are in the front end or video sections of the receiver. Of the applied 360 volts, 230 volts are dropped across the audio amplifier tube, leaving 130 volts at the cathode. This 130 volts then serves as the plate "B+" for all of the stages to which it is connected.

The reason for using such an arrangement stems primarily from its economy. To obtain 130 volts from the power supply would require a voltage divider with appropriate bleeder resistors to step down the voltage from 360 volts to whatever level is desired. High-wattage bleeder resistors, however, are quite costly. However, by arranging the stages as shown in Fig. 6, the correct voltage distribution can be obtained without bleeder resistors. The audio amplifier tube carries all of the series current while the remaining tubes in the bottom half of this string use as much of this current as they need.

Note that the cathode of the 6V6GT audio amplifier is positive and hence the grid must be given a similar positive voltage in order to establish the proper bias. The bias value in this set is 122.5 volts for the grid, leaving this element negative with respect to the cathode by 7.5 volts.

When tubes are connected as shown in Fig. 6, many defect indications appear which differ from those obtained in a more conventionally designed receiver. Thus, failure of the audio amplifier tube to conduct will remove both sound and picture and raster from the set. Raster removal occurs because one of the accelerating elements of the picture tube is tied into the +130-volt line. Thus, the importance of the audio output tube rises sharply in such an arrangement.

Perhaps the prime lesson to learn from all this is that:

1. Tubes operate by the relative potentials between their several elements and not by the potential between an element and some arbitrary reference level, such as the chassis.

2. Positive grid voltages are perfectly feasible for certain applications.

Learn this and you have taken a long stride toward better television servicing. -30-

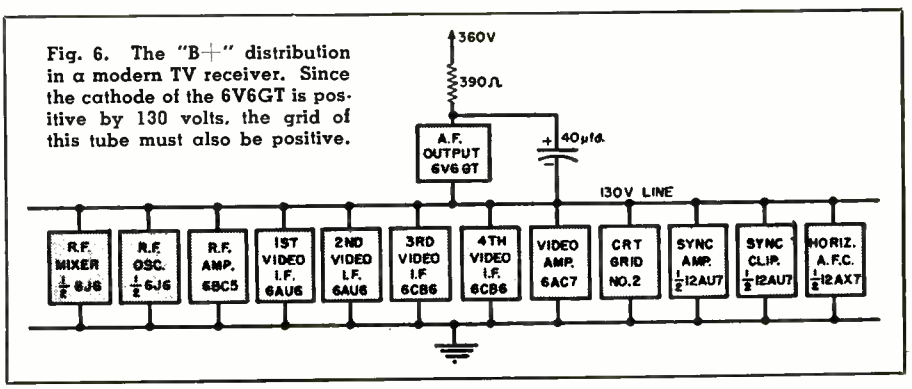

Fig. 6. The "B+" distribution in a modern TV receiver. Since the cathode of the 6V6GT is positive by 130 volts, the grid of this tube must also be positive.

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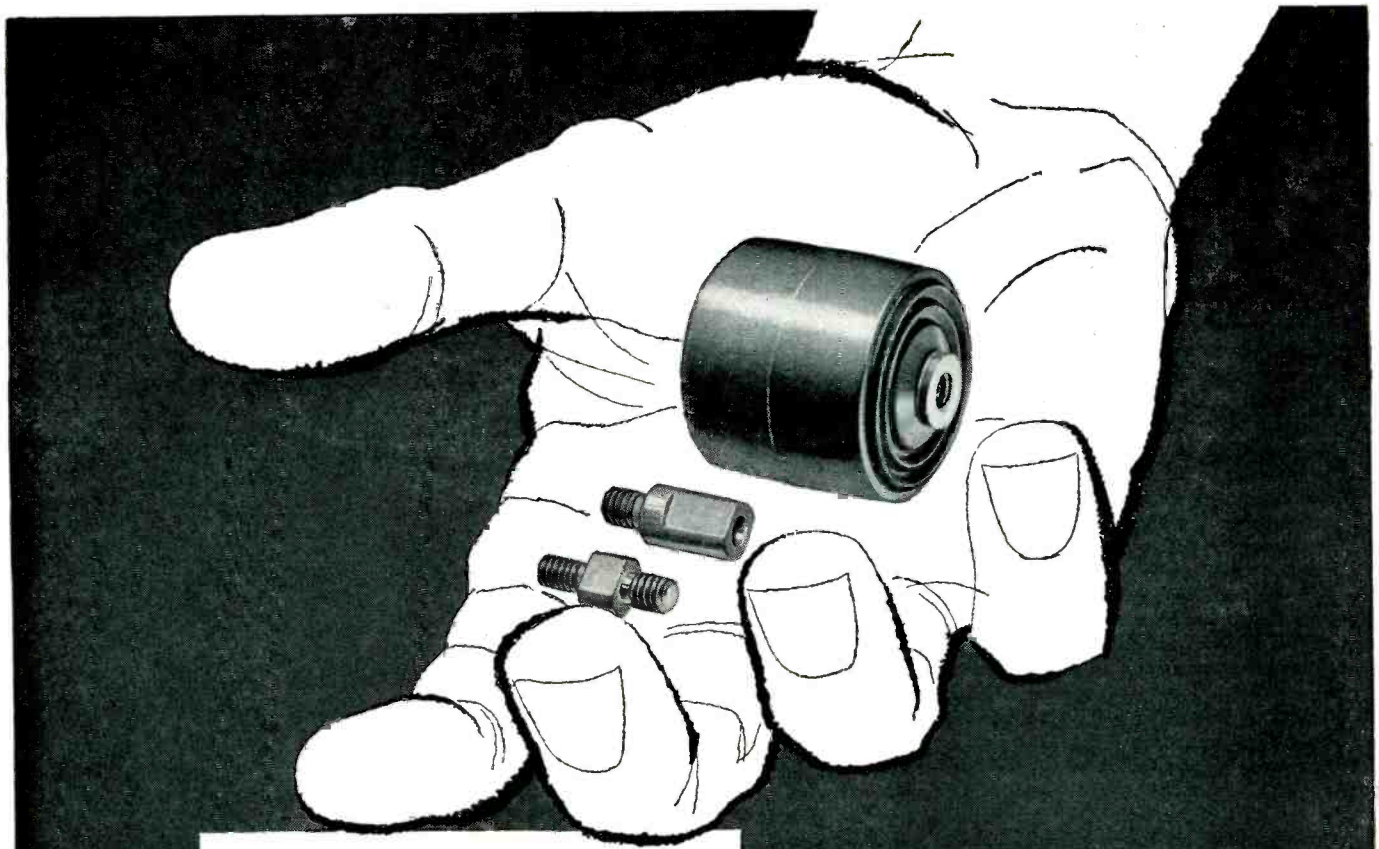

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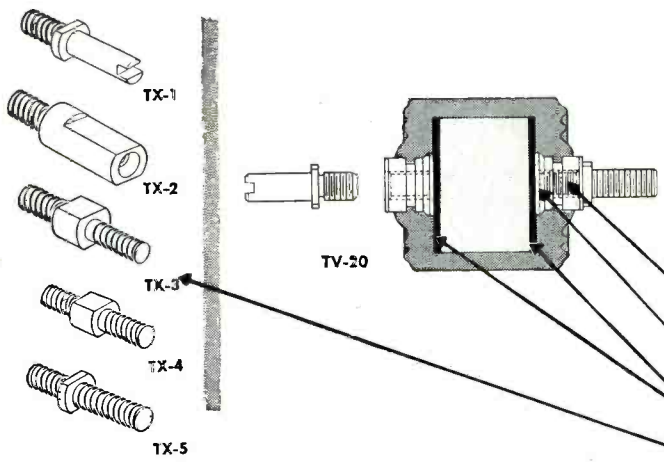

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Tracing Aid

(*Continued from page 65*)

forms in a system (amplifier, filter, etc.) under test. A tracing of the input waveform is first made, and the pad left in place. The scope is then connected to the output, and the output waveform appears superimposed on the input previously traced on the paper. Direct comparisons are then easily made. Small variations in gain may be observed. Distortion that might otherwise be ignored becomes apparent.

Since the Tracing Aid is basically an aid to copying, its use is not confined to tracing scope patterns. It may be used equally well to make copies of drawings or diagrams, to sketch equipment, etc. It cannot be used to copy written matter, however, due to the inverted image.

To use for copying, simply hang the material in front of the aid, so that it is in about the same position as the scope screen would be. The material should be adequately illuminated.

To use for sketching, place the object to be sketched in front of the aid, on a box or stand. Then sketch the image that appears superimposed on the same pad in the manner that the scope image is traced. —30—

TV SERVICE BENCH REPORTS

By MILTON A. KENNEDY, JR.

MOTOROLA TS-74

A hum, very much like sync buzz, was found in this model. Removing the 6J5GT vertical oscillator tube cleared up the hum. However, replacement of the 6J5GT by another glass-type tube did not help at all. When this tube was replaced with a metal one, the set worked fine.

TRAV-LER 219-8A

After this set warmed up, it began to squeal and the raster left the screen. This trouble was traced to an open filter off the high side of the horizontal tank coil. This filter condenser is approximately 15 μfd.

TELE-TONE TV-333

Attempting to set the brightness control to its fullest range caused very bad tearing in this set. This was remedied by lowering the screen voltage on the horizontal output tube.

HOFFMAN 21" SET

Arcing in the high-voltage cage was the problem on this receiver. This fault can usually be corrected by removing the complete 1B3 socket assembly, and cleaning the socket and porcelain standoff with some solvent. However, in this case, this was not good enough.

Normally, the filament winding of the 1B3 consists of only one loop around the core of the high-voltage transformer. On these sets, however, two loops are used. Removing one of the loops eliminated the arcing and did not appreciably affect the brilliance of the raster.

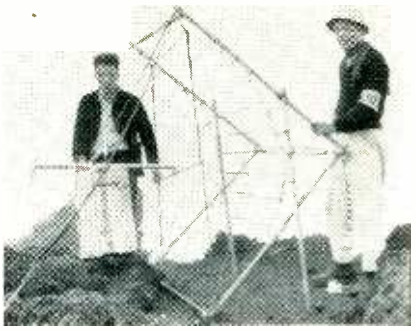
WESTINGHOUSE H-619T12

This set had an intermittent squeal during which time the raster vanished. A circuit check revealed that the plate (pin 6) voltage of the 12AU7 horizontal oscillator tube was a few volts too low. The defective part was the 220,000-ohm plate load resistor. —30—

TV ON MT. FUJI

By **KOICHI KASAHARA**
Exec. Dir., Japan Amateur TV Club

Japanese amateurs check signal strengths during unique series of tests held atop Mt. Fujiyama



A parabolic reflector on Mt. Fuji, made by joining several alpenstocks.

LAST summer an interesting TV reception test was made by the Japan Amateur Television Club on top of Mt. Fuji. The test was carried out by fourteen TV amateurs during a three day period from August 2 through 4 in cooperation with the Japan Broadcast Corp. and the Electronics Laboratory of Shizuoka University which handled the transmissions.

Three TV stations of the Japan Broadcast Corp. in Tokyo, Nagoya, and Osaka, and an experimental TV station of the Electronics Laboratory at Hamamatsu took part in the test with special programs transmitted on the same carrier frequency and with the same standards. Such programs were transmitted successively, alternately, and simultaneously from each of the TV stations in order to permit the TV amateurs on Mt. Fuji to study the various forms of interference as well as to enjoy DX television reception at an altitude of 3775 meters (12,200 feet).

The television stations taking part in the test were JOAK-TV (Tokyo) with an output power of 5 kw.; JOBK-TVX (Osaka) 5 kw.; JOCK-TVX (Nagoya) 500 watts; and JJ3A-TVX (Hamamatsu) 15 watts.

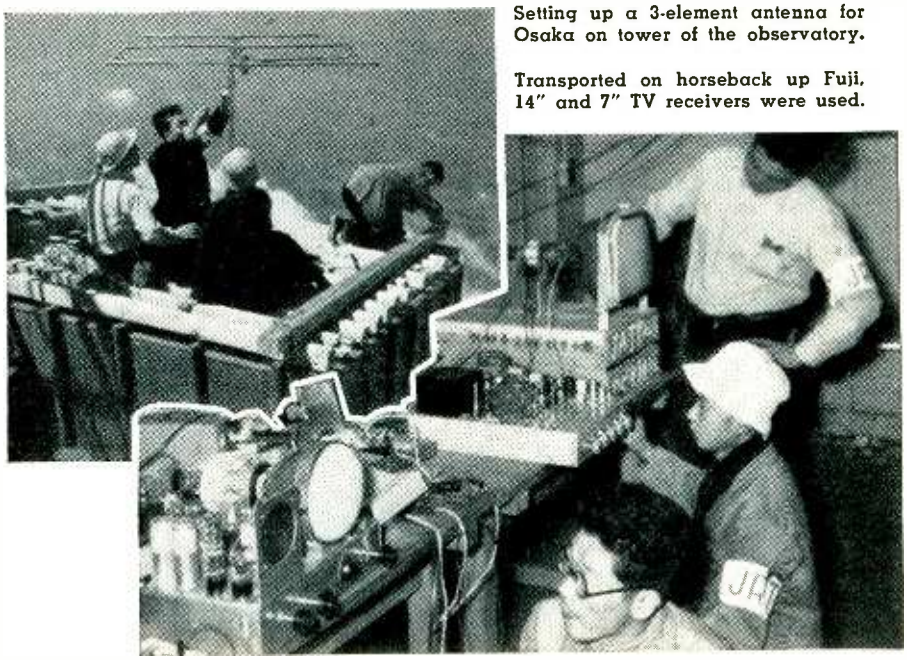
The distances from the stations to Mt. Fuji and the antenna input intensity of the television signals measured on Mt. Fuji are as follows: Tokyo (105 km. or 65 miles) 75 db; Osaka (315 km. or 195 miles) 58 db; Nagoya (108 km. or 67 miles) 21 db; and Hamamatsu (90 km. or 52 miles) 32 db.

Television signals from Tokyo and Osaka were received at practically local level. Nagoya was not received successfully, due, no doubt, to the mountains near the city. Hamamatsu was received much clearer than any of us had anticipated. Station JJ3A-TVX used a two-element doublet beamed directly at Mt. Fuji.

Many interesting results were obtained from the experiments involving interference and further studies are currently being made based on photographic evidence obtained on Mt. Fuji.

During reception lightning was seen in the cloud layers below Mt. Fuji but, surprisingly, noise images, as generally seen at home, were not observed on the *Braun* tubes being used in the tests on Fuji.

Few ghost images due to clouds were observed but a peculiar triple ghost image was observed at night. It was photographed in order to permit further study. —30—



Setting up a 3-element antenna for Osaka on tower of the observatory.

Transported on horseback up Fuji, 14" and 7" TV receivers were used.

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The Scott 99-A

(*Continued from page 67*)

those recording curves in widest use. A very widely used equalization curve for LP records is the original one introduced by *Columbia*. This curve uses more bass and treble pre-emphasis in recording than most and therefore requires less bass and treble compensation in playback. This curve was included in the 99 equalization.

On any professional instrument, such as the 99, it is necessary to make provision for older and foreign records, so the curve marked "EUR" in Fig. 3 was added to the equalization. This curve has a turnover of approximately 250 cycles and a flat high-frequency response.

The AES and new NARTB curves are also widely used. These curves are very similar except in extremely low frequency response. Since each curve is specified to an accuracy of ± 2 db, each curve falls within the tolerance limits of the other. It is therefore possible to draw a single curve falling within these tolerances over practically the entire range of equalization. This combined curve was provided in the equalization, and it is entirely adequate for playing recordings made for either the AES or NARTB curve. (The *RCA* "New Orthophonic" curve is the same as the new NARTB). Since both turnover and roll-off equalizer controls have three positions, a total of nine record compensation curves is possible. For example, a combination of the *Columbia* turnover with the AES roll-off provides an almost exact match for *London* records. Similarly, the "EUR" low-frequency equalization used with the LP high-frequency response provides a perfect match for old 78 rpm *Columbia* shellac records. Table 1 gives a chart of equalization settings for many records. Further compensation for conditions such as pickup response, speaker response, speaker enclosure characteristics, room acoustics, and personal preferences may be obtained easily with the wide-range treble and bass tone controls.

These tone controls are continuously variable throughout their range and each provides either wide-range boost or attenuation of the response. The maximum treble boost or cut is ± 20 db, while the maximum bass range of the control is ± 15 db. These specifications are in addition to the progressive boost provided by the automatic loudness control.

Complete and continuous adjustability of the loudness compensation itself is an interesting feature. The automatic loudness control, of course, compensates for the human ear's insensitivity to extremes of treble and bass at low listening levels. This is done by progressively boosting the treble and bass response as the volume control is turned down. To maintain satisfactory tonal balance, treble loudness compensation is necessary

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excellent condition $14.95 (less tubes) **with 21 tubes $24.95**

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Low Freq. Crystals—FT 241 A for SSB, lattice filter, ½" spc. 54th harm channels listed by fund. Fractions omitted.

370	388	407	425	444	462	481	501	
372	390	409	427	446	464	483	503	
374	392	411	429	448	466	485	505	49c each
375	394	412	431	450	468	487	507	
377	396	414	433	451	470	488	509	10 for
379	398	416	435	453	472	490	511	
381	400	418	437	455	474	492	512	$3.00
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387	405	424	442	461	479	498		

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used, as is, less tubes and cover, excellent for parts only $6.95

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EXCELLENT CONDITION **$9.95**
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Made to operate in conjunction with Radio Receiver R-9( )/APN-4. Unit includes 19 tubes, one 5" scope tube, crystal controlled standard oscillator, sweep circuits, marker pulses.
Excellent cond. **$42.50**

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BC-455 Receiver, 6 to 9 mc	—	9.95	—
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PE-218, inverter, excellent condition 24.95

BC-640 ..... $695.00
BC-639 with RA 42 rectifier 225.00

NATIONALLY ADVERTISED TUBES

5BP1 ..... $3.95 5AP1 ..... $3.95
All Brand New in Original Cartons
304TL ..... $5.95 720DY $29.50
808 ..... $1.95

QUANTITY PRICES AVAILABLE!

1625, 1626, 33, 34, 954, CK1005, 6Z7G, 9002, 9006, 1619, 955, 9004, 12A6, 1F4, 1F5, 2I1, 6F5, 1A6, 1629, 19, 50.

10 for $3.00

RT7/APN-1 TRANSCEIVER UNIT—Used as an altimeter, it may be converted for signaling control circuits, etc. Used, less tubes, as is **$4.95**

RT/34 APS 13 TRANSCEIVER—Used as a tail warning radar on 415 MC. Containing a 30MC IF Strip and various other parts, these units have been stripped of RF sections and all tubes, but are an excellent buy if only for parts and IF Strip. Used **$4.95**

BC 906 FREQUENCY METER—Range 150-225 MC with modification possible for lower frequencies of TV, etc. Contains 0-500 DC microammeter and uses Battery pack of 1.5 V and 45 VDC **$4.95**

R-1/ARR-1—220 MC converted with minor alterations becomes a high gain converter with two stages of RF amplification—(complete with diagram). New **$4.95**

ALL FOUR ABOVE ITEMS FOR $10.00

BEAM ANTENNA SELSYN TRANSMITTER and indicator, per set **$12.00**
BC-684 FM Transmitter, 27-38 mc, used, exc. **$14.95**
BC-604 FM Transmitter, 20-27 mc, used, exc. **$11.95**

LOOK WHAT YOU GET FOR $14.95

- 350 feet of continuous length of 50 ohm coaxial cable
- 100 feet of same coaxial cable
- Cavity type attenuator
- 6 Short lengths of RG8U with connectors and sockets
- In wooden case—shipping weight 30 lbs.—all for $14.95

BC 347 Interphone Amplifier $2.95
I-70 Tuning Meter ..... .89
APS 13 UHF Antenna, Pair ..... .98
I-97 Bias Meter $3.95 4.95
RL 42 Antenna Gearbox Motor and Reel 1.95
BC 1066 B—150 to 225 MC Portable Receiver adaptable to many amateur uses. Used $5.95
One Tube Interphone Amplifier—Small compact aluminum case fully enclosed. 2¼"x3¾"x5¾". Less Tube 79c
BC 709 Battery operated lightweight interphone amplifier. Complete with tube and shock mount, but less battery ..... New $3.95

DYNAMOTORS

DYNAMOTORS: The best dynamotor for conversion to 6v. Multiple windings! After conversion you get choice of 190 or 350 v. at 50 MA or 250 v. at 100 MA. Complete dope sheet furnished.
BRAND NEW (See "CQ" Aug. issue) **$4.65**

DM-28—Dynamotor for BC-348—28V DC at 1.25 amps in 220 V at 70 MA output Good $4.95
DM-32A—Dynamotor for Command Receiver 28V at 1.1 input 250V at 60 MA output ..... Used 2.95 New 7.50
DM-33—Dynamotor for Command Transmitters—Used $2.95
D-101 Imp. 27V 1.75 Amp. output 285 VC .075 amp ..... each $1.95
3 for $5.00
PE-94 ..... each $1.95
PE103—6V Dynamotor ..... Used $22.95
BC-1033 62-80 mc recvr. Like new, less tubes ea. $5.95
BC-1023 brand new with tubes 9.95

SCR-625—FAMOUS ARMY MINE-DETECTOR

For Prospectors, Miners, Oil Companies, Plumbers, etc. This unit is being offered now at a considerable reduction in price. Recently advertised at $79.50 it is now available in the same brand new wrappings in suitcase style carrying case (less batteries).
New **$59.50**
SCR-522—Transceiver, complete in case with top bracket, less tubes **$29.95**
RU-19—Receiver. Complete control box and coils—brand new ..... ea. **$17.95**

BUY NOW! R W ELECTRONICS Dept. N, 2430 S. Michigan Ave., Chicago 16, Ill. **BUY NOW!**

PHONE: Calumet 5-1281-2-3

as well as compensation for bass tones, if a "boomy" effect is to be avoided at low listening levels.

It should be pointed out that the loudness compensation provided in the 99 is based on extended listening tests by juries of listeners rather than upon blind application of the *Fletcher-Munson* curves. Using a variety of program material, the listeners were allowed to adjust calibrated variable condensers until the music sounded best to each listener. These adjustments were made at many different volume levels. The tests, over a period of months, were statistically correlated so that subsequent analysis provided loudness compensation curves with contours and degrees of compensation most pleasing to the human ear. This was particularly important because the attempts, in some loudness controls, to provide extreme *Fletcher-Munson* compensation had almost caused loudness compensation to fall into disrepute through the invalid application of the *Fletcher-Munson* effect.

For broadcast and recording applications, of course, little or no loudness compensation may be required or desired. The loudness compensation may be continuously adjusted or entirely removed by proper settings of an input level control in conjunction with the loudness control. This input level control also permits compensation for the different outputs of various commercial pickups. For example, to remove loudness compensation entirely, the loudness control may be turned to a high value thereby removing compensation from a circuit. Volume is adjusted by the level control which functions as a simple volume control.

An input selector switch is also provided. This allows ready selection of "Tuner," "Phono," "TV," "Tape," or other channels. Separate input jacks are provided on each input circuit. In addition to the usual constant-velocity "Phono" input for magnetic pickup cartridges, a constant-amplitude input is provided for FM pickups. The constant-amplitude input is obtained with a differentiating network which matches the constant-amplitude pickup to the normal constant-velocity response of the preamplifier circuits.

On the underside of the chassis, input jacks are provided for connection of an accessory "Dynaural" noise suppressor, such as the Type 111-B. The "Dynaural" noise suppressor virtually eliminates high-frequency record scratch and low frequency turntable rumble, without eliminating music components which are audible to the human ear. The patented "Dynaural" noise suppressor should not be confused with fixed filters, since these latter eliminate audible musical frequencies under all conditions where undesirable noise and rumble are eliminated. The dynamic rumble suppression feature is particularly important with wide-range systems which include extended bass response speakers. All but the very best professional turntables are susceptible to some rumble, and sometimes rumble is actually recorded on records. Under such conditions, dynamic rumble suppression can increase listening pleasure without loss of any low bass musical tones. The inputs for the noise suppressor may also be used for dubbing records on tape while continuing to monitor through the normal sound system.

Speaker output terminals of 4, 8, 16, and 500 ohms are provided, allowing use of virtually any speaker or professional line-impedance conditions. A separate a.c. power outlet is provided on the rear of the chassis for powering accessory components such as turntable, tuner, etc. The power supply operates on 105 to 125 volts, 50-60 cycles. A "Slo-Blo" fuse provides circuit protection but prevents fuse burnout as a result of normal a.c. line transients.

It is believed that this new amplifier will be a significant contribution to professional music reproduction since the 99 exceeds all FCC requirements for FM broadcasting station performance. While its circuits are similar to those of previous *H. H. Scott* amplifiers, the over-all electronic and mechanical design is completely new and of rather remarkable simplicity. In design, construction, appearance, and performance, the 99 meets, in every respect, the amplifier standards established by its manufacturer. —30—

SNAP-ON GROUND CLAMP

By ARTHUR TRAUFFER

THOSE Gibson "gripper clips," which sell for 10c each at many hardware stores, make handy radio ground clamps for experimenters, or for use with portable radios, etc. You simply snap the clip onto a cold water faucet, or onto an unpainted water or gas pipe, and then pull the clip off again when you are through.

As shown in the photograph, fasten a binding post in the mounting hole on the flat side of the clip, and then connect your ground wire to the binding post. The binding post also serves as a handle for snapping the clip onto the pipe and for pulling it off again.

These clips are made in two sizes, and with chrome finish or black finish. The chrome finished clips are best for use as ground clamps. —30—

A simple and inexpensive ground clamp.

ference from other stations is fairly high. It is common, in such cases, to be able to hear interfering modulation in the background. However, it was said, the continuity of the program will usually enable the listener to follow the correct station unless the interference is drastic. Such coverage will be found to be usually considerably less than that of any signal station; and this is a high limitation.

In rural areas, coverage may or may not be intelligible, depending on the particular situation. This coverage aspect, it was noted, is of greatest importance in metropolitan areas, where the population density makes it imperative that every means possible be used to avoid mass panic and provide instructions for the movements of large numbers of people. Civil defense organizations will use the Conelrad system to give evacuation instructions in case of an attack.

When the Conelrad rules were originally issued, the Commission said that all FM and TV stations would have to go off the air, when the alert is sounded. Now, it has been reported that the FCC has not permanently shut the door on FM or TV sign-off. If someone can prove to the Commission's satisfaction that the operation of the high-frequency stations will be safe during *C* operation, it will revise the rule. To date, there has been no safe method devised to permit such operation, as with standard stations.

TV SATELLITES OR BOOSTERS, or both, may soon appear on the broadcast scene, in communities where it has been found economically unsound to install even small stations and where reception from any neighboring station has been found to be impossible. A manufacturer and a broadcaster have petitioned the Commission for permission to operate such stations on a regular basis. It was noted that the booster permits transmission of programs from the master station on the same channel, while satellites retransmit programs on different channels.

In support of its request, the broadcaster who wants the booster grant, said that there are hundreds of additional markets with channel assignments not adequate for even the smallest station. It was pointed out that during the latter part of the year, the table of assignments showed that there were 1283 cities; no applications were pending or grants made to around 900, or about 70 per-cent. Of that number, it was said, over 500 were in areas of less than 10,000 population, over 200 in zones with cities of between ten- to twenty-thousand, and about 100 in areas with populations over 20,000. The petitioner then said that, according to TV market reports, there are only 112 markets in the country with populations of at least 35,000 or more

in a 50-mile radius, which are useful to national advertisers. Since a minimum investment of $100,000 must be made for the smallest station, the broadcaster added, an operator will find it impossible to amortize this expense and survive in the remote areas without national advertising support.

The broadcaster asked the Commission to approve operation of subsidiary stations, with power output of 10 watts at 300-foot average antenna elevation for low ultra-high stations; 31.6 watts for high v.h.f. stations; and 100 watts for upper ultra-highs; all for unattended systems using vertical polarization. The boosters would be required to have automatic power shut-off facilities and provide identification only at sign-on and sign-off.

The satellite proponent declared that his system offered more freedom of program selection. This argument has won the support of Rep. Bush who declared that such flexibility was important. In addition, he said, the use of specially-approved channels for the satellites on low power, would remove the problem of interference that could obtain on mother-station operation using the same channel.

The Congressman also went on record not only urging the approval of satellites but their use in place of community systems, which he called unreliable. For over a year the Commission has been probing the exact place of the community system in the broadcasting picture, and as reported in earlier columns even Congress has taken a lively interest in the matter.

Either the boosters or satellites could be built for between ten and twenty-thousand dollars, applicants declared, and the maintenance costs would be very low.

Both the broadcaster (WSM, Nashville) and manufacturer (KG2XDU-KG2XEL owned by *Sylvania*—channel 82) are operating their systems experimentally and with substantial success, it was said.

INDUSTRIAL MOBILE radio makers and potential users are making a bid for a portion of the FM band in an effort to expand two-way service facilities. The request, to be filed with the Commission, is being prepared by a committee on manufacturer's radio use of the National Association of Manufacturers.

According to a spokesman of the NAM, the re-allocation of the FM band is now simply a question of when, and not whether. This drive has been prompted by the apparent declining use of the FM bands for broadcasting; members of the Commission had warned broadcasters that unless they took a more active interest in FM, others would seek slices of the band. Only a few weeks ago, Commissioner Webster reviewed the seriousness of this situation.

Commenting on NAM's concern for more bands, the association spokesman added: "The Commission now has outstanding proposals in the mobile field

that will cut back many types of radio use formerly found to be in the public interest. How are those proposals, for example, to be squared with a substantial non-use of the FM broadcast band? . . . Of course, it is no answer for the existing FM broadcast licensees to suggest that they will meet the demands for mobile radio service by multiplexing their present facilities and supplying such service, presumably on a charge basis . . . There are existing communications common carriers in almost every community of any size who will vigorously resist any such effort, and there is a curious inconsistency in the reasoning of those, who in one breath, voice their resistance to any re-allocation of the FM band for non-broadcast purposes, and in the next, announce their plans for supplying such service there."

Currently, channels in the 150-mc. band are being used for two-way, and these must be shared with other services.

DROPOUTS AND MERGERS. resulting in rows of transfer grants, kept hearing examiners on the run during the last weeks of the old year.

Millions of dollars worth of radio and TV properties were traded during the year-end rush. Station sales and transfers approved included facilities in Des Moines, Ia.; Washington (D.C.); Orlando, Fla.; Atlantic, Ia.; Augusta, Ga.; Roswell, N. M.; Cleveland, Tex.; DeKalb, Ill.; Newport, R. I.; Asheville, N. C.; and Talladega, Ala.

In Maine, WGAN received channel 13 after another applicant dropped its bid for that channel and filed instead for channel 2 in Bangor. And in Atlanta, Ga., channel 36 was awarded to WQXI, when the University of Georgia, who operates WGST decided to drop its request for that channel.

New grants issued to very-high and ultra-high bidders appear below.

THE RECENTLY-FORMED U.H.F.-TV Association has begun an industry-wide campaign for the development and distribution of all-channel receivers that are really *efficient*, and the installation of transmitters operating on high power.

Thus far, the group said, many of the receivers have not been too sensitive. Coupled with the low powers of most of the u.h.f. transmitters, reception has been poor and interest on the higher bands has drooped, they added.

To combat this problem the association plans a public-relations program designed to accent the superiority of higher-band reception. Group also proposes to effect legal action within the Commission which will restore the balance between the u.h.f. and v.h.f. facilities and prevent new allocations or regulatory actions harmful to the public or to the ultra-high industry.

Members of this new group were severely critical of the FCC, declaring that some Commissioners are surrendering to pressure from Congress and political lobbys to . . . "accelerate grants to v.h.f. operators even in cities which already have grants for the higher bands."

ONE OF THE WORLD'S foremost physicists, Dr. Herbert E. Ives, who not only pioneered in the development of black and white, but color TV, too, and as far back as the '20's, died recently.

