RADIO & TELEVISION NEWS

SEPTEMBER
1954
35 CENTS
In U. S. and Canada

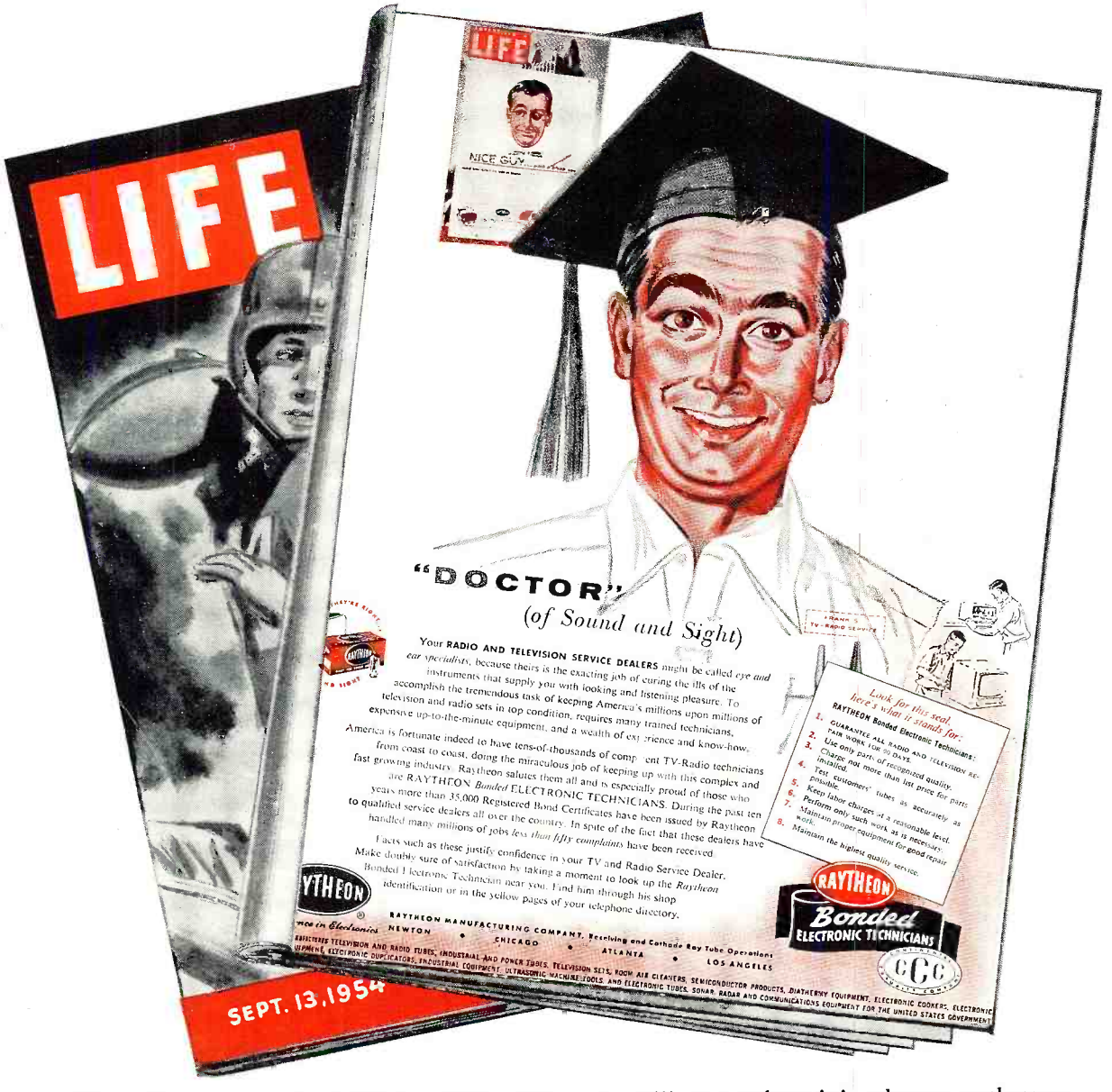
1919 ★ 1954 35th ANNIVERSARY YEAR

World's Leading Electronics Magazine

IN THIS ISSUE

Mr. Service Dealer:

THIS RAYTHEON AD IS YOUR AD



More than twenty-six million people will read about you and the good work *you* are doing, in the September 13th issue of LIFE Magazine. We at Raytheon are publishing this advertisement because we believe you deserve a public pat on the back for the successful way you have met every challenge of the Radio and Television Service industry. We are telling you about it in advance so that you can take full advantage of its appearance to help increase your volume and profit. It's our way of saying thank you for using and recommending *Raytheon Quality Radio and Television Tubes.*

RAYTHEON®

Excellence in Electronics

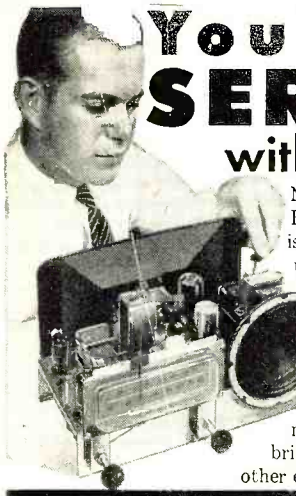
RAYTHEON MANUFACTURING COMPANY

Receiving and Cathode Ray Tube Operations

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

RAYTHEON MAKES ALL THESE:

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



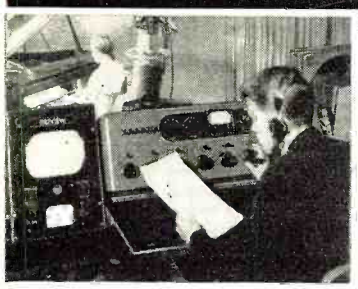
You Practice SERVICING with Kits I Send You

Nothing takes the place of PRACTICAL EXPERIENCE. That's why NRI training is based on LEARNING BY DOING. You use parts I send to build many circuits common to Radio and Television. With my Servicing Course you build the modern Radio shown at left. You build a Multitester and use it to help make $10, $15 a week fixing sets in spare time while training. All equipment is yours to keep. Coupon below will bring book of important facts. It shows other equipment you build.

You Practice BROADCASTING with Kits I Send You

As part of my Communications Course I send you parts to build low-power Broadcasting Transmitter at left. Use it to get practical experience. You put this station "on the air" . . . perform procedures demanded of broadcasting station operators. An FCC Commercial Operator's License can be your ticket to a bright future. My Communications Course trains you to get your license. Mail coupon. Book shows other equipment you build for practical experience.

I Will Train You at Home in Spare Time to be a RADIO-TELEVISION Technician



TELEVISION

Making Jobs, Prosperity

25 million homes have Television sets now. Thousands more sold every week. Trained men needed to make, install, service TV sets. About 200 television stations on the air. Hundreds more being built. Good job opportunities here for qualified technicians, operators, etc.

J. E. SMITH, *President*
National Radio Institute
Washington, D. C.

Our 40th Year

America's Fast Growing Industry Offers You Good Pay, Success

Training PLUS opportunity is the PERFECT COMBINATION for job security, 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 is bigger than ever with over 3,000 broadcasting stations and more than 115 MILLION sets in use, and Television is moving ahead fast.

N.R.I. Training Leads to Good Jobs Like These

I TRAINED THESE MEN

"Am transmitter-studio operator at KPAT. Most important day of my life was when I enrolled with NRI."—Elmer Frewaldt, Madison, S. Dakota.

"Made my first $100 from spare time work before I finished my course. Now I average better than $10 a week, spare time."—Frank Borer, Lorain, Ohio.

"I've come a long way in Radio and Television since graduating. Have my own business on Main Street."—Joe Travers, Asbury Park, New Jersey.

"I didn't know a thing about Radio. Now have a good job as Studio Engineer at KMMJ."—Bill Delzell, Central City, Nebraska.

BROADCASTING: Chief Technician, Chief Operator, Power Monitor, Recording Operator, Remote Control Operator. SERVICING: Home and Auto Radios, Television Receivers, FM Radios, P.A. Systems. IN RADIO PLANTS: Design Assistant, Technician, Tester, Serviceman, Service Manager. SHIP AND HARBOR RADIO: Chief Operator, Radio-Telephone Operator. GOVERNMENT RADIO: Operator in Army, Navy, Marine Corps, Forestry Service Dispatcher, Airways Radio Operator. AVIATION RADIO: Transmitter Technician, Receiver Technician, Airport Transmitter Operator. TELEVISION: Pick-up Operator, Television Technician, Remote Control Operator.

Start Soon to Make $10, $15 a Week Extra Fixing Sets

My training is practical, complete; is backed by 40 years of success training men at home. My well-illustrated lessons give you basic principles you need and my skillfully developed kits of parts "bring to life" things you learn from the lessons. I start sending you special booklets that show you how to fix sets the day you enroll. Multitester you build with my parts helps you discover and correct set troubles, helps you make money fixing neighbors' sets in spare time while training. Many make $10, $15 a week extra this way.

Mail Coupon—Find Out What Radio-Television Offer You

Act now to get more of the good things of life. I send actual lesson to prove NRI home training is practical, thorough. My 64-page book "How to be a Success in Radio-Television" shows what my graduates are doing and earning. It gives important facts about your opportunities in Radio-Television. Take NRI training for as little as $5 a month. Many graduates make more than the total cost of my training in two weeks. Mail coupon now to: J. E. SMITH, President, Dept. 4JE, National Radio Institute, Washington 9, D. C. Our 40th year.

AVAILABLE to all qualified VETERANS UNDER G.I. BILLS

Good for Both—FREE

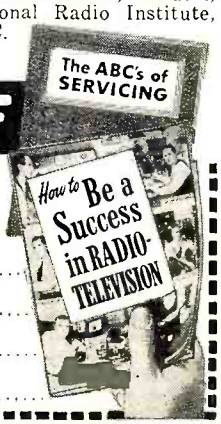
MR. J. E. SMITH, President, Dept. 4JE
National Radio Institute, Washington 9, D. C.
Mail me Sample Lesson and 64-page Book, FREE.
(No salesman will call. Please write plainly.)

Name.....Age.....

Address.....

City.....Zone....State.....

VETS write in date of discharge.....



Mail Today-Tested Way to Better Pay

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COVER PHOTO: "It's like putting an elephant in a birdcage," according to Bob Hope when he first glimpsed the new Ampex 600 portable tape recorder at NBC's Hollywood studios. (Ektachrome by Jerry Holscher)

First in radio-television-audio-electronics

Average Paid Circulation over 230,000

RADIO & TELEVISION NEWS

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DEPARTMENTS

VOLUME 52 • NUMBER 3

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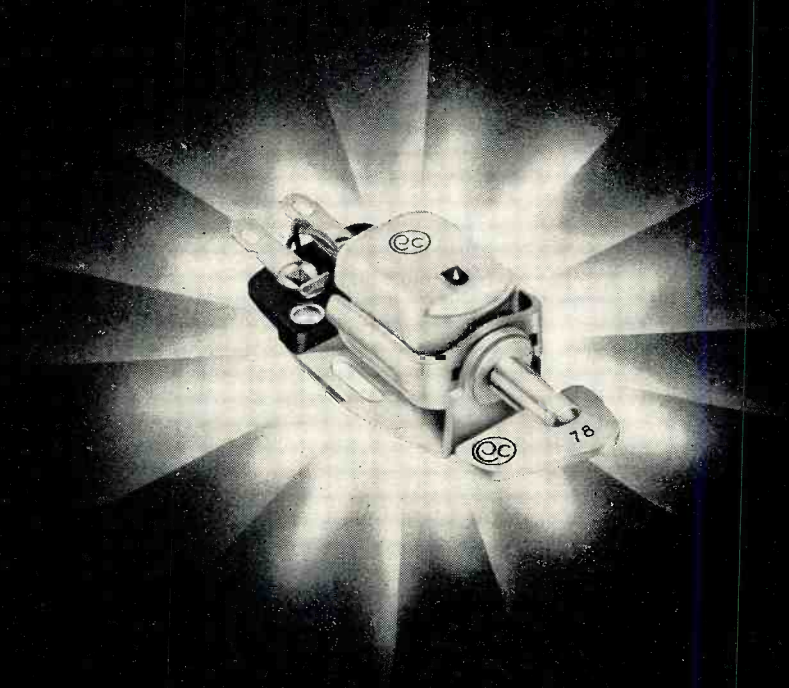
It's no secret



Professionals use Pickering MAGNETIC Cartridges

You're in the best of company if you use a Pickering MAGNETIC Cartridge. You have this in common with:

1. *Leading record companies who use Pickering Cartridges for quality control.*
2. *Leading FM/AM good music stations and network studios.*
3. *Leading manufacturers of professional equipment for radio stations, recording studios, wired music systems and automatic phonographs, who install Pickering Cartridges for the maximum performance of their equipment.*

Why Pickering MAGNETIC Pickups are the Choice of Recording and Broadcast Engineers!

"All modern disc recordings are made with MAGNETIC cutters. Within the geometrical and mechanical limitations of recording and reproducing equipment, a Pickering Pickup will re-generate an exact replica of MAGNETIC cutter response to the original program of music, speech or sound. This is a fundamentally inherent characteristic of the Pickering Pickup, supported by basic electromagnetic theory and countless precise laboratory measurements. This is why Pickering MAGNETIC Pickups provide the most nearly perfect coupling possible, between reproducing equipment and original program. This is why they sound cleaner ... less distorted.

"Through the medium of the disc material, the reproducing system is effectively driven by the cutter electrical response itself."

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-5.

COLOR-TV IS HERE

. . . where are you?

TV Color Course FREE of extra charge with your RCA Tube purchases

The TV technician who is ready—who knows color TV theory, receivers and servicing techniques—will be the one to make the BIG profits. YOU can be one of those technicians—*if you start learning now!*

Home Study Course

The RCA Home Study Course in Color TV has been planned and prepared by instructors at the RCA Institutes, with the close cooperation of engineers and training specialists of RCA. By studying at home, under the guidance of these experts, you can learn the facts about Color TV Theory, Receivers, and Servicing—quickly . . . clearly . . . thoroughly! The RCA Institutes' Color TV course is a practical, down-to-earth home-study plan that covers the facts you will need to install and service color sets successfully.

This valuable, important course in Color TV is FREE of extra charge with your purchases of RCA Tubes. See your RCA Tube Distributor for complete details.

Nine Easy-to-Follow Lessons:

COLOR-TV THEORY

1. Introduction to Color TV
2. Principles of two-phase modulation and colorimetry
3. Principles of Color TV receivers

COLOR-TV RECEIVERS

4. Tricolor Kinescopes
5. The color television system
6. Color TV receiver circuits

COLOR-TV SERVICING

7. Set-up and adjustment of color
8. Servicing and alignment
9. Test equipment for Color TV servicing

DO YOU KNOW THESE COLOR-TV TERMS?

- dynamic convergence
- shadow mask
- three-beam gun
- purity
- matrix
- saturation
- chroma
- dynamic-phase control
- beam-positioning magnet
- burst
- gamma corrector

RCA®

RADIO CORPORATION of AMERICA

ELECTRON TUBES — HARRISON, N. J.

For the RECORD

BY THE EDITOR

POPULAR ELECTRONICS

FROM modest basement shops and experimental attic laboratories have emerged the fundamental ideas that have resulted in the fastest growing industry of our times—electronics. Our vast radio communications systems—spread like a giant web over the entire world—keep us informed of news almost as soon as it happens. The radio "ham," using simple electronic equipment, communicates with his fellow hobbyists throughout the world as simply as the housewife talks to her neighbor *via* telephone.

A large group of medics watch a delicate operation on a color TV screen. Every detail seen by the operating surgeon and the color camera is observed in isolated rooms. Instructions and comments of the surgeon are heard clearly from the loudspeaker system. An airplane is lost and is forced down at sea. Its call for help is heard by or made known to the FCC monitoring stations. A "fix" is made by electronic direction finders and the position of the lost plane is flashed to nearby vessels which quickly proceed to the rescue. A hostile airplane is spotted on a radar screen. Interceptors are dispatched to engage the enemy. Radio navigational aids protect us as we fly in an airliner and bring us to a safe landing on a fog-bound runway.

These are but a few of the thousands of applications for electronic devices that serve to protect life, limb, and property and that provide means of education and entertainment never dreamed of by our forefathers.

Many electronic devices are born in the great laboratories of the industry—but a greater number of pioneer developments have emerged from the experimenter's bench and the basement ham shack. So-called tinkerers or gadgeteers have contributed many valuable ideas and important discoveries that have led to valuable patents.

The problem of maintenance of electronic devices, especially home units such as radio, television, and hi-fidelity equipment has been a real bottleneck and will become an even greater problem as we reach sizable production of color television.

A vast field of opportunity in electronics awaits the individual who will learn, by simple experiments, the fundamentals of circuitry, components and equipments. Others will become indoctrinated with electronics at the hobby level. The fascinating hobby of radio control finds thousands of youngsters and oldsters meeting frequently to fly their airplanes and to sail their boats. And many a garage door is opened and closed by radio impulses from simple devices made in the home shop. One of the greatest hobbies in the world—amateur radio—has been tremendously stimulated by relaxed requirements to qualify for a coveted license and the "novice" class is attracting thousands of newcomers to this world-wide hobby.

Industry has recognized the importance of training new engineers, scientists, and technicians and our trade schools have produced thousands of technicians and other specialists. But many thousands more are needed to meet the ever-increasing demand for new blood in the industry.

Those of us who have grown up with electronics have been forced to keep pace with new developments at an ever-increasing rate. Circuitry has become more complicated through the years. Television and industrial electronics, telemetering and computing, and now color TV have necessitated a higher level of approach for RADIO & TELEVISION NEWS and other technical magazines. This, unfortunately, has deprived thousands of people interested in electronics of a regular source of information written in simple, understandable terms. POPULAR ELECTRONICS, a brand new magazine now on the press, is the answer to the demand for a monthly publication devoted entirely to electronics at a practical and hobby level.

POPULAR ELECTRONICS will be devoted to the science of electronics at a How-It-Works, Why-It-Works, How-To-Do-It, and How-To-Use-It level. Its writers and editors have all grown up with electronics. They have all cut their eyeteeth in radio, TV, and communications as experimenters and hobbyists. They appreciate, from long experience, that "practical know-how" is all-important and essential to success in the fascinating science of electronics. They include experimenters, hams, short-wave experts, radio-control enthusiasts, instructors, technicians, editors, and engineers.

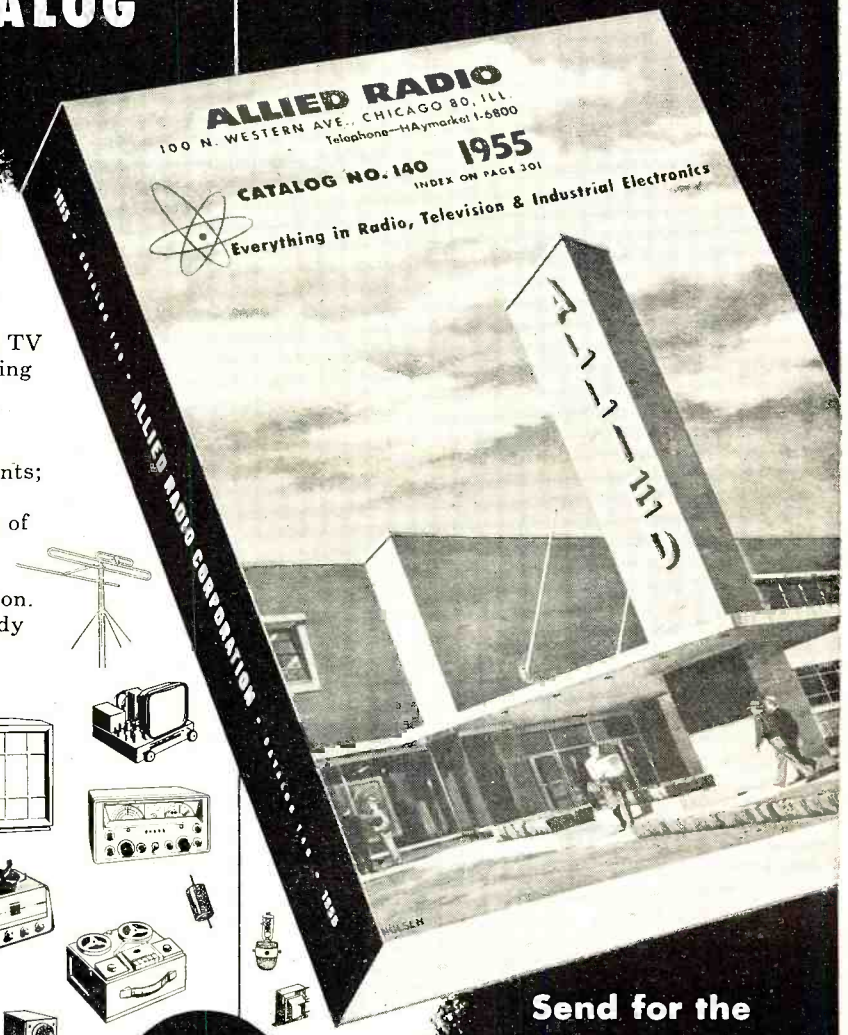
We will appreciate your help in telling your friends about POPULAR ELECTRONICS. It will reach the newsstands later this month. Perhaps they too will be interested in this leading science of our times. And, finally, won't you please tell us how *YOU* and your family like POPULAR ELECTRONICS? O. R.

free

1955 VALUE PACKED ALLIED

308-PAGE CATALOG

the only COMPLETE catalog for Everything in TV, Radio and Industrial Electronics



SEND FOR IT TODAY

Get ALLIED's 1955 Catalog—308 pages packed with the world's largest selection of quality electronic equipment at lowest, money-saving prices. Select from the latest in High Fidelity systems and components; custom TV chassis, TV antennas and accessories; AM and FM receiving equipment; P.A. Systems and accessories; recorders and supplies; Amateur receivers, transmitters and station gear; specialized industrial electronic equipment; test instruments; builders' kits; huge listings of parts, tubes, tools, books—the world's *most complete* stocks of quality equipment. ALLIED gives you *every* buying advantage: fastest shipment, expert personal help, lowest prices, assured satisfaction. Get the big 1955 ALLIED Catalog. Keep it handy —save time and money on *everything in* Electronics. Send for your FREE copy today.

World's largest Stocks

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Send for the leading Electronic Supply Guide

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Use ALLIED's liberal Easy Payment Plan—only 10% down, 12 months to pay—no carrying charges if you pay in 60 days. Available on Hi-Fi and P. A. units, recorders, TV chassis, test instruments, Amateur gear, etc.

HI-FI SPECIALISTS

To keep up with the latest and best in High Fidelity, look to ALLIED. Count on us for *all* the latest releases and largest stocks of Hi-Fi equipment. We specialize, too, in TV supply —and are foremost in the field of Builders' Kits.

ultra-modern facilities for the FASTEST SERVICE IN ELECTRONIC SUPPLY

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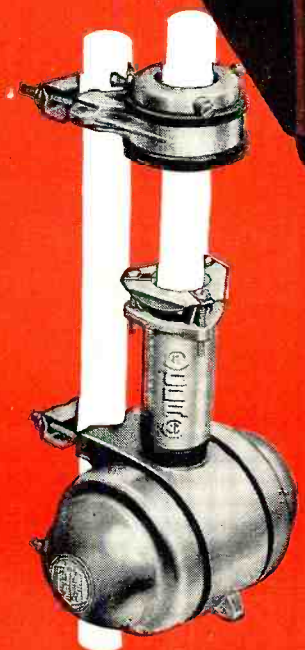


Pre-Sold to consumers in every leading TV market area with saturation TV spot announcements as well as newspaper advertisements. These further helps—animated point-of-sale display... newspaper mats ...envelope enclosures... window streamers.

Models AR-1 and AR-2

CDR AUTOMATIC ROTOR

40% sharper tuning than any other AUTOMATIC ROTOR

They said it couldn't be done – never thought it possible – but HERE IT IS! The AR-1 and AR-2... the sharpest tuning AUTOMATIC ROTORS in the world. Superior construction and quality manufacture are featured in these as in the other CDR ROTORS, plus a handsome NEW MODERN DESIGN CABINET styled along lines for gracious, contemporary living. An added feature is a MECHANICAL BRAKE THAT IS RELEASED MAGNETICALLY! Here, truly, is the ultimate in rotors – handsome design, accurate, pinpoint, automatic performance easier to set and adjust – and CDR dependability!

Model AR-2

... complete, AUTOMATIC rotor with THRUST BEARING... and handsome modern design plastic cabinet, uses 4 wire cable.

Model AR-1

.... same as AR-2, without thrust bearing.

Model TR-2

The heavy-duty rotor with plastic cabinet featuring "Compass Control", illuminated "perfect pattern" dial, uses 8 wire cable.

Model TR-4

The heavy-duty rotor complete with handsome, modern design cabinet with meter control dial, uses 4 wire cable.

Model TR-11

The same as the TR-12 without thrust bearing, complete with meter control dial cabinet, uses 4 wire cable

Model TR-12

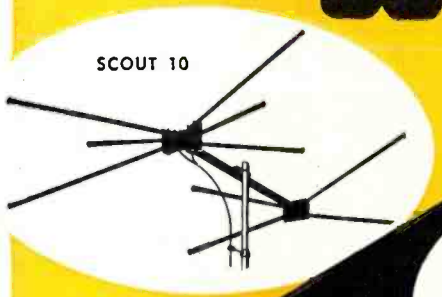
A special combination value consisting of complete rotor including thrust bearing. Handsome modern cabinet with meter control dial, uses 4 wire cable

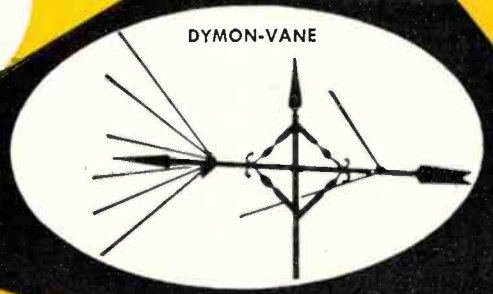
CORNELL-DUBILIER
SOUTH PLAINFIELD, N. J.

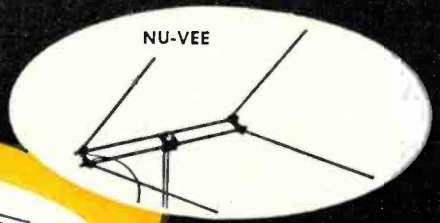
THE RADIART CORPORATION
CLEVELAND 13, OHIO

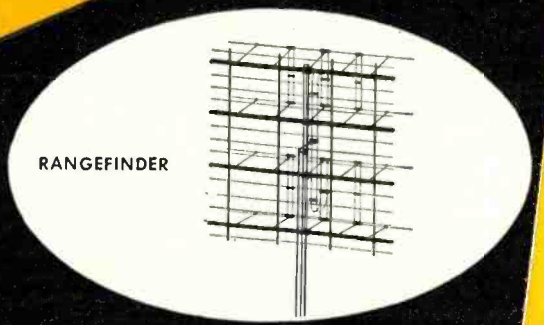
WARD Antenna Rama

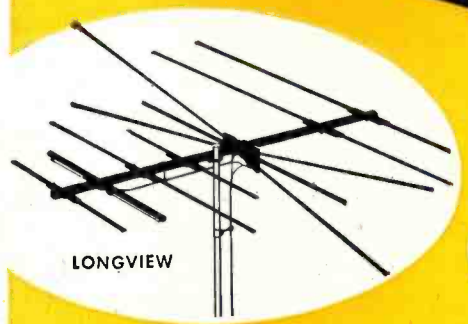
. . . means a complete merchandising and profit building program for TV antenna dealers . . . antennas designed to meet any installation requirement . . . in every price range . . . smartly styled . . . precision engineered . . . and backed by dynamic advertising and merchandising . . . all designed to make WARD your most profitable line!

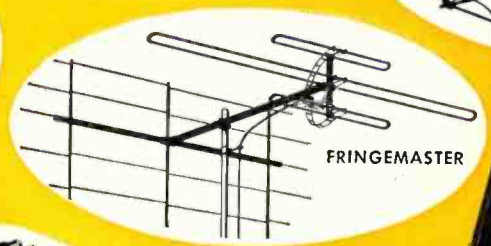












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THE FISHER

Custom Audio Components

■ If you are buying 'for keeps' buy the best *first!* Buy FISHER, *quality* leader for seventeen years. Engineered for the professional, functionally designed for home use. "Of the very best!"—*High Fidelity.*

FM-AM TUNER, Model 70-RT

Features extreme sensitivity, low distortion and low hum. Armstrong system, *adjustable* FM-AFC and AM selectivity. Preamplifier-equalizer, 2 inputs, 2 cathode follower outputs. Six controls. Self-powered. **$184.50**

FM-AM TUNER, Model 50-R

Same features as 70-RT above, but designed for use with external preamplifier-equalizer such as 50-C. Hum level better than 100 db below 2 volts output. Fully shielded and shock-mounted. Self-powered. **$164.50**

MASTER AUDIO CONTROL, Series 50-C

25 choices of record equalization, plus separate bass and treble tone controls, loudness balance control. Five inputs and input level controls, two cathode follower outputs. Chassis only, **$89.50** · With cabinet, **$97.50**

25-WATT AMPLIFIER, Model 70-A

50-watts peak! More *clean* watts per dollar. Less than ½% distortion at 25 watts (0.05% at 10 watts.) Response ±0.1 db, 20-20,000 cycles; 1 db, 10 to 50,000 cycles. Hum and noise virtually non-measurable! **$99.50**

50-WATT AMPLIFIER, Model 50-A

100-watts peak! World's *finest* all-triode amplifier. Uniform within 1 db, 5 to 100,000 cycles. Hum and noise 96 db below full output. IM distortion below 2% at 50 watts. Highest quality components thruout. **$159.50**

SPEAKER ENCLOSURE, Series 50

NEW! Regardless of the speaker or enclosure you are now using, the "50" Horn will revolutionize its performance. For use with 12" or 15" speaker systems. 50-HM (Mahogany) **$129.50** · 50-HB (Blonde) **$134.50**

PREAMPLIFIER-EQUALIZER, Model 50-PR

Professional phono equalization facilities at low cost! Independent switches for LF turn-over and HF roll-off. Output lead up to 50 feet. Can accommodate any low-level, magnetic pickup. Self-powered. **$22.95**

HI-LO FILTER SYSTEM, Model 50-F

Does what ordinary *tone* controls cannot do, for it suppresses all types of noise with *an absolute minimum* loss of tonal range. High impedance input; cathode follower output. Use with any equipment. **$29.95**

Prices slightly higher west of the Rockies

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FISHER RADIO CORPORATION · 39 EAST 47th STREET · NEW YORK, N. Y.

IT'S SYLVANIA'S

SCREEN 85"

The Picture Tube with three amazing design features!

SILVER-ACTIVATED SCREEN...SUPER ALUMINIZED REFLECTOR PRECISION-FOCUS ELECTRON GUN

YOU CAN BE PART OF THE BIGGEST PICTURE TUBE CAMPAIGN IN THE INDUSTRY!

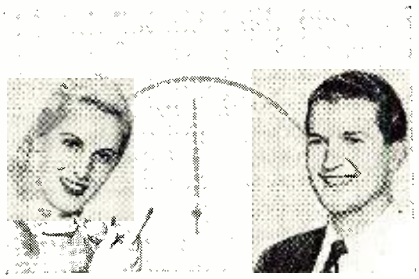
All this promotion material is yours FREE
—All you have to do is ask for it!

- attractive window streamers . . .
- colorful counter and window displays . . .
- radio and TV commercials for you to use on your local stations . . .
- newspaper mats . . .
- publicity releases . . .
- postcards . . .
- envelope stuffers . . .
- a brand new booklet to describe the revolutionary "Silver Screen 85" to your customers . . .

Here is a truly great achievement in television picture tubes! Sylvania's "SILVER SCREEN 85" is the last word in design and engineering perfection. It's the picture tube with the SILVER-ACTIVATED SCREEN, to produce television's sharpest, clearest pictures; the SUPER ALUMINIZED REFLECTOR to catch and use all available light, giving pictures more depth, more dimension than ever before; the PRECISION-FOCUS ELECTRON GUN that scans every inch of the screen, making images stand out in pinpoint detail.

From foreground to background, pictures are razor-sharp, crystal clear! Blacks are *really* black—whites are *true* white. Only professional movies can duplicate the "Silver Screen 85" picture. It's a SUPER ALUMINIZED PICTURE TUBE, designed to give top performance, made to the highest quality standards, and backed by the world's most experienced manufacturer of picture tubes!

YOUR SYLVANIA DISTRIBUTOR HAS THE "SILVER SCREEN 85" NOW! MAKE SURE YOU ARE PART OF THIS PROFIT-PACKED PROMOTION—CALL HIM, WRITE HIM, SEE HIM TODAY!



24 MILLION PEOPLE—INCLUDING YOUR CUSTOMERS—WILL HEAR ABOUT THE "SILVER SCREEN 85" EVERY WEEK ON "BEAT THE CLOCK"! 80 STATIONS NOW REACH 93% OF THE TV HOMES IN THE COUNTRY.

Right in your own town! That's where Sylvania will help you sell the "Silver Screen 85"! Hard-selling commercials will tell millions of people every week that you're the man to see for a new "SILVER SCREEN 85."

SYLVANIA

Sylvania Electric Products Inc., 1740 Broadway, New York 19, N. Y.

In Canada: Sylvania Electric (Canada) Ltd., University Tower Building, St. Catherine Street, Montreal, P. Q.

LIGHTING • RADIO • ELECTRONICS • TELEVISION

Within the INDUSTRY

JERRY KIRSHBAUM has been re-elected to the post of president of the Eastern Division of the Sales Managers' Club. He is sales manager of *Precision Apparatus Company, Inc.* of Elmhurst, New York.

Robert Fenee of *International Resistance Co.* was re-elected vice-president of the club. Walter Jablon of *Freed-Eisemann Radio Co.* was elected to the board of directors of the Show Corporation for a period of two years.

The Sales Managers' Club is one of the sponsoring organizations for the Radio Parts Show.

* * *

CORNELL-DUBILIER ELECTRIC CORPORATION opened its new Sanford, N.C. plant recently with elaborate ceremonies and an open house. The new facility provides 275,000 square feet of operating space including a two-story administration building . . . **COLLINS RADIO COMPANY's** New York office has been moved to 261 Madison Avenue . . . The Powder Metal Division of **THE BASSICK COMPANY** has announced its third facilities expansion in Bridgeport, Conn. . . . The establishment of a new Midwest sales office at 1 South Northwest Highway, Park Ridge, Illinois has been announced by **POLYTECHNIC RESEARCH AND DEVELOPMENT CO., INC.** of Brooklyn. Kenneth W. Meyers is in charge of the new office . . . **TRANSAMERICA ELECTRONICS CORP.** has moved into its own building at 115 Liberty St., New York. The move gives the company 10,000 square feet of warehouse space . . . **LENNOX ENGINEERING ASSOCIATES** has transferred its high production manufacturing to **PARK PRODUCTS COMPANY** of Cleveland. The transfer includes its dual-ring centering device and ion traps for TV. The **LENNOX** organization will continue its consulting, research, and design activities . . . **GRANCO PRODUCTS, INC.** has opened a new plant annex at 36-17 20th Ave., Long Island City, N.Y. adjacent to its original plant . . . **TRAVLER RADIO CORPORATION** has built a new 80,000 square foot addition to its central plant in Orleans, Indiana, bringing the total footage of the Orleans plant to 250,000 square feet . . . **PENTRON CORPORATION** has acquired a modern plant occupying the entire 700 block of South Tripp Ave. in Chicago. The 3-story building has 75,000 square feet of floor space . . . **SYLVANIA ELECTRIC PRODUCTS INC.** has commenced operations in its new 110,000 square foot warehouse and sales office it has leased in Teterboro, N.J. . . . **MAGNECORD, INC.** has purchased a manufacturing and office building at 1101 S. Kilbourn St., Chicago.

* * *

WILLIAM P. SHORT is the new general manager of the *Gabriel Electronics Division* of *The Gabriel Company.* He will also continue his post as assistant to the president of the parent firm.

Prior to his new appointment, Mr. Short headed a number of staff and facilities organization programs in the electronics industry and was formerly vice-president in charge of piezoelectric and acoustic development for the *Clevite Brush Development Company.*

After the war he was assistant technical director in charge of microwave commercialization at *Federal Telecommunication Laboratories.* He also held posts with *Crosley, RCA,* and at the Radiation Laboratory of MIT.

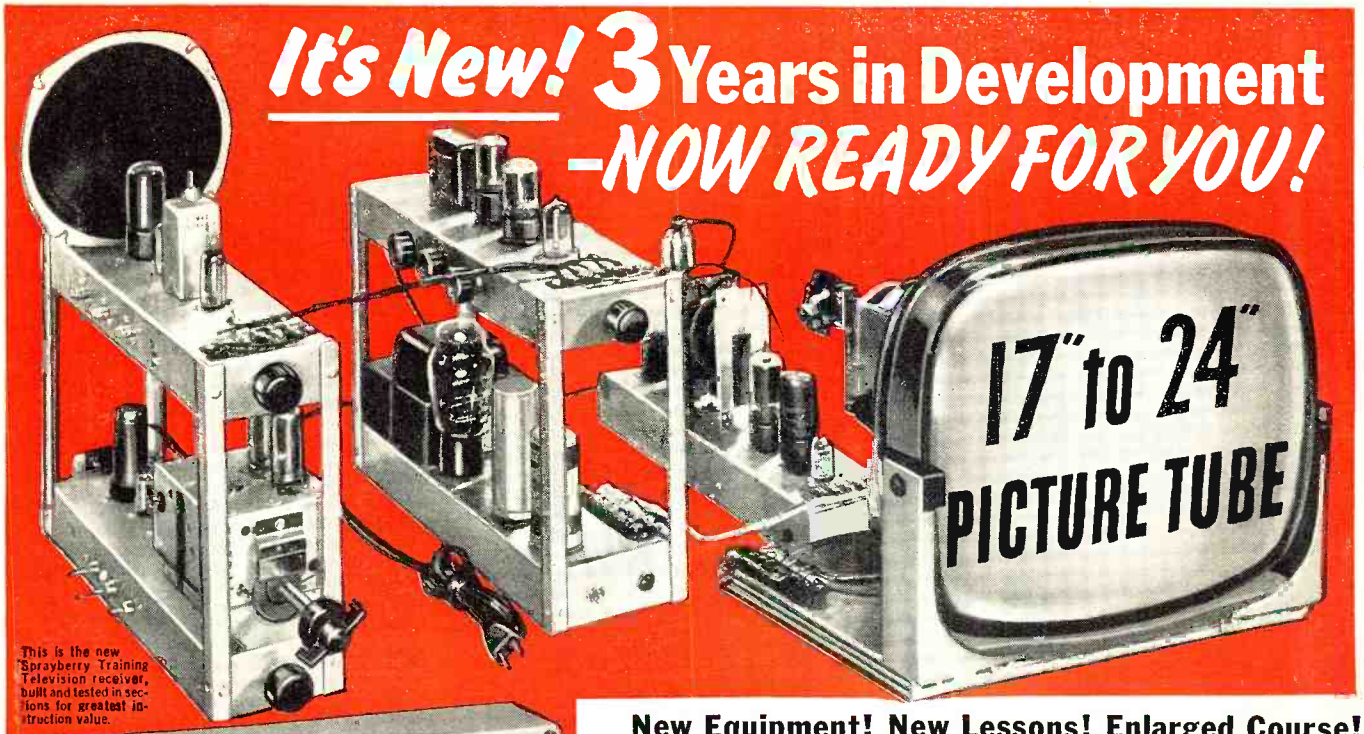
* * *

STANLEY W. HORROCKS has been appointed general manager of the Special Products Division of *Aerovox Corporation.* He is responsible for the engineering, manufacturing, and market analysis and development for products of the division . . . **ALLEN J. DUSAULT** is the new sales manager for the transistor division of *CBS-Hytron.* He will be responsible for coordinating all ac-

(*Continued on page* 18)

HOWARD E. ANTHONY—well known for his pioneering in the test instrument field met with tragic death in his private airplane when it crashed recently. The success of the Heath Co. which he founded was due to his foresight and engineering genius. He was very active in civic affairs and a respected leader in his community. His innovations in the kit field have substantially contributed to the widespread acceptance of electronic test instruments. The Heathkit has become world famous and a respected item in laboratories and radio-TV service shops in every nation. Industry has lost a great leader. The service profession has lost a real friend.