In '27, Dr. Ives supervised the first demonstration of TV, when the telephone company arranged for a video talk from Washington by Herbert Hoover, then Secretary of Commerce, that was seen and heard at the *Bell Labs* in New York. Shortly after, a TV color test, featuring Ives' developments, was put on and with striking success.

During 1930, he demonstrated a two-way TV system, and in '37, Dr. Ives arranged for the first practical transmission of motion pictures over coax cable, showing that it was entirely possible to network television programs.

The world will truly miss the wisdom and the talents of this brilliant scientist . . . . . L.W.

NEW TV GRANTS SINCE FREEZE LIFT

Continuing the listing of construction permits granted by FCC since lifting of freeze. Additional stations will be carried next month.

STATE	CITY	CALL	CHANNEL	FREQUENCY (mc)	POWER* (Video)
Florida	West Palm Beach	.....	5	76-82	60.3
Georgia	Atlanta	WQXI-TV	36	602-608	240
Kansas	Topeka	.....	42	638-644	88
Louisiana	Lake Charles	KPLC-TV	7	174-180	51.3
Maryland	Cumberland	WTBO-TV	17	488-494	19.1
Massachusetts	Pittsfield	WBEC-TV	64	770-776	17.4
Michigan	Detroit	.....	62	758-764	200
"	Saginaw	WSGW†	51	692-698	26
"	Traverse City	WTCM†	7	174-180	51.3
South Carolina	Florence	.....	8	180-186	316
"	Spartanburg	WORD†	7	174-180	316
Wisconsin	Marinette	WMAM†	11	198-204	102

*ERP = (effective radiated power, kw.). . . = Call letters to be announced † = Temporary call letters.

NO INTEREST!!

Buy on our radically new

Time Payment Plan

NO CARRYING CHARGES!!

Measures 6¼" x 9½" x 4½"

Superior's new Model 670-A SUPER METER

A COMBINATION VOLT-OHM MILLIAMMETER PLUS CAPACITY REACTANCE INDUCTANCE AND DECIBEL MEASUREMENTS

SPECIFICATIONS:

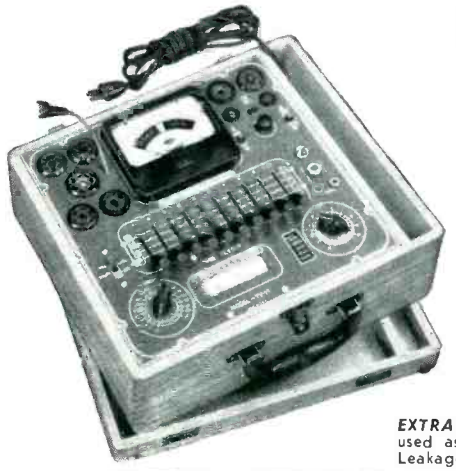
D.C. VOLTS: 0 to 7.5/15/75/150/750/1,500/7,500 Volts
A.C. VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
OUTPUT VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
D.C. CURRENT: 0 to 1.5/15/150 Ma. 0 to 1.5/15 Amperes
RESISTANCE: 0 to 1,000/100,000 Ohms 0 to 10 Megohms
CAPACITY: .001 to 1 Mfd. 1 to 50 Mfd. (Quality test for electrolytics)
REACTANCE: 50 to 2,500 Ohms, 2,500 Ohms to 2.5 Megohms
INDUCTANCE: .15 to 7 Henries 7 to 7,000 Henries
DECIBELS: —6 to +18 +14 to +38 +34 to +58

ADDED FEATURE:

The Model 670-A includes a special GOOD-BAD scale for checking the quality of electrolytic condensers at a test potential of 150 Volts.

The Model 670-A comes housed in a rugged, crackle-finished steel cabinet complete with test leads and operating instructions.

$28.40 NET



Superior's new Model TV-11 TUBE TESTER

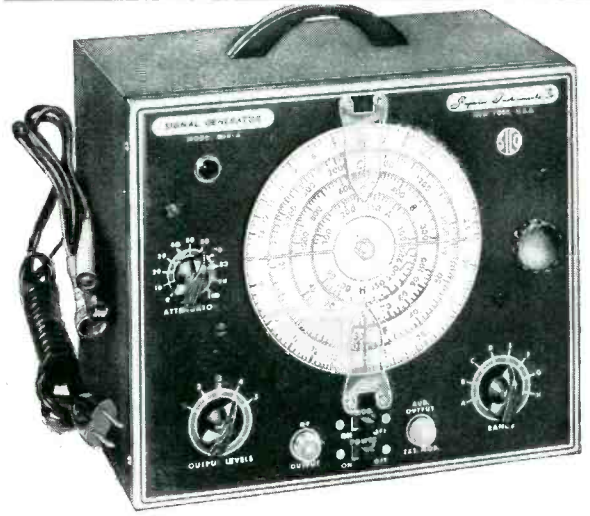
SPECIFICATIONS:

★ Tests all tubes including 4, 5, 6, 7, Octal, Lock-in, Peanut, Bantam, Hearing Aid, Thyratron, Miniatures, Sub-Miniatures, Novals, Sub-minars, Proximity fuse types, etc.
★ Uses the new self-cleaning Lever Action Switches for individual element testing. Because all elements are numbered according to pin-number in the RMA base numbering system, the user can instantly identify which element is under test. Tubes having tapped filaments and tubes with filaments terminating in more than one pin are truly tested with the Model TV-11 as any of the pins may be placed in the neutral position when necessary.
★ The Model TV-11 does not use any combination type sockets. Instead individual sockets are used for each type of tube. Thus it is impossible to damage a tube by inserting it in the wrong socket.
★ Free-moving built-in roll chart provides complete data for all tubes.
★ Newly designed Line Voltage Control compensates for variation of any Line Voltage between 105 Volts and 130 Volts.
★ NOISE TEST: Phono-jack on front panel for plugging in either phones or external amplifier will detect microphonic tubes or noise due to faulty elements and loose internal connections.

The model TV-11 operates on 105-130 Volt 60 Cycles A.C. Comes housed in a beautiful hand-rubbed oak cabinet complete with portable cover.

$47.50 NET

EXTRA SERVICE—The Model TV-11 may be used as an extremely sensitive Condenser Leakage Checker. A relaxation type oscillator incorporated in this model will detect leakages even when the frequency is one per minute.



Superior's New Model 660-A AN AC OPERATED SIGNAL GENERATOR

PROVIDES COMPLETE COVERAGE for AM-FM & TV Alignment

SPECIFICATIONS:

• Generates Radio Frequencies from 100 Kilocycles to 60 Megacycles on fundamentals and from 60 Megacycles to 220 Megacycles on powerful harmonics. • Accuracy and Stability are assured by the use of permeability trimmed Hi-Q coils. • R.F. available separately or modulated by the internal audio oscillator. — Built in 400 cycle sine wave audio oscillator used to modulate the R.F. signal also available separately for audio testing of receivers, amplifiers, hard of hearing aids, etc. • R.F. Oscillator Circuit: A high transconductance heptode is used as an R.F. oscillator, mixer and amplifier. Modulation is effected by electron coupling in the mixer section thus isolating the oscillator from load changes and affording high stability. • A.F. Oscillator Circuit: A high transconductance heptode connected as a high-mu triode is used as an audio oscillator in a High-C Colpitts Circuit. The output (over 1 Volt) is nearly pure sine wave. • Attenuator: A 5 step ladder type of attenuator is used.

TUBES USED:

1—6BE6 as R.F. Oscillator, mixer and amplifier
1—6BE6 as Audio Oscillator
1—6H6 as Power Rectifier

THE MODEL 660-A COMES COMPLETE WITH COAXIAL CABLE, TEST LEAD AND INSTRUCTIONS.

$42.95 NET

MOSS ELECTRONIC DISTRIBUTING CO., INC.
Dept. B-92, 3849 Tenth Ave., New York 34, N. Y.

Please send me the units checked. I am enclosing the down payment with order and agree to pay the monthly balance as shown. It is understood there will be no carrying, interest or any other charges provided I send my monthly payments when due. It is further understood that should I fail to make payment when due, the full unpaid balance shall become immediately due and payable.

Name.....
Address.....
City.....Zone.....State.....

☐ MODEL 670-A.....Total Price $28.40 $7.40 down payment. Balance $3.50 monthly for 6 months.
☐ MODEL TV-11.....Total Price $47.50 $11.50 down payment. Balance $6.00 monthly for 6 months.
☐ MODEL 660-A.....Total Price $42.95 $12.95 down payment. Balance $5.00 monthly for 6 months.
☐ I enclose $.....as down payment.
☐ Ship C.O.D. for the down payment.

ested in best receiver sensitivity, it will pay to try the circuit with and without a ground on the antenna coil. The proper connection will depend on the antenna layout at your location.

There are a number of different door openers on the market. As a result, it is not practical to show exactly how the receiver may be used to actuate all of the various models. By exercising a little ingenuity, however, the home constructor should have no difficulty in adapting the receiver to work with the particular door opener at hand.

RL_1 acts as an s.p.s.t. switch that closes only while a signal is being received from the car transmitter. When the door is down, the closing of RL_1 should cause the door to go up, and when the door is up, the closing of RL_1 should cause the door to go down. Since RL_1 is unable to differentiate between a command to raise the door and a command to lower it, some intermediate relay between the receiver and the opener must be used to tell the opener motor which direction it is supposed to run. This relay is usually of the locking, or ratchet type. It locks in one position when its coil is energized and remains in that position, even when power is removed from its coil. It shifts to the opposite position only after the coil is re-energized.

The circuit of a typical door opener is shown in Fig. 6A. Operation of this unit may be easily understood if you will assume that a momentary signal has just been received from the car transmitter. RL_1 closed, energized the locking relay, and then opened. Power from the a.c. line is now flowing through the locking relay and the limit switch to the motor and garage light. The door is going up. When the door has opened completely, the limit switch will flip to the down

Fig. 10. Transmitter control switch and pilot bulb mounted on small bracket for easy installation beneath car dash. Since only momentary transmitter operation is required to actuate door opener, a push-button may be substituted for the toggle switch shown.

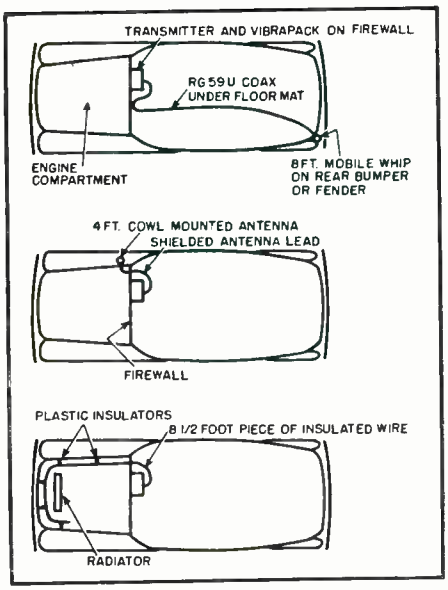


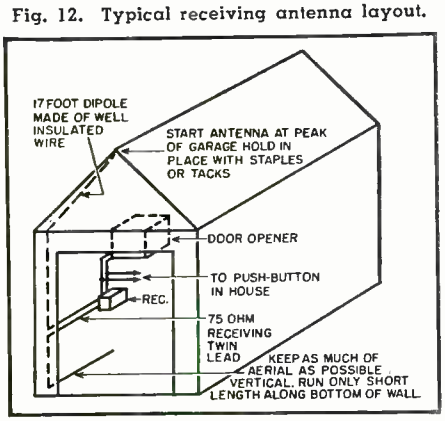
Fig. 11. Three methods for connecting the transmitting antenna. See text for details.

position, the motor will stop and the light will go out. The door will remain open until another momentary signal is received from the car transmitter. This time, the latching relay will jump to the opposite position and current will flow through it and the limit switch to the reverse winding of the motor. The door will go down, until it reaches the end of its travel, at which time the limit switch will flip to the "up" position and the motor will stop.

Some openers contain built-in locking relays and, for this reason, require very little external wiring. A unit of this type, illustrated in Fig. 13, is produced by *Ebbert Engineering Co.*, Birmingham, Michigan. A glance at Fig. 6B will show how easily the receiver may be connected to the *Ebbert* mechanism.

After the car has been put away and the door closed behind it, the problem of getting back into the garage presents itself. The most convenient way to solve this particular difficulty is to install, in the house, a push-button wired across the points of RL_1. As a safety precaution, the push-button should be located where you can look through a window to check on the door's operation. It will be noted that push-buttons are in-

Fig. 12. Typical receiving antenna layout.



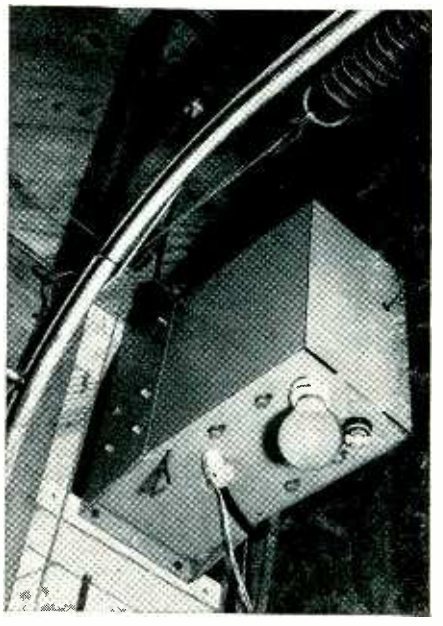


Fig. 13. "Ebbert" motor-driven door opener, a commercially-built unit suitable for use with equipment described in the text.

cluded in both Figures 6A and 6B.

Like other Citizens Band equipment, the transmitter must be registered. Obtain a copy of FCC form 505, fill it out carefully, and mail it to the nearest Commission field office. In a short time you will receive a class C Citizens Radio License covering this particular piece of gear. Upon receipt of the license, you, or anyone else with your permission, may use the transmitter to control your garage door. As long as you make no adjustments on the transmitter, outside of turning it on and off, no operator's license will be necessary.

Further information regarding Citizens Radio is contained in FCC's "Rules and Regulations Governing the Citizens Radio Service" obtainable from the Superintendent of Documents, Government Printing Office, Washington 25, D. C. The price of this pamphlet is 10c in coin. —30—

GUILD ELECTS

THE Long Island Television and Radio Technicians Guild has named Henry Wawryck president for this coming year with Arthur Cyr serving as vice-president.

John Wheaton is the new treasurer, Murray Barlowe was named secretary while Al Weil is recording secretary and Earl Horton is the sergeant at arms. Four members were added to the executive board, Jack Buck for a three-year term, Dick Bishop for two years, and Bill Allen and Ralph Milne for one year terms.

—30—

RADIO-TV CONFERENCE

THE ninth annual Michigan State Radio and Television Conference of commercial and educational broadcasters will be held Friday, March 5, 1954 at Michigan State College in East Lansing, Michigan.

The topic for the conference this year is the role of radio and television as mass media.

Robert P. Crawford of Michigan State College is conference chairman. —30—

Come Again

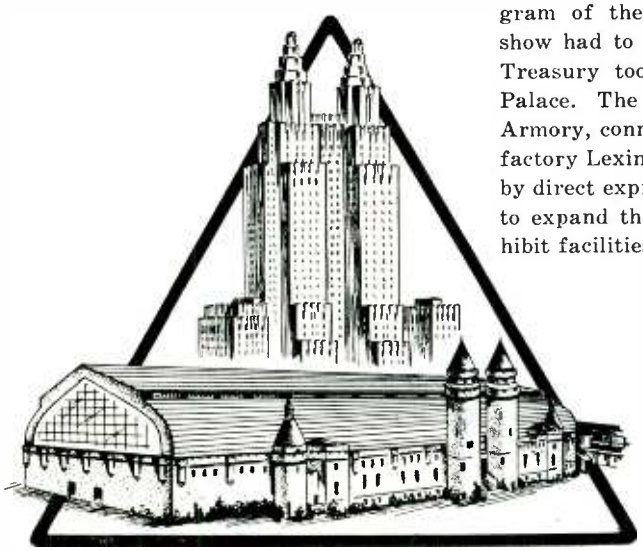
Radio - Electronic Men!

Just as you have been coming since 1945 to the IRE National Convention and Radio Engineering Show — coming by the thousands, 35,642 in '53 — so come again to see and hear all that is new in the engineering advances of your industry.

▲ Fifty-four in '54! — 243 scientific and engineering papers will be presented, skillfully grouped by related interests into 54 technical sessions. More than half these sessions are organized by IRE Professional Groups, thus making the IRE National a federation of 21 conferences in one. The whole provides a practical summary of radio-electronic progress.

▲ 600 Exhibitors "spotlight the new!" — A mile and a half of exhibits line the avenues of this show, intriguingly named for the elements of radio — such as "Instruments," "Components," "Airborne," "Radar," "Transistor," "Audio," "Microwave," etc., filling the four acres of the great Kingsbridge Armory to capacity. An expanding radio industry shows why it is growing by proving how engineering research pays out in new products. The exhibits themselves are an education, condensed to one place — reviewed in four days.

▲ Kingsbridge is the solution! Only the combined facilities of the Waldorf-Astoria Hotel, plus the three great halls in the Kingsbridge Armory, seating 906, 720, and 500 respectively, are able to keep pace with the increased technical papers program of the IRE Convention. The show had to move because the U. S. Treasury took over Grand Central Palace. The immense Kingsbridge Armory, connected to the very satisfactory Lexington Avenue Hotel area by direct express subway, serves well to expand the already outgrown exhibit facilities of the Palace and provide space for 200 new firms to exhibit, as well as seat greater audiences at the high-interest sessions. In addition to the subways, free busses leave the Waldorf every ten minutes in which you may travel in the congenial company of fellow engineers, direct to Kingsbridge.



Waldorf-Astoria and Kingsbridge Armory

▲ Admission by registration only! Registration serves for the four day period. It is $1. for IRE members, $3. for non-members, covering sessions and exhibits. Social events priced separately.

March 22-25, 1954

The IRE National Convention

and

Radio Engineering Show

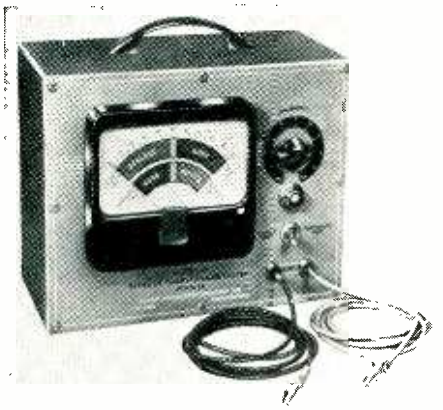
THE INSTITUTE OF RADIO ENGINEERS

1 East 79th Street, New York City

NEW TV PRODUCTS on the Market

FLYBACK TESTER

Kirby Products Corp., 20 E. Herman St., Philadelphia, Pa. has developed a



new television service instrument which has been designated as the Model 98 flyback transformer tester.

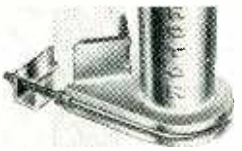
The instrument is designed to indicate shorted turns within the flyback transformer, while the transformer is in the set, by the power absorption method. It will supply an indication on as low as one shorted turn anywhere in the transformer. In addition, the instrument will test for continuity on yokes, transformers, switches, etc.

The instrument is portable, compact, and moderately priced. It is being handled through franchised electronic parts distributors. Free literature is available on request.

ANTENNA ROTATOR

Leader Electronics, Inc., 2925 East 55th Street, Cleveland 27, Ohio is now offering a new antenna rotator which is said to provide easier installation and servicing in addition to finer tuning.

Known as the "Superotor," the new



unit features a quick detachable drive unit for easy one-man removal without dismounting the antenna, a double lock stop to eliminate both drift and coast, a built-in chimney mount design thus eliminating stub mast assemblies, steel reinforced construction, and vernier precision adjustment.

The rotator is 16¼" x 7" x 4½" overall. It is rated at 60-75 watts input, 117 volts, 60 cycle a.c.

TV ALIGNMENT TOOL

General Cement Mfg. Co. of Rockford, Ill. has added a plastic television set alignment tool, the X-57, to its line of service accessories.

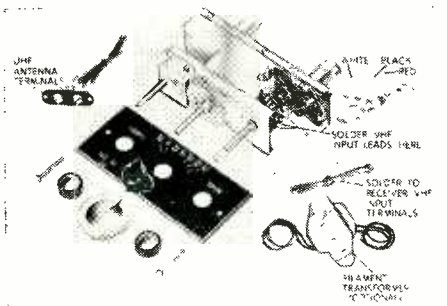
Designed in response to a demand for an extra-long, extra-slim, high-dielectric TV alignment tool, the new X-57 meets these requirements. It is only ⅛" in diameter and is available in three blade lengths, 7", 12", and 16".

Complete descriptive literature on this accessory is available from the company.

U.H.F. CONVERSION KIT

The Allen D. Cardwell Mfg. Corp., 97 Whiting St., Plainville, Conn. is currently marketing a new u.h.f. conversion kit for installation inside existing TV sets, irrespective of make, to provide all-channel u.h.f. tuning.

The Model ES-2 is completely fac-



tory-aligned and assembled and comes complete with escutcheon plate, knobs, and pointer. Installation requires only soldering connections and the drilling operation using a template.

The tuner will cover channels 14 to 83 with one knob and an easy-to-read dial. A printed circuit is said to give stable tuning with no drift. Either channel 5 or 6 is used as the i.f.

MARKER GENERATOR

The Tube Department of *Radio Corporation of America*, Harrison, N.J. has announced a new crystal-calibrated marker generator, the WR-89A.

Featuring continuously tunable operation for the alignment and trouble-shooting of a wide range of communications equipment as well as TV sets, the new instrument combines the functions of a marker generator, a vertical or horizontal bar-pattern generator, a rebroadcast transmitter, and a heterodyne frequency meter.

The instrument provides an r.f. out-

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18A436. 10 Asst..... 99c

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10 Assorted—toggle, push button and slide type switches for a multitude of uses. The use of only several will pay for the lot.
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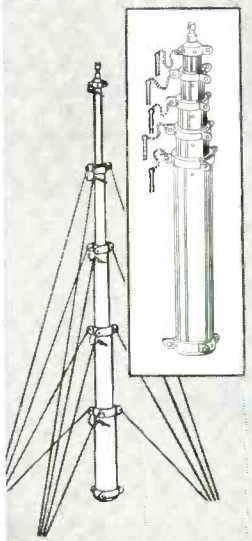


Thousands were previously grabbed up as an outstanding buy at $24.88. Now, another huge special purchase from Gov't. surplus makes passible this Terrific Bargain. (Original Gov't. cost said to be $60.00 each.)
Built to rigid Army Specs. (AN--S-2) for portable field lighting . . ideally suited for a truly superior TV mast as well as for amateur beams, lighting, flagpoles, etc.
Compare these specifications with ordinary TV Masts . . . 5 sections extend to 41 ft., telescope to 9½ ft. Super-strong chrome alloy seamless steel tubing, baked brown weather-proof enamel inside and out. Two machined close-fitting bushings and 3-hole guy ring at each joint. Sections extend easily, are held in position by heavy cross pins . . . **May even be raised horizontally fully extended, with no buckling!** Can be dis-jointed for shortening or dividing. Top section diameter ¾" yet stronger than usual TV masts and of ample size to accommodate antenna mast clamp hardware. Mid-sections 1⅜", 1¾" and 2⅛". Base section 2½" diameter.
Makes possible at low cost ground mounted antenna systems commonly preferred to roof-top installations because of less hazard for the installer and the home—plus better choice of antenna location. Order Now While Available at this Low Price! Every Mast **Brand New.**
No. 6A85. Shpg. wt. 40 lbs.
SPECIAL EACH..... $13.69
4 Masts in Original Wood Crate Shpg. wt. 200 lbs.
Lots of 4 for..... $49.97

A VALUE THAT DEFIES COMPARISON

FAMOUS "APPROVED" MODEL A200

SIGNAL GENERATOR

$49.50 VALUE NOW ONLY **$19.75**

BRAND NEW! FACTORY PACKED! FULLY GUARANTEED!

Hundreds sold at ½ the Regular $49.50 Net Price. Now a final B-A lucky purchase makes available an additional quantity at a greater saving to you. Buy Now While They Last.

Extremely stable, built for long, dependable service. 8 BANDS, 100 kc to 75 mc—with 455 kc position indicated in red for quick reference. Large open-face frequency dial has multi-colored scales for 6 over-lapping fundamental ranges from 100 kc to 25 mc, with Band F2, 18-50 mc and Band F3, 27-75 mc on harmonics. Phase shift audio oscillator and internal modulator for 440 cps., internal or external—and continuously variable from front panel from 0-100%; external modulation possible, 40-30,000 cps. Extremely low leakage on all bands; completely isolated from power line. Ceramic insulated, low drift, wide spaced variable condenser of "invar" metal used as frequency selector. 3-step RF attenuator and continuously variable RF-AF attenuator control—ultra stable 2-terminal RF oscillator, 6SH7 tube as cathode follower output to a coax lead assuring frequency stability regardless of attenuator control setting. Lucite dial pointer with hair-line indicator. Pilot light line indicator. With 4 tubes, cable, instructions. Steel cabinet is 8x10x12", for operation on 105-120 volt, 60 cycle AC. Weight 20 lbs.
No. 34B173. $49.50 Value **Now While They Last..... $19.75**

"BUILD-YOUR-OWN" WITH MODEL A200K PARTS KIT

Identical to factory-wired Model A-200 described above EXCEPT in KIT form! Complete with 4 tubes, cables, cabinet, operating instructions and circuit and pictorial diagrams for easy assembly.
No. 34B175. $32.50 Value **Now While They Last..... $16.75**

LATEST TEST INSTRUMENTS ON CONVENIENT PAYMENT TERMS
Includes these popular makes: Hickok, Simpson, Triplett, EMC, RCP, Precision, etc.

B-A BURSTEIN-APPLEBEE CO. 1012-14 McGEE ST; KANSAS CITY, MO.

TERMS: F.O.B. Kansas City. Remit with order, include postage for parcel post shipments.

put signal on fundamental frequencies from 19 to 260 mc. and can be used with TV receivers and other equipment operating in this range. A built-in crystal-controlled oscillator also provides an output signal at 4.5 mc.

The WR-89A measures 10" x 13½" x 7½" and weighs 15 pounds. It is available from the company's test instrument distributors.

U.H.F. CONVERTER

The Turner Company, 909 17th Street, Cedar Rapids, Iowa is now

offering a new u.h.f. television converter that is said to be especially effective in low signal area installations.

The new converter features a two-section preselector which has two silver-plated coaxial cavity tuners; a double-shielded fundamental oscillator; and a broadband amplifier with cascode circuit. The signal power loss in the preselector has been reduced to 3 db, according to the company. The noise figure is a maximum of 17½ db and a minimum of 15½ db.

The converter itself has an illuminated slide-rule dial, continuous single-knob tuning from 470 to 890 mc. using channels 5 or 6, and measures 8" x 6" x 6". It is designed to be used with either a u.h.f. or combination antenna. The unit is self-powered.

ISOLATION TRANSFORMER

Standard Electrical Products Company, 2240 E. Third St., Dayton, Ohio has added an adjustable variable me-

tered isolation transformer, the type LR, to its line of equipment.

Suitable for applications involving the use of a variable transformer or an isolation transformer, the new unit is designed for radio and television serv-

ice work. It has an isolated primary winding that permits servicing a.c.-d.c. sets without shock hazard. Electrostatically shielded, the LR is used to check intermittently operating radio and TV sets by dropping the line voltage to 105 volts or lower to detect a faulty oscillator. It can also be used to "cook" sets at 130-140 volts to break down intermittent parts.

For additional information write the company direct.

TRIO ANTENNA

A new single-bay, all-channel antenna has been added to its "Zig-Zag" line by *Trio Manufacturing Company* of Griggsville, Illinois.

Known as the "Twin-Six," the new antenna is ruggedly constructed, light in weight, and features single lead-in operation. The company states that it offers exceptional gain and, in addition, provides satisfactory u.h.f. reception in primary areas.

The new antenna is competitively priced and further details on it are available from the manufacturer.

CONVERTER-BOOSTER

Sutton Electronic Company of Lexington, Ky. is currently offering a

u.h.f. converter-v.h.f. booster combination housed in a compact cabinet.

Modern in design and the size of a small radio, the sturdy plastic cabinet is finished in marble-walnut with a gold panel. The new unit adds all u.h.f. channels to any TV set without sacrificing any v.h.f. channels.

The company will supply additional details on request.

SOLO LISTENING

Kentrol Corporation, 10 E. Coulter Street, Philadelphia 44, Pa. is now offering a compact headset unit which has been designed to permit personal TV listening.

The new unit has a 25-foot cord that can be run under a rug if desired. It can be easily attached to any set in 3 minutes and does not require wire cutting or splicing.

The company will supply additional details and price data on these units upon request.

RETRACE ERASER

Tele-matic Industries, Inc., 1 Joralemon St., Brooklyn, New York has announced a new service accessory which

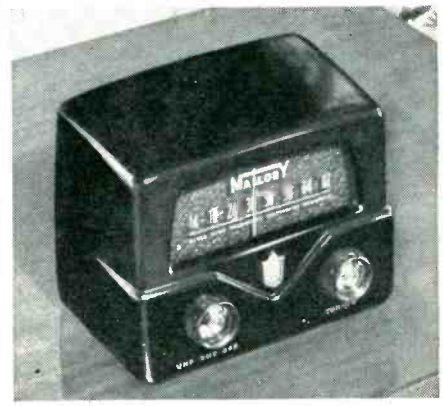
is said to eliminate the annoying retrace lines that interfere with TV reception.

Known as the "Retrace Eraser," this plug-in electronic network permits the set owner to turn up the brightness and contrast controls and enjoy optimum reception without interference from retrace lines.

The unit is easily installed by plugging it into the back of the cathode-ray tube and connecting one lead to the yoke. Installation time is approximately 2 minutes.

U.H.F. CONVERTER

A redesigned, all-channel u.h.f. converter, the Model 88, is now available



from *P. R. Mallory & Co., Inc.*, distributor division, Indianapolis 6, Indiana.

The converter is 50 per-cent smaller than the company's previous model and incorporates all of the principles which have proven successful in that earlier model.

A single knob tunes all the u.h.f. channels in a total of 7½ turns. A second knob switches from u.h.f. to v.h.f. and also turns both the converter and TV set "on" and "off." When using the Model 88, the set may be left on either channel 5 or 6, whichever receives less external interference.

For more information write the company's distributor division.

"CASCADIAN" BOOSTER

Mark Simson Mfg. Co., Inc., 32-38 49th Street, Long Island City 3, N.Y. is

now in production on a new tunable v.h.f. TV booster which is said to increase the signal strength at least 35 db average on all channels.

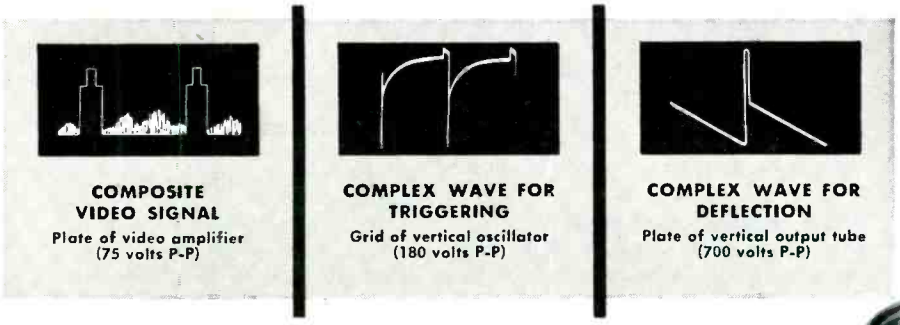
The *Masco* "Cascadian" has been specifically designed to bring noise-free reception to new low-noise, high-

SYLVANIA *Presents*

The New Deluxe POLYMETER

TYPE 302

QUICK, ACCURATE MEASUREMENT OF COMPLEX WAVE FORMS



COMPOSITE VIDEO SIGNAL
Plate of video amplifier (75 volts P-P)

COMPLEX WAVE FOR TRIGGERING
Grid of vertical oscillator (180 volts P-P)

COMPLEX WAVE FOR DEFLECTION
Plate of vertical output tube (700 volts P-P)

CUTS SERVICE TIME
READ DIRECT PEAK TO PEAK VOLTAGES

The new A.C. input circuit provides for full wave rectification to give you direct "P-P" readings of symmetrical and asymmetrical wave forms. This feature has been included in the new Polymeter to aid in measuring signals of a complex nature. A point to point search quickly localizes circuit failures and minimizes service time.