It's New! 3 Years in Development —NOW READY FOR YOU!



This is the new Sprayberry Training Television receiver, built and tested in sections for greatest instruction value.

New Equipment! New Lessons! Enlarged Course!

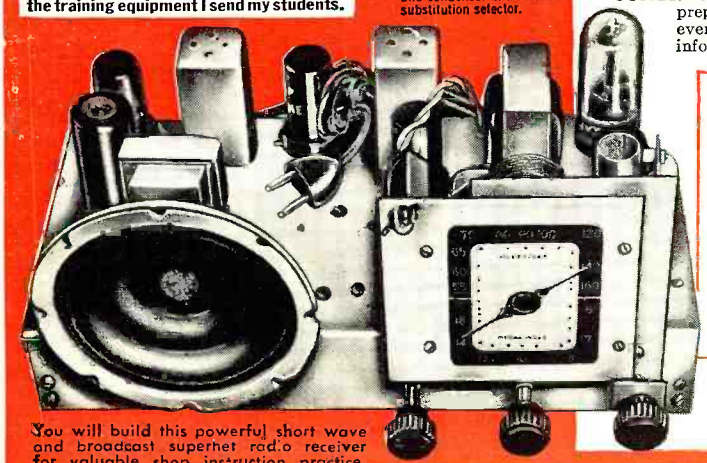
SPRAYBERRY PRACTICAL TRAINING IN

RADIO-TELEVISION

3 NO OBLIGATION TRAINING PLANS

You build the new Sprayberry Tester . . . 18-range Volt-Ohm-Milliammeter readings plus output meter and condenser and resistor substitution selector.

These photos show only a small part of the training equipment I send my students.



You will build this powerful short wave and broadcast superhet radio receiver for valuable shop instruction practice.

Frank L. Sprayberry
President, Sprayberry Academy of Radio

You have NO MONTHLY PAYMENT CONTRACT to sign . . . pay for this outstanding training as you learn!

The complete facts are so big and so important to any man seeking training in Radio-Television that I urge you to mail the coupon below at once for my big all-new 56 page FREE CATALOG and FREE Sample Lesson. Get the full story of this remarkable new and up-to-the-second Training Plan. You'll read about my 3 NO OBLIGATION PLANS or "packaged unit" instruction for both beginners and the experienced man. You'll learn how I can now prepare you in as little as 10 MONTHS to take your place in this fast moving big money industry as a Trained Radio-Television Technician. You'll see that you take no risk in enrolling for my Training because you DO NOT SIGN A BINDING TIME PAYMENT CONTRACT. I have been training successful Radio-TV technicians for 22 years . . . I can prepare you, too, to get into your own profitable Service Shop or a good paying job, even if you have no knowledge of Radio-Television. Mail the coupon . . . I rush full information FREE and without obligation. (No salesman will call.)

NEWEST DEVELOPMENTS

Your training covers U H F, Color Television, F M, Oscilloscope Servicing, High Fidelity Sound and Transistors.

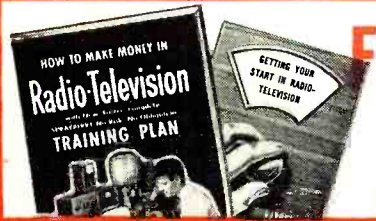
PRACTICE AND TRAIN AT HOME WITH 25 NEW KITS OF EQUIPMENT

You get valuable practical experience in construction, testing and shop practice. You build a powerful 2 band superhet radio, the all-new 18 range Sprayberry multitester, the new Sprayberry Training Television receiver, signal generator, signal tracer and many other projects. All equipment is yours to use and keep . . . and you have practically everything needed to set up a Radio-Television Service Shop.

All your training is IN YOUR HOME in spare hours. Keep on with your present job and income while learning. I help you earn extra spare time money while you learn. If you expect to be in the armed forces later, there is no better preparation than practical Sprayberry Radio-Television training. Rush coupon below for all the facts—*FREE!*

SPRAYBERRY ACADEMY OF RADIO

111 NORTH CANAL STREET, DEPT. 25-N, CHICAGO 6, ILLINOIS



FREE CATALOG AND SAMPLE LESSON

Rush coupon for my catalog "How to Make Money in Radio-Television". PLUS an actual sample Sprayberry Lesson without obligation—ALL FREE. Mail coupon NOW!

SPRAYBERRY ACADEMY OF RADIO
Dept. 25-N, 111 N. Canal St., Chicago 6, Ill.

MAIL THIS COUPON FOR FREE FACTS AND SAMPLE LESSON

Please rush all information on your ALL-NEW Radio-Television Training Plan. I understand this does not obligate me and that no salesman will call upon me. Include New Catalog and Sample Lesson FREE.

Name_____ Age_____

Address_____

City_____ Zone_____ State_____

tivities pertaining to the company's sales of semi-conductor products . . . *Sprague Electric Company* has named **JAMES C. P. LONG** manager of its Washington, D.C. office, succeeding **JOHN P. SHERIDAN** who has been promoted to the post of coordinator of government liaison at the company's home office in North Adams, Mass. . . . **LESLIE ROBERTS** was elected president and chief executive officer of *Philharmonic Radio and Television Corp.* at a recent meeting of the board of directors. He replaces **BERNARD H. LIPPIN** who stepped up to board chairmanship . . . **S. JOHN LaPUMA** is the new publicity director for *JFD Manufacturing Company, Inc.* He succeeds **DAVID B. TOLINS, JR.** who is joining the creative staff of *Cowan and Dengler,* New York advertising agency . . . *DeWald Radio Manufacturing Corporation* has named **HERBERT A. FRANK** general sales manager for all operations in both radio and television . . . **JOHN J. HOLLAND,** formerly electronic equipment contracting officer for the U.S. Army Signal Corps at Fort Monmouth, has joined *Stromberg-Carlson Company* as head of quality control and inspection for the company's radio-television division. His duties will cover both commercial and military production . . . **DAVID TURNER,** founder and chairman of the board of *The Turner Company,* died recently in Cedar Rapids, Iowa. He was 72 . . . **S. W. GROSS,** vice-president in charge of sales for *Emerson Radio and Phonograph Corporation,* has been appointed vice-president and assistant to the president of the firm . . . **DWIGHT H. LADD** is the new manager of the Dallas plant of *Federal Electric Products Company* and its subsidiary, *Pacific Electric Manufacturing Corporation.*

* * *

JAMES O. BURKE has been elected executive vice-president of *Standard Coil Products Co., Inc.,* Chicago manufacturer of television components and aircraft instruments.

The company also announced the appointment of Jere H. Cavanaugh as financial administrator for the company.

Mr. Burke, who founded *Standard Coil* with Glen E. Swanson in 1935, is also treasurer and a director of the company.

Mr. Cavanaugh, formerly treasurer of *McCord Corporation,* will work directly under Mr. Burke.

* * *

THE 1954 HI-FI SHOW, which will be held at the Palmer House in Chicago, September 30, October 1 and 2, is sponsoring a unique contest for those attending the Show.

The management has announced that the contest will be built around the theme "What Hi-Fi Means to Me." Persons attending the Show may obtain

(*Continued on page* 170)

Now, TV set owners can understand benefits of Aluminized Tubes!

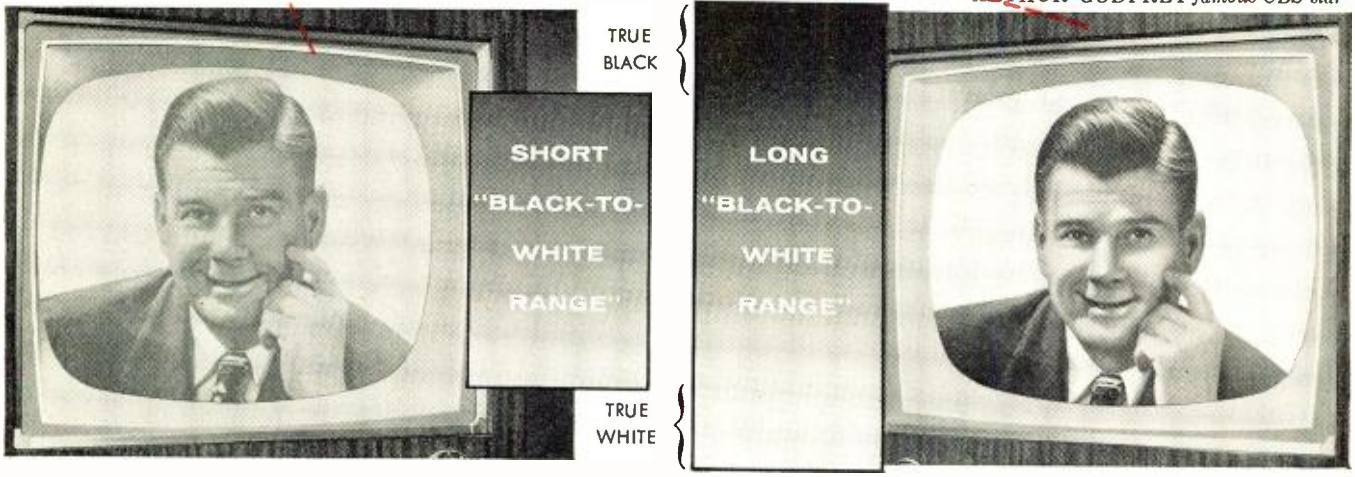
These three advertisements will appear in POST *this fall.*

THESE ADVERTISEMENTS IN POST EXPLAIN THAT:

1. **IN MAGAZINES,** *the pictures* you see (when magnified) are made by a series of tiny dots applied to the paper *mechanically.*

ON YOUR TV SCREEN, *the pictures* are also made by a series of dots (which appear as lines) applied *electronically.* These dots, in both cases, create a variety of tones including black, a range of grays, and white. BUT, it is the LENGTH of this "Black-to-White Range" (the gray scale) that makes the picture excellent, good, fair, or poor.

ARTHUR GODFREY *famous CBS star*



2. **ORDINARY PICTURE TUBES** used in most TV sets made before 1953 produce a *short* "Black-to-White Range." While the picture is good, the picture tube cannot develop enough *light output* for a *long* "Black-to-White Range."

3. **CBS-HYTRON MIRROR-BACK TUBES** produce up to *twice the light output* of ordinary picture tubes. Like the silver backing on a mirror, the *shiny* aluminum backing on a Mirror-Back tube reflects to the viewer *all the light* on the screen. The resulting increased brightness and reduced halation (unwanted spreading of light from one dot to another) is *essential* to give you a *long* "Black-to-White Range." The full range you *must* have for the clearest, sharpest, brightest pictures that are a joy to watch.

TALK LONG "BLACK-TO-WHITE RANGE" PICTURES ...SELL BIGGER-PROFIT

CBS-HYTRON MIRROR-BACK PICTURE TUBES

Talk . . . demonstrate . . . and sell "Long-Black-to-White-Range" clearer, sharper, brighter pictures. It's easier to sell premium-grade, brand-new CBS-Hytron Mirror-Backs . . . with their controlled quality and dependable full-year guarantee. Profit more. Tie in with POST. Get this Mirror-Back Promotion Kit . . . from your CBS-Hytron distributor, or mail coupon.

CBS-HYTRON Main Office: Danvers, Massachusetts

A Division of Columbia Broadcasting System, Inc.

A member of the CBS family: CBS Radio
CBS Television • Columbia Records, Inc.
CBS Laboratories • CBS-Columbia • CBS International • and CBS-Hytron

CBS-HYTRON, Danvers, Mass.

I want all the material to identify me as a *Certified* Quality Service dealer who sells Mirror-Back tubes. Please rush me CBS-Hytron Mirror-Back Promotion Kit containing:

1. 22 x 28-inch Advertised-in-POST window poster.
2. 25 consumer self-mailers. "How *You* Can Have Clearer, Sharper, Brighter TV Pictures."
3. *Certified* Quality Service decalcomania.

I enclose 25¢ for postage and handling.
I want ..... more consumer self-mailers at 1¢ each, for which I enclose an additional $.....

Name .....
(please print)

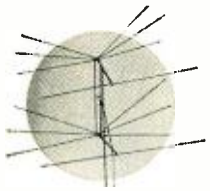
Street .....

City ..... *State* .....

GUARANTEED TO OUTPERFORM ANY EQUIVALENT TYPE ANTENNA OR

YOUR MONEY and LABOR COSTS BACK

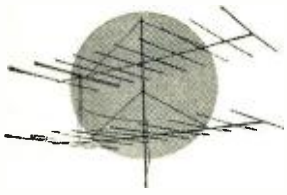
There's been enough words written about TV antenna performance. Now . . . *see the facts for yourself!* Compare any of the new PHILCO Super-Performance TV Antennas with any equivalent type on the market. If the new PHILCO does not give you the finest picture possible, your money back for the antenna *plus* your labor costs up to $10.00. Ask your PHILCO Distributor for complete details on this amazing offer!



PHILCO VHF SUPER CONICAL

PHILCO TWO-BAY SUPER CONICAL ALL-CHANNEL ANTENNA

Strong signal pickup on VHF channels 2 through 13 . . . UHF channels 14 through 83 . . . ideal for fringe area reception . . . all-aluminum construction with dowelled elements: Part No. 45-3096-2. Rugged single bay design: Part No. 45-3096.



PHILCO VHF LOW BAND YAGI

PHILCO TWO-BAY VHF LOW BAND YAGI ANTENNA

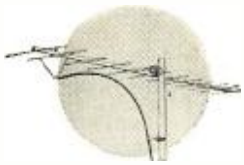
10 elements . . . all-aluminum . . . factory pre-assembled. Top performance on channels 2 through 6 . . . 13 db to 15 db gain on various channels. Single bay Part No. 45-3112-2 through 6. Stacked version harness Part No. 45-3267.

PHILCO GOLDEN YAGI UHF ANTENNA

Designed for 300 ohm operation . . . all metal construction . . . 11 db to 12 db gain on various channels. "Cronak" coated components resist salt air . . . humidity. Six models cover entire UHF spectrum: Basic Part No. 45-1996.

PHILCO PARAFLECTOR ALL-CHANNEL UHF ANTENNA

Pre-assembled, all-aluminum . . . 8 to 10 db gain . . . outstanding fringe area performance . . . immediate mounting on existing masts. Part No. 45-3071. Bow Tie, Part No. 45-3069 and Bow Tie with reflector, Part No. 45-3070 give top quality pictures in many UHF areas.



PHILCO UHF GOLDEN YAGI

PHILCO UHF PARAFLECTOR

PHILCO CORPORATION ACCESSORY DIVISION

"A" AND ALLEGHENY AVE. • PHILADELPHIA 34, PA.

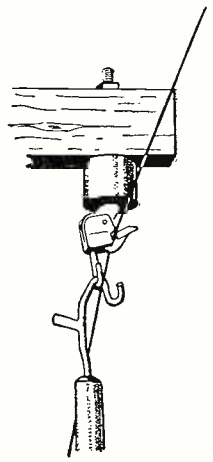
The pole that need not be climbed

Fastening wires with new tool.

Since telephony began, there has been just one way to install telephone wires on poles: have a trained man climb up and fasten them there. Now Bell Laboratories engineers have developed a special pole line for rural areas. The entire line can be erected without climbing a pole.

The whole job is done from the ground. Light-weight poles are quickly and easily erected. Newly created tools enable men to fasten wires to crossarms 10 to 25 feet over their heads.

This inexpensive line promises more service in sparsely populated places. From original design to testing, it exemplifies a Bell Telephone Laboratories team operation in widening telephone service and keeping costs down.



Key to the new "climbless" pole is this insulator. Ground crews use long-handled tools to place the wire in position and then lock it fast.

Bell Telephone Laboratories

IMPROVING TELEPHONE SERVICE FOR AMERICA PROVIDES CAREERS FOR CREATIVE MEN IN SCIENTIFIC AND TECHNICAL FIELDS

Write your Own Ticket

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

Use your experience in radio to step into a higher paying television job by studying AT HOME in your SPARE TIME.

The fabulous television industry has seen many booms — in building of broadcasting stations, manufacture of black and white VHF sets, and sale of these sets to millions of families — *but the biggest booms are yet to come.*

From my experience in the radio-television-electronics field and my contacts in high places, I can tell you that past TV booms will look small compared to the booms that will come with construction of new VHF and UHF stations and perfection of low-cost color television sets.

These developments are just around the corner. If YOU want to be in on the ground floor for the jobs that will be created, *now* is the time to do it. You can keep your present job and study one of my two NEW courses — FM and Television Technician Course — TV Cameraman and Studio Course.

These Courses — especially prepared for home study — will train you for top-paying jobs in the ever-expanding radio-television-electronics industry. You'll be able to write your own ticket to get a better pay job or set up your own business.

VETERANS!

My School fully approved to train veterans under new Korean G.I. Bill. Available only to Veterans discharged after June 27, 1950. If eligible, CHECK COUPON.

FREE FCC COACHING COURSE

Important for BETTER PAY JOBS requiring FCC License. You get this training AT HOME and AT NO EXTRA COST. Top TV jobs go to FCC-licensed technicians.

EARN while you LEARN

Almost from the very start you can earn extra money while learning, repairing Radio-TV sets for friends and neighbors. Many of my students earn up to $25 a week ... pay for their entire training from spare time earnings ... start their own profitable service business.

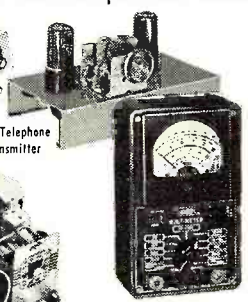
EXPERT FM-TV TECHNICAL TRAINING

My FM-TV Technician Course lets you take full advantage of your previous experience — either civilian or Armed Forces. YOU CAN SAVE MONTHS OF TIME. My FM-TV Technician Course completes your training by providing a thorough background in Frequency Modulation and Television Theory and Practice.

You "Learn by Doing", working with parts and equipment I send you. Six large kits of FM and TV parts are given to you as part of the course. You build and keep a professional GIANT SCREEN TV RECEIVER complete with big picture tube (designed and engineered to take any size up to 21-inch).

Upon completion of your training you may — if you desire — take two weeks of shop training at my associate resident school in New York City AT NO EXTRA COST!

Super-Het Radio Receiver



C-W Telephone Transmitter

Combination Voltmeter-Ammeter-Ohmmeter

RF Signal Generator

Public Address System

PRACTICAL TV CAMERAMAN AND STUDIO COURSE

My TV Cameraman and Studio Course is designed to train TV Studio Technicians and TV Cameramen, urgently needed today by Television Broadcasting Stations throughout the nation.

New TV Stations are now mushrooming throughout the country. Men who can work as Audio Technicians, TV Cameramen, Microphone Boom Operators, Monitor Operators, Turntable Operators, Control Room Technicians can write their own tickets.

I will train you for an exciting high pay job as the man behind the TV camera. Work with TV stars in TV studios or "on location" at remote pick-ups.

Available if you want it . . . one week of actual work with studio equipment & TV Cameras at my associate resident school in New York City.

This course is a MUST for those who wish to increase their technical knowledge of television operations.

TRAINING FOR BEGINNERS

My Radio-FM-Television Technician Course is especially prepared for men with no previous experience or training. I have trained hundreds of men for successful careers in radio-television-electronics. Many of them had only a grammar school education and no previous experience whatsoever in the field.

Two weeks of intensive shop practice at my associate resident school is also included with this Course.

YOU GET THESE FOUR Free

- FREE SAMPLE LESSON
- FREE 48-STATE LIST OF FUTURE TV STATIONS
- FREE TV JOB OPPORTUNITIES LIST
- FREE HOW TO MAKE MONEY IN TV

MAIL THIS COUPON TODAY!
NO SALESMAN WILL CALL!

Mr. Leonard C. Lane, President — Dept. T-9
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 Technician Course

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

Radio Television Training Association

52 EAST 19th STREET • NEW YORK 3, N. Y.

Licensed by the State of New York • Approved for Veteran Training

Spot Radio News

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

By RADIO & TELEVISION NEWS' WASHINGTON EDITOR

THE ULTRA-HIGH PROBLEM, which has become one of the most entangled issues ever placed before a Congressional committee, has kept the midnight lamps burning not only in the offices of the investigating Senators, but in quarters of the Commission and industry, too. Up for study were a parade of proposals, presented by scores of witnesses, which could start a new freeze, eliminate intermixture of v.h.f. and u.h.f. stations in the same market, remove all TV to u.h.f., institute a new plan for licensing of networks, cut back v.h.f. facilities to single market coverage, or perhaps provide subsidies for panicky ultra-high operators.

One of the boldest recommendations from Madame Commissioner Frieda Hennock, suggested that the committee must move promptly in a number of directions to aid the high bands. She felt that all Fall mergers, including dropouts and dropins must be halted; network programs should become available to the ultra-high stations; cancelled construction permits of u.h.f. permittees who had requested extensions should be re-instated; station coverage should be extended by boosters, and TV should eventually be moved to the upstairs channels. She also recommended legislation which would bar from interstate shipment any chassis that were not equipped to receive channels 2 to 83.

Intermixture was also soundly criticized by Senator Edwin C. Johnson. In a talk presented before the National Television Community Association, he called the decision to mix channels "insane," comparing it to an attempt to mix oil and water. And yet, he said, the . . . "FCC still stubbornly maintains that its original decision is correct."

According to the fiery Senator, the Commission entered . . . "two horses in the race; one a thoroughbred with breeding lines which showed it could run a long race superbly well; the other electronically fit, but hobbled by the big boys with monopoly in their hearts.

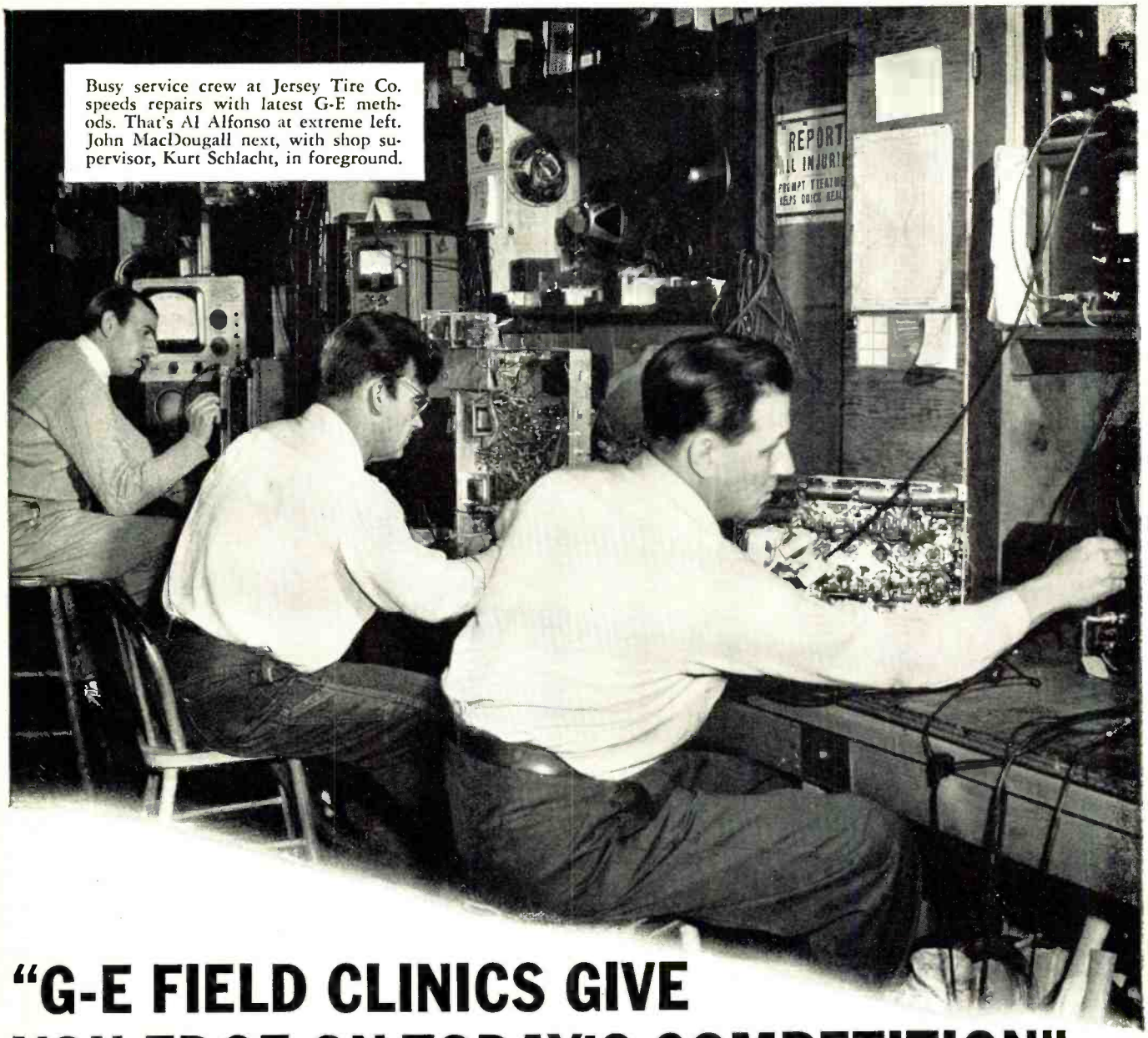
"The eggs have been scrambled and the omelette is on the way to being fried," NCTA listeners were told. "Once you start down Niagara Falls you do not retrace your steps," the Senator went on. So, he said, the Commission . . . "clings to the hope that by some miracle the jockey on the second horse will push him into running a dead heat."

The plea for demixing was also supported by *CBS* Prexy Frank Stanton, who said that *Columbia* had always opposed intermixture, since it placed too great a burden on the ultra-high stations who had to compete with established low-band stations in the same markets. Commenting on the proposal to move all stations upstairs, he said that such a move would weaken the whole system, deprive some areas of service, and damage the quality of programs. He also criticized the suggestion that antenna heights and power of very-high stations be reduced; this approach, he felt, was equivalent to abandonment of the low-bands, for circulation would be reduced and the usefulness of channels 2 to 13 would be seriously impaired.

The plan to move everything to the ultra channels was censured too by Mayor David L. Lawrence of Pittsburgh, who went to Washington to ask for v.h.f. channels for his city. The ultra-highs, he said, did not and cannot provide sufficient coverage in the nation's steel center, because of the hilly terrain. His testimony revealed that eight applicants for the city's two v.h.f. channels had invested nearly a half-million dollars preparing for a hearing, and another half-million might be spent before decisions were rendered. In addition, he said, about $14-million was tied up in pledges and subscriptions to those applying for low-band licenses to operate.

In a blistering statement filed with the subcommittee by Dr. Allen B. Du Mont, the '48 freeze was called the core of the present trouble. For, he said . . . "the freeze reserved to two networks the almost exclusive right to broadcast in all but 12 of the 63 markets which had television service." Because of this situation, he added, the . . ."other two networks did not have and have not had . . . more than a ghost of an opportunity to get their programs into the markets so necessary, if high quality programs are to be produced and attract advertisers from whom revenue and profits must come."

(*Continued on page* 124)



Busy service crew at Jersey Tire Co. speeds repairs with latest G-E methods. That's Al Alfonso at extreme left. John MacDougall next, with shop supervisor, Kurt Schlacht, in foreground.

"G-E FIELD CLINICS GIVE YOU EDGE ON TODAY'S COMPETITION"

WITH competition keener, now more than ever it pays to take advantage of free G-E Field Clinics. They'll show you newest short cuts in diagnosing and correcting TV ailments. You'll give better, faster service—keep customers happier, step up number of calls a day. Call your G-E Distributor today for place and date of next clinic nearest you.

"Yesterday's TV service methods are outdated today. That's why all of us here at Jersey Tire Co. think the G-E Field Clinics are so great. The Clinics give you the edge on today's competition with the latest TV service methods. Customers tell us our service is far better than our competitors'—and that's the biggest boost a service business can have. We handle more repairs quicker. Just can't beat those G-E Field Clinics."

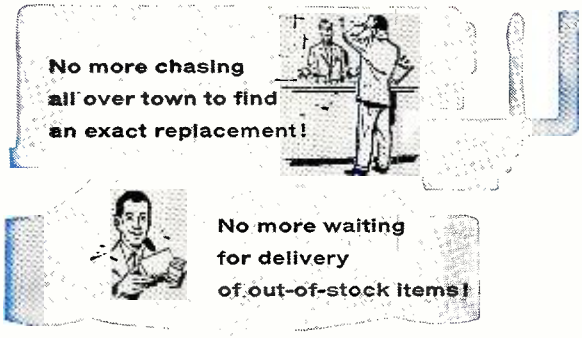
says *Leo Kaplowitz*

owner of this enterprising Perth Amboy firm.

Progress Is Our Most Important Product

GENERAL ELECTRIC

RADIO & TELEVISION DEPARTMENT, SYRACUSE, N. Y.



Heard about Centralab's new Fastatch Custom-Control System?*

Now 4,000 combinations of resistance and taper

are ALWAYS IN STOCK, wherever you see this sign

With this new plan, your Centralab distributor always has the dual-concentric replacement you need . . . one that's 100% tested and guaranteed by Centralab

Again, pioneering by Centralab pays off for you. Again, Centralab saves you time, steps, and money. Here's how:

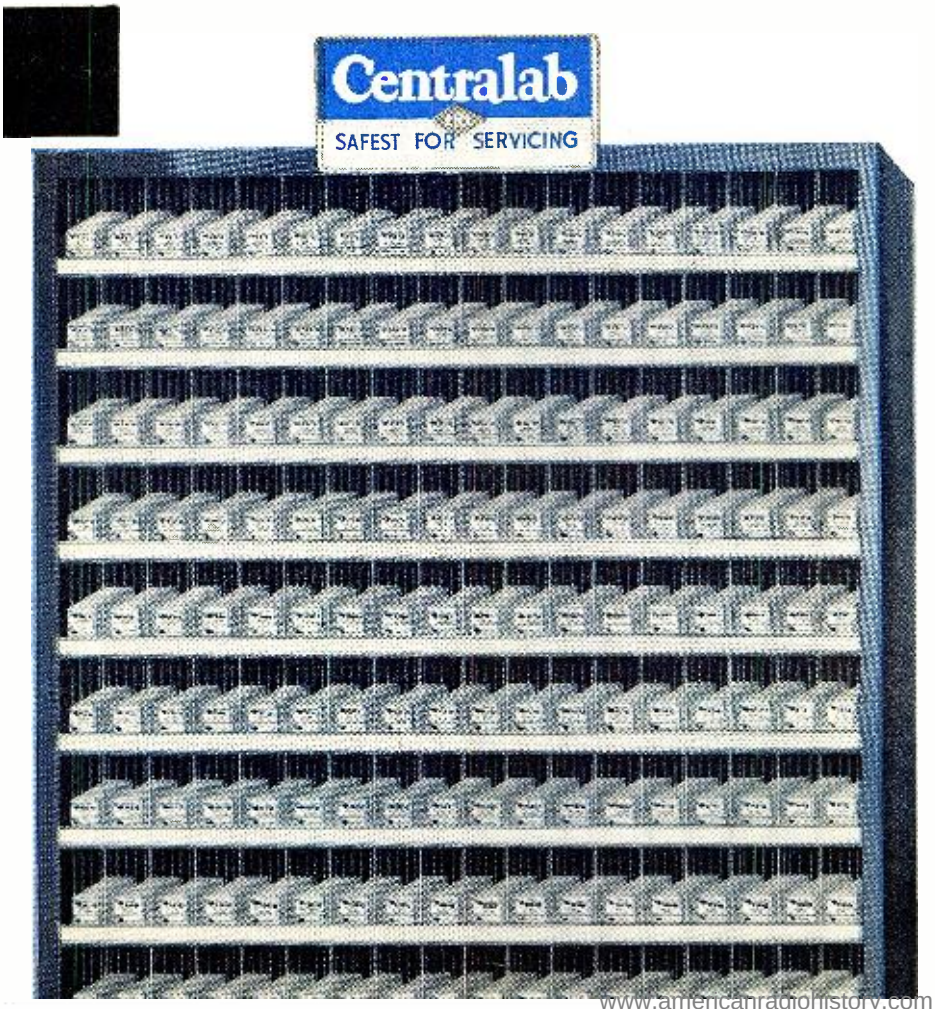
Centralab introduces a unique system of Fastatch dual-control units that snap together to give you more than 4,000 different combinations of resistance and taper.

So now your Centralab distributor can give you the right replacement for practically any dual-control custom, current or future (including color TV)!

Moreover, you don't have to do the manufacturer's job—there are no loose parts . . . no lugs to bend . . . no tricky assembling. Fastatch units are completely assembled, tested, and guaranteed by Centralab.

Have your Centralab distributor demonstrate these new Fastatch units. And send coupon for bulletin 42-218.

Centralab ®



It's a snap

to get the
right
custom dual

Snap front unit...
(with outer shaft
cut to length)

To rear unit...
(with blue shaft
cut to length)

Snap on switch...
(from Fastatch
KB series)

Add the knobs
—and there's your
custom dual

Tear out coupon and mail today!

CENTRALAB,
A Division of Globe-Union Inc.
910-1 E. Keefe Avenue, Milwaukee 1, Wisconsin

Send me free bulletin 42-218.

Name.....

Company.....

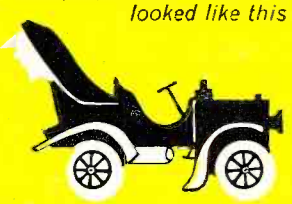
Address.....

City.....*Zone*.....*State*.....

B-3754

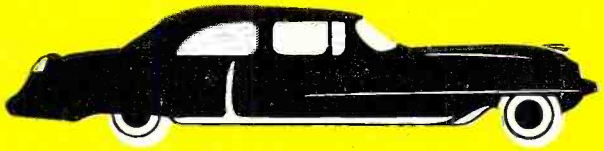
*Trademark

When the profile of the Cadillac looked like this



It was understandable that the profile of a V.O.M. might look like this

But this is the profile of today's Cadillac



And if you buy a V.O.M. that is truly of today it will have a profile like this

STREAMLINING *signifies the difference!*

In cars, streamlining symbolizes the tremendous advances in automotive engineering and performance. In fine test equipment, too, streamlining signifies the difference.

The flush switches, dials and jacks of the Smoothie make it easy to slip in your pocket, carrying case or tool kit, eliminate snag hazards on your bench.

But even more—the streamlining expresses externally the advanced internal design which makes the Triplett Model 630 as superior to the obsolete knobby bumpy-faced testers as the Cadillac of today is to the Cadillac of fifty years ago. These internal design features include such developments as selector switch of molded construction, completely enclosed; elimination of harness wiring, etc. Your most frequently used tester—your V.O.M.—should be the best—the one of which many thousands are in use in laboratories today—the Smoothie, Triplett Model 630 Volt-Ohm-Mil-Ammeter, $39.50 net. Ask your parts jobber or write Triplett Electrical Instrument Company, Bluffton, Ohio.

the SMOOTHIE

the only streamlined V.O.M. with a smooth face

TRIPLETT

630

Volt-Ohm-Mil-Ammeter

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Home Study Courses in

TELEVISION SERVICING

offered by

RCA INSTITUTES

Study Television Servicing—from the very source of the latest, up-to-the-minute TV and Color TV developments. Train under the direction of men who are experts in this field. Take advantage of this opportunity to place yourself on the road to success in television. RCA Institutes, Inc. (A Service of Radio Corporation of America), thoroughly trains you in the "why" as well as the "how" of servicing television receivers.

FIRST HOME STUDY COURSE IN COLOR TV SERVICING

Now you can train yourself to take advantage of the big future in Color TV. RCA Institutes Home Study Course covers all phases of Color TV Servicing. It is a practical down-to-earth course in basic color theory as well as how-to-do-it servicing techniques.

This color television course was planned and developed through the combined efforts of instructors of RCA Institutes, engineers of RCA Laboratories, and training specialists of RCA Service Company. You get the benefit of years of RCA research and development in color television.

Because of its highly specialized nature, this course is offered only to those already experienced in radio-television servicing. Color TV Servicing will open the door to the big opportunity you've always hoped for. Find out how easy it is to cash in on color TV. *Mail coupon today.*

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Thousands of men in the radio-electronics industry have successfully trained themselves as qualified specialists for a good job or a business of their own—servicing television receivers. You can do this too.

This RCA Institutes TV Servicing course gives you up-to-the-minute training and information on the very latest developments in black-and-white television.

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There are ample opportunities in TV, for radio servicemen who have expert training. Mail coupon today. Start on the road to success in TV Servicing.

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Without obligation on my part, please send me copy of booklet on:

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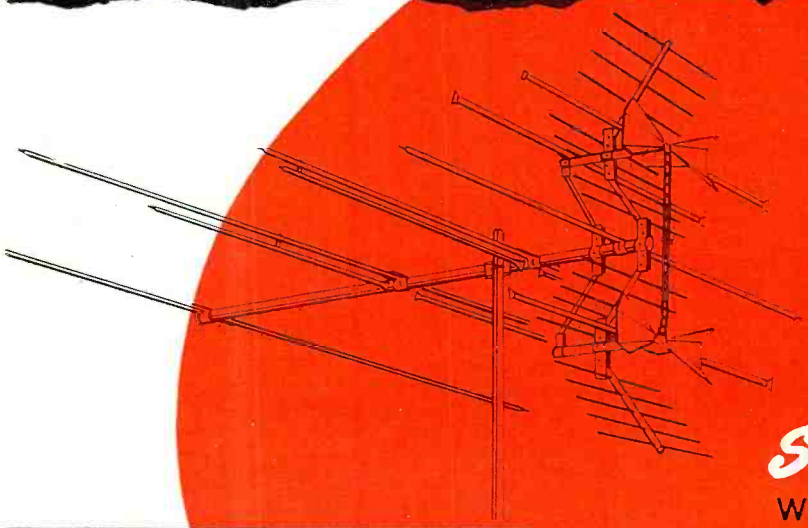
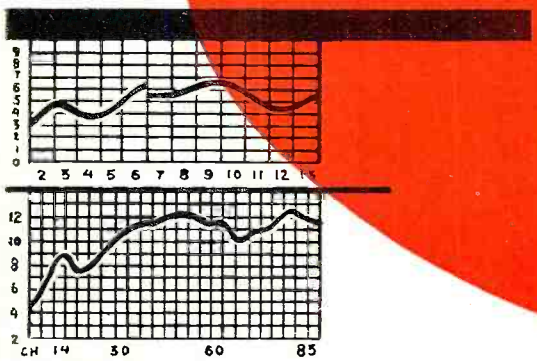
A SERVICE OF RADIO CORPORATION of AMERICA
350 WEST FOURTH STREET, NEW YORK 14, N.Y.

RECEIVE EVERY CHANNEL
NOW AND IN THE FUTURE
TRU-YAGI PERFORMANCE on ALL CHANNELS 2-83 - B & W or COLOR

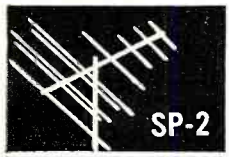


At last, a high gain, low cost antenna everyone wants that meets every need in all sections of the country.