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...world famous in electronics

Styled by
SUNDBERG AND FERAR
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LABORATORY PRECISION ACCURACY FOR DIRECT MEASUREMENT OF...

- P-P voltages from .2v to 2800v.
- DC voltages of plus or minus polarity from .05v to 1000v.
- AC voltages from .05v to 1000v.
- RF voltages from .1v to 300v in the band of 10 kc to 300mc.
- Resistance from .5 ohms to 1000 megohms.
- Decibels from –20 db to +61.4 db

LOOK AT THESE
PLUS FEATURES

- Peak to Peak Scale
- New Sylvania 7" Meter Movement
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- Screw-on Connectors

Available through your

SYLVANIA RADIO TUBE DISTRIBUTOR

Sylvania Electric Products Inc., Radio and Television Division
Williamsport, Pennsylvania

gain television receivers as well as to older style receivers. The booster uses a special low-noise circuit employing a 6BZ7 tube.

A single control knob provides simplicity of operation. The metal cabinet, finished in two-tone brown and tan, can be used in any setting. The booster is automatically switched "on" and "off" by the TV set.

GUYLINE WINCH

Royal Television Supply Co., P.O. Box 1383, Modesto, California is now offering a new guy line winch which has been tradenamed "Royal Giline Winch."

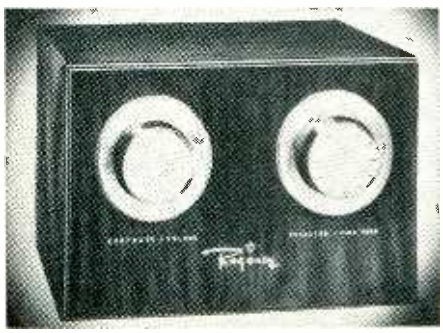
The new product is designed to simplify and improve guy line installations. Its design for one bolt mounting makes for speedy installation. The channel and ratchets are made of 12 gauge steel with drums of heavy steel rods. The entire unit is electroplated. A cotter pin locks firmly in place against the ratchet pawl. A turn of the wrench gives proper tension on the line.

A data sheet on the new winch is available on request.

REMOTE CONTROL

The *Regency Division, I.D.E.A.*, 7900 Pendleton Pike, Indianapolis 26, Ind. is now offering a remote control unit which is operated on a single conductor cable.

Capable of being installed by an experienced technician in 15 minutes, this versatile unit selects stations, adjusts fine tuning, and controls contrast and volume at distances up to 100 feet.



The new control has been designated as the Model RT-700.

ADHESIVE FOR TV

National Adhesives, 270 Madison Ave., New York 16, N. Y. has developed a permanently tacky, solvent-type adhesive for TV production use.

The Resyn 35R2625 is painted on in all areas where there is contact between the cabinet and metal parts in order to trap chips and dust fall. The tacky film holds these minute particles, thereby keeping the inside of the set clean and reducing unnecessary service calls.

Manufacturers desiring further details on this adhesive for production applications may obtain full details from the company direct.

—30—

Admiral TV Receivers

(*Continued from page* 60)

overdriving the video amplifier, and will cause horizontal picture jitter, bending or tearing, and possibly complete blanking out of the picture, especially in strong signal areas. In using the "DX Range Finder," keep its setting as low as possible consistent with satisfactory pictures.

In early runs (1 and 2) of the 23A1 chassis, a.g.c. voltage for the r.f. amplifier (V_{101}) and the 1st and 2nd video i.f. amplifiers was obtained at test point "T," between R_{333} and R_{337} to ground. To reduce tube noise (snow in the picture) in the 23A1 chassis stamped run 3, the a.g.c. voltage for the r.f. amplifier is held at a lower negative value than the a.g.c. voltage at test point "T". The a.g.c. voltage applied to V_{101} is determined by a resistor network consisting of R_{333}, R_{337}, R_{350}, R_{351}, and R_{352} between test point "T," "B+," and ground.

Sync Separators. The sync separator (V_{403}) also receives a portion of the composite video signal from the video amplifier plate circuit. The sync separator, the sync clipper, and V_{401B}, the sync inverter, separate the sync pulses from the rest of the video signal and then direct these pulses to the vertical and horizontal sweep oscillators. The three separator stages are so designed as to effect as clean-cut a separation as possible, while at the same time minimizing the effects of noise pulses. This is achieved by the careful choice of "B+" operating voltages and the use of *RC* networks throughout these stages.

Vertical Deflection. The vertical oscillator (V_{401A}) is of the familiar blocking variety, preceded by an integrator network. An unusual aspect of the circuit is condenser C_{411}. This is incorporated to filter out any 15,750 cycle horizontal pulses picked up on the grid from the horizontal deflection circuit that would tend to trigger the vertical oscillator, causing poor interlace or vertical flutter.

In the vertical output stage, V_{402}, a 6AV5 pentode provides sufficient voltage to sweep the full height of the picture tube. Also provided by this circuit is a vertical retrace blanking pulse. Condenser C_{406} couples the negative pulse present at the vertical output transformer to the grid of the picture tube. C_{318} and R_{346} properly shape the waveform to insure cut-off of the picture tube only during the vertical retrace interval.

Horizontal Deflection. In the horizontal deflection system there is a 6AL5 sync discriminator, a 6SN7GT horizontal oscillator, and a 6CD6G output amplifier. The sync discriminator develops a d.c. voltage across R_{429} that is proportional to the phase difference between the received sync pulse frequency and the sweep voltage developed by the horizontal oscillator. This d.c. voltage is then fed to the

TUBES & PARTS

ALL TUBES are guaranteed for one year . . . individually boxed. Every BEST BRANDS available for immediate delivery!

0A4	6... 1.04	2A6	89c	6AH6	1.89	6BH6	69c	6K5GT	.69	6SQ7		7C5	.89	12AU7	.79	12SN7GT	.99	26	59c	57	79c
0Z4	59c	2A7		6AK5	.89	6BJ6		6K6GT	.59	6SQ7GT	59c	7C6	79c	12AV6	.59	12SQ7		27		58	
0Z4G		2B3	.89	6AK6	1.08	6BK7	1.19	6K7GT	.69	6SR7GT		7C7		12AV7	.89	12SQ7GT	69c	35A5	.99	70L7	1.49
1A5GT	.79	2B7	.89	6AL5	69c	6BL7	.79	6K8GT	1.19	6SS7	.99	7E5		12AW6	1.19	12SR7GT		35B5		70L7GT	
1A7	.69	2C34	.60	6AQ5		6BN6	1.19	6L5G	.95	6T7G	1.15	7E6	79c	12AX4	.69	12Z3	.95	35C5	69c	71A	.87
1A7GT	.79	2E5	.89	6AQ6	.81	6BQ6G	1.19	6L6G	95c	6T8	.89	7E7		12AX7	.69	14A7	1.05	35L6		75	.79
1B3GT	.95	2X2/879	.74	6AQ7	1.19	6BQ6GT	1.19	6L6GA		6U5		7F7	.89	12AY7	1.95	14AF7	.93	35W4	.59	77	.69
1B5	.29	3LF4	1.25	6AR5	.79	6BQ7	1.29	6L7	1.19	6U6GT	69c	7F8	1.47	12BA6	.59	14B6	89c	35Y4	99c	78/6D6	1.10
1H5GT	.59	3Q4	.69	6AT6	.59	6BZ7		6N6G	1.40	6U7G		7G7	1.19	12BA7	1.19	14B8		35Z3		80	.69
1J6GT	69c	3Q5GT	.89	6AS5	.90	6C4	.59	6N7GT	1.19	6U8	.89	7H7	1.05	12BE6	69c	14C5	1.25	35Z4	.75	83	1.45
1L4		3S4	.69	6AU5GT	1.29	6C5GT	69c	6P5GT	.69	6V3	1.29	7J7	1.19	12BF6		14C7	1.12	35Z5	.55	84/6Z4	.72
1L6	1.29	3V4	.95	6AU6	.59	6C6		6Q7GT	.59	6V6GT	.69	7K7		12BH7	.89	14F7	1.05	35/51	.79	85	.79
1LA4	1.19	5T4	1.40	6AV5GT	.89	6CB6		6R7GT	.69	6W4GT	.59	7L7	.79	12BY7	.89	14F8	1.45	36	1.06		
1LA6	1.19	5U4G	.59	6AV6	.59	6C8	1.29	6S4	.59	6W6	.69	7N7	.69	12BZ7	1.19	14H7	1.12	37	.93	VR90	
1LC5	.69	5V4G	.87	6AX4	.69	6CD6	2.49	6S7GT	1.15	6X4		7Q7	.79	12F5GT	.65	14Q7	1.05	38	88c	VR105	$1.19
1LC6	1.19	5W4		6AX5	.79	6CD6G	1.69	6S8GT	1.25	6X5GT	59c	7R7	1.19	12H6	.89	14W7	1.19	39/44		VR150	
1LD5		5W4GT	59c	6AX6	.69	6CF6		6SA7GT		6X8	1.29	7S7	1.19	12J5GT	.75	14X7	1.19	41	.72	VT51	
1LE3	1.19	5Y3GT	.45	6AY5GT	.89	6D6/78	1.19	6SC7	69c	6Y6G	.69	7V7	.79	12K7GT	.69	19BG6		42	.69	VT52	29c
1LH4	1.19	5Y4G	.54	6B4G	1.44	6D8G	1.15	6SD7GT		6Z4/84	.72	7W7	1.19	12K8	.89	19BG6G	1.89	43	72c	117L7	1.40
1LN5	1.19	5X4G	81c	6B8GT	1.15	6E5	.69	6SF5	.59	7A4	.95	7X6	1.05	12Q7GT	.89	19T8	.89	45		117N7	1.95
1N5GT		5Z3		6BA6	.59	6F5GT	59c	6SF5GT	.59	7A5	1.19	7X7	79c	12S8	.89	20	1.40	45Z5	.69	117P7	1.95
1P5GT	79c	6A3	1.68	6BA7	.89	6F6GT		6SG7		7A6	.89	7Y4		12SA7GT	.69	24A	.69	46		117Z3	.59
1Q5GT		6A7	89c	6BC5	.69	6F7	1.59	6SH7	69c	7A7	79c	7Z4	.89	12SC7	1.05	25AC5GT	1.04	47	89c	117Z6	1.19
1R5		6A8GT		6BC7	1.05	6F8G	1.59	6SH7GT	.69	7A8		12A7	1.59	12SF5GT	.69	25BQ6		50A5	1.05	715B	7.75
1S4	.99	6AB4	69c	6BD5GT	.89	6G6G	.95	6SJ7	.79	7B4	.89	12A8	.69	12SF7	.99	25BQ6GT	1.19	50B5		807	1.55
1S5		6AB7	1.15	6BE6	.59	6H6GT	.89	6SJ7GT		7B5	.89	12AH7	1.38	12SG7	.89	25L6GT	.59	50C5	69c	866A	1.49
1T4	69c	6AC5GT	.89	6BF5	69c	6J5GT	.59	6SK7GT	59c	7B6	.89	12AL5	.54	12SH7GT		25W4GT	.69	50C6G	1.39	1299	
1U4		6AC7	1.45	6BF6		6J6	.79	6SL7GT	.69	7B7	89c	12AT6	.59	12SJ7GT		25Z5	.69	50L6	.69	1619	49c
1U5	.59	6AF4	1.19	6BG6	1.89	6J7G	.69	6SN7GT	.69	7B8		12AT7	.89	12SK7GT	69	25Z6GT	.69	50X6	.69	2051	1.15
1W	89c	6AG5	1.05	6BG6G		6J8G	1.15			7C4	1.30	12AU6	.69	12SL7GT		32L7GT	1.15	50Y6	.99		

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8-8	450 V.	.45	20-	50 V.	.19
10-	450 V.	.39	25-	50 V.	.19
10-10	450 V.	.45	50-	50 V.	.25
20-	450 V.	.45	100-	50 V.	.29
20-20	450 V.	.49			
30	450 V.	.45	20 mfd.	150 V.	.35
30-30	450 V.	.59	20-20	150 V.	.45
40	450 V.	.49	30	150 V.	.45
40-40	450 V.	.69	30-30	150 V.	.49
60	450 V.	.69	40	150 V.	.49
60-40	450 V.	.89	40-20	150 V.	.49
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80-40	450 V.	1.29	50-30	150 V.	.49

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All UHF channels $2.75

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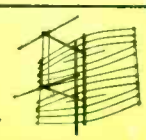

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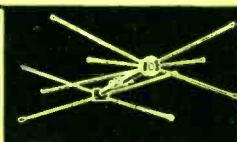
.02	12c	.5 mfd	ea. 29c

TV Antennas



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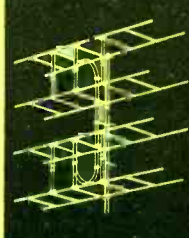

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grid of one triode section of the horizontal multivibrator where it causes the generated frequency to change as required to keep in step with the frequency of the incoming sync pulses.

In the horizontal output amplifier, a special high voltage, high current 6CD6G tube is used to meet the necessary power requirements in this circuit. This includes the horizontal deflection coils, the high-voltage rectifier, and the damper tube. The latter tube, a recently developed 6V3, suppresses oscillation in the horizontal deflection coils and then converts the oscillatory current that flows after retrace into useful "B+" voltage which is added to the voltage delivered by the power supply. Beneficiaries of this boosted voltage include the horizontal output amplifier, the vertical oscillator, and grid number 2 (pin 10) of the picture tube.

Width control is obtained by using one winding of the width control coil, L_{102}, as a variable inductance to change the loading of the horizontal output transformer T_{101}, and at the same time, using the other winding as a variable inductance in series with the horizontal deflection coils. The inductance of the width control coil is varied by a slug moving out of one winding and into the other winding. Thus, when the inductance of the winding connected across the secondary winding of the horizontal output transformer is maximum, the inductance of the winding in series with the horizontal deflection coils is minimum. This condition results in minimum loading of the horizontal output transformer T_{101}, by the shunt winding of the width coil, and maximum transfer of energy to the horizontal deflection coils, resulting in increased width. This type width control coil provides a constant load on the horizontal output transformer and results in little or no change in the second anode voltage for the picture tube as the width control is varied.

Power Supplies. An important aspect in the servicing of any television receiver is the ability to trace your way through the d.c. distribution system. In radio receivers, the simplicity of the circuit permits all the stages to feed directly off one "B+" line. In television sets, however, not all tubes have the same voltage requirements and while it is possible to step down voltages to a desired value by means of voltage divider networks, the power wasted in this way can be considerable. A more efficient approach is employed in the 23A1 chassis in the form of two separate low-voltage power supplies. See Fig. 2. One, labeled the "H.V. Rectifier" (V_{502}), develops a voltage of 280 volts past the filter; the other, labeled the "L.V. Rectifier" (V_{501}), develops 150 volts past the filter. Both systems are relatively independent of each other, although the a.g.c. tube, V_{107}, uses the +280 volts for its screen grid and the +150 volts for its cathode. The picture tube cathode ties into the +150-volt line, the control grid connects to the 280-volt line, and

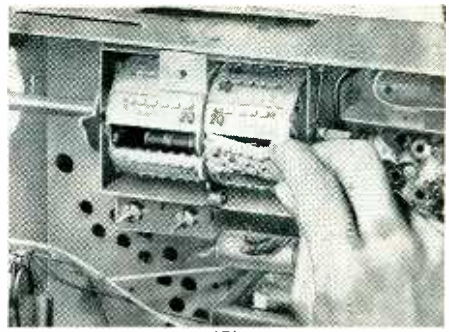
grid number 2 receives its positive voltage from the boosted "B+". A diagram such as that shown in Fig. 3 can be of considerable assistance in tracking down defects in the receiver, especially when they concern abnormal d.c. voltages.

Table 1 contains the video and sound i.f. alignment procedure of the *Admiral* television receiver. The various slugs and test points mentioned in the chart can be readily located from Fig. 4. Also useful, not only for alignment, but service as well, is the tube location diagram, Fig. 5. Unless a man deals exclusively with one type of set, and very few technicians do, such a chart is one of the most useful service aids available.

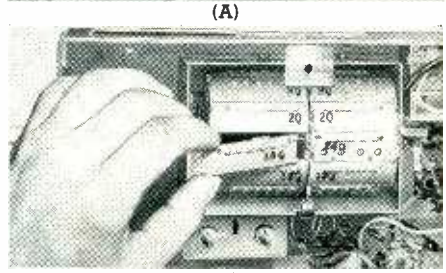
U.H.F. Reception

Reception of u.h.f. signals on *Admiral* receivers is accomplished in one of two ways: either by the insertion of u.h.f. strips for unused v.h.f. strips in the turret tuner, or by the addition of a continuous tuning type of u.h.f. tuner to the standard v.h.f. turret tuner.

The installation of the u.h.f. strips is illustrated in Figs. 6A and 6B. First, remove a pair of channel coils for an unused v.h.f. channel from the turret of the TV tuner. For convenience in tuning the set, it is suggested that the coils removed be adjacent to the coils for a v.h.f. channel in operation. Then, the u.h.f. channel strips are inserted



(A)

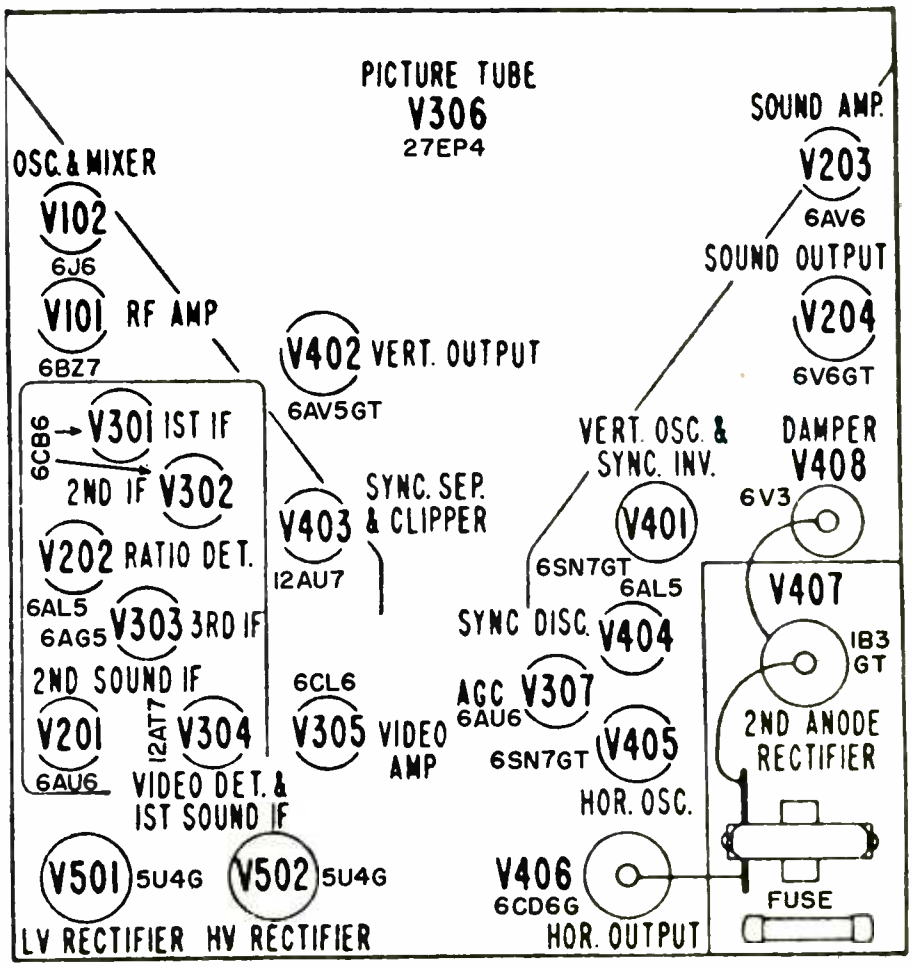


(B)

Fig. 6. Installing u.h.f. strips in a turret tuner. (A) Inserting the 5-contact antenna strip, (B) slipping in the 6-contact oscillator-converter strip.

in the usual manner, starting with the antenna (5 contact) strip first and then the oscillator-converter (6 contact) strip. The oscillator-converter strip has a connecting pin extending from one end which must be carefully fitted into the metal sleeve at the end of the antenna strip.

Fig. 5. Tube location chart for the Admiral 23A1 television chassis.



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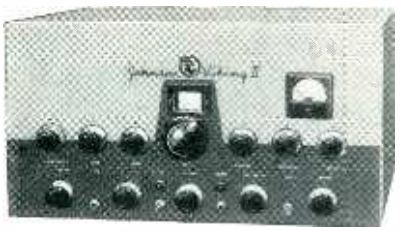

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There are several precautions to observe when installing these u.h.f. strips.

1. If more than one set of u.h.f. channel strips is to be installed, they must not be inserted adjacent to each other.

2. The transmission line from the tuner to the antenna terminal board should be straight. If any loops exist, these should be removed.

3. Handle u.h.f. strips very carefully so lead dress and spacing between wires and components is not disturbed. The antenna strip should always be inserted first for ease in installation and protection against damage to the connecting pin.

The continuous u.h.f. tuner is physically located directly in front of the v.h.f. tuner. See Fig. 7. The channel selector and fine tuning control shafts for the v.h.f. tuner protrude through the hollow channel selector shaft of the u.h.f. tuner. Thus, the channel selector and fine tuning controls of the two tuners operate independently of each other.

Circuitwise, the u.h.f. tuner appears as shown in Fig. 8. The u.h.f. signal is coupled to the first tuned line of the preselector circuit by a coupling loop CL_1. The loop is center-tapped in order to provide a balanced 300-ohm input. The signal from Z_{1A} is transferred to the second tuned line Z_{1B} by means of coupling loop CL_2. To provide the most uniform coupling over the entire tunable range, the loop is placed as close as possible to the point of current maximum.

Coupling from the second tuned line Z_{1B} to the cathode of the 6AM4 mixer tube, V_1, is provided by coupling loop CL_3. Tuning is accomplished by means of variable condensers.

A Colpitts oscillator, employing a 6AF4 tube, is used as a local oscillator. To sustain oscillation, feedback is provided by the cathode circuit; the

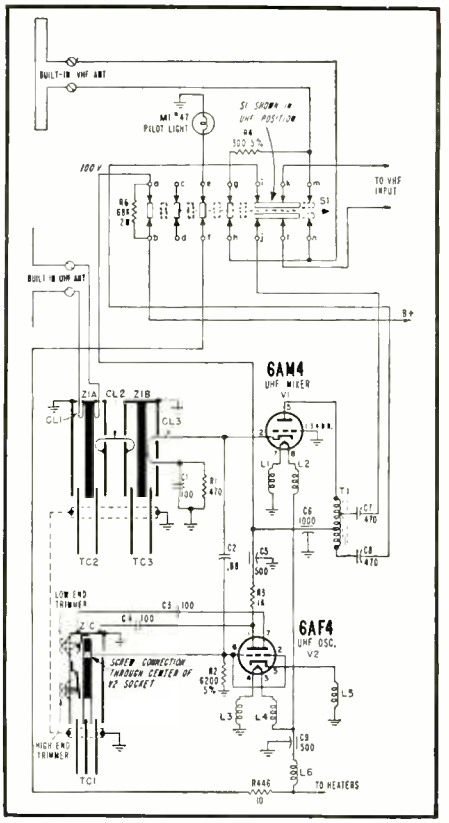
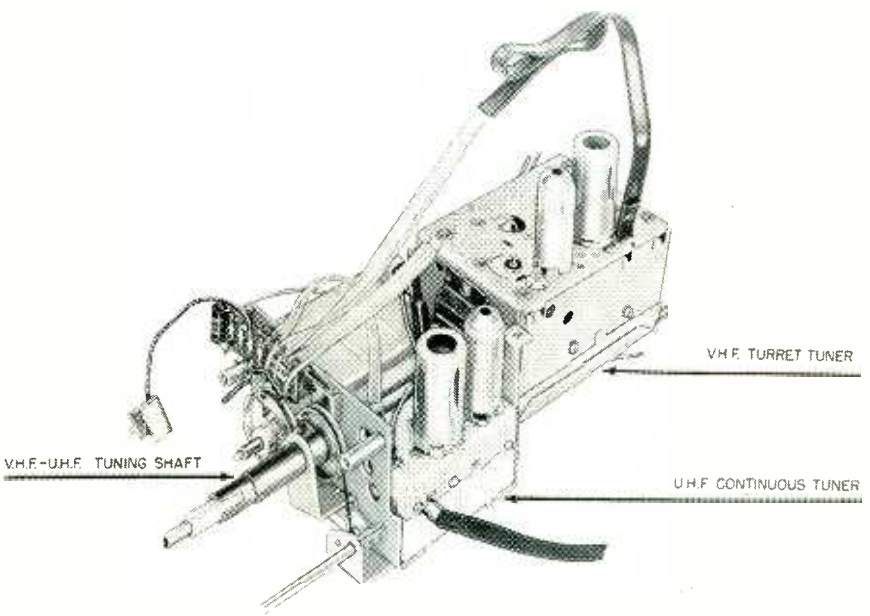


Fig. 8. Schematic diagram of the u.h.f. continuous tuner described in the text.

plate is grounded by condensers C_3 and C_4. Two condensers are used to reduce lead inductance which would restrict oscillation at the high end of the u.h.f. band. The r.f. choke, L_5, is effectively the load for the 6AF4 tube and keeps the cathode at an r.f. potential above chassis ground. The oscillator frequency is varied by tuning line Z_{1C} with condenser TC_1. Condenser TC_1 is ganged to preselector condensers TC_2 and TC_3.

For tracking purposes, a low-fre-

Fig. 7. Combination turret-type v.h.f. and continuous-type u.h.f. tuner used by Admiral; the v.h.f. tuner is in the rear, u.h.f. in the front.



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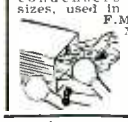

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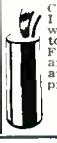

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10-20	450-25 F.P.	.39
10-8-8-8	450-450-450-150	.49

Kit of 10 Assorted Electrolytic Condensers

Consists of singles, doubles, triples and quadruples, all of popular voltages and capacities—all standard popular brands.

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Made by National, famed for quality and precision communications equipment. Turret selects each channel. Completely self-contained including tube and selenium rectifier for A.C operation. Housed in metal cabinet. In factory-sealed cartons with complete instructions.

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An assortment of 25 by-pass condensers, made by leading manufacturers. Top quality. Most popular sizes and voltages. Values .002 to .2 MFD. 200 to 1000 VDC.

KIT OF 25 **99c**

Hi-Voltage POWER SUPPLY

4500 VOLTS 6 MA.

12AU7 oscillator, 1B3 rectifier

Completely wired, enclosed in shielded metal case, removable cover. Use as R.F. high voltage supply.

BRAND NEW! **$2.95**

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2 Gang AM and FM contains 2 separate sections for AM and 2 for FM with padder condensers. Attached a slug tuned high frequency coil whose plunger is geared to condenser shaft. Pulley type drive wheel. **89c**

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Assortment of 6, 7, 8 and 9 pin sockets. These are brand new, standard manufacture. Kit of 50. $1.49

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For damper use with 6W4, etc. High voltage insulation between primary and secondary to withstand high voltage surge. Can be used for general replacement. **79c**

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Lowest net price elsewhere—$4.70. At this give-away price, order in quantity while they are available. Each . . **95c**

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Very popular, used in most T.V. sets. Well-known manufacturer. Matches vertical output tube to the deflection yoke. 10 to 1 ratio. A terrific buy on a top performer. **95c**

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List price—$7.50

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Horizontal Output TRANSFORMER

Type 204T1 A horizontal Output Transformer designed for deflection circuits employing rf-operated high-voltage supplies. Intended for 50° magnetic-deflection kinescopes. Used with RCA Deflecting Yokes 201D1, 201D2, 201D3 or 201D12. . . **$2.95**

List price—$13.95

HIPO TV rectifier tube—replaces the 5U4 tube directly! Makes pictures bigger, brighter, larger and increases the gain in TV receivers. HIPO 567. . . . . **$1.39**

RESISTORS (Assortment of 200)

Standard RTMA Coded or Value Printed, Uninsulated, ¼ Watt, 1 Watt, 2 Watt, and Some 10 Watt. RAD-TEL SUPER BUY!!! Assortment of 200 for **$1.39**

List price—$10.00

Kit of 50 MICA CONDENSERS

All popular sizes of mica condensers. In regular and silver construction. For FM and TV use. . . **$1.95**

List price—$12.50

American Makes Kit of 100 Insulated RESISTORS

50 - 1g and ½ watt, 25 - 1 Watt, 25 - 2 Watt. All new, all clean. Good value **$2.65**

List price—$15.00

Hi-Voltage T.V. CONDENSERS

500 mmfd 10KV. **$ .39 ea.**

500 mmfd 15KV. **.49 ea.**

500 mmfd 20KV. **.49 ea.**

500 mmfd 30KV. **1.59 ea.**

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Kit of 10 includes 3 wire-wound, 2 dual post, 5 carbon

The price of one (1) for the quantity of ten (10). Short and long shaft.

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Ea. per set. **$2.95**

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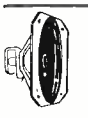

Size	Ohms	Price
3"	1000	79c
4"	1800 (tapped at 300)	79c
5"	4 (auto speaker)	79c
6"	2500	99c
10"	2500	1.49
4 x 6	1800	99c
4 x 6	2750	99c
5 x 7	1000	99c
5 x 7	1800	99c
5 x 7	2750	99c
6"	90 (with 6K6 output transformer)	1.49
8"	680 (with 6V6 output transformer)	1.95
6.5"	38	1.49

Alnico V P.M. standard brand Speakers

4" 1.47 oz. with 50L6 output transformer. **$1.95**

5" 1.47 oz. with 50L6 output transformer. **$1.95**

6" 2.15 oz. **$2.19**

4" .68 oz. with 50L6 output transformer. **$1.89**

4 x 6 . . . . . **$1.95**

5" 2.15 oz. **$1.69**

7½" 3.16 oz. Mopar **$2.95**

8" 2.15 oz. **$2.95**

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12" Magnavox **$5.95**

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TERMS: A 25% deposit must accompany all orders—balance C.O.D. All shipments F.O.B. Irvington warehouse. Orders under $10—$1.00 Handling Charge. Subject to prior sale.

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Kit of 48—very usable assortment of solder lug terminal strips. Brand new. Unusually fine value! Comp. Kit of 48. . . . **89c**

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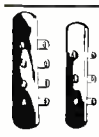
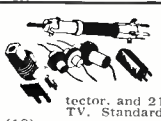
TERMINAL STRIPS



Assortment of 50 terminal strips (screw type). Kit contains wide selection to meet every design. Kit of 50. . . . . **89c**

2, 3, 4 and 5 screw strips.

T.V., RADIO, and F.M. COIL KITS



Kit for television servicemen and experimenter consisting of width coil, peaking coil, 4.5 m.c. ratio detector, and 21.9 m.c. IF coil.

TV. Standard kit of ten (10) **99c**

TV. Super value; not duplicated. 25—**$1.85**

Broadcast and short-wave, midget to multi-band replacement coil's.

BC. Standard kit of ten (10). **99c**

BC. Super value; not duplicated. Kit of 25. . . . . **$1.85**

BC kits include RF, Osc., IF, and detector coils.