THE VEE-D-X SUPER CHIEF WITH "DYNA-PHASE"*

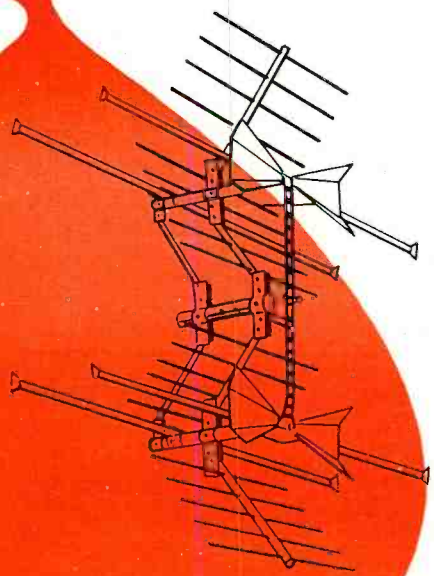


The FIRST all-channel antenna employing Dyna-phase, the sensational development recently released by the VEE-D-X laboratories. This new phasing technique permits extremely high gain over the entire VHF-UHF band with excellent directivity - high front-to-back ratio - all with a single transmission line. Neat in appearance, the SUPER CHIEF is completely pre-assembled. Ruggedized all aluminum construction featuring new VEE-D-X "squeeze lok" tubing on all elements - doubly reinforced at the stress points with a swaged aluminum sleeve and braced to the boom with triad lock hardware for durability plus easy installation.



THE VEE-D-X CHIEF

Small in size but a Goliath in performance, the CHIEF is essentially a high-gain antenna for channels 7-83 that performs satisfactorily on channels 2-6 as well. Same rugged construction as the SUPER CHIEF, this antenna comes pre-assembled for trouble-free installation within minutes.



A COMPLETELY NEW LINE OF VEE-D-X ANTENNAS

LaPOINTE ELECTRONICS INC.
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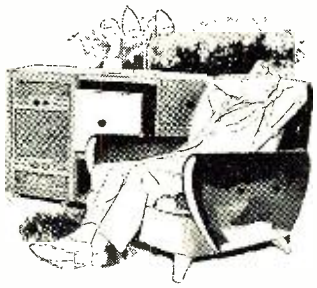
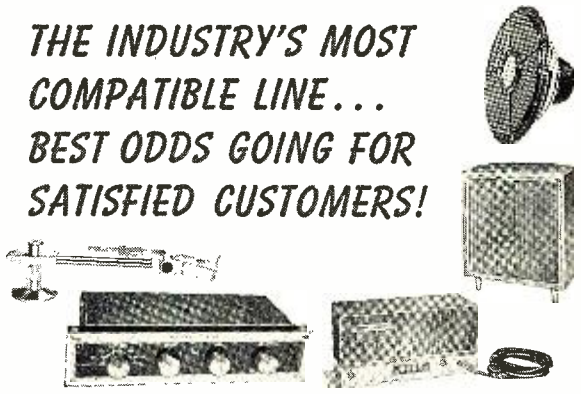
EVERYTHING IN PERFORMANCE ... AT A PRICE YOUR CUSTOMERS WILL LIKE!



THE INDUSTRY'S MOST COMPATIBLE LINE... BEST ODDS GOING FOR SATISFIED CUSTOMERS!



SIMPLE TO SELL... THEY LISTEN ONCE... LOOK AT THE PRICE TAG ... AND BUY!

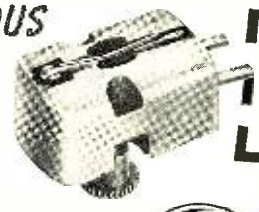
HIGH-FIDELITY, the G-E way, MAKES SENSE!

THOSE seven simple words tell the complete story. Your customers may spend a lot more money for equipment, but they'll never buy better performance than the General Electric Custom Music Ensemble delivers! Here, in *one integrated sound system,* lies the answer to widest high-fidelity customer interest... your greatest potential for profit and sales.

To go places in the high-fidelity business, go all the way with General Electric! Get aboard early... mail the coupon below for complete information today.

CUSTOM INSTALLATIONS WITH MATCHED EQUIPMENT HAVE BONUS APPEAL!

UNEQUALLED REPUTATION FOR QUALITY... G-E's FAMOUS VARIABLE RELUCTANCE CARTRIDGE PROVES IT!



General Electric Company, Section R994
Electronics Park, Syracuse, New York.

Send me information on all units in the G-E high-fidelity equipment line.

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ADDRESS.....

CITY.....STATE.....

GENERAL ELECTRIC

"HI-FI IS FOR EVERYBODY" . . .

says Robert Newcomb

. . . Regardless of budget, way of life, or space limitations. Ownership of a true high fidelity system no longer requires an extensive technical background. In fact, today it doesn't even require more than a moderate expenditure to enjoy the wonderful realism of high fidelity.

Look over these new Hi-Fi Products and you'll see that Robert Newcomb not only believes that Hi-Fi is for everybody . . . but has a complete line of products to prove it.

Whatever your Hi-Fi plan, whatever your Hi-Fi budget, Newcomb is right there with the right amplifier.

FOR SUPERIOR RADIO RECEPTION . . .

New CLASSIC 200
2 KNOB FM-AM TUNER

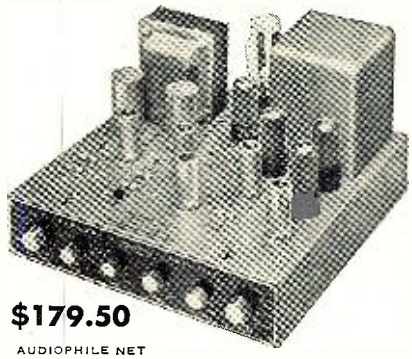
$169.50 AUDIOPHILE NET

Designed for use with any amplifier having its own complete set of controls. It's today's most advanced tuner. Designed and built by Newcomb . . . Completely new, distinctly different, and noticeably better! Fully enclosed and beautifully finished to use "as is." To place in a cabinet, Newcomb's exclusive "Adjusta-Panel" feature makes a simpler, neater job. U/L approved. Output is 10 volts at less than ¼%. 1 volt at less than 4/100%. Effective to 200 ft. from amplifier.

Many new circuit advances have been made in both FM and AM sections. Results: *30 db* of quieting with only 1½ micro-volts input on FM. 1 Microvolt AM sensitivity for 1 volt output. Only 6⅜" high by 11½" by 11½".

FOR TRUE STEREOPHONIC REPRODUCTION . . .

New MODEL 3D-12, 25 WATT
2 CHANNEL AMPLIFIER



$179.50
AUDIOPHILE NET

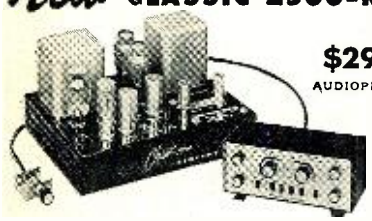
Really two complete matched 12½ watt amplifiers and preamplifiers in one. Common set of control knobs for both amplifiers offers easier operation, perfect results. All normal controls are provided plus new "focus" control. Channel selector switch gives operator choice of stereophonic reproduction, stereophonic reversed, Channel A, Channel B, or enhanced 2 channel monaural for simulated stereophonic reproduction of ordinary records. Dual tape "inputs" and dual "outputs" to tape make the 3D-12 ideal for use with the new "Binaural" tape recorders. Crossover selector provides various recording curves for both channels. Special switch provides correction for Cook Binaural recordings. Distortion below 1% at 25 watts. Response ±1 db 20—20,000 cycles.

NEWCOMB *Classic Series* AMPLIFIERS . .

WITH REMOTE CONTROL . . . . . OR . . . . . .

These remote controlled Newcomb Classic Series Amplifiers offer matchless performance and complete sound control . . . music exactly as you want to hear it. Words can't describe these superb products. Both give you: True remote control up to 50 or 100 ft.; Separate crossover and rolloff controls for up to 36 different recording curves; New "Level" control; Advanced design Loudness control; New rumble filter; Seven inputs; Mike input; Tape "Input"; "Output" to tape; No-Glare petite pilot light; and they're U/L approved. Only your ears can convince you Hi-Fi can be so close to perfection. For utmost pride . . . for classic beauty . . . for luxurious operating ease and utmost listening pleasure . . . for substantial savings in cabinetry and installation expense . . . for lowest distortion *for life* . . . Own a Newcomb Classic Series Remote Controlled Amplifier. Don't fail to see and hear these premier products of Newcomb's 17 years of sound leadership.

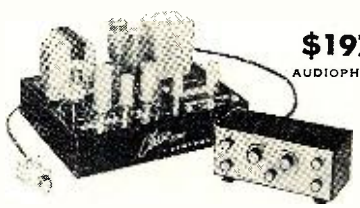
New CLASSIC 2500-R



$297.50
AUDIOPHILE NET

25 watt Ultra Fidelity Remote Controlled Amplifier-Preamplifier • Less than 1/100% distortion up to 10 watts, less than 2/10% at 20 watts • 10 to 100,000 cycle response within 1/10 db from 10 to 30,000 cycles • Program condition compensator • Unequalled dual range tone controls, Bass range —16 db to +23 db, Treble range —25 db to + 23 db • D.C. operated preamplifier.

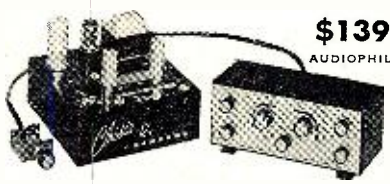
New CLASSIC 1500-R



$197.50
AUDIOPHILE NET

20 watt Ultra-Fidelity Remote Controlled Amplifier-Preamplifier • Less than 5/100% distortion at average listening levels • Less than ½% distortion at 15 watts • 10 to 100,000 cycle response within 1 db to 30,000 cycles • Dual range tone controls, Bass range —17 db to +20 db, Treble range —20 db to +18 db • Ultra conservative design for extended tube life.

New CLASSIC R-7



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AUDIOPHILE NET

Remote Controlled Ultra-Fidelity Pre-Amplifier
Bring your present amplifier up to date with a new "front end." The New Classic R-7 Remote Master Control Unit and Pre-Amplifier offers guaranteed results, the most modern of circuitry, tremendous range of control . . . plus operating and cabinet saving advantages of real remote control. All inputs connect directly to the power supply chassis only. Beautiful control unit is a decorator's delight.

"AUDI-BALANCE" for LIFETIME FREEDOM from DISTORTION!

Newcomb Classic Series Amplifiers with their exclusive "Audi-Balance" (Pat. Pending) distortion control device assures you of absolute minimum distortion for life! No matter how perfect your amplifier when new, its distortion is bound to increase with age. During the useful life of a set of tubes, output tube unbalance is the greatest single cause for amplifier distortion being above the minimum of which the amplifier is capable. Aging can unbalance a set of tubes and replacement pairs are seldom sufficiently identical twins to balance automatically.

With Newcomb's exclusive "Audi-Balance" feature for lifetime distortion control, you are not left to guess whether your amplifier is continuing to provide the lowest distortion possible. You *know* by just pressing a button! What's more, you can do something about it . . . instantly . . . by just turning a small control and listening to the distortion disappear!

New NEWCOMB "COMPACTS"...

For Use "As Is"...Need No Cabinetry!

With these "Compacts," Newcomb makes true Hi-Fi via selected components practical for everyone. They're simplest of all to install. Just sit down, plug in and use. They need no cabinetry but include Newcomb's exclusive "Adjusta-Panel" feature to make installation in a cabinet extremely easy if necessary. Both U/L approved. They're absolutely ideal for the apartment dweller because they're so easy to set up or move.

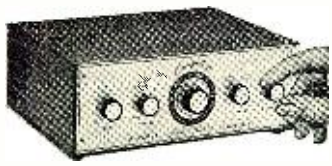
COMPACT 12

$99.50 AUDIOPHILE NET

12 Watt High Fidelity Amplifier-Preamplifier-Control Unit. • Less than 1% distortion at 12 watts • Response ±1 db 20-20,000 cycles • Separate crossover and rolloff controls give 36 different recording curves • Input selector and rumble filter • Seven inputs • Mike input • Tape input • Output to tape • Wide range separate bass and treble tone controls, Bass range −15 db to +18 db, Treble range −18 db to +16 db • Hum balance control • New "Level" control • Advanced design "loudness" control • Size only 4⅛" high x 12½" x 9".

COMPACT 10

$79.50 AUDIOPHILE NET



10 Watt High Fidelity Amplifier-Preamplifier-Control Unit. • 10 watts at less than 1% distortion • Response ±1 db 20-20,000 cycles • 6 position recording curve selector • Input selector • Built-in rumble filter • Separate bass and treble tone controls in new "Interlocked" tone circuitry for "foolproof" results and less frequent need for tone control adjustments • Hum balance control • 6 inputs • Tape input • Output to tape • Mike input • Loudness control • Size 3⅞" x 7¾" x 9⅜".

. . . FOR PERFECTION IN EVERY DETAIL

. . . . WITHOUT REMOTE CONTROL

Identical to the Classic 2500-R and Classic 1500-R without remote control, the Classic 2500 and Classic 1500 offer full Classic Series perfection in every detail at lowest possible cost. All controls are on chassis. They also feature Newcomb's exclusive "Adjusta-Panel" that lets you instantly extend knob shafts to accommodate cabinet panels up to ¾" thick. Dial panel is removable, beautifully finished in "gold" anodizing process that never tarnishes. Panels include petite pilot light. Both U/L approved. All ratings identical to the equivalent remote control models.

New CLASSIC 2500

$219.50
AUDIOPHILE NET

New CLASSIC 1500

$119.50
AUDIOPHILE NET

LISTEN . . . *and you'll hear something wonderful!*

NEWCOMB®

Sound Quality Since 1937

New NEWCOMB "A" SERIES

For the Budget Minded Perfectionist

MODEL A-127R 12 watt Semi-Remote Controlled High Fidelity Amplifier-Preamplifier.

MODEL A-127R
$89.50 AUDIOPHILE NET

12 watts at less than 1% distortion • Control unit on 4 ft. cable solves many installation problems • 20-20,000 cycles ± 1 db • 6 position recording curve selector • Input and rumble filter selector • Large potted output transformer • Advanced design tone controls, Bass range −15 db to +18 db; Treble range −18 db to +16 db • 6 inputs • Tape input • Output to tape • Mike input • Loudness control • Loudness compensation switch • "Adjusta-Panel" • Removable "gold" anodized dial plate • Hum balance control • "Petite" pilot light • U/L approved.

MODEL A-127
$79.50 AUDIOPHILE NET

Identical to A-127R except all controls are on chassis.

MODEL A-107

$59.50 AUDIOPHILE NET

10 Watt High Fidelity Amplifier-Preamplifier. 10 watts at less than 1% distortion • 6 position recording curve selector • Potted output transformer • New electrically isolated input circuitry requires no input switching . . . Just turn on and use • 6 Inputs • Tape input • Output to tape • Mike input • Separate bass and treble tone controls with new "Interlocked" circuitry for foolproof operation • Adjusta-Panel • Removable "gold" anodized dial panel • Petite pilot light • U/L approved.

NEW, FASCINATING, INFORMATIVE BOOK ON HI-FI . . . **25c**

This 25¢ book can save Hi-Fi enthusiasts and music lovers hundreds of dollars. Not a catalog, "Hi-Fi Is For Everybody" is packed with money-saving facts, how-to illustrations and suggestions. Written in easy-to-understand language, this new, practical approach to Hi-Fi tells how to get more for each dollar invested in components, how to cut costs without sacrificing quality or looks, how to plan the simplest system with an eye toward building the most elaborate. Beautifully illustrated. Handy cost-estimating sheet makes it easy to keep track of purchases and budget.

NEWCOMB AUDIO PRODUCTS CO., DEPT. F-9
6824 Lexington Ave., Hollywood 38, California

☐ I am enclosing $_____. Please send me_____copies of "Hi-Fi Is For Everybody" @ 25¢ each.

☐ Please send me free catalog MCS54 on Newcomb High Fidelity Components.

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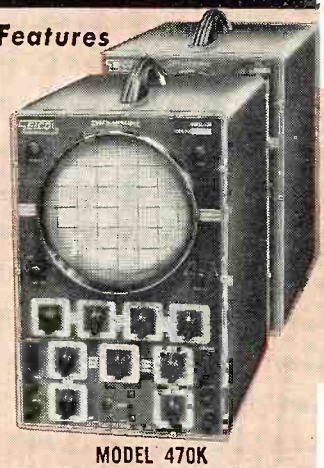
NOW . . . 2 SENSATIONAL EICO SCOPE VALUES!

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.

& 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*

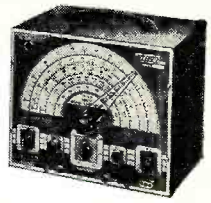
*at less than our cost of handling (See EICO Guarantee Card enclosed with each Kit & Instrument).

221K VTVM KIT $25.95 WIRED $39.95

- AC/DC volts: 0-5, 10, 100, 500, 1000 (30 kv with HVP probe)
- Res.: 0.2 ohms—1000 megs, 5 ranges
- DC input R: 25 megs
- 4½" meter in can't burn out circuit
- 1% mult. resistors

HIGH VOLTAGE PROBE $4.95
- Extends range of VTVMs & voltmeters to 30 kv.

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.

630K CATHODE RAY TUBE CHECKER KIT $17.95 WIRED $24.95

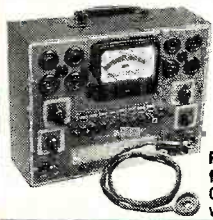
- Checks all types of TV picture and C.R. tubes in the set or carton. Bridge measurement of peak beam current (proportional to screen brightness).
- Detects shorted & open elements.

214K VTVM KIT $34.95. WIRED $54.95.

Large 7½" meter

- 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 R:25 megs;
- 1% mult. resistors.

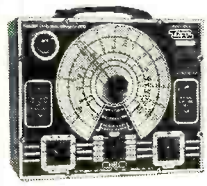
625K TUBE TESTER KIT $34.95. WIRED $49.95.



- Illum. gear-driven "Speed Rollchart."
- New lever-action switches for individual testing of every element.
- Tests all conventional & TV tubes.

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

950B-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.

352K BAR GENERATOR KIT $14.95 WIRED $19.95

- Reliable, accurate, portable, easy-to-use.
- Operates on channels 2-6. 16-23 vert. bars to check H linearity. 13-22 hor. bars to check V linearity.
- Shows pic size & V & H sync circuit stability.
- Entirely independent of station-sent signals.

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New! EICO SCOOPS!

232K PEAK-to-PEAK VTVM with DUAL-PURPOSE AC/DC Uni-Probe*

KIT $29.95 WIRED $49.95

Measures directly p-p voltage of complex and sine waves: 0-4, 14, 42, 140, 420, 1400, 4200 V. DC/RMS sine voltage range: 0-1.5, 5, 15, 50, 150, 500, 1500 v. Ohms: 0-1000 megs. 7 non-skip ranges on every function. Calibration without removing from cabinet. Zero center. Freq. Resp. 30 cps-3mc. 1% precision ceramic multipliers. Exceptional stability and accuracy. Compact, portable (8½x5x5"), smart, rugged.

NEW! UNI-PROBE! Terrific time-saver! Only 1 probe for all functions—a half-turn of probe-tip selects DC or AC (Peak-to-Peak or RMS)/OHMS!

(Pat. Pend.)

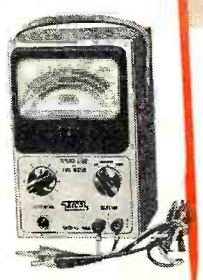
249 K PEAK-to-PEAK VTVM with 7½" METER KIT $39.95 WIRED $59.95

944 K FLYBACK TRANSFORMER AND YOKE TESTER

Kit $23.95 Wired $34.95

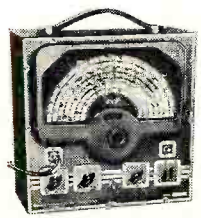
Tests all flybacks and yokes, in or out of TV set—in just seconds! Detects even 1 shorted turn!

Exclusive separate calibration for air—and iron-core flybacks assures utmost accuracy. Large 4½" meter, 3 colored scales. Compact, portable (8½ x 5 x 5"), smart, rugged.



488K ELECTRONIC SWITCH KIT $23.95. WIRED $39.95
1171K DECADE RESISTANCE BOX KIT $19.95 WIRED $24.95
1180K DECADE CONDENSER BOX KIT $14.95. WIRED $19.95

315K DELUXE SIG. GEN. KIT $39.95. WIRED $59.95.



- Covers range of 75 kc to 150 mc.
- 7 calibrated scales: accuracy better than 1%.
- Bandspread vernier tuning.
- 4-step RF shielded output multiplier: constant output Z.

565K MULTIMETER KIT $24.95 WIRED $29.95.

555K MULTIMETER KIT $29.95 WIRED $34.95.

(1% precision resistors)

- 20,000 Ω/V; 31 ranges.
- DC/AC/Output volts: 0-2.5, 10, 50, 250, 1000, 5000.
- DC Current: 0-100 ua; 10, 100, 500 ma; 10 A.
- Ohms: 0-2K, 200K, 20 meg.

377K SINE & SQUARE WAVE AUDIO GEN. KIT $31.95. WIRED $49.95.

- Complete sine wave coverage, 20-200,000 cps in 4 direct-reading ranges.
- Complete square wave coverage, 60-50,000 cps.
- Cathode follower output circuit.

145K SIG. TRACER KIT $19.95. WIRED $28.95.

- Audibly signal traces all IF, RF, Video & Audio circuits from ANT to SPKR or CRT in all TV, FM, AM, etc. without switching.
- Germanium crystal diode probe responsive to over 200 mc.
- Integral test speaker.

536K MULTIMETER KIT $12.90. WIRED $14.90.
526K MULTIMETER KIT $13.90. WIRED $16.90.

- 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.

- Vernier tuning condenser.
- Stable Hartley RF osc., range: 150 kc to 34 mc, calibrated harmonics to 102 mc.
- Pure or modulated RF, & Colpitts oscillator 400 cps sine outputs.

322K SIG. GEN. KIT $23.95. WIRED $34.95. (As above, plus individual calibration of its 5 bands.)

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A MODERN METAL LOCATOR

By RUFUS P. TURNER, K6AI

Complete construction details on a modern, streamlined version of old-fashioned "treasure locator" of the '30's.

Fig. 1. The streamlined metal locator in operation. Here the operator is observing the deflection of the meter. The unit also includes headphones which can be used in conjunction with the meter or as an independent indication of presence of metal.

DURING the thirties, portable electronic treasure locators were built enthusiastically by radio experimenters. It is not known to what extent these pieces of equipment were actually applied to metal prospecting, but response to constructional articles was startling. Today, one sees locators of the same general type in use by utilities workmen to locate underground pipes, and there certainly is no hocus-pocus about these modern metal divining rods.

It has been some time since constructional details on a simple metal locator have appeared in a popular electronic magazine and the Editor's mail shows a growing demand for information along this line. It is interesting to note that an early 1954 news item mentioned large sales of treasure locators during 1953!

Most underground-metal locators of the electronic type operate on the same basic principle, that is, reflection of radio waves by an underground metallic mass. The equipment consists of a separate low-frequency transmitter and receiver. For maximum portability, each is provided with its own loop antenna. The transmitter loop is oriented to send a good portion of its signal into the earth, and in plain ground this signal for the most part is lost. When the waves strike an underground metallic mass, however, a portion of the energy is reflected and is picked up by the receiving loop. Some indicating means, such as the deflection of a meter or an increase in headphone volume, then informs the operator of the presence of the metal.

Over some soils, the response of the metal locator can be quite sharp, occasional operators having reported the possibility of finding small pipes buried at considerable depth. In general, however, a number of factors influence success of the method. A few of these are type of soil, terrain, amount of moisture, purity of the metal, size of the mass, depth of location, transmitter power, receiver sensitivity, operating frequency, influence of nearby conducting or non-conducting objects, and presence of underground water. As in playing the Theremin, the operator of a metal locator develops a certain amount of skill and "sense of feel" only after gaining experience with the device, and the metal locator accordingly must be regarded as a tool unable to do any thinking of its own but capable of aiding an operator who is able to appraise all of the conditions under which it is used.

Instrument Requirements

There are several reasons for choosing a low frequency for a metal locator. First, there must be a maximum of earth penetration with a minimum of reflection from the surface of the ground. High frequencies bounce from the surface. Second, capacitance effects due to nearby objects react less severely with large tuned loops at low frequencies. Third, FCC regulations stipulate that the field strength must not exceed 15 microvolts-per-meter at

Fig. 2. Top chassis view of receiver. The 90-volt "B" battery is shown for comparison. The coaxial cable for connection to the receiving loop leaves the chassis on the left, as shown.

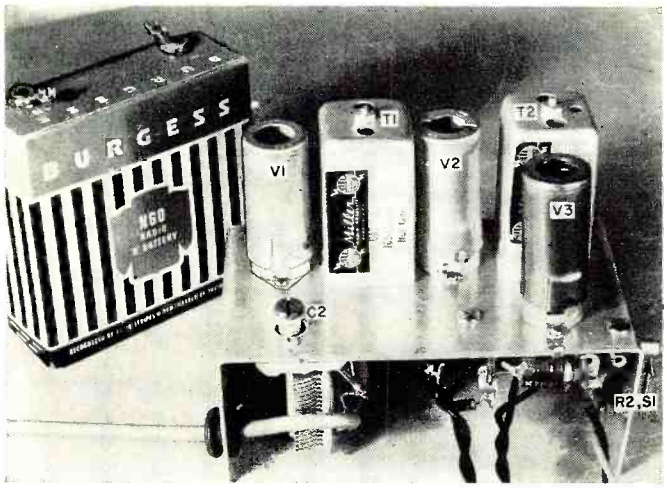
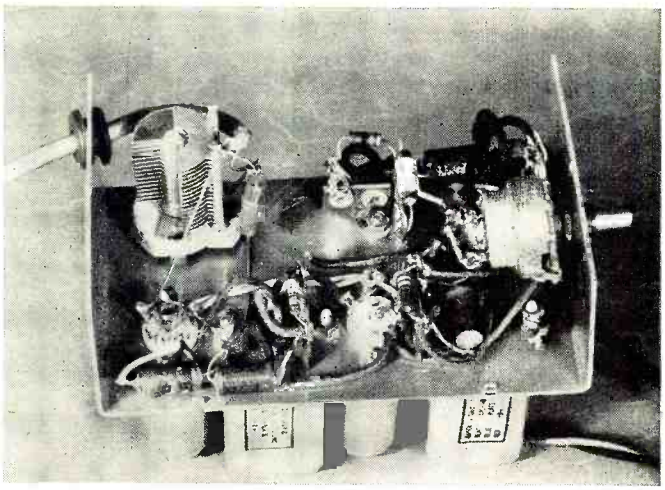
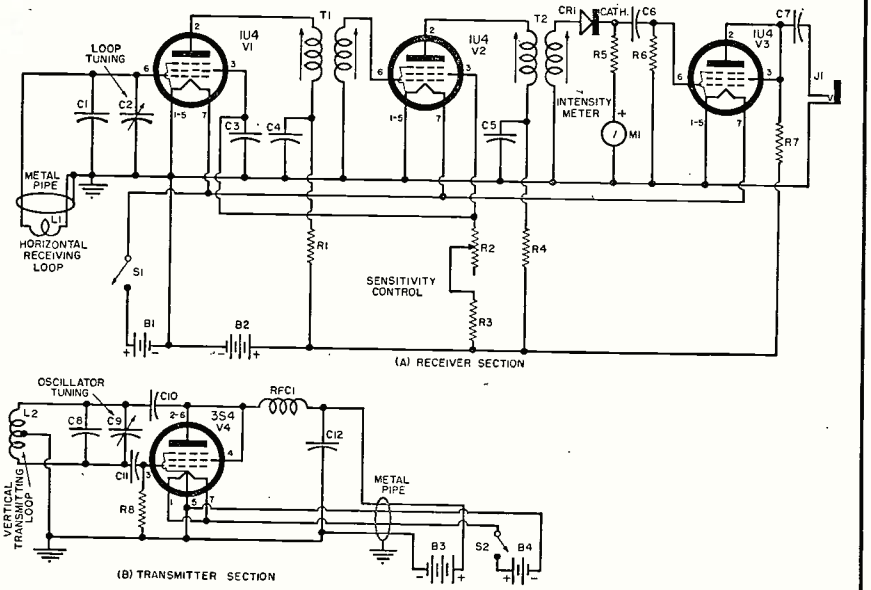


Fig. 3. Under chassis view of the receiver unit. Note the simplicity of the device and the liberal use of miniature components to reduce the over-all size to a mere 5 x 3½ x 2 inches.





R_1, R_4—43,000 ohm, ½ w. res.
R_2—250,000 ohm pot (with switch S_1)
R_3—5000 ohm, ½ w. res.
R_5—1000 ohm, ½ w. res.
R_6—1 megohm, ½ w. res.
R_7—100,000 ohm, ½ w. res.
R_8—3.3 megohm, ½ w. res.
C_1, C_8—1050 μμfd mica cond. (1000 and 50 μμfd. in parallel)
C_2, C_9—140 μμfd. midget var. cond. (Hammarlund APC-140)
C_3, C_4, C_5, C_6, C_7—.1 μfd., 200 v. metallized tubular cond.
C_{10}, C_{11}, C_{12}—.005 μfd. mica cond.
J_1—Midget open-circuit phone jack
L_1—740 μhy. receiving loop. 34 t. #22 en. closewound 12" in dia. (see text)
L_2—740 μhy. transmitting loop. 34 t. #22 en. closewound 12" in dia. Tap 17th t. from plate end (see text)
M_1—0-100 d.c. microammeter
CR_1—1N34 germanium diode
T_1—175 kc. miniature input-type iron-core i.f. trans. (Miller No. 012-K2)
T_2—175 kc. miniature detector-type iron-core i.f. trans. (Miller No. 012-K4)
RFC_1—60 mhy. r.f. choke (Miller No. 693)
S_1—S.p.s.t. switch (on R_2)
S_2—S.p.s.t. toggle switch
B_1, B_4—1½ volt battery (Burgess 2FBP)
B_2—90 v. battery (Burgess N60)
B_3—135 v. battery (two Burgess XX45 67½ v. units in series)
V_1, V_2, V_3—1U4 tube
V_4—3S4 tube

Fig. 4. Complete schematic of metal locator (A) receiver and (B) transmitter.

a distance from the transmitter equal to 1/6.28 of the transmitting wavelength. This means that the lower the frequency, the greater will be the operating distance available without violating the law. Practical considerations determine how low the frequency should be. One of the most important of these is the increasingly large size of the transmitting and receiving loops. A good compromise seems to be frequencies in the range 100 to 200 kc.

Another important requirement is transmitter power. For maximum penetration into unfavorable soils, high power would seem desirable. However, the input power is limited by the requirement that the locator be battery-operated, and also by the FCC restriction on field strength. Furthermore, even in the absence of those two considerations, the power could not be extended to the point where severe interference would occur directly between the transmitter and receiver in the locator.

Receiver sensitivity receives its share of consideration. Reduced transmitter power would appear to be compensated by employing a high-sensitivity receiver. But here again, a practical limit appears. If the receiver is too sensitive, the transmitter, although low-powered, will interfere directly with its operation. An extremely sensitive receiver also is susceptible to interference from radio transmitters, static, and hum fields.

Streamlined Layout

The old-time treasure locators were extremely bulky. The loop antennas were usually 2 to 4 feet square and were placed on the front and rear ends of a 5-foot-long wooden framework which the operator straddled. These devices were heavy, ungainly, and hard to transport.

In developing the locator described in this article, size reduction was a major consideration. The over-all dimensions of the loop antennas were reduced progressively to determine the smallest size at which satisfactory 175-kc. operation could be obtained with metals at known depths. The final selection was 1-foot-diameter coils, 1¼ inch wide. The distance between transmitting and receiving loops was closed down to the smallest separation at which direct interference was negligible. This was done in order to shorten the locator framework. Final separation is approximately 26 inches between the nearest points with the loops at right angles to each other.

The time-honored wood construction was eliminated. All-metal construction gives superior shielding, slenderized proportions, and better durability.

The present model has substituted miniature tubes and components and small batteries, all with the same capabilities as the larger tubes and components formerly used.

Structural features of the instrument are shown in the photographs and drawings. The main box, which holds the receiver chassis and batteries, is a standard 10" x 8" x 7" radio utility box. The carrying handle, intensity meter, sensitivity control, headphone jack, and "on-off" switches are mounted in the top of this box. (See Fig. 8.)

An 18-inch length of ⅜-inch-diameter dural pipe (with 1/16" wall thickness) extends backward from the top rear of the main box and supports the transmitter box. The entire transmitter circuit is contained within the latter, a 5" x 4" x 3" aluminum chassis box. "A" and "B" battery leads are pulled through the 18-inch pipe into the main box. The pipe is strong and gives good support to the transmitter. The transmitter loop is mounted directly to the bottom of the transmitter box by means of a shaft bushing passed through the hole in the hub of the loop wheel.

A 12-inch length of pipe extends downward from the bottom of the main box and holds the receiving loop. A length of RG-29/U coaxial cable brings the loop connections through this pipe into the main box to the receiver. This cable is visible in Figs. 2, 3, and 7.

The two loops are wound on 12-inch-diameter flanged Lucite wheels. These wheels have been designed especially for this metal locator and are obtainable from D. M. Ackley, 131 E. 137th Street, Hawthorne, California.

In use, the metal locator is grasped by the carrying handle. The transmitting loop extends to the rear, and the receiving loop downward. (See Fig. 1). The layout keeps all sections of the instrument in the proper relationship without requiring an awkward superstructure. The transmitter is mounted close to its loop tank, and the all-metal construction provides good electrical shielding. Use of aluminum in all parts, except the main box, which was available only in steel, minimizes weight. When necessary, the pipe assemblies may be dismantled for easy transportation of the instrument.

Fig. 4 is the complete circuit diagram. The receiver (Fig. 4A) is a fixed-tuned t.r.f. unit, consisting of two 1U4 pentode, i.f. transformer-tuned, r.f. amplifier stages (V_1 and V_2); a germanium diode detector (1N34); and a triode-connected 1U4 audio amplifier stage (V_3). Both of the transformers are of the miniature iron-core-tuned type. T_1 is a *Miller* No. 012-K2. T_2 is a *Miller* No. 012-K4. Fixed condensers shunting the primary and secondary windings of the transformers are inside the transformers and are not shown in the schematic. The receiving loop, L_1, is the grid coil of the 1st r.f. amplifier, and is tuned by the combination of C_1 and C_2.

The rectified d.c. component from

the diode is applied to the 0-100 d.c. microammeter, M_1, through the 1000-ohm resistor, R_5. The deflection of this meter is proportional to the average value of the received carrier.

The audio component of detector voltage, developed across R_5, is presented to the grid of the a.f. amplifier, V_3. High-impedance headphones are capacitance-coupled to the output of V_3 through jack J_1.

The screen potentiometer, R_2, serves as an r.f. gain control for adjusting sensitivity of the receiver.

The receiver operates on 1½ volts for the tube filaments and 90 volts for the plates and screens. A small 90-volt "B" battery (*Burgess* N60), B_2, and medium 1½-volt "A" battery (*Burgess* 2FBP), B_1, are used. The receiver "on-off" switch, S_1, is mounted on the sensitivity control, R_2. This switch interrupts filaments only. Since there is no "B" battery drain unless the filaments are burning, this switch is the only one required in the receiver.

The entire receiver is built on a standard aluminum U-chassis, 5" long, 3½" wide, and 2" high. Figs. 2 and 3 show constructional details of the receiver. Mounting of the receiver inside the main box is shown in Fig. 7.

The transmitter (Fig. 4B) is built around a triode-connected 3S4 tube, V_4. At 135 volts, this tube has the same capabilities as the paralleled pair of 1A5G tubes so often used in the transmitter sections of the old-time treasure locators. A shunt-fed Hartley arrangement is used with the tank-coil tap grounded. The tank coil, L_2, is the transmitting loop, and is tuned by C_8 and C_9 in parallel. The air trimmer, C_9, which is screwdriver-adjusted from the outside of the transmitter box, allows close adjustment of the transmitter to the receiver frequency.

The oscillator circuit employed in the transmitter is self-modulating. An amplitude modulation frequency of approximately 250 cycles is obtained by means of squegging action by the high value of the grid resistor (3.3 megohms) R_8. This expedient saves the complication of an additional audio modulator stage.

The transmitter is powered by a separate 1½ volt "A" battery, B_1, (*Burgess* 2FBP) and 135 volts of "B" battery, B_3, provided by two 67½-volt batteries (*Burgess* XX45) in series. As in the receiver, only a filament switch, S_2, is provided, since there is no "B" battery drain when the 3S4 filament is extinguished.

Construction

The photographs show the mechanical details of the instrument.

The 18-inch, ⅜"-diameter dural pipe supporting the transmitter box, and the similar 12" pipe supporting the receiving loop are threaded ½-inch on each end for ⅜-24 hexagonal nuts. The pipes are attached to the boxes by means of a pair of nuts on each end of each pipe. Scrape the enamel clean around the pipe holes on the boxes, to insure good grounding.

Mechanical details of the transmitter and receiver units are given in the section "Streamlined Layout." The receiver tubes must be shielded to prevent oscillation.

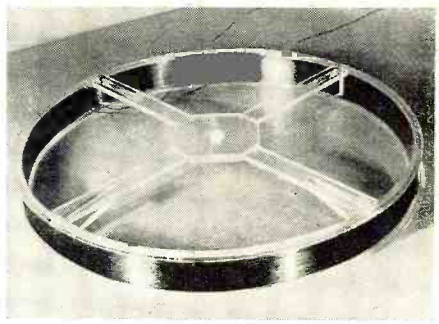


Fig. 5. One of the loop antennas employed in the metal locator. Both loops are wound on 1-foot diameter Lucite wheels. The center hole takes the supporting dural pipe.

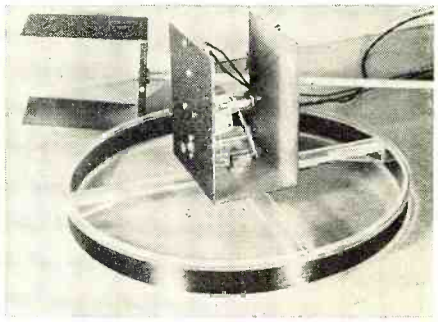


Fig. 6. The transmitter section. The unit is assembled inside the metal box which is attached directly to the transmitting loop which is the transmitter tank coil. The sides of the transmitter box with supporting pipe, through which the leads are pulled into the main box, are shown at rear.

Wiring is not critical in either transmitter or receiver. However, attention must be given the usual rules of good wiring practice, especially

(*Continued on page* 119)

Fig. 7. Inside view of main box. Transmitter loop pipe is visible at upper right. The receiving loop pipe has not been attached. Batteries were later secured with a strap and buckle.