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0B2	.81	6BQ6	.79	12BA6	.38
0C3	.72	6BQ7	.90	12BA7	.60
0D3	.70	6BZ7	.90	12BD6	.45
0Z4	.55	6CC4	.37	12BE6	.39
1A5	.30	6C5	.39	12BF6	.39
1A7	.47	6C6	.58	12BH7	.63
1AX2	.62	6CB6	.44	12BY7	.65
1B3	.68	6CD6	1.11	12BZ7	.65
1B7	.30	6E5	.48	12C8	.34
1C5	.43	6F5	.39	12J5	.42
1E7	.29	6F6	.59	12K8	.59
1G6	.24	6G6	.52	12Q7	.59
1H4	.30	6H6	.41	12S8	.62
1H5	.49	6J5	.43	125A7	.65
1L4	.46	6J6	.52	125F5	.50
1LA4	.59	6J7	.43	125J7	.67
1LE3	.59	6K5	.47	125K7	.63
1N5	.67	6K6	.37	125L7	.47
1P5	.57	6K7	.44	125N7	.52
1Q5	.58	6L6	.64	12SQ7	.56
1R5	.49	6Q7	.45	125R7	.49
1S4	.59	6S4	.38	12V6	.46
1S5	.43	6S8	.53	12X4	.38
1T4	.49	6SA7	.43	14A5	.59
1U4	.49	6SD7	.41	14AF7	.59
1U5	.43	6SF5	.46	14H7	.59
1V	.53	6SG7	.41	14J7	.30
1X2A	.63	6SH7	.49	14W7	.30
2A3	.30	6SJ7	.41	19BG6	.95
2A4G	.24	6SK7	.41	19C8	.70
2W3	.38	6SL7	.48	19T8	.69
2X2	.59	6SN7	.52	19V8	.79
3A4	.45	6SQ7	.37	24A	.39
3E5	.46	6SR7	.45	25AV5	.83
3Q4	.48	6SS7	.42	25BQ6	.79
3Q5	.49	6T4	.99	25L6	.39
354	.49	6T8	.56	25W4	.59
3V4	.51	6U4	.60	25Z5	.66
5U4	.50	6U5	.44	26	.45
5W4	.50	6U6	.59	27	.39
5Y3	.37	6U8	.61	35	.58
5Z4	.59	6V6	.39	35B5	.40
6AB4	.44	6W4	.44	35C5	.39
6AC7	.86	6W6	.44	35L6	.41
6AF4	.90	6X4	.37	35W4	.37
6AG5	.48	6X5	.37	35Z3	.59
6AH4	.57	6X8	.75	35Z4	.47
6AH6	.73	6Y6G	.48	35Z5	.47
6AJ5	.65	7A4	.47	36	.39
6AK5	.55	7A5	.59	41	.42
6AL5	.38	7A6	.69	42	.42
6AQ5	.39	7A7	.69	43	.55
6AQ6	.37	7AF7	.53	45	.55
6AR5	.37	7B4	.44	45Z3	.44
6AS5	.50	7B6	.69	45Z5	.49
6AT6	.37	7C4	.59	50B5	.43
6AU4	.68	7C5	.69	50C5	.39
6AU5	.82	7E5	.59	50L6	.61
6AU6	.38	7E6	.30	50Y7	.50
6AV5	.83	7E7	.59	53	.24
6AV6	.37	7H7	.59	57	.58
6AX4	.53	7L7	.59	58	.60
6B4	.64	7X7	.70	70L7	.97
6BA6	.39	7Y4	.69	76	.44
6BA7	.57	7Z4	.59	77	.57
6BC5	.49	12A8	.61	78	.47
6BD5	.59	12AL5	.37	80	.35
6BD6	.45	12AQ5	.52	83V	.68
6BE6	.39	12AT6	.37	85	.59
6BF5	.41	12AT7	.66	117L7	.99
6BF6	.37	12AU6	.38	117Z3	.37
6BG6	1.25	12AU7	.54	807	.99
6BH6	.46	12AV6	.39	866A	1.39
6BJ6	.43	12AV7	.63	1274	.30
6BK7	.80	12AX4	.56	2050	.89
6BL7	.83	12AX7	.56	1000FM	.59

RAD-TEL TUBE CO.

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quency trimmer is used to set the local oscillator on channel 14 frequency. This trimmer is adjustable externally from the rear of the tuner. A high-frequency tracking fin is located near the tuning condenser plates (TC_1) and is set on channel 83 frequency. In later production tuners, the high-frequency tracking fin is replaced by a trimmer, which is adjusted at the factory externally the same as the low-frequency tracking trimmer.

The mixer uses a special u.h.f. triode connected as a grounded-grid amplifier. The 6AM4 tube is designed with low interelectrode capacitances and multiple grid pin connections to reduce lead inductance in the tube. The control grid and the multiple pin connections, spaced around the tube base, serve as a shield between plate and cathode. In addition to this, any energy fed back to the cathode is out-of-phase and oscillation will not occur.

Coupling loop CL_3 and condenser C_2 feed the u.h.f. signal and oscillator injection voltages to the cathode of the mixer stage. C_1 and R_1 provide cathode bias. The two voltages mix within the 6AM4 tube and the resultant frequency appearing in the plate circuit is that of channel 5 or channel 6 (v.h.f., 76 mc. to 88 mc.). Transformer T_1 and the mixer tube plate-to-ground capacity resonate at this first conversion frequency to form the mixer plate load impedance. A balanced 300-ohm output impedance is also provided by tapped transformer T_1. The d.c. blocking is accomplished by coupling condensers C_7 and C_8. Proper matching to the v.h.f. antenna is furnished for approximately 12 mc., so that either channel 5 or 6 can be used to receive the output of the u.h.f. tuner.

There are three series of chassis in the *Admiral* 1954 line. One of these, the 23 series, was described in this article. The second, the 22 series, differs principally from the 23 series in the design of the horizontal deflection system. Furthermore, because of this difference, the 22 series chassis requires only one low-voltage rectifier whereas the 23 series uses two. The third series of chassis is the 19 series and this is quite different from either of the other two. For one thing, it possesses 19 vacuum tubes against 22 for the 22 series and 23 for the 23 series. Other differences include a somewhat narrower video i.f. bandpass, use of the synchroguide a.f.c. system, a modified a.g.c. system, and a simpler sound system. All series, however, are available with the u.h.f. tuner, if desired.

All *Admiral* combination u.h.f.-v.h.f. receivers come equipped with two built-in antennas; one for u.h.f. and one for v.h.f. The v.h.f. built-in antenna is connected to the two lower antenna terminals at the top rear of the high-voltage cage, and the u.h.f. antenna is connected to the two upper terminals. If the set is positioned properly, external antennas may not be required. —30—

Mac's Service Shop

(*Continued from page 74*)

in the past that worked pretty well. This unit here, however, is representative of several new all-electronic remote controls that are being placed on the market by various manufacturers at this time; and these new units have several things to recommend them. In the first place, they can be installed easily and quickly and do not interfere with the normal operation of the receiver. It is a well-known fact that you can do a better job of adjusting a picture from the viewing position. That is proved by the wide use of that earliest form of remote control: a wife in her easy chair instructing her husband at the set exactly how to set the volume and contrast controls. Unless you are a contortionist, it is practically impossible to set the controls on the set without blocking the view of some of the watchers. Finally, a remote control unit fits in beautifully with the radio-phonograph-TV custom installations that are becoming so popular these days.

"I have been thinking these control units would be a good item for small shops such as ours to stock and sell," Mac said musingly. "They are small and take up very little room. Every owner of a set we repair is a potential customer. We have the jump on an ordinary store because only a service technician is in a position to install them.

"A technician friend of mine reports a kind of sneaky but effective way he has of selling them. When he has to remove a tuner and send it in for repair, he temporarily installs one of these units so the set can be used while the tuner is away. He says not a single set owner so far has let him remove the remote control when the repaired tuner is returned."

"Say, I think I know another use for that remote control unit," Barney exclaimed. "Suppose I run the output of that coax line through a blocking condenser into the antenna connections on my communications receiver tuned to twenty-one megacycles. Then a short piece of twin-lead, run through a high-pass filter to the tuner's antenna terminals ought to make a dandy probe for detecting TVI-causing harmonics leaking out of any transmitter. The receiver's S-meter would show instantly any change in the strength of those harmonics."

"It would probably work," Mac said with a grin; "but you remind me of a guy who can't watch a steam shovel at work without thinking about how he could use it to dig his garden potatoes."

Barney wandered across to the bench and picked up a large red-backed book lying by Mac's elbow. "What's this?" he asked.

"Handle that with care," Mac warned. "I had a heck of a time borrowing that copy. It contains the in-

formation *RCA* presented to the FCC when they were seeking approval of their color television system."

"What kind of information?"

"Just about any sort you can think of, from detailed engineering description of the apparatus used in transmitters and receivers to purely personal opinions of the observers."

"I've read a lot about color television," Barney remarked, "but I have never seen anything about how color receivers are going to compare with black and white sets in fringe areas. How will color reception be affected by things like adjacent channel interference and noise?"

Mac took the book from Barney and flipped the pages to a section near the center. "Ah, here we are," he said. "Color and monochrome sets are about equally susceptible to co-channel interference and to lower adjacent channel interference. Color sets, though, are a little more disturbed by upper adjacent channel interference. Color reception, too, is a little more susceptible than monochrome to random noise. However when the noise is of the impulse type, such as is produced by an electric razor, one type of reception is not bothered any more than the other. And for good measure, I might add that observers decided multi-path reception—'ghosts' to you—interfered a trifle more with the enjoyment of color reception. The important thing is, however, that in every comparison of the effect of interference on color and black and white receivers, the difference was slight."

"That must be a pretty complete report," Barney conceded, "but let's give it one more acid test. See if it can answer the same disturbing question everyone pops at me when I try to talk about color television: What color is the snow?"

A slow grin spread across Mac's wrinkled face. "I know the answer," he said, "but I must confess I did not find it in the book. I thought I knew what color it would be, but I was not sure; so when everyone out here in the fringe area kept asking the same question, I wrote to *RCA* and asked them. They came right back with a telegram, which made me feel that I was getting serious consideration of a rather silly question; but now we have an authoritative answer right from the horse's mouth.

"As we might have suspected, snow on color television can be, and is, any color through the whole spectrum. Since it is a manifestation of random noise, it affects the color circuits as well as the others; and this results in the snow's appearing as multi-hued sparkles of light."

Barney heaved a big sigh of relief. "It may be a silly question, but I'm surely glad they answered it. You can't imagine the awful thing it was doing to my ego to have to say, 'I don't know,' every time someone asked about the color of the snow. Now I'll just snap, 'It's technicolored, of course!' "

—30—

Color Alignment

(*Continued from page* 54)

transmitted, the white portion serves to allow color brightness adjustment. On the color test pattern the relative intensity of each primary color, not the hue, is dependent on the color contrast control setting. As a check on this adjustment observe the yellow portion of the test pattern to find any unbalance in the color contrast control setting. To sum up, the brightness controls are balanced out to obtain white, and the contrast controls are set for relatively equal color intensity and the correct shade of yellow.

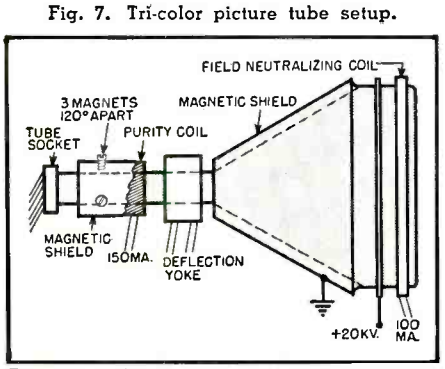
Tri-color Tube Adjustments

Single gun color picture tubes are not much more difficult to adjust than ordinary picture tubes, therefore, this discussion is limited to the tri-color tube and its equivalents.

On any color tube the conventional adjustments for vertical linearity, height, width, and horizontal linearity are the first steps towards obtaining a picture. All these adjustments can be made by electrical controls on the chassis, without affecting the positioning of any of the components on the picture tube. In color TV the linearity, height, and width must be much better than in monochrome receivers and these adjustments should be made carefully and precisely. In addition to the conventional adjustments, a number of special color controls and settings are required at the tri-color tube. One type of adjustment is the physical placement and setting of the various components around the neck of the tube; the second series of adjustments are electrical controls for the operation of the tube.

In Fig. 7 are shown the various components mounted on the *RCA* tri-color tube. The purity coil assembly is placed next to the tube socket. This assembly consists of three parts: the outer shield, which is a magnetic shield and is usually grounded; the purity coil itself (shaded portion); and three threaded magnets. These three magnets are spaced 120 degrees apart and should be located directly over each of the three electron guns. Before starting the adjustment procedure, set all three brightness controls for zero brightness, set the convergence and

Fig. 7. Tri-color picture tube setup.



focus controls at their center positions, and set the purity coil and field neutralizing coil controls for zero current. Unscrew the three magnets on the purity coil assembly to provide minimum field. With high voltage on, adjust each of the brightness controls to obtain a raster. Next, connect a signal, monochrome or color, and adjust the focus controls to get focus over the entire screen. Check height, width, linearity, etc. as in monochrome receivers without regard to color.

To adjust for color purity cut the blue and green guns off, remove the test signal, and rotate the purity coil while adjusting the current through it until the center of the screen shows a uniform red pattern. The position of the deflection yoke along the neck of the tube will have a great effect on the purity of the red field along the edges. Another adjustment to be made for edge purity is the amplitude and direction of current through the large field neutralizing coil. When the optimum red field is obtained, check the green and blue fields next. It may be necessary to touch up some of the previous adjustments for best results on all the three colors. Recentering of the raster may also be necessary after the purity adjustments. To adjust the three beam positioning magnets, a dot pattern generator is helpful. The position of each magnet is set so as to produce a small equilateral triangle made up of three adjoining color dots. Each magnet also affects the positioning of the other two beams so that a number of touch-up adjustments may be necessary. The d.c. convergence voltage is set so that three color dots near the center of the screen are clearly visible. After they have been brought to an equilateral triangle, the convergence control can be reset to produce a white spot at the center.

The d.c. convergence and focus control should be set for best convergence and focus at the center, while the dynamic convergence and focus controls are adjusted for best over-all focus and convergence. Each setting of the convergence control may require a touch-up of its corresponding focus control and *vice versa*. When it is possible to obtain optimum convergence and focus all over the screen by merely setting the d.c. controls, the dynamic controls have been properly adjusted.

When all the adjustments have been satisfactorily made, examine the picture critically, with a signal, without a signal, and with each single gun operating alone. It may well happen that after other adjustments are made, the color purity is off and each of the purity adjustments must be reset. Centering, width, or height may also be off, requiring further adjustment.

Setting up a tri-color tube for correct color reproduction is not a simple, five minute job, but requires time, patience, and know-how. A complete, detailed article could be written about purity adjustments alone or about the operation of the dynamic convergence circuits. This article only furnishes

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the basic data which will permit the service technician to undertake a color installation. Obviously a great deal more information will be required.

At the present stage of color television receiver development, the initial adjustment of many of the color circuits will be time consuming and extremely subjective. The adjustment of the voltages to the set of first anodes, for example, which is necessary to effect a proper gray scale for the monochrome image, is time consuming because the settings must be made for various beam currents so that the black-and-white picture will not be color tinted. Also, the color hues that the service technician adjusts for may not be the ones the customer thinks are natural.

A great deal more experience in color adjustments, receiver alignment, and installation procedure is required before a hard and fast method of setting up a color receiver can be evolved. However, many simplifications in adjustments, automatic control circuits, and new service aids eventually make the color TV receiver much easier to install. —30—

CITIZENS BAND TRANSCEIVER AVAILABLE

THE TV, radio, and electronics division of Stewart-Warner Corporation, Chicago has been granted an FCC class B radio telephone-type approval on its new "Portafone" transceiver.

Operating in the Citizens band at a fixed frequency of 465 mc., the new transceiver may be operated as a portable station when used with a battery pack or as a fixed central station by connecting it to a special power pack designed to plug into any 115-volt, 60-cycle a.c. outlet. It may also be used in a car by plugging a special adapter into the cigarette lighter socket of the car's instrument panel.

The "Portafone" requires an FCC station license, but not an operator's license. It is sold in pairs. Each instrument weighs 28 ounces. The case measures 10½" long with a 6½" antenna.

The elements of the two-tube superregenerative receiver are reconnected by the "press-to-talk" switch so that the unit operates as a two-tube transmitter. Transmission is set at 465 mc. Stability of the unit is such that there is a drift of less than ± .5% over the temperature range of 0 to 125 degrees F and from 0 to 100% humidity with the "B" battery voltage change from 130 to 90 volts and the filament voltage change from 7 to 5.2 volts. This includes 500 kc. of a frequency-modulated component which is inherent in the unit when it is modulated at maximum. Stability of the receiver is the same as that of the transmitter.

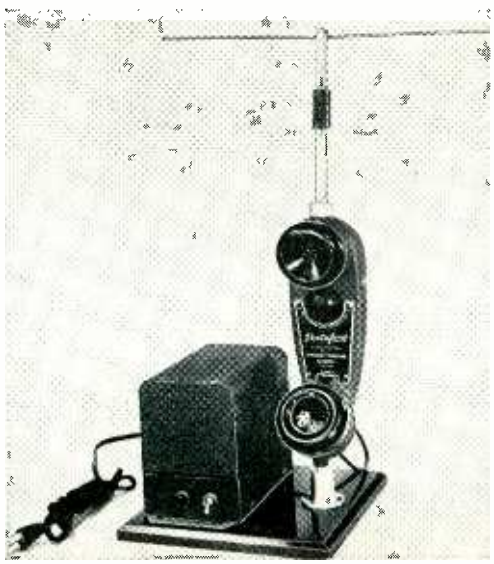
All components used in the unit are operated at 50 per-cent of their maximum ratings or less with most being operated at about 20-per-cent of maximum. All of the parts which normally require replacement are standard and are available through jobbers. Transmitter adjustments, however, must be made by an FCC licensed operator of the proper rating.

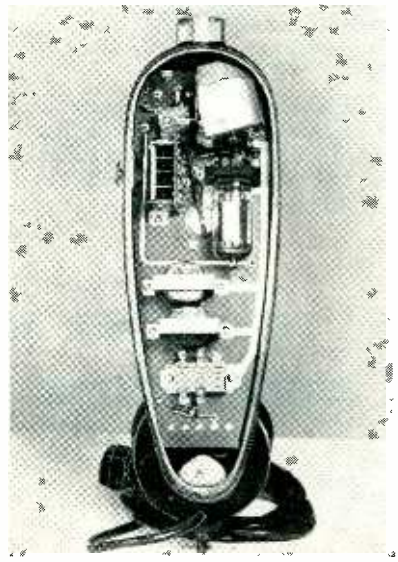
The unit normally delivers a power of 500 milliwatts. Audio output is about 15 milliwatts as measured into a 600-ohm earphone. Sensitivity of the receiver is about 12 microvolts (absolute) for a readable signal.

Under a condition of 10 per-cent transmit time and 90 per-cent receive time, the battery pack gives a life of about 10 hours with a recovery of an additional life of some 5 hours after the battery rests 24 hours. The unit includes an indicator light which shows whether the voltage of the pack is sufficient to provide "on frequency" transmission.

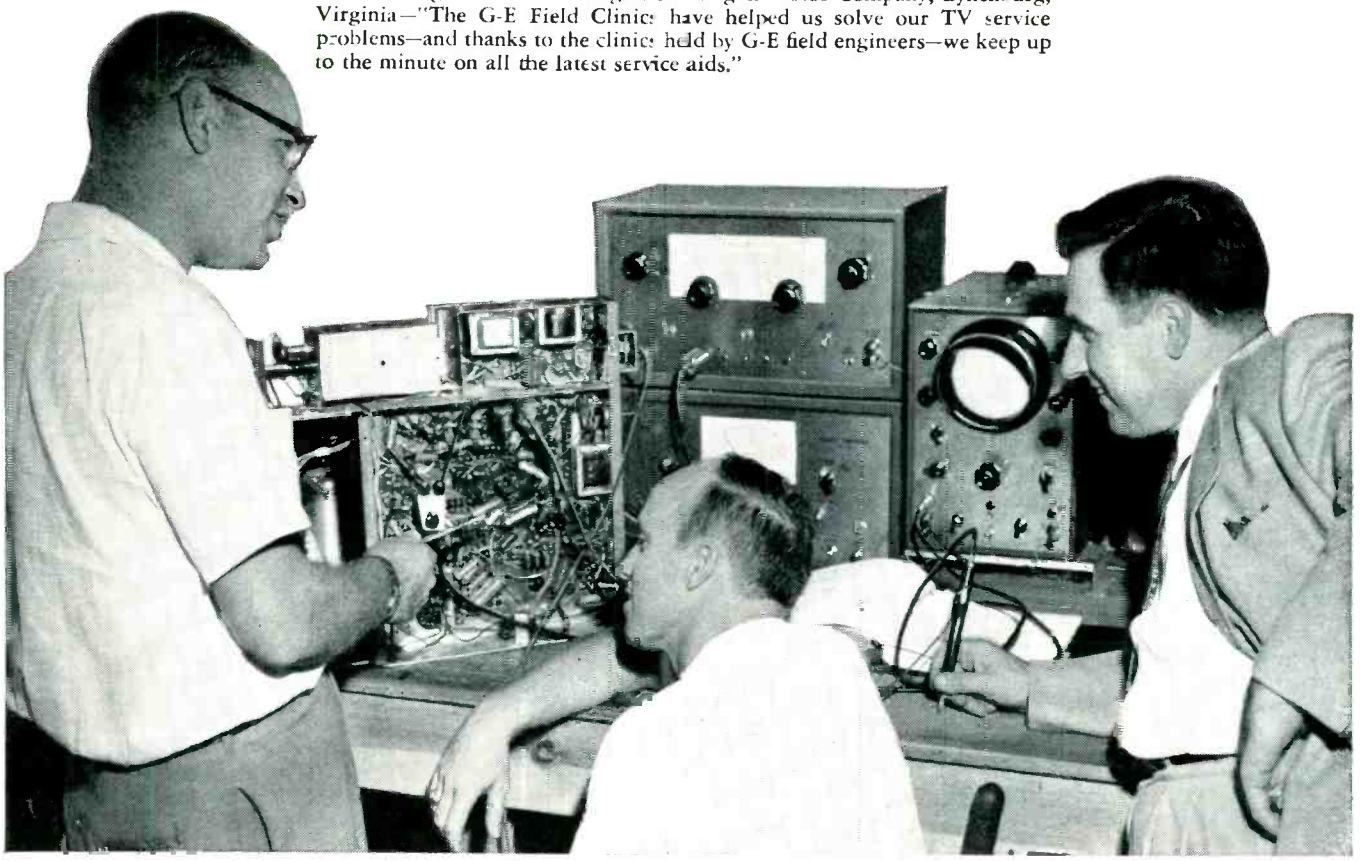
The new Model 73 will be distributed through major parts jobbers which have special industrial electronics departments. —30—

(Left) The central station power pack, shown with the Stewart-Warner "Portafone," permits operation of the unit from a fixed location. The power pack, plugged into a 115-volt, 60-cycle a.c. outlet, permits use of the unit without a battery pack. (Right) Internal view of the "Portafone." The use of printed circuits makes possible the required compactness and light weight. A glow lamp in the antenna base indicates the battery reserve. The battery pack can be worn strapped to the waist.





● According to William Vaughn of Vaughn Motor Company, Lynchburg, Virginia—"The G-E Field Clinics have helped us solve our TV service problems—and thanks to the clinics held by G-E field engineers—we keep up to the minute on all the latest service aids."



Left to right – C. R. Lewis, Alex A. Driskill and William Vaughn discuss TV service.

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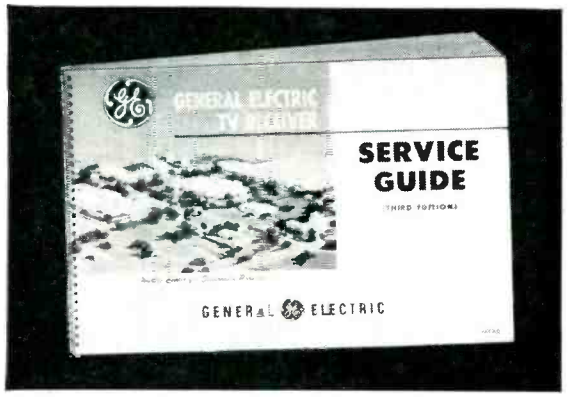

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GENERAL ELECTRIC

International Short-Wave

(*Continued from page* 102)

Noted to North America 0000-0100 over JOB2, 7.18, and JOA3, 9.695. (Stein, Morgan, Calif.) JKI2, 9.655, is in the clear, after 0200 sign-off of *Radio Moscow*, with Japanese Home Service; JKL, 4.86, AFRS, Tokyo, is noted at weak level around 0700. (Morgan, Calif.) Tokyo noted on 9.535 at 0100-0200 with music and phone talk, *irregularly;* formerly was on 9.555; fair level. JOB, 7.18, and JOA3, 9.695, noted at good level at 0925 beamed to China. (Balbi, Calif.) JOB2, 7.180, heard to Europe 1400-1500; announces 9.695 as parallel. (Pearce, England)

Kuwait — Radio Kuwait officials say the station is scheduled on 5.000 in Arabic 1200-1500 with 1 kw.; will install a *new* station of 25 to 50 kw. soon, but didn't say if would be s.w. or not. (Scheiner, N. J.)

Liberia — ELBC, 6.024A, Monrovia, noted 1752 with popular music, weak level. (Cox, Dela.) Closedown is 1845.

Libya—Forces Broadcasting Service, Benghazi, sent QSL card for broadcasts on 4.782, 4.965; said has two *test* transmitters, of 500 and 700 watts, using transmitter Type BC690's, antenna half-wave dipole; further reports welcomed. Heard on 4.785A to 1600 closedown, when said would open again 2330; signature tune had bugles, is *not* National Anthem. (Pearce, England)

Malaya — BFEBS, Singapore, noted on 11.82 at 0515 with news, music. (Sanderson, Australia). And in Calif. 0730; 9.69 is fair at that time. (Balbi) With news on 11.82 at 0415, when *announced* use of 15.435, 11.820, 7.120, 6.110. (Ballou, Calif.) Kuala Lumpur, 6.025, heard with organ recital at 0430; at times a station on 3.330A seems parallel. (Saylor, Va.)

Mexico—XEBR, 11.820, Hermosillo, has sports news in Spanish 1600. (Kahan, Calif.)

Mozambique — Lourenco Marques noted signing on in *English* 2300 on 3.48A and 4.916A; 3.48A fades out rapidly *after* 2315, and 4.916A *after* 2330; is heard sometimes on 11.764A *after* 0030. (Morgan, Balbi, Calif.) The 4.916A channel noted around 1450. CR7BV, near 4.780, heard 1242 in Portuguese, call after chimes 1300. (Pearce, England)

New Zealand—ZL19 is call of *Radio New Zealand's new* channel on 11.830, fair around 2300, with ZL4, 15.280, parallel. (Niblack, Ind.) Used from 1800. (Collett, N. Z.) Noted on 9.52, 9.62 around 0200-0545A. (Sawyer, Ont.)

Northern Rhodesia—Central African Broadcasting Station, 4.826, Lusaka, tuned 1245 with music and announcements in native African dialect; usually relays BBC news 1300. (Pearce, England)

Pakistan — Radio Pakistan, 17.710, noted with news 0330; with news at slow speed 1310-1330 on 6.235, 7.010; heard on 7.010 with news 1545. (Pearce, England) Closing on 7.010 at 1615. (Campbell, Pa.) News noted 0200 on 17.770. (Sanderson, Australia) Heard in native on 9.484 around 0900, with *English* news 1015-1030. (Saylor, Va.) Noted on 6.235 at 1510 with news commentary. (Bellington, N. Y.)

Panama—HOLA, 9.505, Colon, noted 1648 tune-in with *English;* started another *English* session 1700; good level; announced *Radio Atlantico.* (Bellington, N. Y.) HOF7, 9.685, *Ondas Popular*, noted at weak to fair level in Spanish 2010. (Cox, Dela.) And around 0800. *Radio Miramir,* 6.031, opens 0555. (Stark, Texas)

Peru—OAX4R, 15.150A, *Radio Nacional,* Lima, has news in *English* daily 1315-1330; and now announces this as in "Overseas Services." (Niblack, Ind.)

Philippines — The *new* VOA relay channel 11.700 is fair to 1500 sign-off. (Balbi, Morgan, Calif.) DYH4, 6.055, Silliman University, Dumaguete City, is scheduled 0500-0830, soon will *test* on 3.277. (Radio Australia) DZH7, 9.73, and DZH2, 9.64, are strong around 0500. (Ishikawa, Japan) DZH9, 11.855, Manila, heard announcing for FEBC in *English* 2015; DZH7, 9.730, noted in *English* 1945, Japanese 2000. (NNRC)

Portuguese India—Radio Goa, 9.610, noted 1100 with "Catholic Hour" in *English.* (Pearce, England)

Roumania — Bucharest has been heard on *new* 5.990 opening 2200 with *English* to North America; still on the air 2331. (Bellington, N. Y.) Heard in Sweden 1200-1730 on this channel. (Radio Sweden)

Saudi-Arabia — Djeddah noted on 7.095A at 2335 with news in Arabic, fair level in Dela. (Cox) On 11.95A in Japan from 2300-0205. (Japanese Short Wave Club)

South Africa—Springbok Radio, Johannesburg, is heard in Ireland on 3.356A around 1330 when amateur and CWQRM permit. (*Radio Amateur,* London) Cape Town, 4.892A, noted from 2345 sign-on; news in Afrikaans 2400. (Cox, Dela.)

South Korea—Radio Pusan, 2.510, is heard in Korean 0430; *Radio Seoul,* 9.555, is noted from 0400. (Hardwick, N. Z., *via Malmo-DX-aren,* Sweden) The Pusan 7.935A channel has *English* 0430-0500, announces *"Voice of Free Korea."* (Cushen, N. Z.)

Spain — Madrid, 9.363A, noted with *English* for Europe 1515-1545, news, music. (Zerosh, Pa.) Heard on 15.626 at 1110 tune-in when had program for Spanish seamen to 1818; re-opened 1126 to Canary Islands, closed 1150 with march; good level in N. C. (Ferguson) Malaga, 6.180, noted 1800. (Pearce, England) *Radio Falange de Valladolid,* 6.997A, noted 1445 with classical music; *Radio S.E.U.,* 7.140A, is fair to good around 1535; *Radio Murcia,* 7.104A, noted 1541 with overture, fair level. (Cox, Dela.) FET5, Leon, has been heard on 6.840A to 1800 sign-off. (Radio Sweden)

Surinam — Paramaribo, 5.758, noted closing in Dutch 2100. (Roberts, Conn.)

Sweden—Radio Sweden, 6.065, noted with *English* for Canada 1930-2000. (E. Gates, Conn.) Heard to Eastern North

America now on 9.62 at 0700 in *English*. (Grace, Conn., others)

Switzerland — HER7, 17.784, Berne, noted 1000 and onwards. (Zerosh, Pa.) Home Service noted over HER22, 3.985, at 1045, music. (Pearce, England) Is good level on 7.165, 7.210, 9.535 to North America from 2030. (Todosiev, Ont.; Rivers, Mass.)

Taiwan — BED6, 11.735, heard 2315 with news, music; BED24, 9.820V, noted 0645 with Western music, Chinese news; BED36, 7.344, heard 0700 with Western music, Chinese news; BED3, 15.235, noted 0045 with news, then music; BED26, 10.080V, heard 0500 at good strength in Chinese news, Western music. (Sanderson, Australia) BED7, 7.130A, Taipeh, is one of the most consistently heard Asiatics at present, peaks around 1015, dropping off until sign-off 1200; in native dialects. (Morgan, Calif.)

Thailand — HSK8, 6.240, Bangkok, noted 0600 with news in Thai and music in Home Service. (Sanderson, Australia) Strong during hour before sign-off which varies 1020-1045; closes with announcements in *English*, Thai, followed by National Anthem; 7.100A parallels but is much weaker. (Morgan, Calif.) HSK9, noted on *measured* 11.670, in native session 0800; should run to 0920A. (Ferguson, N. C.) Heard in England signing on 0500 with news. (Pearce) Final announcements in *English* are given before leaves the air 0700-0715V. (Catch)

Trieste—FBS sent letter verification, said still is *experimental,* using channel formerly occupied by FBS, Malta; schedule was given 1100-1800 although this is *not rigidly adhered to during testing period.* (Pearce, England) Frequency is presumed 15.125.