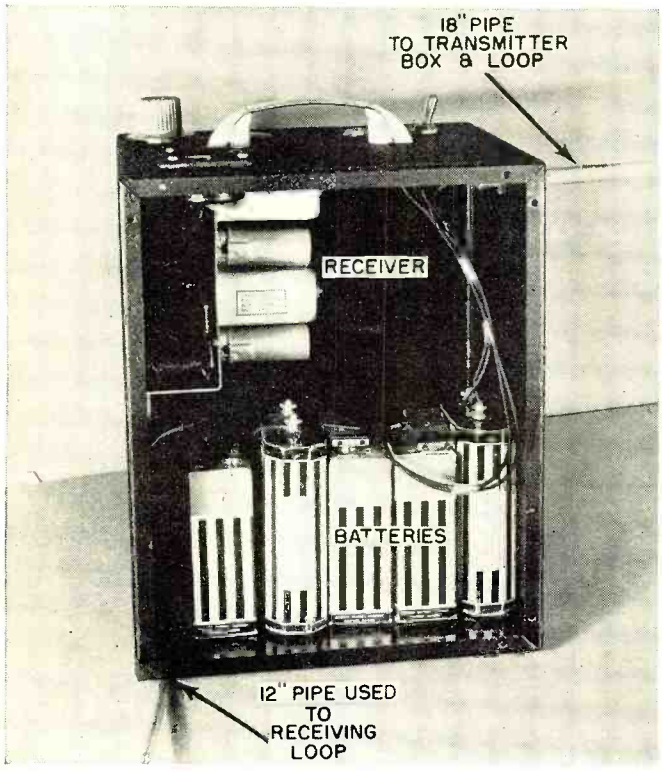
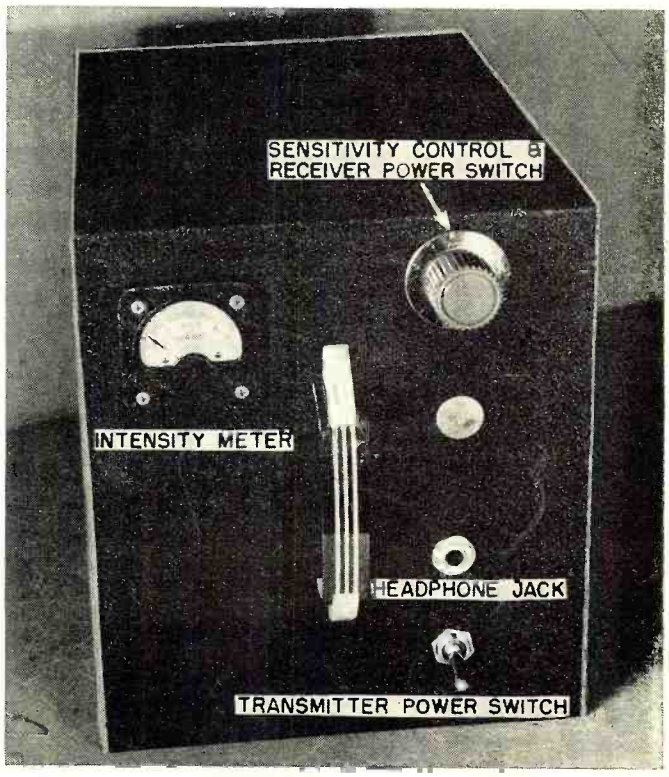
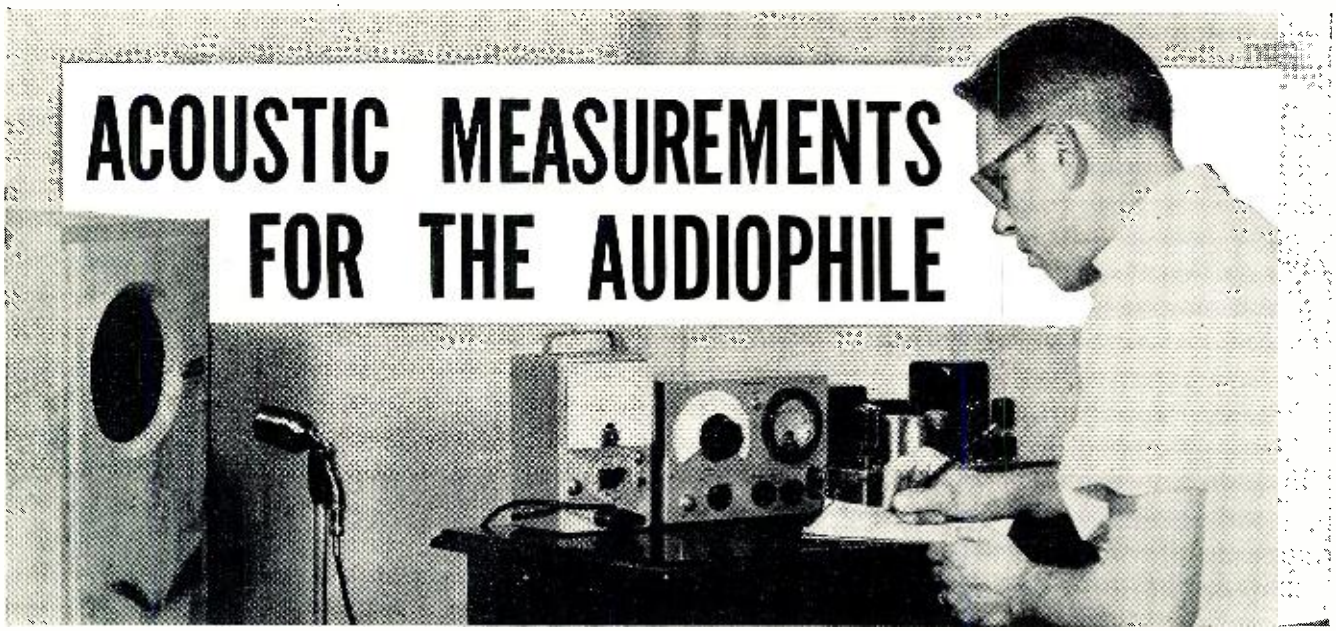


Fig. 8. Top view of the main chassis. The loop antenna pipes have not been attached as yet to the bottom and back of box. "Butch plug," at right of meter, covers hole cut by mistake.



ACOUSTIC MEASUREMENTS FOR THE AUDIOPHILE



Author's setup for making the acoustic measurements described in text. Room was 15x30 feet.

By **LAWRENCE FLEMING**

Many important and pertinent details about your speaker system can be obtained from the simple tests described.

WHY can't the frequency response of a loudspeaker be measured with a good microphone and some simple test equipment, as is done every day with amplifiers and tone control circuits? The answer is that it can. Room reflections will put a lot of extra humps and valleys in the response curve, so that it can't be called very accurate or authoritative; but it will show the performance of the speaker in that location, and will give a far better index of the quality of the system than no curve at all.

Besides the speaker itself and an amplifier to drive it, only three pieces of measuring gear are needed: an audio oscillator, a microphone, and an audio voltmeter. In this day of inexpensive kits, a perfectly satisfactory oscillator and audio voltmeter can be bought in kit form for less than sixty dollars. For less than half this cost, microphones are available that are flat ± 2 db from 60 to 10,000 cycles—so much better than any cone speaker that they can serve as a good practical standard.

The big laboratories such as *Bell Telephone* and Harvard use only one facility, barring such luxuries as automatic curve recorders, that can't be duplicated by an individual. This is the big acoustically-dead room or anechoic chamber. This article is intended to show how one can get useful and interesting results without such a room, but a short look at what the room does will not be amiss. The walls of any ordinary room reflect sound pretty well, and even acoustic tile is a poor absorber at low frequencies. The standing waves which result will fill the measured response curve full of extra peaks and dips which are not the fault of the speaker at all, but of the room. The best way to get rid of these room resonances is to build a really dead room, a good-sized anechoic chamber which, incidentally, costs at least as much as a five-room house. The next best solution is to hang the speaker and microphone from the top of a tall pole out-of-doors. Wind and ambient noise are difficulties here. The third best scheme is to point the speaker out of a window, with the microphone supported in front of it on the end of a pole.

To get a reasonably accurate, *authoritative* response curve, which can be used in engineering reports and manufacturers' literature, the tests must be made in an anechoic chamber or at least out-of-doors.

Indoor Tests

No one listens to a speaker in an anechoic chamber. What we listen to is a speaker-living-room combination. Why not, then, check a sound system in the room in which it is used? True, the results will not be exactly valid for some other room, or even for a different location in the same room. But the maximum frequency range of the system can always be found and the best equalization for that room and speaker system can be determined.

Trials made by the writer, and published data, indicate moreover that room reflections do not mask the important over-all characteristics of a speaker's response curve. The authoritative text by Beranek[1] shows smoothed response curves for the same speaker in five widely different rooms. With the small kinks smoothed out, all curves agreed within ± 3 db below 700 cycles and within ± 1 db above 700 cycles.

Working in an attic room about 15 x 30 feet with ordinary *Celotex* walls, the writer finds that the effects on response of sizeable changes in the size of the port in a bass-reflex enclosure, of changes in enclosure volume, and of the cavity due to the speaker being set back an inch or so from the front face of the cabinet, all stand out clearly in the plotted curves.

Equipment

Fig. 2 is a block diagram of the test set-up. Any of the audio oscillators on the market, either in kit or assembled form, will do for the signal source. Constant output within 1 db or so from 30 to 15,000 cycles is all that is required. The amplifier should be flat over this range, but need not deliver much power, since only half a watt or less is needed to deliver a good signal to the mike. If the amplifier should be a poor pentode job with little damping, incidentally, a boomy speaker resonance will stand out like a sore thumb when the curve is drawn.

The audio voltmeter used by the writer was a *Heathkit* AV-2. Others may be available; the *Ballantine* Model 300 is one of the best but too expensive for the average audiophile, or one can be constructed from available parts[2] if a well-stocked junk box is on hand.

The microphone used by the writer

is an *Electro-Voice* Model 630, an inexpensive dynamic unit which has exceedingly flat response (as supplied by the manufacturer) from 80 to 5000 cycles, and no peaks greater than 1 db from 70 to 10,000. It is down 5 db at 50 and 13,000 cycles. Most microphone manufacturers will supply an individual response curve at small cost. The dynamic was preferred to the crystal because the low (1 megohm) input impedance of the audio voltmeter will droop the bass response of a crystal somewhat, perhaps 3 db at 50 cycles, and this droop will vary in Rochelle salt crystals with temperature. The dynamic is somewhat an individual preference, however, and many microphone manufacturers recommend crystal mikes for this type of service.

If higher cost is no drawback, a top-quality condenser microphone is the best of all, with a high-grade, broadcast-quality dynamic ranking second. Ribbon microphones are probably less desirable because of their lower output and the artificial bass emphasis that results from placing the microphone too close to the sound source.

The important point is that any microphone (except carbon and speech-only types) has vastly smoother response than any cone speaker, and much smoother than most horns. This is because a microphone is much smaller than a speaker. Where the size of any speaker cone leads to complicated multiple resonances from a few hundred cycles on up, the small dimensions of a mike make it inherently smooth up to 10 kc. or so. In the middle audio range where enclosure resonances and cone breakup produce the rough jagged frequency response typical of cones, the mike is flat as a die, relatively, and makes a perfectly practical standard of comparison.

Taking the Curves

The closer the microphone is to the speaker, the greater will be the ratio of direct-to-reflected sound picked up by the mike. While there are advantages to working several feet away, the best practice in ordinary indoor surroundings is to place the mike a foot or two away. In non-coaxial, two-way systems, the mike should be placed closer to the front of the tweeter, because the bass unit is less directional;

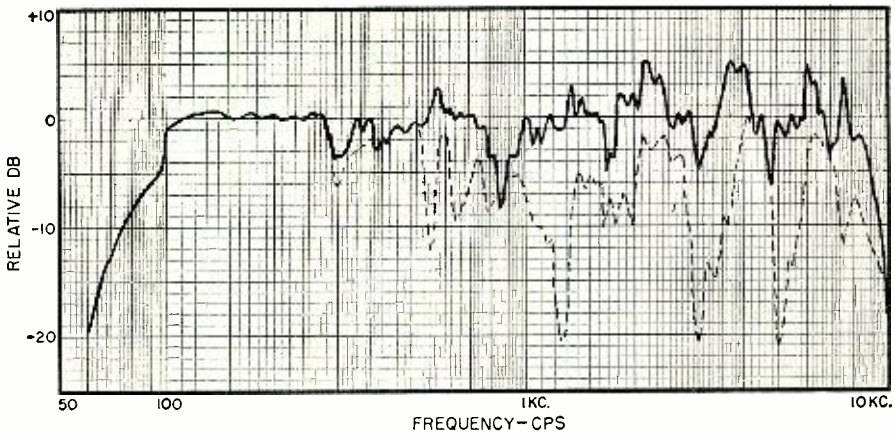


Fig. 1. Response of a good quality, 8-inch speaker as measured in a 2 cubic foot padded enclosed cabinet, and taken in a large room. Dotted curve shows effect of cavity resonances due to the closing of one of double doors on front of cabinet.

but if the curve obtained is jagged at the crossover frequency it may be the fault of the mike location, and some experimenting with its position is indicated.

The audio oscillator and the audio voltmeter must be located alongside each other, because a lot of looking back and forth will be needed.

Set the oscillator at around 200 cycles and set the level to give a convenient reading on the audio voltmeter —high enough so that a 10 db dip is easily readable, and low enough to keep from waking the neighbors. Around 8 millivolts is typical. Now run the oscillator frequency over the audio range to get a general preliminary visual picture of the character of the curve, and reset the level if necessary.

The actual plotting on graph paper cannot be done completely point-by-point, as it is when measuring electrical circuits, because the curve is generally far too complicated. Cones, at any rate, have hundreds of little peaks and dips throughout the range, and much of this fine detail is affected by the presence of nearby objects and even by the position of the operator himself. Even in large laboratories the practice is to discard much of this fine structure before publishing a curve. The procedure required is to plot, as points, only a couple of dozen or so of the crests of the main peaks and troughs of the important valleys. Sketch in the intermediate wiggles to

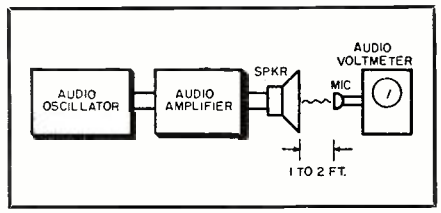


Fig. 2. Setup for measuring speaker response.

taste. One might, for example, mark the top of a 6 db peak at 310 cycles, then the bottom of an 8 db dip at 550 cycles, and fill in the space between freehand, based on the observation that there were four small wiggles alternating between 0 db and + 2 db in the interval.

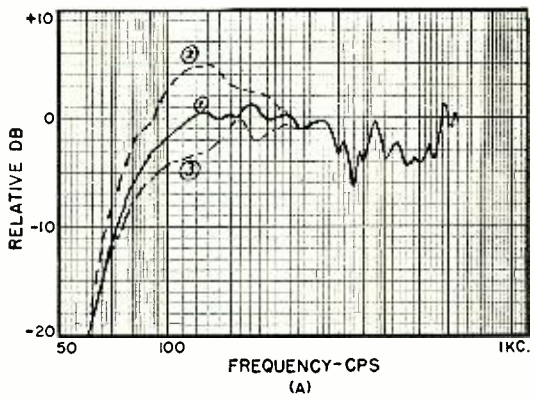
An estimate of the order of magnitude of the room reflections can be gained by placing the microphone facing away from the speaker in various locations near the other walls, and looking for frequencies where an appreciable signal is picked up. Such reflections are generally strongest in the low and middle audio range, less so above 1 or 2 kc.

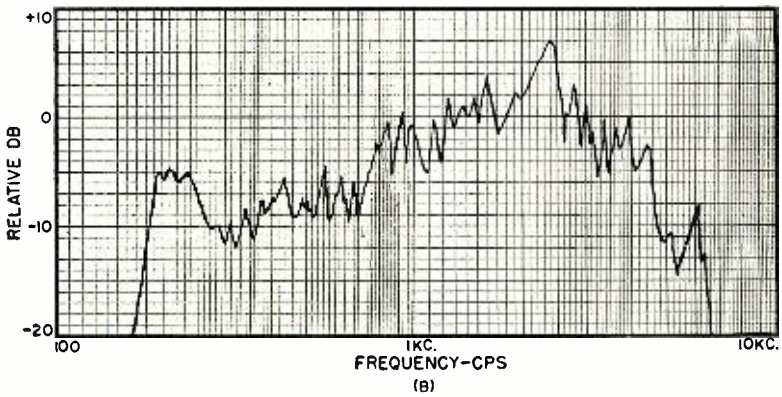
Practice in taking this kind of data is very helpful. A single curve is not of too much value, but after taking several in different locations, or with different speakers or modified enclosures, the utility of the set-up can be appreciated.

Some curves taken by the writer in

(*Continued on page* 112)

Fig. 3. (A) Example of bass changes. (1) 8" plastic-edged cone, triode feedback amplifier, 2 cu. ft. closed box; (2) Same unit driven from high-impedance source; and (3) With back of box removed. (B) Measured response of 4" speaker in table-model receiver.

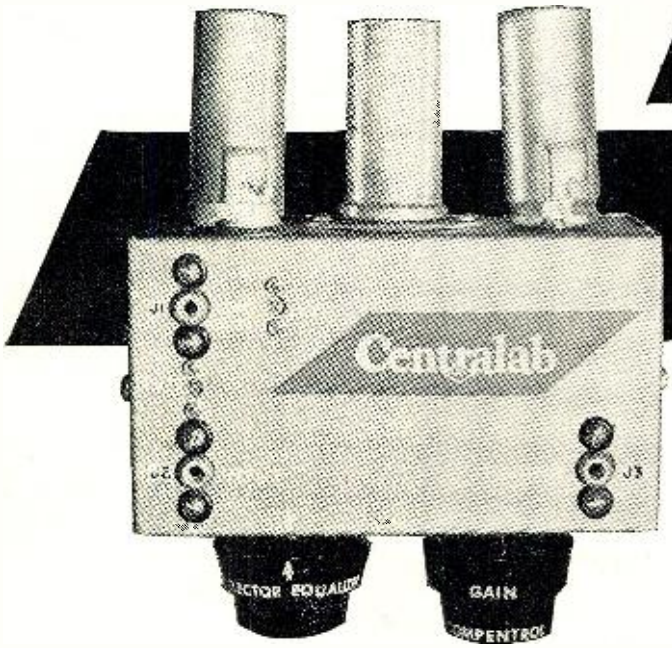




MINIATURE PREAMP

By
ROBERT WIENER
Product Engineer
Centralab, Div. of Globe-Union, Inc.

Fig. 1. The Printed Electronic Circuit preamp which measures 5½"x3"x2⅛". With equalizers using standard components, the over-all size of the unit will have to be enlarged.



This compact preamplifier was designed to demonstrate how miniaturization can be accomplished through use of printed circuits. Although it cannot be duplicated exactly in the form shown, it can be reproduced to a reasonable degree by substituting standard radio parts for the printed circuits which are not currently available at parts distributors.

THE miniature preamp to be described was designed, primarily, to demonstrate the practicality of printed circuits in audio gear rather than to present any radically new or startling circuitry.

The fact that the final version of this experimental circuit required only two dual-triodes and a minimum of controls was a pleasant "bonus."

The most important feature of the unit is its small size which has been achieved by using *Centralab* PEC's (Printed Electronic Circuits) wherever possible. With the exception of the five equalizer circuits, all of the listed components are readily available. By making the chassis slightly larger, standard components can be substituted for the printed equalizer networks.

Simplicity of operation is obtained by using only three controls: a selector-equalizer switch and a dual control consisting of a "Compentrol"[1] (*Centralab's* compensated loudness control) and a gain control. The selector-equalizer switch has six settings, the first five being phono equalizer positions and the sixth bypassing the equalizers for other sources. More inputs may be added but, for the purposes of this article, only one additional position is included. The selection of equalizer positions, as shown in Fig. 4, will provide most settings normally required.

Centralab has recently introduced the "Senior Compentrol." This is a dual concentric unit with the compensated loudness control mounted on the rear and operated by the inner shaft (front knob). A level-set unit, the front control, is connected to the "Compentrol" and is operated by the outer shaft (rear knob).

The debate over compensated loudness controls *vs* tone controls has been, is, and always will be waged. However, based on the author's experience in building various control systems, he has found that usually bass and treble controls are set for flat response or some degree of boost—seldom for cut. The "Compentrol" offers a combined bass and treble boost in itself and, with the judicious use of the level set, a flexible tonal range is obtained. Despite the controversy, the reader is urged to try the unit himself and make up his own mind.

The schematic of the preamp is given in Fig. 4. There are, as mentioned previously, two dual-triodes—a 12AX7 and a 12AU7. The 12AX7 serves as the equalizer section and the 12AU7 is the preamp.

The two switch decks of the single ganged switch (S_1) in the preamp section serve separate functions. The section which switches the inputs is designated as S_{1A}. The first five positions are shorted together since these positions are the five phonograph equalizer positions controlled by the other deck. The sixth position connects directly to the input J_2 and R_8. Switch S_{1B} is used to select any of the five available equalizer circuits and in its sixth position disables this portion of the circuit.