Trinidad — Radio Trinidad, 3.275, noted opening 0500. (Hardwick, N. Z., via *Malmo-DX-aren,* Sweden) Heard on 6.085 at 0715 tune-in. (Stark, Texas)

USI (Indonesia) — YDF6, 9.710, Djakarta, has been weaker lately in the 0930-1030 *English* transmission; has CWQRM. (Morgan, Calif.) Noted closing 1100. (Brown, Wyo.) YDB2, 4.910, 300 watts, and YDF6, 9.710, 50 kw., are used 0600 - 1100, *English* 0600 - 0700, 0930 - 1030. (Navarro, Philippines) YDF7, 11.770, noted in Indonesian language 1150. (Dahlgren, Sweden) YDF, 6.045, noted signing off 1030 with chimes. (Balbi, Calif.)

USSR—Home Service has powerful signal on 7.150 from around 0500 to 1000 sign-off; noted on 7.190 at slightly lower level. (Morgan, Balbi, Calif.) Moscow is good signal on 6.07 to North America 1900 with news, commentaries, classical music. (Calos, Calif.) Tiflis, 5.040, Georgian S.S.R., appears to be the Russian on this channel, logged 1405 with call of "Govori Tbilisi;" Baku, Azerbaidjan S.S.R., 4.958, is heard in Britain around 1330 with speech which sounds like a mixture of Russian and Arabic. (Fairs, *via* URDXC)

Vatican — HVJ is noted with news 1000 on 9.646; weaker in parallel on

11.685; Polish session 1015 is *jammed.* (Morgan, Balbi, Calif.; Catch, England) Heard on 15.120 with news in French 0930-0945. (Kary, Va.) Heard in Sweden with *English* 1315-1330 on 9.646. (Olsson)

Yugoslavia—Radio Yugoslavia, 6.100, Belgrade, noted with news 1645. (Zerosh, Pa.) And 0115 on 9.505. (Cox, Dela.)

* * *

Press Time Flashes

The Universal Radio DX Club, 21446 Birch St., Hayward, Calif., recently observed its 20th anniversary; its prexy is Charles Norton.

A station heard on 5.990 with news 0730 just after opening is probably *Radio Pakistan.* (Stark, Texas) *"Radio Free Japan,"* clandestine Communist station believed located at Peking or Tientsin, China, now seems to be on a regular schedule on 1230 kc., 10.180, 11.896 at 1630-1700, 2230-2300, 0530-0600, 0630-0700, 0745-0815, 0900-1000. (Wada, Japan) The clandestine *Yugoslav Emigrant Station* is noted on 6.890A around 1625 to *after* 1700. (Hill, Mass.) Cushen, N. Z., reports HLKA, South Korea, on 3.895, 1 kw., signing on 0400.

A Spanish station, believed *Radio Mediterraneo,* Valencia, Spain, is sometimes audible through strong CWQRM on 7.000A from about 1615 *past* 1800. (Kary, Va.) *Radio Athens* more recently has been on 9.607 for the 1245 news session; AFN, 5.470, Germany, heard 1040 with popular music, AFN news 1100.

Radio Commerce, Box 1143, Port-au-Prince, Haiti, lists schedule of 0630-2300 (0600-1900 *Sun.)* on 4VA, 1080 kc., 1 kw., m.w.; 4VB, 6.091, 7.5 kw., and 4VC, 9.485, 7.5 kw.; at present uses *only French. Radiodiffusion Nationale Kemere Cambodia,* Phnom Penh, Cambodia, Indo-China, uses 6.090 with 1 kw. (over an American-made transmitter) and 1433 kc., 500 watts, 1800-1900, 2300-0100, 0500-0815. Complete schedule received from *"Voice of Free China."* Taipeh, Taiwan, is to America 2300-0200, BED6, 11.736, BED3, 15.235, with news 2305-2320, 0035-0050; for Europe and Near East 1400-1600, BED4, 11.920, with news 1420-1430; for mainland China, Japan, Korea, South Sea Islands, Southeast Asia 0530-0800, and for mainland China, South Sea Islands, and Japan 0800-1200, BED7, 7.130, BED4, 11.736. (Scheiner, N. J.)

The 1954 *"World Radio Handbook,"* a "must" for the SWL, is now available for $1.50, postpaid, direct from Ben E. Wilbur, 47 Mounthaven Drive, Livingston, N. J. Contains many new features, up-to-date information on both radio and television stations throughout the world.

YDR, Ambon, 4.865, Moluccas, Indonesia, now closes 0950; relays news in Indonesian from Djakarta 0930. (Cushen, N.Z.) *Radio Parkistan* schedules for the Home Service include APL2, Lahore, 1 kw., 6.138, 4.785, 3.915, 2125-2330; 7.284, 6.138, 0200-0400; 7.284, 4.785, 3.335, 0730-1300; APD2, Dacca, 7.5 kw., 7.150, 6.112, 4.807, 2000-2230;

9.614, 7.150, 6.120, 0030-0230; 6.120, 4.807, 3.955, 0600-1130. (Scheiner, N.J.) *Bayerischer Rundfunk*, Munich, Germany, lists schedules on 6.160 as weekdays 2330-0420, 0515-1900; *Sun.* 0000-1900. (Catch, England) This one noted with setting-up exercises in German just prior to 0100, then with news in German. (Sawyer, Ont.) Zurich sunspot predictions include Feb. 10; March 9; April 8. (Ferguson, N.C.)

Acknowledgment

Thanks for all the fine reports. Keep them coming to Kenneth R. Boord, 948 Stewartstown Road, Morgantown, West Virginia, USA. Good DX-ing, fellows! . . . . . K. R. B.

VERSATILE ANTENNA COUPLER

By R. H. MITCHELL, W6TZB

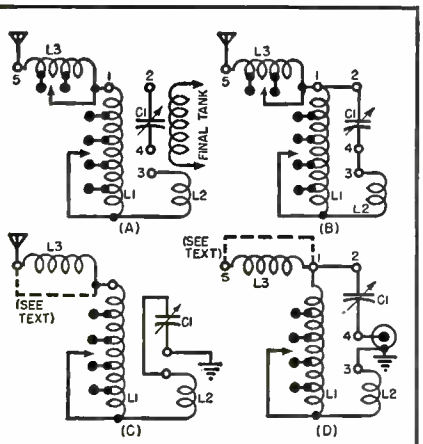
A FEW years ago, Frank C. Jones described an antenna coupling unit ("The Engineering Forum," Amateur Radio Defense, February 1941) which permitted the use of either series or parallel tuning with a single-wire antenna. The writer has made a couple of changes in the tuner to permit the use of coaxial feedlines or random length single-wire antennas.

The circuit of the tuner is shown in Fig. 1A. The numbered points indicate banana jacks. Short jumpers, terminating in banana plugs, are used to make the various connections. Switches could be used in place of the jumpers but this would increase the complexity of the tuner. Figs. 1B, 1C, and 1D show the proper connections for the tuner when used with voltage-fed, current-fed, and coaxial-fed antennas, respectively.

L_3 may be omitted if the antenna to be used is resonant in the ham bands. However, its use will be necessary with random-length, voltage-fed antennas. With this coil, the tuner can be used to load a transmitter into anything from the bedsprings to a mile or so of barbed-wire fence, from 10 through 160 meters.

-30-

Fig. 1. (A) Circuit of antenna tuner. (B) Connections for tuner when used with voltage-fed antenna, (C) current-fed, and (D) coaxial-fed antennas. See text for details.



C_1—300 to 500 μμfd. var. cond. (365 μμfd. receiver-type var. is satisfactory for powers up to 150 watts)
L_1—20 t. #14 en. tapped at 2nd, 5th, 10th and 15th turns. Space dia. of wire, 2½" dia.
L_2—Regular pick-up coil from final tank
L_3—15 t. #14 en. tapped every 3rd turn. Space dia. of wire, 2½" dia.

RADIO-TV Service Industry News

AS REPORTED BY THE TELEVISION TECHNICIANS LECTURE BUREAU

THE response from readers to the various discussions that have been carried out in this department during the past several months about the up-grading of service practices by stabilizing the methods of charging for service labor, has been truly phenomenal. It has been most interesting to observe the unanimity of opinion among the better service business operators about service labor pricing policies. This has been clearly reflected in the letters that have come from every section of the country.

Comments carried in the letters indicate that many service operators have been very much confused about how to charge for their labor. The idiosyncrasies of complex electronic circuits are such that some circuit failures take hours to locate and minutes to fix once they have been isolated. Many service operators badly underrate their own capabilities; they feel if they were more advanced in their technical knowledge they would be able to service the tough ones in less time. Yet these same technicians will usually locate and correct circuit failures that would stump the engineers who designed the circuits.

This lack of confidence in his own capabilities and know-how often results in a technician making a smaller charge for a service job than the job actually was worth. The existing charts of standard labor charges for television service and repair provide good yardsticks for measuring the adequacy of the service charges in any shop. However, many other factors must be taken into consideration in the determination of the net income a service business will have when using these basic labor charges charts.

Determining Service Income

To provide an intelligent analysis of the factors involved in labor costs in a service business, we will take a specific case that represents a typical situation—paralleled in service businesses in every section of the country. The situation in this service business is accurately described in the following excerpts from a letter from the owner:

"Our firm now employs two outside technicians on house calls. These men are much better qualified technicians than the average 'tube changer' but they are not fully qualified bench men. These men work on a strictly commission basis figured at 50% of all labor charges and 20% of all tubes and parts they install. However, the company is going in the red on this basis. We are currently doing about three thousand dollars a month gross business.

"Here are my questions: (1) What are some of the averages, percentage-wise, technicians of this caliber are now getting? (2) We work a six-day week and on that basis what would these men be getting if they were on salary? They average about twenty-two calls per week for each man."

While there is no such thing as a national wage average for various classes of field service technicians, the recently adopted union scale for journeymen technicians may serve as a convenient guide. This union scale provides for the payment of $2.35 per hour for journeymen technicians—technicians fully qualified to handle electronic service in the home. On the basis of this new union scale, technicians working 8 hours per day, 6 days per week will be paid $112.80 per week. In addition to these weekly wages they would receive a mileage allowance for operating and using their own cars or would be furnished company-owned service cars or trucks.

It is a generally accepted fact among successful service operators that labor costs must not exceed 40% of the service labor income if the business is to show a profit from its service activities. To provide the income needed to warrant the payment of $112.80 per week for their work, each of the technicians in the company in question must manage to make enough completed home service calls to bring in $282.00 per week in labor charges for their work. On the basis of a $5.00 minimum charge per call it would be necessary for each of these technicians to average 9.6 calls per day.

It is unrealistic to even assume that field service technicians can average nine and one-half completed calls per day. The most efficient service companies in the business with expertly handled field service control systems

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SPECIAL! Brush Model BA-116 crystal microphone 5.95
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20-20 mfd.—150 V. Guideman tub. elect. cond. ..... .29
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PHONE PLUG, standard type ..... .29
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100 assorted ½-1-2 watt carbon resistors 1.95
50 assorted 5 mfd. to .001 mfd. mica condensers 1.95
100 assorted (18 values) ½ watt resistors in partitioned plastic box 4.95
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Willard type N-T-6 midget 6 volt storage battery (less acid) 2.49
Volume controls, with switch (2" shaft). Choice ¼, ½, or 1 meg. Each ..... .49
100 ma. selenium rectifier 1 13/64" sq. plates ..... .85
250 ma. selenium rectifier 1 17/32" sq. plates 1.35
350 ma. selenium rectifier 1 3/4" sq. plates 1.75
400 ma. selenium rectifier, 2" sq. plates 1.95
Audio amplifier—5 watt, 3 tube AC amp. Model 305MP 14.95
Army surplus headphones Type HS-16A. 125 ohm DC resistance 1.95
Signal Corps Hand Key Type J-38 ..... 1.49
Mechanical reproducer head (plastic) ..... .90
2 volt storage battery (surplus) Willard 20-2. (Less acid) 2.95
2 volt vibrator, round can, 7 prong. Surplus Type VB-8 ..... 1.95
18" extension for auto antenna lead-ins. Type LLA ..... .49
Crystal phono cartridge (78 rpm) 3 volt output 1.95
Vertical Output Transformer. Turns ratio 10:1, mtg. centers 2 13/16". Part =43T011. Replaces Stancor A-8112 and Merit A-3036 ..... 1.79
Vert. Block Osc. Transf. (shielded). Turns ratio 1:4.2, mtg. centers 1 15/16". Part =16TV11. Replaces Stancor A-8121 and RCA 208T2 ..... 1.49
4 ft. Ground Rods ..... .75
DPDT Knife Switch ..... .45
Clothespin type TV Antenna Connector ..... .30
Rytel "AIM" Automatic Impedance Match 1.77
Swivel Mt. Base (for 1¼" OD mast) Lots of 10 or more 35¢ ea. ..... Singly .39

FREE! Write For Big New FYI Bulletin #127

TV ANTENNA ACCESSORIES

Strap type 3½" Stand-off Ins. for 300 ohm twin; takes masts up to 2½" OD—$7.50 per 100, Singly ..... $ .09
Snap-on type 3½" Stand-off Ins. for 300 ohm twin; clips on to 1¼" mast—$5.50 per 100, Singly ..... .06
Guy Rings for 1¼" OD masts—$6.00 per 100, 5 ft., 1¼" OD Mast (one-end crimped) 1.19

WALL MOUNTS

6" PAM-1 for masts 1" to 1½" Dia. 1.15
12" PAM-4 for masts 1" to 1¾" Dia. 1.89

ROOF MOUNTS

BMA-136 for sloping or flat roofs and side walls; takes masts ¾" to 1½" Dia. 1.79
PRA-148 for peaked or flat roofs and side walls; takes masts ¾" to 1½" Dia. 2.69

TWO SET COUPLERS (for 300 ohm line)
Operate 2 TV Sets Off One Antenna

Snyder AC-800 ..... $1.50
RMS AC-2 ..... 2.40
Penn TC-374 ..... 2.95
JFD T12-300 ..... 3.57
Telematic AM-200 ..... 4.77

FOUR SET COUPLERS

JFD TC4L-300 Couples 4—300 ohm sets to one 300 ohm antenna 7.77
JFD TC4L-72 Couples 4—72 ohm sets to one 300 ohm antenna 7.77

PENN ANTENNA SWITCH
To Couple More Than One Antenna To A Set

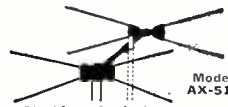
TS-551 2—Antenna Switch $1.55
TS-587 3—Antenna Switch 2.10

LEAD-IN WIRE & CABLE
Antenna Rotator Wire

4 Cond. flat Rotor Wire, 3c per ft., $2.70 per 100 ft., $25.00 per 1000 ft.
8 Cond. round Rotor Wire, 6c per ft., $5.50 per 100 ft.
Tubular 300 Ohm Twin-Lead
Amphenol =14-271 ..... 5c per ft., $4.77 per 100 ft.
Federal =TV-1185 ..... 5c per ft., $4.77 per 100 ft.
AWG 20 strand copper, 55 mil. web poly $1.95—100 ft., $14.50—1000 ft.
STEEL MASTS, 10 ft. 1¼" dia. 99c
95c each in lots of six
UNIVERSAL STAND-OFF INSULATORS, each 3c
31/2" wood screw-in type, for tubular and flat 300 ohm twin lead or RG59U coax. ..... $2.50 per 100
GUY WIRE, 6 strand =20, 50 ft. coil 39c
1200 ft., consisting of 24 interconnected 50 ft. coils $6.00
CHIMNEY MOUNTS, in lots of six, per set $1.49
Complete with straps, hardware, instructions.
Holds masts ¾" to 1½" ..... $1.59 per set
RMS LIGHTNING ARRESTOR, Model LA-3 ..... 59c
U/L approved ..... 10 for $5.50
NEW UHF-VHF ARRESTORS, Model LA-UH3 ..... 79c
U/L approved. Universal for all tubular and twin lead and 375 and 450 ohm open line ..... 10 for $7.50

SNYDER'S SENSATIONAL NEW CONICAL TV AERIAL

8 hi-tensil ⅜" aluminum elements. Included Universal U clamp. Easy multi-stacking. $2.49 each, $2.39 in lots of 6



Model AX-513

Tie Rods For Stacking Conicals 75c a pair ..... 65c six or more pair

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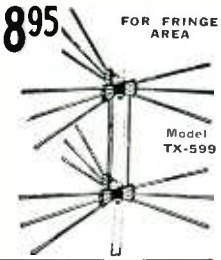
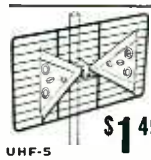
360° DIRECTRONIC SYSTEM

Exclusive Snyder Engineering and designs cut cost to $18.95 FOR FRINGE AREA

COMPLETE with three 3½ ft. masts, 75 ft. 3 cond. cable, Beam selector sw., guy rings and mtg. base. Electronically beams complete 360° rotation to give clear pic on all channels. You choose direction with directronic selector sw. mounted on or near TV set. Complete double stacked array with 18 hi-tensil double alloy aluminum elements. AX-599 same as TX-599 less masts, guy rings & mtg. base $16.95



Model TX-599



UHF-5 $1.49

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- For Fringe and Ultra Fringe

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RB2-6 for Ch. 2 thru 6 $9.95
RB7-13 for Ch. 7 thru 13 $4.95

WHOLESALE RADIO PARTS CO., Inc.

311 W. BALTIMORE ST., BALTIMORE 1, MD.

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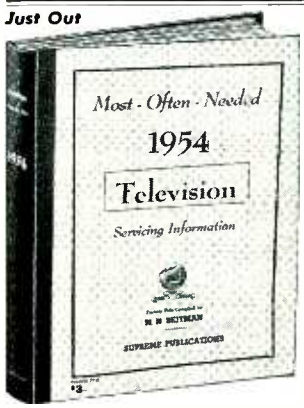

This newest giant volume of the *Supreme* **TV** manuals covers **1954** factory data on all popular television sets of all makes. There are explanations of new circuits, 192 pages of alignment procedure, test patterns, response curves, pages of waveforms, voltage charts, service hints, production changes, and dozens of double-spread circuit diagrams. Manual-style binding (opens flat). Special price, only **$3**

New SUPREME 1954 TV Manual

FULL YEAR'S TV MATERIAL IN A GIANT VOLUME — $3

COVERS ALL POPULAR SETS

This new *Supreme* **1954 TV** manual has all the required service material on every popular television set of every important manufacturer. Here is helpful, practical, factory-prepared data that will really make TV servicing and adjustment easy for you. More pages, more diagrams, more service data per dollar of cost. This new giant TV manual and previous volumes for other years have complete circuits, alignment facts, test patterns, response curves, service hints, recommended changes, voltage charts, waveforms, and many double-page diagram blueprints. Here is your TV service material to help you do more expert work quicker; and priced at only $3 and $2 per manual covering a whole year of material. See coupon below for complete list of all eight TV volumes, from **1947** to **1954**, and the **1953 UHF Converters** manual. Order for a 10-day trial.

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The new **1954 TV** manual is the most remarkable value offered by **Supreme Publications** in their 20 years of business. This mammoth television servicing manual at only $3, or the TV manuals for previous years for only $3 and $2 each, are amazing bargains and defy competition. There is nothing else like them. Each manual is a virtual treatise on practical television repairs. By normal standards, each such large manual packed as it is with practical facts, hundreds of illustrations, diagrams, charts, photographs, and expensive extra-large blueprints, should sell for $10—but as SUPREME special values they are priced at $3 and $2 each. Only a publisher who sold over one million TV and radio manuals can offer such bargains based on tremendous volume-sales. Be ready to repair any TV set by having in your shop all eight **Television Manuals** listed in coupon. Or try the new **1954 TV** manual to see what an amazing bargain you get for only $3. Send trial coupon or ask your jobber.

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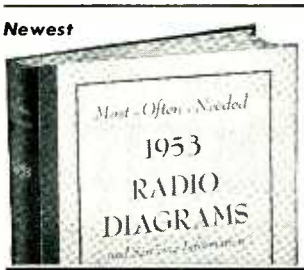

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Here is your complete source of all needed RADIO diagrams and service data. Covers everything from most recent radios to pre-war old-timers; home radios, auto sets, combinations, changers, and portables. Sensational values. Still sold at pre-Korean prices. Only $2 for most volumes. Every Radio manual contains large schematics, all needed alignment facts, parts lists, voltage values, trimmers, dial stringing, and helpful service hints. All volumes are large in size, 8½x11 inches, about 192 pages. See coupon at right for a complete list of these low-priced manuals.

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are able to average only seven calls per day per man. For a six day week, an average of 7 completed service calls per day would total forty-two for the week. To develop a service labor income of $282.00 from 42 calls it would be necessary to raise the charges for home service calls to $6.70 per call.

It is quite obvious from these figures that the company whose letter was quoted at the beginning of this discussion cannot even hope to break even on 50% of the revenue from only 22 completed calls per man in a six-day week. If these men were to receive the union scale of wages and the company got even the marginal "break" of 50% of the income from their labor, it would be necessary to charge $12.82 per call.

It is also quite obvious from this analysis that it would be impossible and inadvisable to set labor charges that would be applicable in service businesses of all sizes and operating at varying degrees of management and technical efficiency.

A series of tables is now being prepared that will show the various relationships between service charges and costs of doing business for organizations of varying sizes and with different levels of technical and management efficiency.

Delving into the rising costs of doing business and the continuing high mortality rate among small service businesses invariably leads to one undeniable conclusion: Every man engaged in any phase of the electronic service business must raise his sights about the value of competent technical skill and the public must be educated to pay adequate labor charges for service on home electronic instruments.

Service business operators who are seriously interested in building stable, reliable, long-range businesses in electronic servicing realize that the activity is now *basically a business*. When service is considered in the light of being a business, the owner or manager realizes that it must earn an income commensurate with the investment involved and the managerial know-how to run it. He knows that to gain recognition as a businessman in his community he must act and live like a businessman and operate his service shop as a business.

Lots of service operators have been afraid to raise their charges for service because they think their customers would not stand for it. They have feared, too, that if they raised their rates and their competitors did not, the latter would gobble up all of the service business in the community. These facts have been revealed in dozens of letters received by the editors of this department.

However, sheer economic necessity has made it necessary for small service shop operators to either raise their labor charges or load their service jobs with a lot of unnecessary tubes and parts. Many men have a natural revulsion against sticking a customer for tubes and parts not actually needed in repairing the set. To them this

practice is a form of petty thievery—akin to stealing something of value from a customer's home to make up for inadequate service charges which it is *assumed* the customer would not pay.

So what has been happening?

During a period of less than three weeks twenty-seven service operators wrote your editors to say they had raised their charges to conform with those listed on the standard TV labor charges schedules and they were not getting any more complaints about charges than they had when their charges were on a low, inadequate scale. Fifteen of these companies said they were observing *an increase* in their volume of service business in a few weeks after adopting the higher scale! Most of them attributed this increase to the fact that they were able to give better service after they started to get adequate pay for it and the whole *tone* of their businesses was better.

A number of organizations are using the Standard TV Labor Charges Charts available through this column rather extensively in their areas. The Television Service Association of Michigan reproduced it in their monthly house organ, the "TSA News." The Utah Association of Radio & TV Servicemen is distributing a reprint of the contents of this department from a recent issue of RADIO & TELEVISION NEWS, along with copies of the Standard TV Labor Charges Charts in the hopes of encouraging service shop operators throughout the State of Utah to base their service charges realistically on sound pricing practices. The GMP Qualified Service Dealers of northern California are using the charts in an aggressive program to indoctrinate set owners in what they must expect to pay for competent, reliable TV service.

Wall charts (size 11 x 14 inches on heavy bristol board) of the schedules of standard TV labor charges are still available to readers of this department. You may obtain copies of these charts by sending $1.00 to the TTLB, P. O. Box 1321, Indianapolis 6, Indiana. In writing to the Bureau for charts, bulletins, or other information please be sure to *write your name and complete address* on your letter. A number of letters have been received asking for charts or bulletins without any other identification than the sender's name.

Your editors would also like to suggest that more service businesses should get the fine stationery that is offered to them by the tube companies. These letterheads, imprinted with the name of the service business, are very impressive. Here's a specific instance that clearly indicates the effectiveness of these imprinted letterheads that are made available to you through your parts distributors by the tube companies:

A new employee on the Bureau staff was assigned the job of filling requests for bulletins, Notebooks, and Standard TV Labor Charges charts. While casually watching her do her work, your

editor noticed that she carefully separated the letters into two stacks—one stack consisted of letters on printed letterheads; the cards and other letters were put in the other stack. Then she filled the requests called for on the printed letterheads first and took special pains in supplying what they wanted.

In answer to a query about why she followed this routine she said, "Isn't it better to take care of the important companies first?"

The moral to that is: If you want to be rated as an "important company" in the eyes of office workers who may handle your correspondence, get yourself some printed letterheads.

Customer Relations

Perhaps the most important factor in the operation of a TV service business is that of maintaining good relations with its customers. The money factor involved in the servicing of sets isn't nearly so important in the mind of the customer when the simple rudiments of good customer relations practices are used in contacts with him.

A few years ago the *Central Television Service Company* of Chicago, perhaps the largest independent servicing organization in the industry, realized that good customer relations were essential to maintain the volume of business necessary to keep its 200 employees busy. They prepared a manual for their own staff and called it the "TV Technicians Handbook on Customer Relations." This manual tells you what to do if the customer invites you to have a drink with her, or if you do some damage to the customer's furniture, or if the customer insists on keeping the old CRT which you replaced. It also gives suggested answers to the oft asked questions: "Did I buy a lemon?" "What kind of set do you have in your home?" "Why is my neighbor's set better than mine, when I paid more for my set?" and many others.

Because of the large number of requests that the Bureau has received from the readers of this department for information on problems that come under the heading of customer relations, arrangements have been made with the *Central Television Service Company* for the Bureau to distribute copies of their handbook to readers who would like one. Send one dollar to TTLB Special Services Dept., P. O. Box 1321, Indianapolis 6, Indiana, and ask for the "*Central* CR Manual."

MODERN MICROPHONE DESK STAND

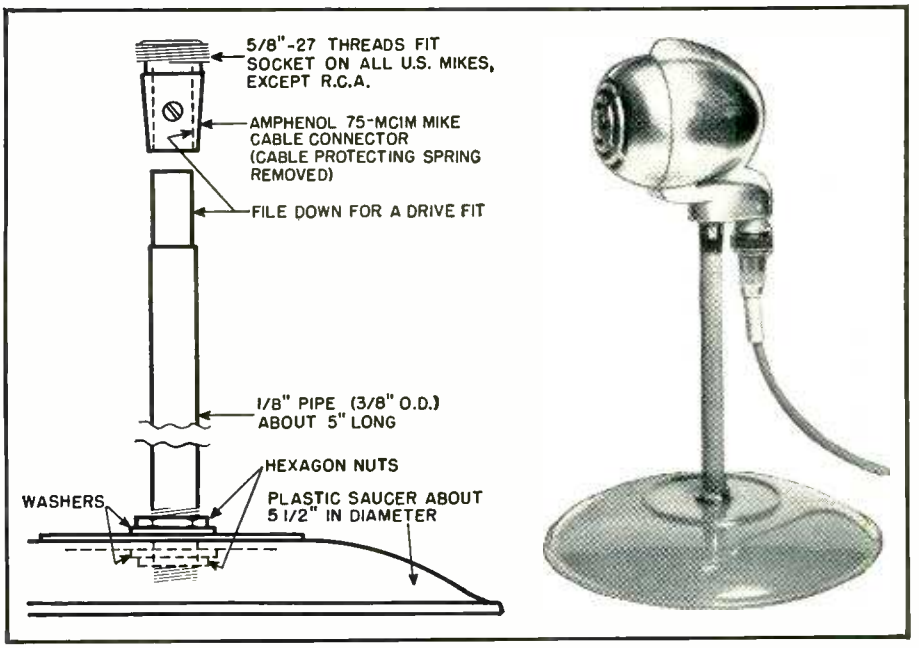
By ARTHUR TRAUFFER

EXCEPT for the plastic saucer, which was borrowed from the pantry, the writer built the microphone desk stand shown in the photograph from materials found in his "junk box." Even if you have to buy all the parts, this stand can be assembled for about 50 cents.

Bore a ⅜" diameter hole in the center of the bottom of a 5½" diameter plastic saucer. Obtain a 5" length of ⅛" pipe (⅜" o.d.) which is threaded on one end. Using a flat file, the other end of the pipe is reduced just enough for a drive fit into the end of an Amphenol 75-MC1M cable connector, as shown in the diagram. Tighten the setscrew in the connector.

Next fasten the pipe to the inverted saucer by means of two washers and two hexagon nuts, as shown. The pipe can be enameled to match the color of the saucer. The threads on the end of the cable connector are standard microphone threads and will fit sockets on all U.S.-made microphones except for RCA units which use a special thread. —30—

Mechanical details for constructing the desk stand and photo of finished product.



Leonard Smith, president of the Texas Electronics Association, sent in a suggested solution to a ticklish problem facing service operators. In Fort Worth, Texas, they were up against the growing problem of customers who had made no credit arrangements before a service job was completed, telling technicians to "Charge it," when presented with the bill. When the technician used the stock answer, "Sorry, we don't do a credit business," the customer usually blew a fuse.

To whip this problem, Stan Taber of *Acme Radio & TV* of Fort Worth, bought some credit applications from the Fort Worth Retail Merchants Association with the Credit Bureau seal on them. He gave each of his field service technicians a supply of these forms to carry in his car. When a customer says "Charge it," the technician asks him if he has a charge account with the company. If the answer is "No," the technician hands him a credit application and says, "Sir, since you don't have an account with us, this job must be cash. However, if you will fill out this application and mail it to us we will be able to handle any future work on a charge basis after the application has been approved."

Mr. Taber reports that nine out of ten customers do not fill out and send in the applications and the way is paved for all future relations with him to be on a cash basis without having the customer blow a gasket. —30—

COMPUTER CONFERENCE

THE second annual Western Computer Conference and Exhibit, sponsored jointly by the AIEE, IRE, and Association for Computing Machines, will be held at the Ambassador Hotel in Los Angeles on February 11 and 12.

The conference is composed of two parallel sessions, one on control systems and one on data processing systems.

The exhibit portion of the meet will feature the latest electronic computing machines which are capable of solving the most complex problems.

For further information write H. G. Weightman, publicity chairman, at Weightman & Associates, 1405 W. Magnolia Blvd., Burbank, California. —30—

RADIO COURSES

NEW YORK University has announced several courses of interest to persons in the radio, television, audio, and electronic fields in addition to the basic courses on fundamentals the school offers.

The courses, which will run from February 3 to May 19, include elements of radio tubes and circuits; radio tubes and circuits (2); transistor applications in modern electronics; television circuits; television transmitter and u.h.f. circuits; operation and maintenance of TV equipment; measurements and testing in radio, audio, and TV; high-fidelity reproduction of sound; and radio operator license tutorials.

For full details write to the Program of Technical Studies, New York University, Division of General Education, 3 Washington Square, North, New York 3, N. Y. —30—

What's New in Radio

(*Continued from page* 94)

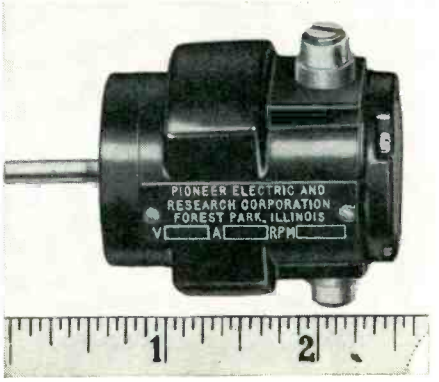
sistors are currently available with guaranteed alpha minimums of .90 for the Type 200, .95 for the Type 201, and .98 for the Type 202.

For further information write the company at 6000 Lemmon Avenue, Dallas 9, Texas.

NEW PM MOTOR

Pioneer Electric & Research Corporation, Forest Park, Ill. is now in production on a new miniature permanent magnet motor which is smaller than a standard cigarette pack.

The new unit offers horsepower ratings from .004 to .0165 and speeds from 2000 to 20,000 rpm with total weights from 3.5 to 9 ounces. It is made with its magnetic structure cast into an aluminum housing. In its basic



construction the new motor conforms to JAN specifications although optional features (watertight and explosion-proof housing, fungicided armature, noise filter, speed governor, and gear reducer) are available.

WIRE STRIPPER

Holub Industries, Inc. of Sycamore, Illinois is currently in production on a completely automatic wire stripper that eliminates triggers, cocking, or other holding devices.

Known as the "Hi-Speed" wire stripper, the new unit is designed to strip all kinds of building and fixture wire with a single squeeze of the handles. After the wire is stripped, a concealed cam holds the jaws open until the wire is removed.

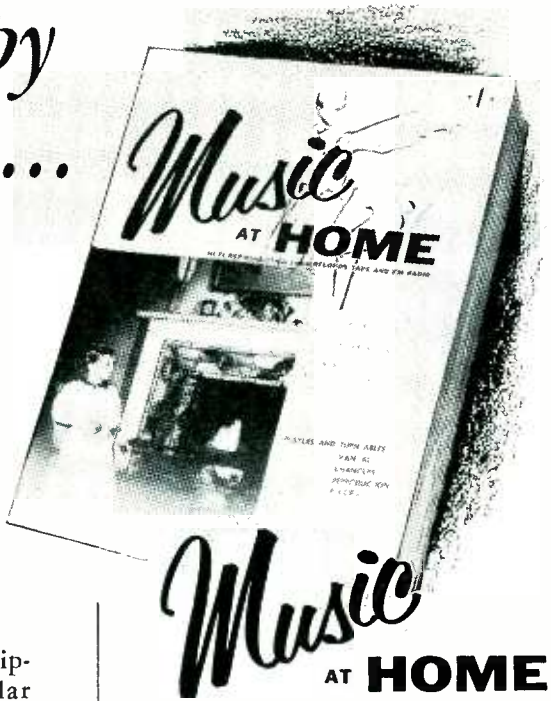
The stripper is made in seven sizes for stripping Nos. 8 to 30 solid and stranded wire, also POSJ for parallel wire and 300-ohm flat twin-lead. An adjustable stop is furnished with each tool.

MINIATURE CONNECTORS

Viking Electric, 1061 Ingraham St., Los Angeles 17 is now offering an improved series of miniature rectangular connectors with 7, 8, 14, 18, 20, 21, 34, or 41 contacts.

Except for the 8-contact unit, all connectors are interchangeable with similar equipment. The company will forward a complete catalogue on these units on request. —30—

The publisher of a fascinating new magazine explains its purposes and offers you the first copy with his compliments...



MUSIC at HOME is a completely new kind of magazine, planned to help everyone find more entertainment in hi-fi records, tape and FM radio. The wealth of intriguing articles, dramatically illustrated, covering both music and equipment, express the concept that music is for everyone, and the more realistic the reproduction, the more enjoyable the music — whether the original was a symphony orchestra, a hot trombone, or a crooner giving out with the blues!

With the perfection of LP records, tape recorders, FM radio, and hi-fi equipment, people are coming to realize that music can make a more important contribution to the home than any other form of entertainment.

It has a special appeal to each member of the family, from the little tot who, with uncertain steps, responds to the rhythm of tunes for children, to the grandparents for whom music recreates happy events of days gone by. And for those ages in between, there is music for dancing, for relaxation, and for the pure joy of listening. This assumes, of course, that what is heard from the loudspeaker is an accurate recreation of the original music, which we have come to call hi-fi reproduction.

The purpose of MUSIC at HOME is to help you:

1. Select the best recordings of the kind of music you enjoy the most,

2. Learn more about the many exciting uses of tape recorders,

3. Find the FM stations that are providing top-quality programs,

4. Select the kind of hi-fi equipment suited to your particular needs, within the limits of your budget,

5. Install the equipment so that it will be both decorative in appearance and fine in performance,

6. Use the equipment correctly, so that you will have all the thrilling enjoyment from your music that hi-fi reproduction can provide.

In short, MUSIC at HOME is a how-to-do-it magazine, filled with articles and special features planned for the thousands of people who are interested in learning more about this wonderful form of home entertainment.

The special offer below is extended so that you can have the first issue with my compliments, and see for yourself how interestingly the subjects of music and hi-fi equipment are presented in MUSIC at HOME.

Milton B. Sleeper.

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Send in your order, using the coupon below. The first issue will be sent you with our Publisher's compliments. If you are not so delighted with this first issue that you will want to receive those following, write us within 30 days after you receive the first copy, and the full amount of your remittance will be refunded promptly, without question. MUSIC at HOME is a large-size magazine, handsomely designed, elaborately illustrated with photographs and drawings, and beautifully printed on fine paper. You'll enjoy it from cover to cover, and you'll be proud to show it to your friends. Mail your order today, so you can be sure of getting it from the very first issue.

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Certified Record Revue

(*Continued from page 56*)

orchestra wound up, he made a terrifying experience of this evil fable. The Borodin and Glinka pieces, while of less stature on this disc, nevertheless are recorded with equal effectiveness. Control setting was flat for the *ffrr* curve. Surface in my copy a little "ticky."

SCRIABIN

THE POEM OF ECSTASY and THE POEM OF FIRE

New York Philharmonic conducted by Dimitri Mitropoulos. Columbia ML 4731, NARTB curve. Price $5.95.

Back in the days when I was more of a romantic than I am now I greatly admired the old Monteaux version of "The Poem of Ecstasy." I thought that was really great shakes as an example of "mood" music. When one becomes more musically mature, one realizes that there is a good deal that is trite and banal in this score. I suppose what really fascinated me was not so much the music as the composer. Now this boy Scriabin was a real squirrel! I haven't got the space to go into all of it here, but he was a character from the word go. He was "high priest" of a sort of "back to nature" cult and as years passed he became ever more of a mystic. He believed that art forms are at their best when co-mingled and he was wont to give and sponsor recitals in which music and voice were merely parts of his whole philosophy as they were combined with color and even odor! For all of his eccentricities he was a clever rascal. He invented a color "organ" an instrument that would produce myriad color variations projected on a screen, by keying certain prisms and mirrors, etc. Yes Sir! Some character! This recording is as good an exposition of this music as you're likely to get in some time. It is far superior to the recent version on *Capitol,* at least as far as sound is concerned. The *Capitol* disc was noteworthy for a good performance. Mr. Mitropoulos has a particular affinity for music like this and his reading accents the broad line rather than highlight detail which, while important, obscures the composers intent. Sound on this disc is typical of some of the late *Columbia* efforts, which is to say, splendid. The strings are well delineated without being edgy, woodwind playing is reproduced with particularly fine overtone and vibrato. "The Poem of Fire" is equally well recorded and performed. Since this is the second of Scriabin's tone poems, its roots in his ever increasing mysticism are clearly evident. Some wonderful sounds on this side and a bow to Leonid Hambro for some brief but very effective solo piano. Conformed perfectly to NARTB curve and required no treble or bass, cut or boost. Surfaces were quiet.

DVORAK

SYMPHONY #2 IN D MINOR

Hamburg Radio Symphony Orchestra

conducted by Hans Schmidt-Isserstedt, London LL778, ffrr curve. Price $5.95.

Those of you who know this work and have been waiting for a really top notch recording, will be gratified to know that your wait is over. At least that is the way I feel about this present version. As one of Dvorak's most interesting and beautiful works, I could not understand the neglect which seemed to be its lot. After all, the LP companies have been turning out hundreds of items far less "standard" than this work. Yes, there has been a previous version on LP, issued by *Urania*. But what worthiness this record had as a performance was marred by its uneven and undistinguished sound. This *London* recording has the advantage of splendid engineering. Blessed with a very live, spacious type of sound, it's not too far off mike to destroy important inner detail. String tone is generally good, some may want to roll off the treble ever so slightly. Percussion is solid, authoritative. Schmidt-Isserstedt is obviously an old hand at conducting this lovely score and he lavishes attention on it to achieve a gracious and compelling reading. He senses the need to maintain a broad melodic line as a framework for Dvorak's colorful orchestration. The disc reproduced well with the *ffrr* curve with perhaps the little extra treble roll-off, I mentioned before. Surfaces were quiet.

AMERICANA
Eastman Rochester Symphony Orchestra conducted by Howard Hanson. Mercury MG 40003, AES curve. Price $5.45.

This is a most unusual disc which will appeal to a greatly diversified group of people. A collection of works by American composers such as Aaron Copland, Wayne Barlow, and Dr. Hanson, the emphasis here is on solo winds such as flute, oboe, and clarinet, accompanied by string orchestra. There is some really beautiful music represented here and some particularly expert performances. The works vary widely, ranging from Copland's "Quiet City," a rather contemplative and moody piece with fine trumpet solo by Sidney Mear, to Dr. Hanson's lovely "Serenade for Flute, Strings, and Harp." This latter work is an inexpressibly beautiful outpouring of sound with some wonderful flute playing by Joseph Mariano. Believe me, if your wife doesn't like this work, you may as well give up this hi-fi business. This is passionate, beguiling music, with a universal appeal. The other pieces are equally interesting and well performed, and the woodwind sound throughout this disc is so clean and articulate, that the disc is sure to find favor among students of the instruments involved. It is interesting to note that while this disc is composed of solo works, *Mercury* did not resort to the use of an extra pickup mike for the solo instruments using their single *Telefunken* as usual. The result is a splendidly balanced recording with the soloists in their proper concert hall perspective.

The disc reproduced perfectly from the AES curve without further compensation. Surfaces were quiet. An off beat item that is highly recommended.

ADAM
GISELLE
L'Orchestre du Theatre National de L'Opera Paris conducted by Richard Blareau. London LL869, ffrr curve. Price $5.95.

For those who have been dissatisfied with the fragmentary recordings of this ballet, here is the complete score at last. Balletomanes will probably pounce on this as "Giselle" is one of the most popular works in the ballet repertory. Beautifully recorded and performed with a great deal of finesse and admirable restraint. Some of the performances I've heard of this work the orchestra sounded like they were going to a fire. I am not familiar with Mr. Blareau or his background, and the shuck is quite mute on his attainments. No matter, for he does a yeoman job in keeping things going at just the right tempi. He handles his forces very well and elicits some warm and effective playing from a better-than-average orchestra. No sensational sound on this disc, but everything is clean and in proper balance. A little touch up on the bass control was necessary with the *ffrr* curve. Surfaces were slightly noisy.

BRAHMS
SYMPHONY #3 IN F MAJOR
Vienna Philharmonic Orchestra conducted by Karl Bohm. London LL857, ffrr curve. Price $5.95.

I suppose the advent of this disc should give vent to more howls about "needless" duplication. Friends, I've just about given up on this duplication of repertoire business. As I explained in a previous column, it's just too much to expect record companies to risk capital on recordings of questionable commercial value. Don't misunderstand me. The companies would be glad to venture further into the musical unknown if they had an idea they would at least cover the cost of recording. In fact, we should be profoundly grateful for the plentitude of works which have already been recorded outside the standard repertoire. But sales figures are notoriously cold-hearted and care not a whit about musical esthetics. So the recording companies take the next best step and endeavour to so polish and refine a previously recorded work that it will find new commercial acceptance. The Brahms "3rd" here is a good case of this thinking. *London* already has this work in their catalogue by George Szell and the Concertgebouw. It is an altogether admirable recording and probably sells very well. However they felt that Szell's interpretation was basically different from that of Mr. Bohm, and reasoned that many people would want the warmer, more Viennese reading to be expected from Bohm. There is also the question of advances in recording technique, to further enhance the salability of the work. I can say that their reasoning is sound, for this *is* a better recording from the audio viewpoint and the reading *is* newly interesting, and as far as I am concerned to be preferred to the Szell. Bohm has conducted here with great intensity of feeling, a reading that is all heart and human. He never becomes maudlin or too introspective, but manages to project sincerity into the score. The sound leaves little to be desired with richly sonorous strings and much cleanliness and weight to the brass. Splendid acoustics add further to the merits of this version. All in all, I am inclined to say this is the most satisfying Brahms "3rd" now available, and a version that is going to be hard to surpass. The disc conformed perfectly to its curve and no touch up of bass or treble was necessary. Quiet surfaces.

TSCHAIKOVSKY
NUTCRACKER SUITE and SLEEPING BEAUTY BALLET
Philadelphia Orchestra conducted by Eugene Ormandy. Columbia ML 4729, NARTB curve. Price $5.95.

Speaking of duplication in the previous review we have here the same situation. Both of these works have been recorded *ad infinitum*. Can these new versions hope to compete in this tough market? The answer is a somewhat qualified yes. I say qualified because of one thing. Performance. Mr. Ormandy does a very expert job with these two charming pieces, but he (and no one else for that matter) can equal the matchless job of conducting done by Stokowski. I don't know what particular facet of Stokowski's talent is responsible for this complete mastery of these scores, but he has it and to spare. His readings are unalloyed magic. Soundwise, the Stokowski versions are good recordings, but it is here where the Ormandy disc really shines. The disc here has been given some fabulous recording, with sharp, precise percussion, clean incisive strings, and some really fine acoustical treatment. Fine tonal balance is maintained throughout. The "Sleeping Beauty" has some terrific effects in it, far beyond any previous version. A tough deal here all right. It's six of one and half dozen of another in matter of choice. It really depends on what qualities weigh most heavily with you, sound or performance, which will determine your ultimate choice.

DEBUSSY
SUITE BERGAMASQUE
RAVEL
GASPARD DE LA NUIT
Friedrich Gulda, pianist. London LL-754, ffrr curve. Price $5.95.

Here is some of the best piano sound you're likely to hear in a long time. Absolutely on pitch, with no evidence of flutter. Warm toned when needed, properly percussive on demand. The music is interesting and beautifully played. In the "Suite Bergamasque" is to be found one of the most famous of all pieces for piano, "Clair de Lune". As for the rest of the work, it can best be described as an attempt to convey a new musical idiom within the frame-

work of 18th century stylism. The Ravel piece is typical of that fabulous talent. This is piano music as brilliantly conceived as his work in other forms. The color, the subtleness, the flashing rhythm are all here. The last section of "Gaspard de la Nuit" called "Scarbo", is supposed to be one of the most technically difficult pieces ever composed for piano. You can well believe it, as Gulda exhibits his amazing dexterity. Here is a young man destined for greater things in music. He possesses an absolutely fabulous technique, comparing in this respect to the great Horowitz. Happily he is not all technique and dazzle, but can play with heart and feeling as he so clearly shows in this disc. The only quibble I have with this whole disc is the somewhat dry acoustical environment the piano was recorded in. No matter, it is still one of the best around, ranking for piano quality with the best *Westminster*. A slight roll-off in the treble was necessary with the *ffrr* curve. Good surfaces.

MASTERPIECES OF MUSIC BEFORE 1750
Danish soloists and ensembles. Haydn Society HSL 2071, NARTB curve. Price $5.95.

This is an monumental undertaking, being the first record of three to be issued in this little known area of music. Actually these recordings can be likened to "talking books" since it follows the complete text of a book of the same title published by *W. W. Norton and Co.* That is, at least the musical pieces contained in the book. Let it be understood that this is certainly not hi-fi demonstration music. The recording *is* high fidelity, the soloists and choruses and the various instruments come through with startling clarity, quite wide range and distortion free. But the musical material does not lend itself to flashy effects if that's what you are after. This is music for the serious student, one who would trace the ancestry of much of our present works. The compilation of this material represents a fantastic amount of work and much credit should be given the researchers and to the Haydn Society for venturing into this unknown and formidable (sales-wise) era of music. It would be interesting indeed to sit down with the book and follow with this disc when the text called for the music. A new departure in learning to say the least! There is much of this music that any music lover will appreciate. If you can overcome a common tendency to consider this type of music "dry", there is much interesting listening here.

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Music Probe

(*Continued from page 61*)

the volume control. (This provides a "ground" for the crystal detector and keeps hum under control. If the TV set is an a.c-d.c. type, there should be an isolation transformer in the power lead to prevent accidental short—or you should test to make certain that the chassis is on the ground side of the line, of course.)

Touching the end of the probe to the "high" end of the volume control should yield a good signal—with the somewhat strange situation of the TV set playing the sound from an AM station while going merrily on with the picture from the TV station.

You can probably tell at once if the audio end is OK—even if there is nothing on but a soap opera. However, once the AM station plays a little music, you will be able to tell for certain. If the sound is still bad, you know that the trouble is in the TV audio circuits and won't waste time chasing rainbows in the front end of the video set.

Likewise, moving the grid to the final output tube will indicate (by fall-off in volume) if the first audio stage is amplifying.

In an AM set, the testing technique is similar, of course. You can start with the volume control, and work your way to the grid of the output stage.

Signal tracking through the video amplifier stages is just as fast as audio checking on a TV set. Applying the probe to the grid of the first video amplifier tube will place a strong, and highly unusual, pattern on the picture tube. This pattern is difficult to describe—but *quite* different from anything ordinarily encountered in television servicing, so once you have seen it you will remember it. And when you *don't* see it, anywhere along the video tube circuit right down to the picture tube, chances are you have the trouble cornered.

So much for *using* the probe—building it takes a little longer, but not much. The photographs are just about self-explanatory. The parts are assembled, and soldered together. Then the unit is "tuned" to the nearest AM (standard broadcast) set in the area—the station which can be depended upon to develop a good signal. The tuning is accomplished by sliding the core of the coil in and out, and cementing it in place at the proper point. (In the preliminary tune-up, the test lead can be connected to an antenna and the clip on the probe to a ground. Then a pair of headphones connected between the prod and ground will provide the signal.)

C_3, parallel with the coil, is needed to tune the coil if the broadcast station is at the low end of the dial—in fact, a larger condenser, up to 250 $\mu\mu$fd. may be needed. For a station at the high end, above 1200 kc. or so, it may be possible to omit the condenser.

Once everything is in working order, the "works" is stuffed into a plastic case from a small penlite flashlight. You may have to modify the physical layout somewhat to fit the particular flashlight you buy.—30—

Headphone Radio

(*Continued from page 42*)

order to compensate for the loading effect of the grid on the resonant circuit. It should not be supposed, however, that the same results can be obtained with an ordinary coil and regeneration. In the latter case, a much longer antenna, together with panel controllable regeneration, still gives inferior performance. The ferrite core of L_1 is adjusted in order to establish the optimum amount of feedback. It should be possible to make the receiver oscillate by means of this adjustment. Oscillation is indicated by whistles as C_2 is rotated through its range. Each whistle is a heterodyne, or beat frequency, between a radio station and the receiver oscillation frequency. This mode of operation should be obtained when the brass adjusting screw has its greatest length protruding from the coil because the core will then be in a position resulting in the highest mutual induction between the feedback coil and the resonant circuit. The screw should be turned slowly clockwise until there is no longer evidence of oscillation for any setting of the tuning condenser, C_2. It is possible to obtain peppy performance with the feedback adjusted a comfortable margin below the point of oscillation. The foregoing adjustment must be made with a four foot vertical antenna. If oscillation cannot be obtained, the connections to L_1 should be reversed.

For very weak or distant stations, the antenna can be made a little longer; conversely, if one is close to powerful stations, it can be shortened. In general, the length will be between three and five feet. There is no advantage in lengthening the antenna much beyond five feet because the *"Q"* of the resonant circuit will be degraded and the advantages of the ferrite core coil will be lost. —30—

460 MC. LICENSE

THE Carey Division of Swan Rubber Company has received the first license granted by the FCC permitting operation of a point-to-point two-way radio system in the 460 mc. band.

The frequency assigned is 460.7 mc. in the u.h.f. portion of the Citizens Radio Service band.

Two Motorola 20-watt, local control desk-top consoles are used at each of the company's two plants. A directional 24-element yagi antenna at one plant beams the signal to its counterpart at the other plant.

The system is said to speed communications between the two plants and to eliminate telephone tie-ups. —30—

Hi-Fi Speakers

(*Continued from page 73*)

In the case of the high-frequency unit of a "Duo Cone" loudspeaker, the nonlinear distortion due to the suspension system was minimized by making the stiffness of the space behind the cone the controlling acoustical impedance. For example, the resonance of the high-frequency unit without the back enclosure occurs at 750 cycles. With the back enclosure as used in the "Duo Cone" speaker, the resonant frequency is 1500 cycles. Thus, the cavity behind the cone becomes the controlling acoustical impedance involving acoustical capacitance elements. The acoustical capacitance of the cavity is linear and, therefore, does not introduce distortion.

Employing these expedients, the nonlinear distortion in the Type LC-1A is very low, as shown by the characteristics of Fig. 18.

Transient Response[6]*:* Since all speech and music is in a continuous state of change, it is, of course, of a transient character. Therefore, a high-fidelity sound reproducing system must be capable of reproducing these rapid changes without any appreciable deviation.

One of the common methods for testing the transient response of a loudspeaker is observing the response to a tone burst. A tone burst is a single frequency, sine wave signal of short duration, having a rectangular envelope. The duration of the signal may vary from 50 to 500 milliseconds, depending upon the frequency. The rectangular envelope characteristic means that a tone burst consists of a signal of practically instantaneous rise and decay periods. A deviation from the rectangular envelope depicts the transient response of the loudspeaker. The maintenance of a rectangular envelope, that is, the almost instantaneous rise and decay of the tone burst, is a very severe test. Therefore, any loudspeaker passing this test will handle any transients encountered in speech and music without distortion. From the shape of the envelope of the tone burst emitted by the loudspeaker, it is possible to correlate the shape with the response frequency characteristic. For example, if there is a peak in the response frequency characteristic, some time will be required for the output to build up to the steady-state value after the electrical input has been applied, and some time will be required for the output to decay after the electrical input has been stopped. If there is a dip in the response frequency characteristic, there will be a rapid build up in the output after the electrical input has been applied; then this is followed by a very low, steady-state value and then another rapid rise in the output when the electrical input has been stopped. From the foregoing it will be seen that the growth and

decay characteristics of speech and music will not be reproduced unless the system exhibits good response to transients. In addition, faithful transient response frequency characteristics of the loudspeakers described herein are smooth. The tone burst tests of these loudspeakers have shown that the shape of the tone burst is faithfully reproduced throughout the frequency range of the loudspeakers. Therefore, these loudspeakers will reproduce the growth and decay characteristics of speech and music.

Sensitivity: During the past decade, considerable emphasis has been placed upon high sensitivity, with little regard for directivity and distortion. The reason for this state of affairs is that high sensitivity is easily demonstrated and is more dramatic in a quick test than the degradation of quality due to distortion and sharp directivity. As a consequence, smooth response, broad directivity, and low distortion have been sacrificed for sensitivity. For example, a loudspeaker with a high order of distortion and a narrow directivity pattern will sound louder than one with low distortion and a broad directivity pattern. Furthermore, the impression is often conveyed that the loudspeaker with the highest sensitivity is the superior one. This is erroneous because a careful consideration will show that a more uniform directivity coupled with lower distortion at the sacrifice of sensitivity will produce a superior loudspeaker. It is after very careful tests are made, that the more important characteristics of low distortion and uniform and broad directivity are realized.

In a direct radiator dynamic loudspeaker, with the following factors fixed, namely; the cone diameter, the amount of magnet material, and the frequency, the only remaining parameter that involves the efficiency in a maximized design is the mass of the voice coil and the cone. In typical loudspeakers, a reduction in mass of the cone of two to one will result in a gain in efficiency of three decibels. The heavier cone in this case will have a stiffness of eight times, a yield point of more than two times. Therefore, it will handle at least four times as much input power as the lighter cone for the same distortion. For the same distortion, the heavier cone will deliver at least two times as much sound power output and the distortion will be much less than from the lighter cone. Thus it will be seen that there is nothing magic about obtaining increased efficiency in a loudspeaker at the expense of nonlinear distortion.

When comparing loudspeakers by listening tests, the observation point is always on or near the axis. However, in the home, the listening position in the room may be almost anywhere. Under these conditions it is important that the loudspeaker cover almost 180 degrees in order that there be no frequency discrimination due to

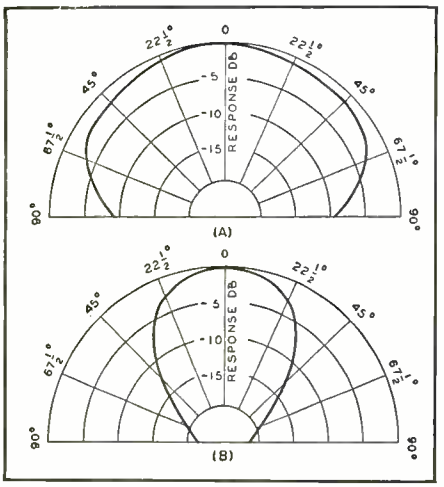

Fig. 19. (A) Broad directivity pattern, and (B) a narrow directivity pattern.

the directivity pattern. Therefore, listening tests on the axis alone are unrealistic. To show how the directivity affects the sensitivity on the axis, a comparison will be made of two loudspeakers with the same efficiency but with different directivity patterns, as shown in Fig. 19. The sensitivity on the axis of the loudspeaker with the narrow directivity pattern will be approximately six decibels above the one with the broad directivity pattern. The loudspeaker with the broad directivity pattern will cover the entire room, if it is placed in the normal location along a wall. However, in the case of the loudspeaker with the narrow directivity pattern, only a fraction of the room can be covered without frequency discrimination.

For home and other small room sound reproduction, high sensitivity is not a requirement because the power available from the amplifier is more than adequate to obtain satisfactory sound levels.[2] For example the loudspeakers described in this article will deliver a sound level of 80 db in the average living room for an input of .05 watt. Most amplifiers used in high-fidelity radio receivers and phonographs have an output of at least 5 watts. A 5 watt input to these loudspeakers will produce a level of 100 decibels. This is the peak level[8] of a full symphony orchestra, in the best seat in an orchestral hall. Furthermore, the loudspeaker with the heavier cone and lower sensitivity, used with conventional amplifiers, will actually deliver more sound power before it overloads than a loudspeaker with a lightweight cone. This is due to a loudspeaker with a light cone overloading at a fraction of the input of one with a heavy cone. Therefore, smooth response, low distortion, and a broad directivity pattern are more desirable than high sensitivity, because high sensitivity is of no practical value if it is obtained at the expense of low distortion and a broad directivity pattern.

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QRZ Mobile

(*Continued from page* 47)

control box duplicated at the transmitter, as they always are, and a headset connected across the extra "audio" line, complete two-way operation for test purposes may be obtained without "leap-frogging" around the car and the pedestrians who inevitably gather to watch.

The controls line up in three rows on the rig's front panel. See Fig. 1. Across the top row are the 1" plate current meter, antenna tuning, and a toggle switch for selecting oscillator or final amplifier plate currents for meter readings. The middle row has the crystal plug-in socket, final plate tuning, and the 3-position bandswitch (shown in the 20-meter position). The bottom row has the main "on-off" toggle switch (duplicated at the dashboard remote-control box and normally left in the "off" position), oscillator plate tuning, and the "transmit-receive" toggle switch (also duplicated at the dashboard and normally left in the "receive" position).

Should the rig have to be removed from the trunk for inspection or service, the job can be done in a jiffy because of the simple 2-bolt mounting employed. A plywood shelf is permanently mounted on the wall of the car trunk. Two 2½" x ¼" machine bolts are secured to the rig's bottom cover plate and two matching holes are drilled through the plywood shelf. When the rig is fully assembled with the top and bottom covers in place, the unit is set on the plywood shelf, the two machine bolts protruding from the bottom of the rig slipping into the two matching holes of the shelf. The rig is then secured with two wing nuts and lock washers. A braid conductor connected from the car body to the forward wing nut is included as an assurance of a good grounding condition between the rig and the car body. It may or may not affect performance in your installation but its inclusion is recommended. Tubes can be replaced, if necessary, in a jiffy, simply by removing the top panel of the rig's box. It is secured by four self-tapping machine screws usually supplied with the box. Please note, however, that the tubes should last indefinitely under the modest operating conditions of this transmitter.

Tuning Up

The transmitter operates satisfactorily with d.c. supply voltages of from 300 to 500 volts. The power output will depend to a large extent on the plate voltage used. For a supply voltage of 400 the power input to the 5516 r.f. final is approximately 25 watts and is consistent with extended tube life. The slider on the bleeder resistor, R_5, should be adjusted for 300 volts for proper oscillator and modulator operation. After the installation is completed and all cables and an antenna load (preferably a "dummy," for the sake of the other hams in QSO) are connected, insert the crystal in its socket and throw the main power toggle switch to "on." (A 40-meter crystal works very well for 20-meter output of the rig. The oscillator has excellent harmonic output and provides sufficient driving power for the grid of the 5516 tube so that it is always operated as a straight-through amplifier. An active 40-meter crystal, therefore, should drive the final as a straight-through amplifier even at the 10-meter bandswitch setting.)

With the bandswitch set for the desired output frequency and the oscillator tube already heated, set the "meter reading" toggle switch to read "oscillator" plate current. Next, throw the "transmit-receive" toggle switch to the "transmit" position and adjust the oscillator tuning for the sharp meter dip which indicates resonance. At resonance the current will be between 30 and 40 ma. (It is suggested that, for the sake of the tube's life, the 5516 be left out of its socket during this initial adjustment of the oscillator, and put back in its socket and the plate cap attached after the ability of the oscillator to be resonated is ascertained.) No difficulty should be encountered in resonating the oscillator if parts values and wiring are correct. You can then proceed to tune the final stage. Throw the meter toggle switch to the opposite direction and adjust the final plate tuning control for resonance. By adjusting the antenna tuning control and readjusting the final tuning control, the final meter reading can be brought to a point of loading which gives a resonant dip at 60 to 65 ma. With a 300-volt plate supply the final current will be about 55 ma. With a 500-volt supply the current should be limited to 60 ma. During the tune-up it is not necessary to have a microphone plugged in. However, in the interest of good operating practice, if a "live" antenna is used instead of a "dummy" for the tune-up, it is recommended that a frequency be selected that will not QRM other stations (don't underestimate the power of a 25-watter) and your own call sign be given at frequent intervals.

Come on and join in the fun. Spring and summer are the times for automobile-ing. Take one on your vacation and meet the guys on the way. There are local rag chews with the gang or exciting DX, all while cruising along the highway or while parked outside the market waiting, as is the usual case, for the XYL! —30—

Manufacturers' Literature

The bulletins reviewed in this section are for your convenience; unless otherwise indicated they are available to all our readers. For prompt attention write directly to the manufacturer for literature described.

RECTIFIER REPLACEMENTS

The Rectifier Division of *Sarkes Tarzian, Inc., Bloomington, Ind.* has issued a new "Selenium Rectifier Replacement Guide" which is currently available for 25 cents.

The publication is divided into two sections—one dealing with television receivers and the other with radios. Sets are listed by make and model number and the manufacturer's part number given. The *Sarkes Tarzian* replacement model number is also listed in the catalogue.

FEDERATED'S SOUND DATA

Federated Purchaser of 66 Dey Street, New York 7, N. Y. has issued a pocket-sized booklet which offers a series of audio components assembled in "packages" available at prices ranging from $100 to $250.

The booklet also lists miscellaneous components and suggested installation layouts. A copy of this booklet may be obtained by writing the company direct.

CENTRALAB DATA

Five new and revised catalogue sheets covering special types of ceramic condensers are now available from Dept. K-10, *Centralab*, 900 E. Keefe Ave., Milwaukee 1, Wisconsin.

Complete technical specifications are given for the following styles: broadcast disc units (Bulletin 42-4R), ceramic trimmers (Bulletin 42-101R), tubular trimmers (Bulletin 42-59R), feedthroughs (Bulletin 42-206), and high-accuracy units (Bulletin 42-123R).

Any or all of these bulletins are available on request.

CONVERTER CATALOGUE

Carter Motor Company, 2644 N. Maplewood Ave., Chicago 47, is now offering copies of its new catalogue which lists the company's entire line of d.c. to a.c. converters.

Known as Catalogue No. 553, the new publication includes 20 pages of electrical and mechanical specifications on the line as well as a "selector chart" for determining the right converter for the job.

For a free copy of this catalogue, write Dept. 7 of the company.

TEST EQUIPMENT

Heath Company, Benton Harbor, Michigan is now offering copies of its

1954 *"Heathkit"* catalogue which lists the wide variety of test equipment, receivers, amateur radio gear, and amplifiers available in kit form.

This colorful new publication lists complete specifications on each item and provides full data for ordering the equipment.

"ANTENAPLEX" DATA

The Engineering Products Department, *Radio Corporation of America,* Camden, N.J., has issued a colorful 4-page brochure describing installations of its "Community Antenaplex" system.

Included are pictures and descriptions of systems installed in Pottsville, Pa., Laconia, N.H., Fayettesville, Ark., Wilkes-Barre, Pa., Graham, Texas, Carmel, Calif., and Brockway, Pa.

For a copy of this brochure, write to the Antenaplex Sales department of the company.

TV ACCESSORIES

Admiral Corporation, 3800 Cortland St., Chicago 47, Ill. is currently offering a copy of its new 20-page, two-color catalogue which lists antennas, masts and towers, tables and bases, multiple installation equipment, transmission lines, and hardware.

The new publication is being offered with distributors' imprints. For a copy of this catalogue or additional information, address your requests to the Accessories Division of the company.

ELECTROLYTIC CATALOGUE

Pyramid Electric Company, North Bergen, N. J., has recently issued a new catalogue which contains listings for almost 300 new dry electrolytics which have been added to its line.

Catalogue DE also includes listings and full information on the company's new Type TDL—a hermetically-sealed dry electrolytic in a tubular metal can which has an outer cardboard tube and 6" flexible insulated wire leads.

G-C CATALOGUE

General Cement Mfg. Co., 904 Taylor Street, Rockford, Ill., has released copies of its No. 156 catalogue which contains detailed descriptions, specifications, and prices of its complete line of radio, TV, and electronic products.

The 64-page catalogue carries a complete index for ready reference. More than 3000 items in over 150 different classifications are included.

C-D REPLACEMENTS

Cornell-Dubilier Electric Corp. of South Plainfield, N. J. has issued a comprehensive catalogue for service replacement needs covering condensers for a wide variety of applications.

The 36-page catalogue provides data on 134 replacement condensers presented in clear, concise form. The listings serve as a valuable inventory guide as well. Another feature of the new #200 D catalogue is the use of two indexes—one according to classification and the other according to type number or brand name.

A free copy of this new catalogue is available from local *C-D* distributors.

MERIT CATALOGUE

Merit Coil and Transformer Corp., 4427 North Clark St., Chicago 40, Ill. has issued a new replacement catalogue covering transformers, coils, and TV replacement components.

The 16-page catalogue gives complete specifications on the company's line including type number, list price, mounting centers, mounting types, etc. A copy of this catalogue, which replaces No. 5211, is available on request.

"MOTOROLA SERVICE NEWS"

A new monthly magazine, *"Motorola* Service News," has made its debut according to an announcement received from *Motorola Inc.,* 4545 W. Augusta Blvd., Chicago 51, Illinois.

The new house organ, published by the service department, will be sent free to service contractors and dealer and distributor technicians. The technical section features service hints, bulletins, and new circuit schematics which may be lifted out for filing.

Articles on technical subjects as well as on business news and methods, etc. are also included. The new publication is edited by Russell C. Hansen, the company's service contract manager.

TUNG-SOL MANUAL

Tung-Sol Electric Inc. of Newark 4, N. J. has announced publication of the 19th edition of its "Tube Characteristics Manual."

Over 166 pages of this manual are devoted to technical information about receiving and cathode-ray tubes. Six different colored pages are used to separate the charts, diagrams, and technical data for easy reference.

The back of the manual carries a special section which contains basic marketing information to help technicians plan local promotion programs for their own businesses.

The manual is distributed through the company's tube wholesalers.

"SOUND ADVICE"

Asco Sound Studios, 115 W. 45th Street, New York 36, N. Y. has recently released a comprehensive 148-page booklet entitled "Sound Advice," prepared by Irving Greene.

The booklet includes the latest information on high-fidelity developments, monaural systems, the binaural trend, new high-fidelity components, cabinetry, and other allied subjects.

The booklet, which measures 7" x 5½", carries on its cover a reproduction of the May 1953 cover of RADIO & TELEVISION NEWS which pictured the *Asco* "Audiomat." Although the booklet sells for 50 cents a copy, readers of this magazine may obtain a copy by sending 10 cents in coin to cover postage and handling costs.

SUN RADIO CATALOGUE

Sun Radio & Electronics Co., Inc., 650 Sixth Avenue, New York 11, New

York has recently issued an eye-catching catalogue covering audio gear of all types.

Prepared by the high-fidelity sound sales department of the company, the new catalogue features a compatibility chart of radio tuner and amplifier components, a 5000-word article on planning a high-fidelity music system, and photographs and specifications on hundreds of items of interest to audiophiles.

First distributed at the New York Audio Fair, copies of this new catalogue are now available upon request to the company.

INVENTORY CONTROL

The Tube Department of *General Electric Company,* Schenectady, N.Y. has come up with a solution to the inventory problems of users of industrial and transmitting tubes.

The answer to the problem is in the form of a new simplified record-keeping system for all required data on such tubes. The record comes in a 10" x 12" leatherette binder which includes sections for a one-year inventory, service report forms, data and prices on the tubes, a sheet describing the company's tube manuals, and an interchangeability data section.

In addition, the system includes tube life record cards for large industrial tube users, broadcasters, and telecasters. This system provides a supply of tube life record cards and a metal file cabinet for the cards.

G-E tube distributors are handling this control system.

MILLER GUIDE

J. W. Miller Company, 5917 South Main St., Los Angeles 3, California has issued a new TV replacement guide, No. 154.

This concise 20-page guide lists hundreds of video and sound i.f. transformers, ion traps, peaking coils, etc., as used in various TV sets and then lists the *Miller* equivalent part number.

In addition, the new guide carries a catalogue page on TV replacement components and another on radio replacement coils.

A copy of this publication is available without charge, on request.

HI-FI CATALOGUE

Hudson Radio & Television Corp., 48 West 48th Street, New York 36, N. Y. has released a new 56-page high-fidelity catalogue and buying guide—the most complete ever issued by the company.

Included in the catalogue are the very latest tuners, amplifiers, speakers, record changers, tape recorders, TV chassis, tubes, replacement parts and accessories, and cabinets. Specifications, photographs, and prices are given on all of these items.

The company invites readers to pick up a copy of this new publication at any one of its three salesrooms or obtain one by writing the firm direct. —30—

NEW EQUIPMENT FOR THE AUDIO TECHNICIAN

MAGNETIC PORTABLE

J. C. Warren Corporation, 21 Hanse Avenue, Freeport, N.Y. has developed a compact magnetic portable recorder-playback unit, the Model 777.

The new unit weighs 22 pounds and measures 6" x 10" x 15". It takes a 5"

reel and tape speed is 1.87 inches-per-second. The motor is a d.c. reed synchronous constant speed type. Playing time is 1 full hour on each track.

The Model 777 features high impedance crystal input, a power output of 200 millwatts, frequency response from 200 to 4000 cps, flutter and wow of ½ of 1 per-cent, and distortion less than 10 per-cent. It will operate on either a.c. or self-contained batteries.

LABELING TAPE

Minnesota Mining and Manufacturing Co., 900 Fauquier St., St. Paul 6, Minn. has developed a new pressure-sensitive labeling tape which is said to make the identification of tape recordings faster and easier.

Called *"Scotch"* write-on tape No. 48, it provides a continuous roll of 40 printed labels that stick at a touch to the reels themselves. Complete with a convenient metal dispenser, the new labeling tape features a special matte

finish that can be written on with pen, pencil, ball point pen, or typewriter.

Printed on the new white tape is "Reel No.," "Date," and "Subject" together with adequate room for filling in the necessary data.

BELL AMPLIFIER

Bell Sound Systems, Inc. of Columbus, Ohio has added a moderately-priced amplifier to its line of audio components.

The Model 2199 has a 12-watt output at less than 1% distortion with a peak of 16 watts. Frequency response is rated from 20 to 20,000 cps, ± ½ db with the controls flat. There are six controls, including a seven-position selector switch with equalization for all types of records, tuner, crystal, tape, and television inputs. Outputs with impedance ratings of 4, 8, 16, and a high impedance jack for tape or disc recorders are also provided.

THREE-SPEAKER RECORDER

Webster-Chicago Corporation of Chicago, Illinois is currently marketing a new three-speaker tape recorder, the *"Webcor"* Model 2030.

The amplifier uses five tubes including a rectifier with three of the tubes being double-purpose types to provide eight-tube performance. The circuit also includes bass and treble boost during playback and bass-compensated volume control. The amplifier is

coupled to the tape speed control to provide automatic equalization for 3¾" tape speed.

The recorder incorporates two six-inch speakers and one four-inch PM type speaker. The three speakers are used to cover a wide frequency range with uniform response.

STROMBERG COMPONENTS

A new combination radio receiver and amplifier and a 15" coaxial loudspeaker have been added to the *Stromberg-Carlson Company's* "Custom 400" series of high-quality sound reproducing equipment.

The receiver-amplifier, known as the "SR-405," combines on a single chassis the company's high-quality tuner and a 10-watt amplifier. It provides radio reception on both the AM and FM bands plus amplification of the entire spectrum from 20 to 20,000 cps.

The "RF-475" fifteen-inch coaxial speaker has a 10½ pound permanent magnet, a woofer cone of special fiber, a 3" voice coil mounted on an aluminum form, and a pressure-type high-frequency tweeter which is mounted coaxially through the woofer

pole piece. A 10-element acoustic lens of non-resonant plastic transmits the highs uniformly through a 90-degree angle of coverage in all planes.

FISHER AM-FM TUNER

Fisher Radio Corporation, 45-41 Van Dam Street, Long Island City 1, N.Y. is now offering its new Model 70-RT FM-AM tuner which includes tone controls, a phonograph preamplifier,

adjustable record equalization, and a loudness control—all in a single cabinet.

The tuner uses fifteen tubes and has separate front ends for AM and FM. There is a separate d.c. supply for all audio tube filaments as well as a completely shielded and shock-mounted main and sub-chassis.

The FM section has two i.f. stages, dual limiters and a cascode r.f. stage; the AM section has two i.f. stages and one tuned r.f. stage. Audio response is uniform ± 1 db from 20 to 20,000 cps. Distortion is less than .04% for 1 volt output and .8% for 10 volts output.

The tuner has six controls on the front of the cabinet which measures 14¾" wide, 8½" high, and 9¼" deep.

AUTOMOTIVE SOUND

A complete sound amplifying system for buses, trucks, and cars is now being offered by the electronics division of *Z & W Machine Products Co.* of 5100 St. Clair Ave., Cleveland 3, Ohio.

The Model 31-A system includes a microphone, remote control head, cables, speakers or reflex trumpets, and a shock-mounted amplifier housed in welded steel. It operates on 6 or 12 volts d.c.

For full information on the Model 31-A or modifications for custom use, write direct to R. M. Wood at the company.

PORTABLE P.A. SYSTEM

The Sound Product Equipment Section of *Radio Corporation of America's Victor Division,* Camden, N.J. has announced the availability of a new portable sound system which has been designed for audiences ranging from a few people to several thousand.

The system includes four newly-designed components: a deluxe dual-speaker carrying case (Type MI-12762); either a 15-watt amplifier (Type MI-13295-A) or a 30-watt amplifier (Type MI-13296-A); and a dynamic microphone (MI-12017) with stand (MI-13240).

The case divides into two acousti-

cally designed baffles, each housing a heavy-duty 12" speaker, provided with 25 feet of cable and connectors. Overall case dimensions are 22½" high, 15¾" wide at the base, and 16¾" deep at the base.

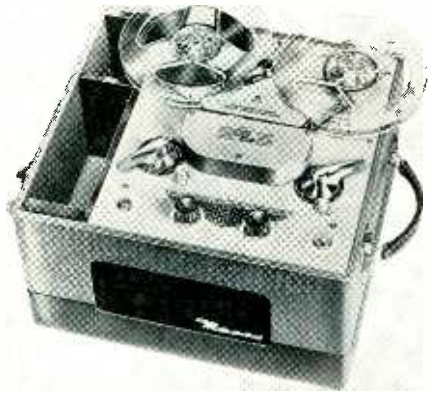
Full details on this new system are now available from the company's sound equipment distributors.

MASCO TAPE RECORDERS

Mark Simpson Mfg. Co., 32-28 49th St., Long Island City 3, N.Y. is now offering its new series 53 tape recorders which feature improved portability and more modern styling.

Both the Models 53 and 53R (with radio) have dual-speed, 3¾ or 7½ ips, with automatic amplifier equalization for each speed; fast forward and rewind speeds; and two-motor drive. Their dual-track feature permits up to two hours of recording on a single 7" reel. Inputs are provided for microphone, radio, or phonograph; outputs for external speaker, external amplifier, or telephone lines are also provided. A press-to-record push-button prevents accidental erasure and provides foolproof recording and playback.

Frequency response is 80 to 8500 cps ± 3 db at 7½ ips and 80 to 5000 cps



± 3 db at 3¾ ips. Additional technical specifications and literature on the series 53 recorders are available.

"IRISH" REEL TABS

Orradio Industries, Inc. of T-120 Marvyn Road, Opelika, Alabama is offering reel tabs for its *"Irish"* brand recording tape without charge to professional tape users.

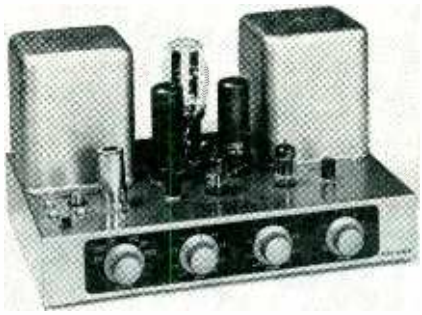
The tab is designed to replace the makeshift scraps of paper and china crayon markings used for labeling purposes. The new reel tab fits snugly beneath the edges of any type of 7" plastic or metal reel, whether the reel is full, half-full, or empty. It is made of sturdy stock and has plenty of room for identification on both sides.

For tabs, write to Nat Welch at the company.

ALLIED AMPLIFIER

Allied Radio Corporation, 100 N. Western Ave., Chicago 80, Ill. is now offering a deluxe 24-watt amplifier which has been tradenamed the "Golden Knight."

This moderately priced unit uses a heavy-duty, grain-oriented output transformer which contributes to the clean response of the amplifier. Frequency response at 24 watts output is ± .75 db from 20 to 40,000 cps. Harmonic distortion is less than 1% at



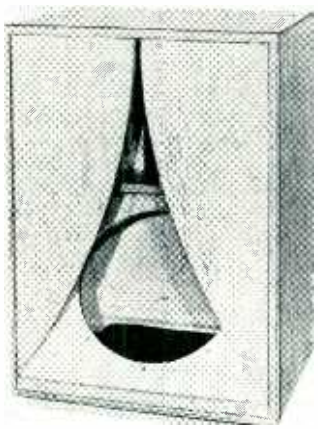
the rated output with intermodulation distortion less than 2% at rated output.

The amplifier has four inputs, one for *G-E, Pickering,* or *Audak* magnetic cartridges; two inputs for radio tuner, crystal cartridge, television, or tape recorder; while the fourth input will take any high-impedance microphone. A panel switch permits selection of any input.

ENCLOSURE KIT

Karlson Associates, Inc., 1379 East 15th St., Brooklyn 30, N.Y. has announced the availability of the new "Ultra-Fidelity" cabinet kit.

The unit is exactly the same size and construction as the finished models made by the company and will provide the same standard of perform-



ance. The kit comes ready to be assembled with all 34 pieces precision-cut to size. It is constructed of rough plywood in order to furnish a good surface for the application of veneer for finishing or it may be used as is in hidden installations.

The Model 15PK is furnished with a hole cut for a 15" speaker. Adapters are available for 12" speakers on request. Construction plans for the kit are available from Dept. 1K of the company.

CRESTWOOD RECORDER

The *Crestwood Recorder Division* of *Daystrom Electric Corporation,* Poughkeepsie, N.Y. has introduced a new tape recorder to the trade, the 401.

Frequency response of this medium-

priced unit is from 30 to 13,000 cps ± 2 db at 7½ ips tape speed. The model 401 has two speeds, 7½ and 3¾ ips. It also has a separate recording volume control in addition to the regular monitor control and magic-eye indicator which prevents recording overlap. Three separate inputs, for radio-TV, phonograph, and microphone, are controlled by a single selector switch.

PUSH-BUTTON RECORDER

Radio Corporation of America. Engineering Products Dept., Camden, N.J. has introduced a new push-button tape recorder which is characterized by ease of operation and good performance.

All of the recorder's functions are actuated by push-buttons. The unit itself has two speeds, a quick-threading feature, a tone-sensitive microphone, easy-to-carry case, and trouble-free construction.

The cabinet measures 9" x 14" x 12" and the cover holds the microphone, two reels, and the a.c. power cord. A data sheet and additional information on the Model SRT-301 are available from the company on request.

PREAMP-EQUALIZER

Fairchild Recording Equipment Corp., 154th St. and 7th Ave., Whitestone, N.Y., has designed and is producing a new preamplifier-equalizer which retails in the moderate price class.

Although it performs every function of a high-quality preamplifier-equalizer, it uses only two knobs in normal operation. An exclusive "balanced-bar" control permits exact shading of tone coloring to suit individual taste. When used in conjunction with the control knobs, this feature provides for adjustment to match the acoustics of the room in which the equipment is installed.

Frequency response is 20 to 50,000 cps ± ½ db with controls in the uniform response position. There are seven input channels and complete equalization for all records, American and foreign, standard and microgroove.

PROFESSIONAL RECORDER

Magnecord, Inc., 225 W. Ohio Street, Chicago 10, Illinois has introduced a new professional magnetic tape recorder, the M80.

The new unit is designed for 10½ inch reels and incorporates all the latest features including slot loading, safety interlocked push-button controls, unitized construction, and full-range frequency response from 30 to 15,000 cps at 7½ ips tape speed.

The recorder will operate at either

7½ or 15 ips without capstan change. Starting time is less than .1 second and stopping time is within less than 2 inches of tape when operating at 15 ips.

The unit is designed for rack, portable, or console operation. The company will supply full details on this recorder upon request.

SHADED POLE MOTOR

Electro Engineering Products Company, Inc., 609 W. Lake Street, Chicago 6, Ill. is now offering a new, powerful, and compact shaded pole motor for phonographs and tape recorders.

The new motor, the Model MS-3600, has been specially designed to withstand high temperatures and rough service yet is low priced for application to mass-produced equipment.

It is a 4-pole, shaded pole, a.c. type motor and is available in either two or four coil design. It has self-aligning, oil-impregnated sleeve bearings with a specially-designed oil retaining washer and dynamically balanced rotors. —30—

Within the Industry

(*Continued from page 26*)

11th and Cambria, in Philadelphia. It will be devoted to the assembly of the company's line of connectors.

* * *

JOHN E. MARTIN has been named director of research for *The Gabriel Company,* Needham Heights, Massachusetts.

Mr. Martin, who was born in Stafford, England, graduated from King's College, London University, after having majored in physics and mathematics. During the war he was engaged in naval radar research for the British Admiralty and later did postgraduate work at London University. Following that he became senior engineer for the *BBC,* specializing in antenna design.

* * *

WILLIAM R. HEWLETT, vice-president of *Hewlett-Packard Co.* of Palo Alto, California, has been elected president of the Institute of Radio Engineers for 1954. He succeeds Dr. James W. McRae as head of the international society of over 35,000 radio engineers and scientists.

Maurice J. H. Ponte, director of *Compagnie Generale de Telegraphie Sans Fil* of Paris, France is the new vice-president.

Elected as directors for the 1954-1956 term are Axel G. Jensen, director of television research for *Bell Telephone Laboratories, Inc.* and George Rappaport, chief engineer of the Countermeasures Branch, Aircraft Radiation Lab., Dayton, Ohio.

* * *

ARTHUR A. CURRIE, assistant general sales manager of the radio and television division of *Sylvania Electric Products Inc.,* has been named sales manager for radio and television.

Assistant sales manager since October 1952, Mr. Currie served as field sales manager from Jan. 1951 to October 1952 and as district sales manager from 1949 to the beginning of 1951.

Prior to joining *Sylvania,* he was associated with *Apex Electrical, Allied Appliance Co.* of Boston, the OPA, and *New England Power.*

* * *

W. S. ANDERSON, director of *Automatic Electric Co.,* was elected president of the New York Chapter of the Armed Forces Communications Association.

Emmett R. Shute was elected vice-president. The balance of the chapter's officers were re-elected for another term. —30—

WIRELESS OPS OF OLD

By C. HOWARD BOWERS

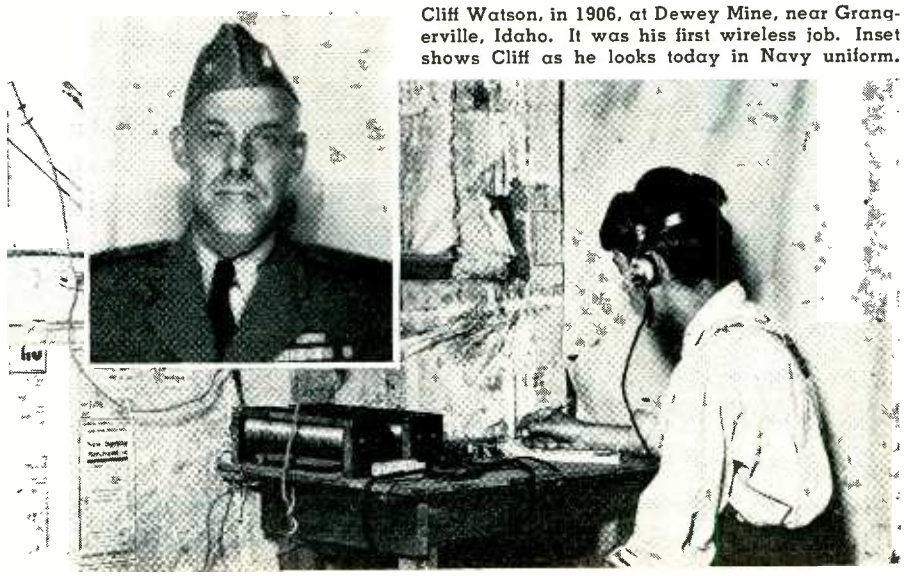
ON THE West Coast they start early too, and in this issue we salute COMMANDER CLIFTON H. WATSON, USNR. and also thank him for his story, as told to his friend E. H. Marriner of La Jolla, California.

The Commander's career started in Portland, Oregon in 1905, after he had read of Marconi's achievement test from Glace Bay, N. S. to Clifden, Ireland. His first experiment was with a magnetic coherer and a spark-coil which transmitted signals the full width of a room. It was during that same year that the *USS Charleston* along with several other war ships came into Portland harbor and our young experimenter, through a personal acquaintance with Admiral Fullam, had an opportunity of looking over some real Navy wireless equipment. He soon became a bona fide amateur—the fourth one in Portland.

Cliff's first wireless job was at Grangeville, Idaho, where his father owned a mine and at 13 he was handling traffic with the *United Wireless Telegraph Co's* station "PE" Portland, Ore., "PH" San Francisco, California, and "PA" Seattle, Washington. There were no news broadcasts those days. By summer, 1906, Cliff found himself breaking in at "PE" Portland where only Morse code was used over their old *DeForest* transmitter. A three slide tuner and a carborundum detector comprised the receiving apparatus.

During 1911 young Watson took the examination for a commercial license (Certificate of Skill in Wireless Telegraphy) at Mare Island (Calif.) Navy Yard, and his first sea-going job after obtaining his certificate was aboard the *SS Chehalis,* sailing between Gray's Harbor, Wash., and San Diego, Calif., with stops at San Francisco and San Pedro, Calif. Following two years on the good ship *Chehalis,* "Sparks" Watson traveled on the steamers *Senator, Alameda,* and *Humbolt*—mostly between Seattle, Wash., and Nome, Alaska. Cliff looks back on this period with a nostalgic interest due to the many young school marms who were then making summer excursions to Alaska. He also had other experiences while on the *Senator.* Once the ship ran into a terrific blow off Cape Serichef in the Bering Sea and for three days no one knew if they would make it to Unimak Pass and calm water. They made it! Another time Cliff, answering an SOS from the *SS Spokane* in distress off Alaska, directed some of the rescue work and remembers receiving $25.00 as his share of the salvage money.

About 1913, the Commander-to-be decided on working "shore-side" and was employed by the *North West Electric Company* of Portland, Ore., as an operator at their power plants, using wireless for dispatching. In 1915 he installed five different wireless stations for the *Montana Power Company* and in 1917 he accepted the appointment of Radio Inspector at Seattle, Wash., relieving Bennie Wolf (well known R.I. in that area) who had been called into the Navy. Before long, however, he went to the Mare Island Navy Yard in charge of their Wireless Laboratory where he remained until 1921. Having gained considerable experience in wireless techniques by this time, he went into business for himself and with an associate, Joe Hallack, formed the *HALLACK & WATSON RADIO CORPORATION,* constructors of broadcasting stations. In 1930, disassociating himself from this business, he became identified with the Portland Bureau of Police and installed their first wireless station, "KGPP," where he remained as their radio engineer until 1941 when he went on active duty with the Navy with the rank of Commander, USNR. On being mustered out in 1946, our "restless electron" was ap-



Cliff Watson, in 1906, at Dewey Mine, near Grangerville, Idaho. It was his first wireless job. Inset shows Cliff as he looks today in Navy uniform.

pointed radio engineer in the Electronic Laboratory of Navy Radio, "NPL," Pt. Loma, (San Diego) California, the very station he used to gaze at in wonder from his old ship.

Cliff Watson has had quite a career and we say, "Lots of good luck, Commander! It looks like your vocation is going to be permanent!"

George H. Mullnix

Not only has the West Coast produced men who pioneered the wireless field, but some who also added materially to the population. Take George H. Mullnix, father of five children and grandfather of four; he started experimenting with wireless in 1913, and learned the code even before that.

George had plenty of ambition in those days as in 1915 we find him presiding over the *DeForest* radiotelephone exhibition at the San Francisco World Fair. This was a forerunner to his joining the aviation section of the U.S. Army Signal Corps as a journeyman electrician.

While in the Signal Corps he attended A & M College of Texas' radio mechanics course, went through the David Rankin Institute's special electrical engineering course, also through tne radio operators' course at University of Texas, with finishing touches at Ellington Field, Texas. The amount of soldiering done by our wireless wizard is the unknown quantity of course, but we do know that he was separated from the Air Service at Mitchell Field, L. I., December 13, 1918 and after a refresher course secured his commercial license in September, 1919.

After some "warm up" duty on Pacific Coast lumber schooners, George sailed as 2nd operator on the *SS Colusa* from San Francisco to Manila, and the Straits Settlements. Then followed a year on the tanker *Miskianza*. The liners *Lurline* and *President* also carried our young wireless expert before he finally decided to come ashore —object matrimony!

George Mullnix was married September 24, 1922 at Carmel, California and has made his home there since 1944. In the interim he was identified with the *Pacific Gas and Electric Co.* as a radio troubleshooter and subforeman and, as a side-line he taught electrical classes in public schools.

After slightly more than 20 years with the power company, our ambitious friend retired October, 1943 and since then has alternated between being in business for himself and being a journeyman electrician.

With this background, our old time wireless man was well qualified to revert to amateur status some time ago with the assigned call of W7WDU.

Mr. Mullnix's own conclusion is, "I am now 53 years of age and with the help of amateur radio, I hope to live to be 100!"

EDITORS NOTE: *If your experiences as a commercial wireless operator date back to 1912 or thereabouts, you are an Old Timer and you should write us giving a thumbnail sketch of your career.* —30—

SERVICE HINTS ON ADMIRAL TV SETS

SERIES 19 CHASSIS

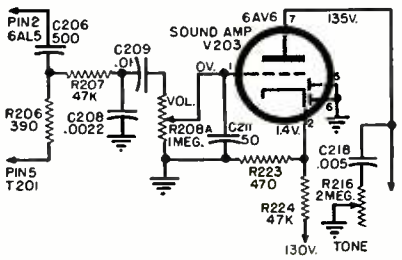
Audio hum.

An objectionable residual hum level may be found in the chassis of this series using a 10-inch electromagnetic speaker.

To remedy this, do the following:

1. Check the lead dress in the audio input circuits, paying particular attention to the a.c. leads of the "on-off" switch. These leads should be kept well away from the audio amplifier grid circuit (pin 1 of V_{203}, 6AV6). The audio coupling condenser, C_{209} (.01 μfd.), should be dressed away from the "on-off" switch.

In models with tone control, dress the lead between the control and the



audio amplifier plate away from the a.c. leads. (See accompanying diagram.)

2. Check all filter condensers, especially C_{101}, the 60-μfd. electrolytic in the "B+" power supply, between pin 8 of the 5U4G and ground.

3. Substitute a PM speaker with choke attached (*Admiral* Part No. 78B80-1). If this clears up the hum, then the original speaker is probably at fault.

Vertical jitter and poor interlace.

This condition may occur if the red lead to the horizontal deflection yoke is too near the grid circuit of the vertical output tube (V_{402}, 6S4). This lead should be dressed against the chassis well away from the grid circuit.

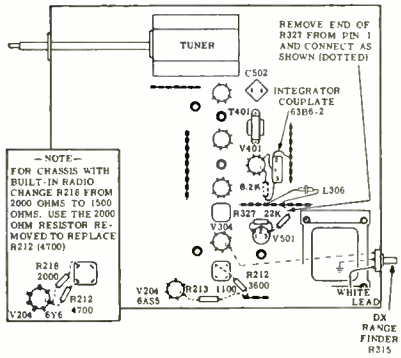
Horizontal instability.

To increase the horizontal sync level and "square up" the horizontal sync pulse, add an 8200-ohm resistor between pin 1 of V_{401B} (12AU7 sync clipper) and the number 3 lead of the vertical integrator Couplate.

Picture bending and unstable horizontal sync.

To minimize bending of the picture at high contrast control settings in strong signal areas, and improve horizontal sync in medium fringe areas, make the following changes:

1. Check the connections to the "DX range finder" control, R_{315}. Be sure that the center terminal is grounded and that the white wire goes to the control terminal nearest the bottom edge of the chassis. Connect a wire lead from pin 1 of V_{304} (6AL5)



to the remaining terminal of the range finder control. (See accompanying diagram.)

2. In chassis using a 6AS5 sound output tube (V_{204}), change resistor R_{212} from 3600 ohms to 1500 ohms, ½ watt, 5%, and change resistor R_{213} from 1100 ohms to 910 ohms, ½ watt, 5%.

In chassis using a 6Y6G sound output tube, change resistor R_{212} from 4700 ohms to 2000 ohms, ½ watt, 5%, and resistor R_{218} from 2000 ohms to 1500 ohms, ½ watt, 5%.

3. Disconnect resistor R_{327} (22,000 ohms) from the junction of resistors R_{325} and R_{326} (2700 ohms), and reconnect R_{327} to the junction of R_{325} and peaking coil L_{306}.

4. Connect an 8200-ohm resistor in series between terminal 3 of vertical integrator Couplate and pin 1 of V_{401B}.

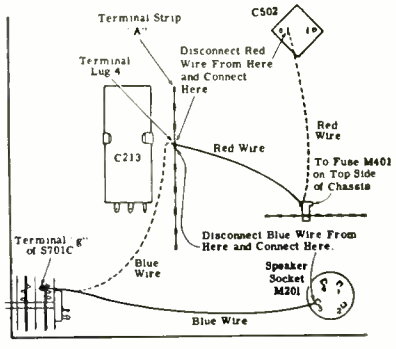
5. Since step 1 is effective only with the "DX range finder" set at zero, use this setting unless a higher one gives better results.

CHASSIS 19E1, 19G1 & 19N1

Repeated fuse failure.

In some of these chassis, the ⅜ ampere fuse, M_{401}, may blow when the function switch is rotated from the "Radio" to the "TV" position. This may occur because the rotor contact of the switch section, S_{701C}, is wide, and during rotation of the switch there is one position where all contacts of this section may short, resulting in a surge of current that blows the fuse.

This difficulty can be corrected by



changing the circuit location of the fuse, as illustrated in the accompanying diagram and explained in the next paragraph. (The dotted lines indicate the original connections.)

1. Disconnect the blue wire from lug 4 of terminal strip "A." This is the blue wire from terminal "g" of switch section S_{701c}.

2. Connect the blue wire to pin 3 of speaker socket M_{201}.

3. Disconnect the red wire that goes to fuse M_{401} from the positive terminal of the electrolytic condenser, C_{502} (80 μfd.). Two red wires are connected to C_{502}, be sure to disconnect only the red wire connected to the fuse.

4. Connect the red wire removed from the positive terminal of C_{502} to lug 4 of terminal strip "A."

SERIES 22 CHASSIS

60-cycle hum.

A cathode-to-heater short in the 2nd sound i.f. tube, V_{201}, 6AU6, will cause a loud 60-cycle hum when there is a signal being received. To test whether this tube is at fault, disconnect the antenna, and if the hum level decreases, it is likely that V_{201} is defective.

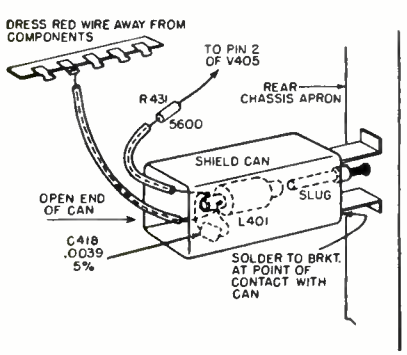
CHASSIS 22A2, 22A2A, 22C2, 22E2, 22M1 & 22Y1

Horizontal ripple.

Horizontal ripple moving up or down in the picture is usually due to a power source frequency difference between the transmitter and the television receiver. It is caused by some of the 60-cycle power source voltage feeding into the horizontal oscillator. This a.c. voltage can come from the "B+" power supply, through the horizontal sync discriminator, and thus be applied to the control grid of the oscillator, or from flux leakage around the power transformer. The most common cause is flux leakage around the power transformer (even though it has a copper band) to the horizontal lock coil.

To shield the horizontal lock coil from the power transformer, see the accompanying diagram and do the following:

1. Disconnect the red lead from the lug on the horizontal lock coil, L_{401},



and reroute it away from all chassis components. Reconnect the red lead to the lock coil lug.

2. Replace R_{431}, the 5600-ohm resistor connected between the lug of the lock coil and pin 2 of V_{405} (6SN7), with

a new 5600-ohm, ½-watt resistor, having longer leads. Cover the resistor with spaghetti. (The original 5600-ohm resistor may be used by splicing a wire to one lead in order to lengthen it.)

3. Remove the horizontal lock coil from the rear chassis apron by placing the fingers on the end of the coil form nearest the rear of the chassis, and pulling the coil toward the front. This leaves the slug and part of the assembly still attached to the chassis. Procure a metal shield can, preferably an i.f. can that is not made of aluminum, and slip this can over the slug as shown in the diagram. The hole through the top of the can should be 7/16 inches in diameter or larger.

4. Insert the lock coil through the shield can over the slug and back into its original assembly. Solder the shield can to the mounting bracket of the assembly, being sure to clean and tin thoroughly the surfaces to be soldered, to insure a good electrical connection.

5. It may be necessary to readjust the horizontal lock slug for optimum receiver operation.

CHASSIS 22C2 & 22E2

Ringing.

This effect, consisting of at least four tunable ghosts about ½ inch apart, may be caused by the 3rd i.f. transformer (T_{303}) being wired in backwards. The numbered terminals on the bottom of the transformer should be connected as follows:

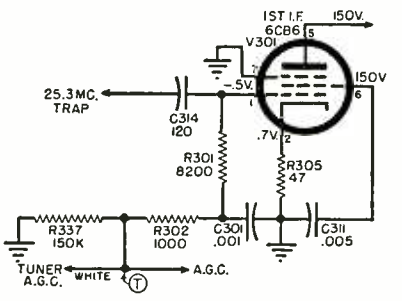
Terminal #1 to the red "B—" wire going to the screen of the 3rd i.f. tube (pin 6 of V_{303}, 6AG5); terminal #2 to the cathode of the video detector tube (pin 3 of V_{304A}, 12AT7); terminal #3 to chassis ground; terminal #4 to the plate of the 3rd i.f. tube (pin 5 of V_{303}).

CHASSIS 22C2, 22E2 & 23A1

Snow in intermediate fringe areas.

To reduce snow (front-end noise) in intermediate fringe areas, reduce the tuner a.g.c. voltage to 1½ or 2 volts. To accomplish this, do the following:

1. Remove resistor R_{337} (150,000 ohms) and replace it with a 100,000-



ohm resistor and a 47,000-ohm resistor connected in series. Connect the 47,000-ohm resistor to chassis ground, and the 100,000-ohm resistor to R_{302}, 1000 ohms (test point "T"). (See accompanying diagram for original circuit.)

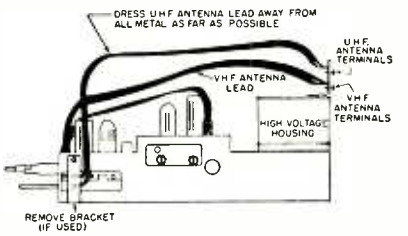
2. Remove the tuner a.g.c. lead (white) from test point "T," and connect it to the junction of the 100,000-ohm and 47,000-ohm resistors.

3. Bypass the tuner a.g.c. lead to chassis ground with a .005-μfd. ceramic condenser.

ALL-CHANNEL TUNERS

Poor performance.

This may be caused by the lead from the u.h.f. antenna terminals to the u.h.f. tuner being close to or touching the metal brackets of the rear picture-tube mount. This lead is purposely long, and acts as a quarter-wave trap at the mean frequency of the lower v.h.f. channels, and a three-quarter wave trap at the mean frequency of the higher v.h.f. channels.



Remove the back cover of the cabinet and check this lead to be sure that it is not close to any metal, and straighten it out if it is looped or doubled up.

While the back is off the cabinet, check the lead from the u.h.f. antenna terminals at the point where it is soldered to the side of the u.h.f. tuner. (See accompanying diagram.) Remove the metal bracket (if used) that covers the u.h.f. antenna connections.

—30—

SYLVANIA TV AWARDS

THE Sylvania Television Awards for 1953, established "to honor those who are advancing creative television technique," were presented recently at the Awards Announcement Dinner held at the Hotel Pierre in New York.

The 16 men and women who served on the awards committee were unanimous in their selection of Rod Steiger as the outstanding TV actor of the year for his performance in the title role of the drama "Marty." Mary Martin won an award for her individual pantomime on the Ford 50th Anniversary Show.

ABC won the network award for its presentation of the Coronation with BBC and CBC similarly honored for their co-operation in making the telecast possible.

A special award was given to the TV-Radio Workshop of the Ford Foundation for its outstanding contribution to the advancement of creative television technique.

Other award winners included "Ding Dong School," "Person to Person," "American Forum of the Air," "Dragnet," "Make Room for Daddy," and "What's My Line."

Individuals named for awards included Donald O'Connor, Leland Hayward, Clark Jones, Jerome Robbins, and Irving Gaynor Neiman.

Deems Taylor served as chairman of the awards committee and read the citations at the dinner.

This is the third year that Sylvania Electric Products Inc. has sponsored this award and hosted the presentation dinner. —30—

U.H.F. Measurements

(*Continued from page 49*)

should be shorted with a piece of copper or other good u.h.f. shorting device to produce strong line reflections. Use a marker generator to produce pips on the response curve and measure the frequency at two adjacent peaks. The frequency change between peaks is Δf.

$$\textit{Velocity of prop. constant} = \frac{L \times \Delta f}{492}$$

where L is the length of the line in feet, and Δf is the frequency difference from peak-to-peak, or valley-to-valley, in megacycles. Multiplying the velocity of propagation constant by 100 gives the velocity of propagation down the line as a per-cent of the speed in air. If the propagation constant of a certain line is 0.6, then a full wavelength on the line will be only 0.6 wavelength for the same distance in air.

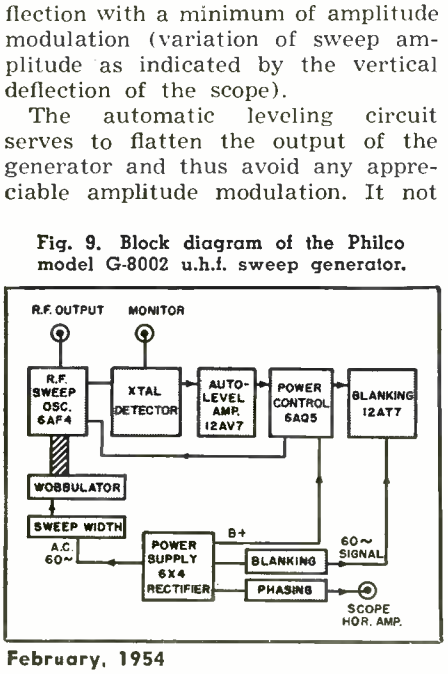
A U.H.F. Sweep Generator

Fig. 9 is the block diagram of a u.h.f. sweep generator such as can be used for the measurements described in this article. The heart of the r.f. section of this generator is a modified form of the new *Philco* u.h.f. tuner. The r.f. sweep oscillator circuit utilizes the new 6AF4 u.h.f. triode. It operates in a simple capacitance-tuned circuit which provides continuous tuning over the entire u.h.f. television band. Both high- and low-frequency compensation are used to maintain more uniform oscillation over the band.

Sweep action is provided by the use of a mechanical "wobbulator" which gives the convenient 60-cycle sine-wave sweep. A silver-plated plunger is made to move inside the oscillator "hairpin loop" or coil, in a way that will give best linearity of scope deflection with a minimum of amplitude modulation (variation of sweep amplitude as indicated by the vertical deflection of the scope).

The automatic leveling circuit serves to flatten the output of the generator and thus avoid any appreciable amplitude modulation. It not

Fig. 9. Block diagram of the Philco model G-8002 u.h.f. sweep generator.



only holds the r.f. output constant during sweep, but it also maintains a practically flat output over the entire u.h.f. band. The circuit works as follows:

The r.f. output of the sweep oscillator is monitored by the u.h.f. crystal detector, and the detector output voltage is amplified by a d.c. amplifier, which consists of the two sections of a 12AV7. The amplified d.c. voltage from this tube is used to control the current flowing through the 6AQ5 power control tube. The current through the 6AQ5 is also the current for the sweep oscillator. Thus, whenever the oscillator output tries to fall off, the output of the crystal starts to decrease and the amplified d.c. bias applied to the 6AQ5 grid also decreases (becomes less negative). This allows the 6AQ5 plate current to increase which, in turn, increases the r.f. sweep oscillator current and plate voltage. Thus, a tendency of the r.f. output to fall off is counteracted by a rise in oscillator plate voltage, with the result that the oscillator output level remains practically constant.

The 6AQ5 and d.c. amplifier also provide a means for manual control of the r.f. power output. The r.f. power control of this circuit serves as an electronic attenuator when low-level outputs are required. This feature can best be appreciated if one has attempted to make very low level measurements at u.h.f., only to find that the high power output of the generator produces enough signal leakage to make true readings a somewhat difficult procedure.

A third function of the 6AQ5 is to blank the r.f. sweep oscillator during the return trace on the scope. The 12AT7 blanking tube, operating on a 60-cycle signal from the power supply transformer, is connected to the 6AQ5 screen grid so that the 6AQ5 plate current flowing to the sweep oscillator will be reduced during blanking or retrace time. In this way, the 6AF4 r.f. oscillator is made to stop oscillating during the return time. This permits the vertical deflection of the scope to drop to zero and, in this way, the return trace is on the zero signal line. The effect is the formation of a base line when the blanking and phasing controls are properly adjusted. The blanking control contains an "on-off" blanking switch.

The phasing control is built into the sweep generator and operates in conjunction with the scope connector to provide the 60-cycle horizontal sweep for the oscilloscope. The phasing control permits adjustment of the scope sweep voltage to give the correct phase or timing with respect to the actual sweeping of the r.f. oscillator frequency.

A full-wave 6X4 rectifier is used in the power supply. The a.c. line cord is very carefully filtered with a low-pass u.h.f. filter network. A low-pass filter is also built into the oscilloscope sweep circuit to minimize leakage from the scope connector. -30-

Technical BOOKS

"HOW TO TROUBLESHOOT A TV RECEIVER" by J. Richard Johnson. Published by *John F. Rider Publisher, Inc.*, New York. 121 pages. Price $1.80. Paper bound.

This is a specialized book on a specialized topic and service technicians seeking specific data on troubleshooting will find a boon in this little handbook.

Written in easy-to-read, down-to-earth style, the author has presented his material in logical progression, starting with available service data and how to use it effectively through TV receiver sections, tools and equipment, preliminary observations and checks, use of test patterns and crosshatch patterns in troubleshooting, controls and their adjustment, tubes and tube checking, the dead receiver, interpreting raster on picture distortion, and sound troubles.

The text material is lavishly supplemented by line drawings, photographs, and schematic diagrams. The text itself does not deal with troubleshooting specific receivers but instead covers the techniques applicable to all troubleshooting.

Those beginning their servicing careers will find this book especially helpful while old timers at the game can use it to speed their troubleshooting tasks.

* * *

"TRANSISTORS AND THEIR APPLICATIONS" by Louis E. Garner, Jr., Published by *Coyne Electrical School*, Chicago. Distributed by *Howard W. Sams Company*, Indianapolis. 103 pages. Price $1.50. Paper bound.

The name of Garner is so familiar to readers of this magazine in connection with transistor circuitry and equipment using transistors that the mere mention of the fact that he has now written a book on the subject should suffice.

This little book is divided into ten chapters which deal with the history of the transistor, transistor action, characteristics, amplifier and oscillator circuits employing transistors, special transistor circuits, components designed to be used with transistors, the care and servicing of transistors, practical transistor circuitry, and reference data.

The author has included a representative selection of transistor circuits for various applications. Complete parts lists accompany these diagrams to permit the reader to build the equipment.

For those interested in workable "projects" in the transistor field, this book should be of considerable interest.

* * *

"PRINCIPLES OF ELECTRONICS" by L. T. Agger. Published by *St. Martin's Press*, 103 Park Ave., New York. 333 pages. Price $3.75.

This book has been written expressly for those whose primary interest is in electrical engineering but who wish to

have more than a nodding acquaintance with electronics and common vacuum-tube circuitry.

The author has assumed that the users of this text have a basic knowledge of electricity and electrical principles and, as a result, introductory material of a general nature is completely lacking. The book opens with a discussion of electron dynamics and carries through eighteen chapters devoted to such subjects as thermionic emission, conduction through gases, diodes, rectification, triodes, voltage amplification, multi-electrode tubes, multi-stage amplifiers, tuned amplifiers, power amplification, gas-filled tubes, controlled rectification and inversion, oscillators, modulation and demodulation, cathode-ray tubes, and photoelectricity.

For the student using this as a home-study text, a series of test questions has been provided to enable him to check his grasp of the subject matter. Since the book is written by an Englishman and published in England, the terminology is, of course, British usage. American readers should experience no difficulty in making the necessary transitions. —30—

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ERRATA & ADDENDA

There are several errors in the parts list accompanying the article, "A New V.F.O.", which appeared in the November issue. L_1 should be #32 s.c.c. closewound on a ⅝" dia. form, 1½" winding length. L_2 should be 68 turns of #26 en. closewound on 1½" dia. form. C_7, C_8, C_{12}, C_{14}, C_{18} should be .002 μfd. or larger not .002 μμfd. as listed.

* * *

The Thordarson choke T14C70 listed in connection with the article "Amplifier Features Phase Shift for 3D Effect" (November 1953 issue) is no longer available. A new and improved version of this choke is available as part T20C74.

* * *

In the article "A Small-Package Modulator" appearing in the November issue the driver transformer, T_2, should have a center tap in the secondary and this center tap should be grounded.

* * *

Hans Schoeneich has sent us a tip to pass along to those building the "Jam-Jar Rectifier" described in the December issue. He suggests that in order to prevent the borax solution or electrolyte from creeping up and over the jar and to prevent evaporation that a thin layer of mineral oil should be added to the top of the solution. He also adds that distilled water is better than tap water for mixing the electrolyte because of the impurities in most tap water.

* * *

In the listing of "Television Stations on the Air" which appeared in the January issue, the listing for KFXD-TV (Nampa, Idaho) and WBES-TV (Buffalo, N. Y.) should be removed. The Nampa station has dropped plans to go on the air and the Buffalo station has returned its license to the FCC and has discontinued operation.

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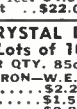

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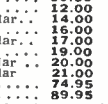

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B	.002	1200	58c; 3 for 1.25
A	.002	2500	98c; 3 for 2.25
A	.001	1200	55c; 3 for 1.20
C	.0007	3000	89c; 3 for 2.39
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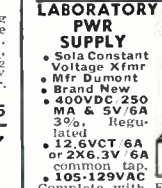

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Complete with Filter Condensers. Chokes, & Rectifier Tubes. $59.00 Value. "TAB" SPECIAL **$18.98**

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15 ohm 25W w/knob...	$1.49; 2 for $2.49
20 ohm 50W Model J...	1.98; 2 for 3.50
60 ohm 50W w/knob...	2.25; 2 for 3.98
100 ohm 50W Model K .	1.98; 2 for 3.50
250 ohm 25W	1.19; 3 for 2.98
300 ohm 225W Model P.	2.98; 2 for 5.00
350, 500, 5000 ohm ...	
Slotted shaft, 25 watt	79c; 3 for 2.00

TACHOMETER GENERATOR

MARK V STUD MTG GENERAL ELECTRIC
Part # 2CM5-AAK-20. Write for quantity price. Brand New Original Carton.
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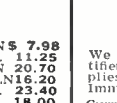
0 to 12 VDC/2 Amp. Variable DC supply, completely built—input. 115V/60 cy. Usable LAB supply. filament D.C. plating, battery charging, model railroad. Includes voltage or speed control and center off reversing sw. Prepaid to Your Door U.S.A. "TAB" SPECIAL ...**$10.95; 2 for $20.00**

FEDERAL "ITT" SELENIUM BATTERY CHARGER RECTIFIER

10-0-10V (CT) 100 Amp., fan cooled. Replace your old inefficient sulfide rectifier w/new selenium type. SPECIAL...**$11.98**

SELENIUM RECTIFIERS



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Current (cont.)	18 14 Volts	36 28 Volts	54/40 Volts	130/100 Volts
1AMP	1.35	2.15	3.70	8.50
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10AMP	6.75	12.75	20.00	44.95
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Full Wave Rectifier & Transformer
All 115V/60 cy inputs

up to 14VDC at 12 amps.....	$19.98
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RECTIFIER XFMR

PRIMARY 115V, 60 cycle.
SECONDARY 0-9-12-18-24-36V

4 Amp	$8.75
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24 Amp	35.75
30-32-34-36V/48Amp	59.75

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4 Amp .07	Hy .6	Ohm	$7.95
12 Amp .01	Hy .1	Ohm	14.95
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ANTENNA Mast Sections MS49 & MS50. 3 FT. EACH SECT. 2 for 49c; 25 for $3
VEEDER ROOT Counter 3-Dig. 85c; 3 for $2
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BAND PASS Fltr 60, 90, 150 cy., 3 at $4
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Lots of 10
Cracked Base or Broken Key
Electrically Perfect
Tested & 90 Day Guaranteed
6SN7; 5Y3GT; 5U4G; 6V6GT; 6K6GT; 6W4GT; 6BQ6; 12SA7GT; 25L6GT; 25BQ6GT; 6H6; 12SG7.
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Write for Amplifier Catalog

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Model AMP5 Hi-Fi 5 Watt AC amplifier, plus built-in Pre Amp GE V.R. pick-up. 60 to 18000 cps/1DB down 20B 40 cvs. Hum level —55DB. Mike & Phone Volume. Continuous Bass Treble Controls. 6SJ7. 6SC7. 6V6. 6X5 Not Shown. "TAB" special to your door. Ppd..$21.39 Same unit less GE Pre Amp. Prepaid **15.98**

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GE RPJ013	Dual Diamond & Sapphire. 12.98

Performs loud & clear, just like your telephone. Hear even whispers. built-in signaling buzzer, oper. up to 1 mile. Set includes: 2 phones, wall brackets, 50 ft. wire, batteries, makers 1-year gtd. "TAB" SPECIAL. Prepaid USA.....**$5.98**
Less Signal Buzzer Prepaid **$4.39**

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6.3V/2AMP .....$1.08; 2 for $1.98
2.5V/2A @ 79c; 2 for $1.49; 10 for 6.49
2.5VCT 10A 12.5KVins @ **$6.98; 3 for $18.**
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All 115 V 60 Cyc Input TV & CR Pwr Xmfr up to 20" tubes. HI VOLTS to 20 KV (w/quadrupler ckt.) ALL Tubes. PL & FIL wndgs 300 VDC 275Ma Full-Wave: 6.4V/10.3A, 5.4V/8A, 2.5V/3A Hypersil Core, Oil Impreg.....**$3.98; 2 for $9.00**
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800VCT/150MA.....**$4.98; 3 for $12.00**
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780VCT/250MA, 5V/6A, 12.6V/5.5A **$7.95**
770VCT 200MA, 5V/6A, 12.6V/5.5A **$6.95**
700VCT/120MA, 2X6.3V/3A, 6.3V/1A Price.....**$3.98; two for $7.25**
680VCT/200MA, 5V/3.5A, 6.3V 4A, 78V/1A .....**$4.39; 3 for $12**
600VCT/50MA, 6V/3A. 6V/1.5A, 5V/1A **$2.49**

866A KIT and XFORMER

2 Tubes, Sckts, xmfr, 115v60cyc Inpt, outpt 2.5vct 10A Hvi **$4.98**
DIODE PROBE TUBE Unexcelled for Noise **VHF** testing. **New.** w/data VR92.....
.....**25c; 5 for $1**

FILTER CHOKES

Check These Reduced Low Prices

12Hy 80Ma/H'Sld/3KVins	.....$2.25
50Hy 125ma/Csd/H'Sld	..... 2.89
20Hy 300ma or 15Hy 400ma/12KVins	8.95
13.5 HY 1 Amp./17KVins/Raytheon	..39.95
Dual 2HY 300ma, USN	...95c; 2 for 1.49
10HY 100 MA Freed.....	1.39
8HY 40ma UTC HI "Q"	...95c; 2 for 1.39

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"TAB" TESTED & GUARANTEED

PRICES SUBJECT TO CHANGE
WRITE FOR COMPLETE LISTING

OA2	$0.88	3D22	13.97	6SQ7GT	.62	81	1.38	829	7.94
OA3/VR75	1.04	3D23	4.90	6SR7	.62	83	1.12	829B	12.48
OB2	1.37	3E29	14.49	6SS7	.88	83V	1.22	832	7.72
OB3/VR90	.92	4D21	21.49	6SU7GTY	2.69	84/6Z4	.62	832A	9.92
OC3/VR105	.92	4D21	18.99	6T8	.96	100TH	9.88	833A	39.45
OD3/VR150	.92	4E27	22.49	6U4	.74	FG105	19.48	834	5.95
1B3 8016	.80	4J22	129.51	6U8	.98	117L/M7GT	1.98	836	5.95
1B22	1.82	4J31	99.51	6V6	1.39	1172GT	.98	837	1.42
1B23	8.87	4J52	199.99	6V6GT	.59	CV148	7.98	849	29.45
1B24	8.98	EL5BHD	15.99	6W4GT	.52	FG166	48.49	860	4.48
1B26	2.24	5C21/C6J	9.89	6X5GT	.54	FG172	29.00	861	22.48
1B27	11.98	5C22	38.95	6Y6G	.88	250TH	18.97	865	1.26
1B32/532A	2.48	5D21	14.98	7A8	.68	250TL	17.75	866A	1.50
1B35	9.15	5J29	11.92	7C7	.76	304TH	8.90	872A	3.29
1B37	14.87	5R4GY	1.20	7F7	.82	304TL	8.90	CK1005	.68
1B38	29.45	5R4GYW	1.75	7F8	1.24	388A	1.48	1613	.82
1B41	49.25	5U4G	.55	7H7	.92	WL-7A	8.48	1614	1.95
1B42	17.48	5V4G	.95	7N7	.92	417A/		1619	.36
1B46	1.98	5Y3GT	.43	7V7	1.06	5842	18.50	1625	.32
1B63	45.00	6A6S	.71	7Y4	.68	GL434A	12.69	1632	.68
1D21/SN4	3.89	6AG7	1.14	8D21	298.00	446B	1.48	1633	.98
1L4	.48	6AH6	1.22	12A6	.48	450TH	49.97	1634	1.18
1L6	1.35	6AJ5	1.40	12AH7GT	1.45	450TL	52.00	1635	1.48
1LD5	.98	6AK5	.77	12AL5	.54	460/		1636	3.08
1LN5	.78	6AK6	.92	12AT6	.54	HF200	15.95	1642	.92
1P5	.78	6AL5	.48	12AT7	.89	CK502AX	1.49	1644	.92
1P21	33.00	6AL7GT	.98	12AU6	.72	CK503AX	1.49	2050	1.48
1U4	.52	6AN5	2.90	12AU7	.69	CK505AX	1.79	2050W	2.48
1U5	.54	6AQ5	.52	12AV6	.52	CK512AX	1.45	5654	1.72
1X2A	.81	6AT6	.52	12AX7	.98	CK531DX	1.89	5670	3.44
2A4G	1.18	6AQ7GT	1.29	12AW6	1.18	531	5.72	CK5672	1.20
2C36	27.00	6AR6	2.98	12AX7	.98	CK532DX	1.89	CK5678	1.28
2C39A	26.98	6AS7G	3.48	12AY7	1.69	WL532A	3.68	5687	1.74
2C40	17.95	6AT6	.54	12BA6	.59	CK533AX	1.29	CK5702	2.90
2C43	17.48	6AU5GT	1.10	12BA7	.94	CK534AX	.99	CK5703	1.29
2C44	1.15	6AU6	.56	12BD6	.59	CK536AX	.99	5713	120.00
2C51	3.88	6AV5GT	.98	12BE6	.59	CK538DX	.98	5812	2.08
2D21	1.15	6AV6	.49	12BF6	.85	CK540AX	2.19	5814	2.08
2E31	1.49	6AW6	1.09	12BH7	1.29	CK541DX	1.99	5840	7.98
2E43	1.49	6B4G	1.18	12SA7GT	.68	CK543DX	.99	8012	2.58
2J31	27.00	6BA6	.54	12SC7	1.08	CK544DX	.99	8013A	3.92
2J32	29.48	6BE6	1.04	12SF7GT	.84	CK545AX	1.99	8025A	4.98
2J33	27.00	6BC5	.63	12SG7	.80	CK571AX/		9001	1.12
2J34	24.98	6BC7	1.23	12SH7	.63	5886	2.49	9002	.82
2J37	12.70	6BD6	.83	12SJ7	.54	CK573AX/		9003	1.12
2J38	69.98	6BE6	.54	12SK7	.66	6029	3.49		
2J39	6.98	6BF5	.49	12SL7GT	.62	WL-576	34.98		
2J42	148.98	6BG6G	1.58	12SN7GT	.68	703A	4.72		
2J48	24.45	6BH6	.63	12SQ7GT	.54	705A	1.88		
2J49	84.00	6BJ6	.69	12SR7	.66	707A	7.90		
2J50	99.98	6BL7	1.58	FG17	3.90	707B	14.88		
2J51	238.98	6BL7GT	1.19	24G/3C24	1.32	715A	4.96		
2J55	84.98	6BN7	2.69	25BQ6GT	.98	715B	7.94		
2J56	149.00	6BQ6GT	1.20	25L6GT	.58	715C	17.98		
2J62	49.48	6BQ7	1.60	25Z5	.76	717A	3.23		
2K22	23.48	6C21	24.50	25Z6GT	.58	719A	24.48		
2K23	11.48	6C4	.52	FG27A	8.24	721A	3.92		
2K25	28.49	6C5	.68	28D7	1.94	722A/287	1.94		
2K25/		6C8G	.59	35B5	.52	723A/B	16.98		
723AB	23.88	6CB6G	1.69	35L6	.58	724A	3.95		
2K28	27.48	6D4	2.70	35T	4.88	724B	2.74		
2K29	22.88	C6J/5C21	9.89	35Y4	.68	725A	9.98		
2K33	219.48	6J4	6.66	35Z5	.54	726A	14.48		
2K39	134.99	6J5	.54	41	.72	726B	44.88		
2K41	126.00	6J6	.58	42	.68	726C	64.88		
2K48	99.48	6K4A	3.68	45Z3	.88	801A	.42		
2X2	.42	6L6	1.48	48	1.98	803	3.48		
3B22	2.48	6L6G	1.08	50A5	.76	805	3.29		
3B23/RK22	4.95	6L6GA	1.08	50B5	.54	807	1.54		
3B24	4.70	6L6GAY	1.98	50C5	.54	808	2.62		
3B25	4.39	6SA7GT	.66	50L6GT	.62	809	3.58		
3B26	3.70	6SC7	.90	RK61/		810	10.88		
3B28	7.90	6SF5	.78	XFG1	2.65	811	3.00		
3C22	85.00	6SG7	.64	FG67	14.68	812	.70		
3C23	8.67	6SH7	.61	HY69	4.98	813	.78		
3C31/C1B	3.45	6SJ7	.58	71A	.78	814	8		
3C33	9.51	6SK7GT	.58	75	.64	815	8		
3C45	9.98	6SL7GT	.64	78	.78	826	5		
3D21A	8.15	6SN7GT	.68	80	.58	828	9		

XTAL DIODES

1N21A	1.55
1N21B	1.92
1N22	1.22
1N23	1.35
1N23A	1.98
1N23B	2.22
1N25	4.98
1N26	8.75
1N34A	1.55
1N34	.64
1N34A	.90
1N35	1.65
1N36A	1.29
1N41	8.95
1N42	16.95
1N43	1.73
1N45	1.49
1N46	.69
1N47	4.00
1N48	.55
1N51	.45
1N54	.78
1N54A	1.00
1N58A	1.15
1N60	.60
1N63/KG3	2.49
1N64	.69
1N69	.98

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on the basis of...

Product Superiority

Microscopic look at the cathode surface reveals soft, even texture, necessary for efficient tube performance

not too wet, not too dry—
not too light or heavy...

THE CATHODE plays an important role as source of electron energy in the picture tube. Moisture content and texture of the cathode coating must meet rigid standards to insure maximum picture tube life.

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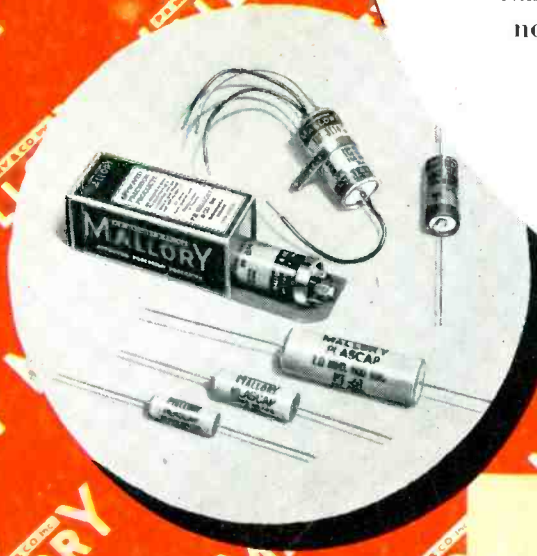

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