The first input, J_1, is for phono. The second input, J_2, is for radio, TV, tape, or any input having the higher voltage output commonly associated with these program sources. This jack is connected to the level set, R_8. This level set, as well as R_7 for the phono input, is a *Centralab* Model 1 control used in hearing aids and miniature radio receivers. The one used in the construction was specially modified with mounting studs so that the control could be attached directly to the chassis, with the screwdriver shaft available as a semi-permanent adjustment. A standard midget hearing aid control (the *Centralab* B16-118) can be used equally as well.

The switch rotor of S_{1A} is connected

Fig. 2. Equivalent circuits for the printed circuit equalizers shown dotted in Fig. 4.

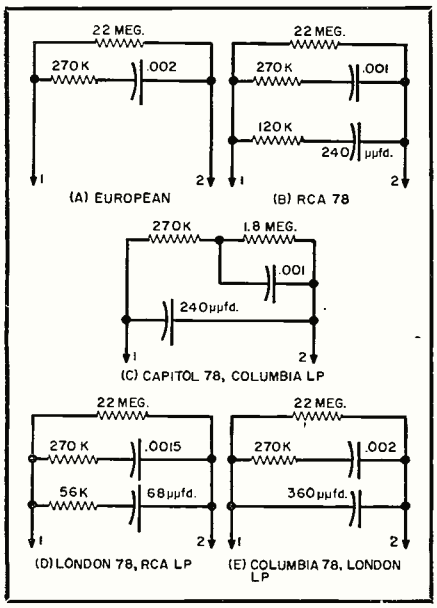
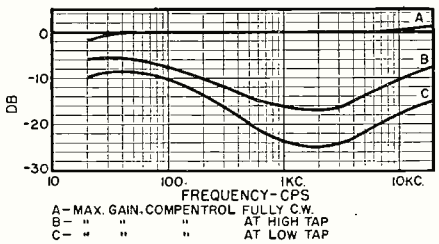


Fig. 3. Gain vs frequency of preamp equalizer. Input is .245 v. at J_2, 0 db level 24.5 v. at 1 kc. "B+" is 240 volts d.c.



to the low-frequency filter composed of C_6, C_7, C_8, R_{12}, R_{13}, and R_{14}. Following this is the first section of the 12AU7 feeding the volume control R_{16}. R_{16} was inserted in the stage preceding the "Compentrol" to do away with a grid resistor for V_{2B}, as well as to decrease some noise commonly encountered in high-gain amplifiers. Ordinarily the "Senior Compentrol" is to be used with the level-set control feeding the "Compentrol" directly. This is the manner in which they are supplied, but the user may make this change if he feels that it is desirable.

The center terminal of the level-set control is tied to the grid of the output stage, V_{2B}, and its plate a.c.-coupled to the right terminal of the "Compentrol." There are several points to be noted about placing the "Compentrol" in the output of the preamp. With this connection, the grid resistor of the following stage, usually the first audio stage of the power amplifier, should be removed. That is, the "Compentrol" should feed directly into the following grid. In addition, the device is one which exhibits decreasing impedance with increasing frequency and thus, aside from exceedingly low frequencies which are filtered out in the low-frequency filter, offers a low-impedance output.

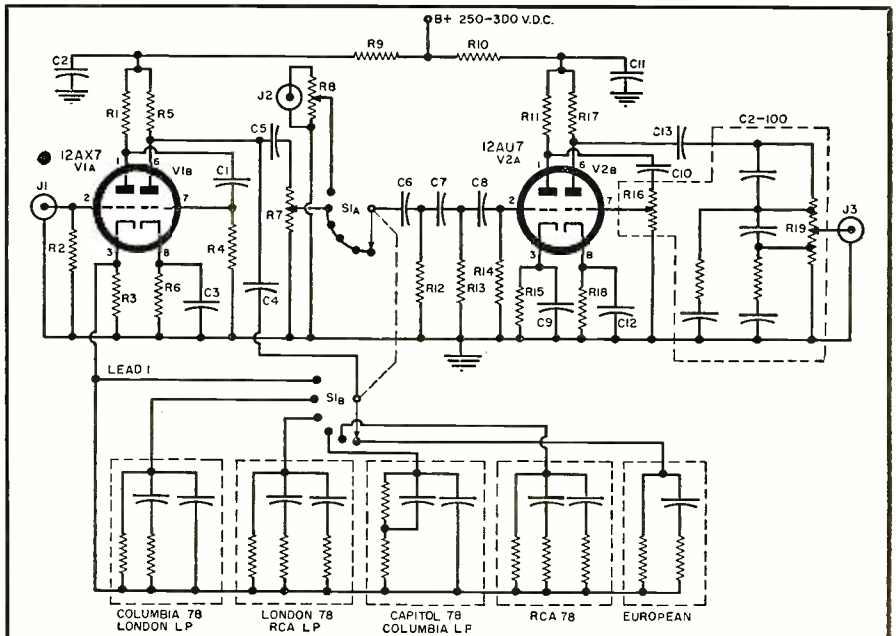
The impedance level may not be comparable to that of a cathode follower when connected with long cables to the power amplifier but with this control in the output, the gain that would have been lost in the cathode follower is retained and some measure of low-impedance output is obtained. A phono jack, J_3, tied to the center terminal of the "Compentrol," is the output take-off to the power amplifier.

The response of the preamp portion of the circuit is shown in the graph of Fig. 3. The response was obtained with the input at J_2 and the gain maximum, *i.e.*, level set, volume, and "Compentrol" full on. Curve A of Fig. 3 shows the response of these two stages. At 20 cps, the output is down about 2 db while at 20,000 cps it is up about 1½ db. The response is quite good but may be modified if desired. The droop at the low-frequency end of the spectrum is due to the low-frequency filter taking over. Unfortunately, none of the audio generators available to the author furnished a lower frequency than 18 cps so the effect of the filter cannot be demonstrated here.

The high-frequency rise could be decreased by changing the value of C_9, the cathode bypass condenser for V_{2A}. This is a .01 μfd. ceramic unit and can be increased in value by some 50 per-cent to drop the response. Other means can be employed but since they are familiar to the hi-fi enthusiast, they will not be discussed here.

Curves B and C (Fig. 3) show the output curve when the "Compentrol" is set at the high (62½ per-cent rotation) and the low tap (37½ per-cent rotation) respectively.

Referring to Fig. 3, the gain figure is 100 or 40 db since the input voltage at J_2 was .245 volt (1 kc.) and the output voltage at J_3 was 24.5 volts.



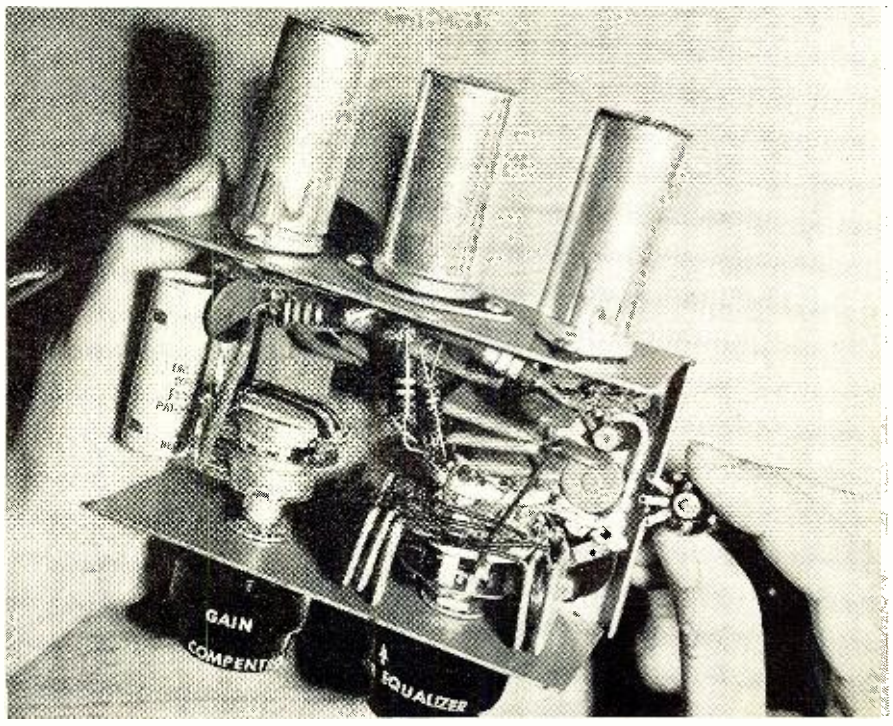
R_1, R_5—270,000 ohm, 1 w. res.
R_2, R_4—1 megohm, ½ w. res.
R_3, R_6—2700 ohm, ½ w. res.
R_7, R_8—500,000 ohm pot. (Any midget unit of type used in hearing aids may be used)
R_9—15,000 ohm, 1 w. res.
R_{10}—10,000 ohm, 1 w. res.
R_{11}—47,000 ohm, 1 w. res.
R_{12}, R_{13}, R_{14}—820,000 ohm, ½ w. res.
R_{15}—1800 ohm, ½ w. res.
R_{16}, R_{19}—Parts of the C2-100 unit. (Note modification as explained in text)
R_{17}—100,000 ohm, 1 w. res.
R_{18}—2200 ohm, ½ w. res.
C_1, C_4—.02 μfd., 600 v. ceramic cond. (Centralab "Hi-Kap" DD-203)
C_2-C_{11}—8/8 μfd., 450 v. elec. cond.
C_3, C_{12}—50 μfd., 50 v. elec. cond.
C_5, C_6, C_7, C_8, C_{10}, C_{13}—.1 μfd., 600 v. ceramic cond. (Centralab "Hi-Kap" DF-104)
C_9—.01 μfd., 600 v. ceramic cond. (Centralab "Hi-Kap" DD-1032)
C_{2-100}—Senior Compentrol (Centralab C2-100)
S_{1A}-S_{1B}—D.p. 12 pos. shorting switch (Centralab PA-2004)
J_1, J_2, J_3—Phono jack
V_1—12AX7 tube
V_2—12AU7 tube

Fig. 4. Complete schematic of the printed circuit preamp. The equalizer networks, shown dotted at lower left, are not commercially available but suitable networks can be substituted by following the diagrams and parts values shown in Fig. 2.

The equalizer circuit is basically the one used in the *H. H. Scott* 120-A

(*Continued on page* 78)

Fig. 5. Interior view of the preamp showing compact arrangement of components, use of the PEC plates, and the special Model 1 subminiature control (held in hand). The equalizer switch's arrow is pointed to the "European" equalizer.



FUNDAMENTALS OF COLOR TV

COLOR SYNCHRONIZATION

By **MILTON S. KIVER**
Pres., Television Communications Institute

Shown below is the new Du Mont 19-inch "Chroma-Sync" color TV picture tube which uses three guns and a curved mask.

Part 7. The color sync section—its job is to make certain that the correct colors are reproduced.

THE SERVICE technician is by now fully acquainted with the function of the sync circuits in a black-and-white receiver. Briefly stated, they serve to maintain the picture in synchronism with the scene being transmitted by the station. In a color receiver similar circuits are employed for the same purpose. In addition, color receivers must be told what colors to produce at each point in the picture and for this purpose a special color sync signal is sent. This sync signal takes the form of a burst which is placed on the back porch of each horizontal sync pulse and consists of at least 8 cycles of the missing 3.58 mc. color subcarrier.

In the receiver this special color sync burst is separated from the rest of the signal and routed to a color sync section. (Here, again, the similarity to the sync pulses is apparent.) The purpose of the color sync section in a color television receiver is to insure that the color subcarrier which is recombined with the received color signal possesses the correct frequency and the proper phase. Both are important if we are to re-obtain the desired color voltages at the output of the *I* and *Q* demodulators.

It may be well to recall at this point that each color is represented by a different angular position of the resultant *I* and *Q* vectors. See Fig. 1. For example, green is 61° behind the reference burst (in a counterclockwise direction); red is 77° ahead of the burst, etc. To produce a given color requires that the *I* and *Q* vectors combine with each other to produce a resultant whose position occupies the angular position of that color. There is nothing fundamentally rigid about these different color positions. Actually, all they represent is a system in which various colors are represented by certain angular positions with respect to a given reference. In the present instance, the phase of the color burst is the reference and the correct reproduction of the color scene at the receiver hinges on the fact that the phase of the color burst is fixed by the FCC and that the color subcarrier which is re-inserted in the color signal has its phase established by the color burst.

Should something occur at the transmitter which causes the color burst phase to vary, without a corresponding change in the angular positions of the various colors, then the set viewer will be treated to the spectacle of seeing the various colors in the picture change. By the same token, any instability in the color sync circuits of a receiver will also lead to the development of the wrong colors. In fact, it has been found that a change of only ± 5 degrees in the phase of the color subcarrier will produce a noticeable change in the color picture. From this it is evident that the tolerances in the color sync section are among the most stringent in the entire color receiver. It is safe to predict that many of the service technician's headaches will originate right here.

There are several approaches to the development of 3.58-mc. signals possessing the proper phase and frequency. One method, illustrated in Figs. 2 and 4, employs an automatic phase control (a.p.c.) system in conjunction with a crystal oscillator. The input to the color sync section is at the burst amplifier. This stage is normally cut off (by a high positive voltage on the cathode) except when the color burst is passing through the receiver. At these instants, a negative pulse of about 37 volts is obtained from a winding on the horizontal output transformer and applied to the cathode of the color burst amplifier. The pulse counteracts the positive cathode voltage and permits the tube to conduct, amplifying and then transferring the color burst to the following phase detector.

The transformer in the plate circuit of the burst amplifier has a high-impedance primary and a bifilar secondary tightly coupled to the primary. The burst signal voltage is on the order of 60 volts peak-to-peak on either side of the secondary center tap.

In the phase detector, two triodes are employed to compare the frequency and phase of the received color burst with the frequency and phase of a locally-generated c.w. signal. The latter voltage is brought into the phase circuit *via* a color phasing amplifier

EDITOR'S NOTE: *Part 1 of this series, which appeared in the March, 1954 issue, explained color mixing and its application in color TV. Part 2, appearing in the April issue, described the NTSC color signal. The block diagram of a typical color TV receiver was described in the May issue. The June article in this series described the tuner, sound, and some of the video circuits of a color receiver. Typical chrominance circuits (demodulator, matrix, adders, etc.) were analyzed in the July article. The formation and composition of the color signal were explained in August.*

In view of the many requests received, RADIO & TELEVISION NEWS *will publish this series in reprint form. The first three parts are in a single unit (50 cents), the balance will be reprinted in individual parts at 20 cents each. For quantities of 50 or more, write for quotations. Address your inquiries to* RADIO & TELEVISION NEWS *Reprint Editor, 366 Madison Ave., N. Y. 17, N. Y.*

and possesses an amplitude of 25 to 35 volts peak-to-peak. If any phase difference exists between the two signals, a correction voltage is developed at point "A" and fed to the grid of a reactance tube. Here it alters the effect of the reactance circuit on the 3.58-mc. crystal oscillator and thereby causes the frequency of the oscillator to change.

For a clearer analysis, the phase detector circuit is shown by itself in Fig. 3. The incoming burst appears across the full secondary of the phase discriminator transformer and since the center-tap of this winding is effectively at ground potential (*via* C_1 which has negligible impedance at 3.58-mc.), the signal polarity at one end is 180° out-of-phase with the signal polarity at the other end. We can represent this relationship as shown in Fig. 5A. E_{K1}, the burst voltage applied to the cathode of one phase detector section is 180° out-of-phase with E_{G2}, the voltage which the grid of the other phase detector section receives.

At the same time, the cathode of V_2 and the grid of V_1 receive a portion of the generated 3.58-mc. voltage from the color phasing amplifier. This voltage, labeled E_0, can be represented as shown in Fig. 5B. The resultants of E_0 and E_{K1} and E_0 with E_{G2} are also indicated in Fig. 5B and it can be seen that they are equal. That is, E_A is equal to E_B. This represents the condition when the generated 3.58-mc. oscillations possess the proper frequency and phase with respect to the incoming color burst. There is no output voltage across C_1 and none to the reactance tube.

On the other hand, when the frequency of the generated 3.58-mc. voltage speeds up or slows down, one section of the phase detector conducts more heavily than the other and the reactance tube receives a correcting negative or positive voltage from the phase detector. Fig. 5C shows the positions of E_0 for these two latter conditions. Notice in each instance that E_A and E_B are no longer equal in length; in one case E_A is greater than E_B and in the other case it is shorter than E_B.

The correcting voltage for the reactance tube appears across condenser C_1 and is applied to grid 1 of the reactance tube (point "A"), as explained previously.

The plates of V_1 and V_2 do not enter into the operation of the phase detector circuit. They merely serve as tube shields. In some later phase detector circuits 6AL5 double diodes are used, the plates of the diodes functioning as the grids do in the circuit of Fig. 4. Another possibility is to use triode tubes connected as diodes, with the plate tied directly to the grid.

A color phase control in the output circuit of the color phasing amplifier permits manual adjustment of the phase of the local oscillator voltage applied to the phase detector. The range here is 150 degrees. This control

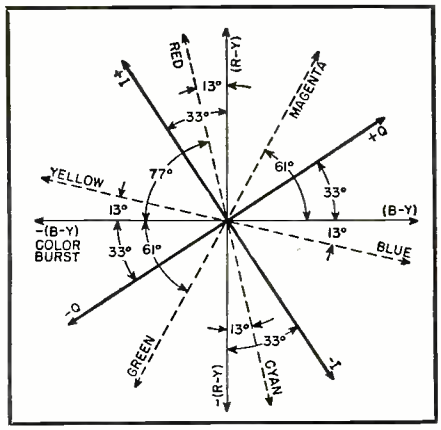
Fig. 1. Color phase diagram showing the positions of the various key colors and the I and Q vectors. The position of the color burst is shown.

is generally made available at the front panel (exposed or hidden behind a plate) to enable the set viewer to compensate for any color changes (*i.e.*, shifts) in the color sync circuits. It is also possible for the phase of the color burst signal to be altered by passage through the receiver and manual adjustment is necessary for proper color rendition. In viewing a picture, the color phase control is adjusted to achieve the most pleasing flesh tones or color of some familiar object.

One other control in the phase detector circuit is the a.f.c. balance potentiometer. This enables the technician to bring both sections of the phase detector into balance should this adjustment be required.

The crystal oscillator also produces the 3.58-mc. color subcarrier signal voltage needed by the *I* and *Q* demodulators. The *I* demodulator receives its voltage directly from the cathode of the oscillator tube. The 3.58-mc. signal for the *Q* demodulator is fed first to a quadrature amplifier where the 90° phase shift is introduced. Then it is transferred to grid No. 3 of the *Q* demodulator. Both 3.58-mc. signals are on the order of 25 to 30 volts peak-to-peak amplitude at the demodulators.

The final item in the color sync section is the color killer stage. The grid of this tube ties into the phase detector at a point ("B" in Fig. 4) where a negative voltage is developed when a color burst (and, hence, a color signal) is being received. The negative



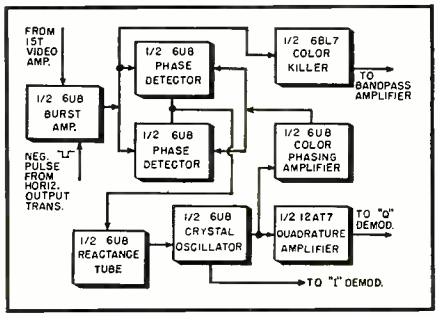


Fig. 2. Block diagram of a color sync section of a color television set.

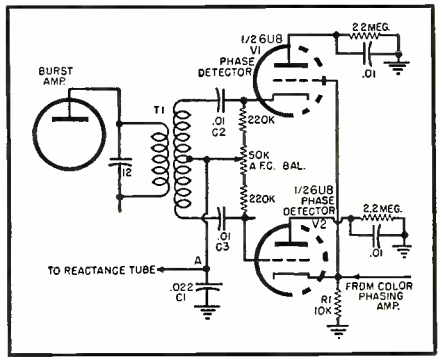


Fig. 3. Phase detector circuit of the color sync section of the set of Fig. 4.

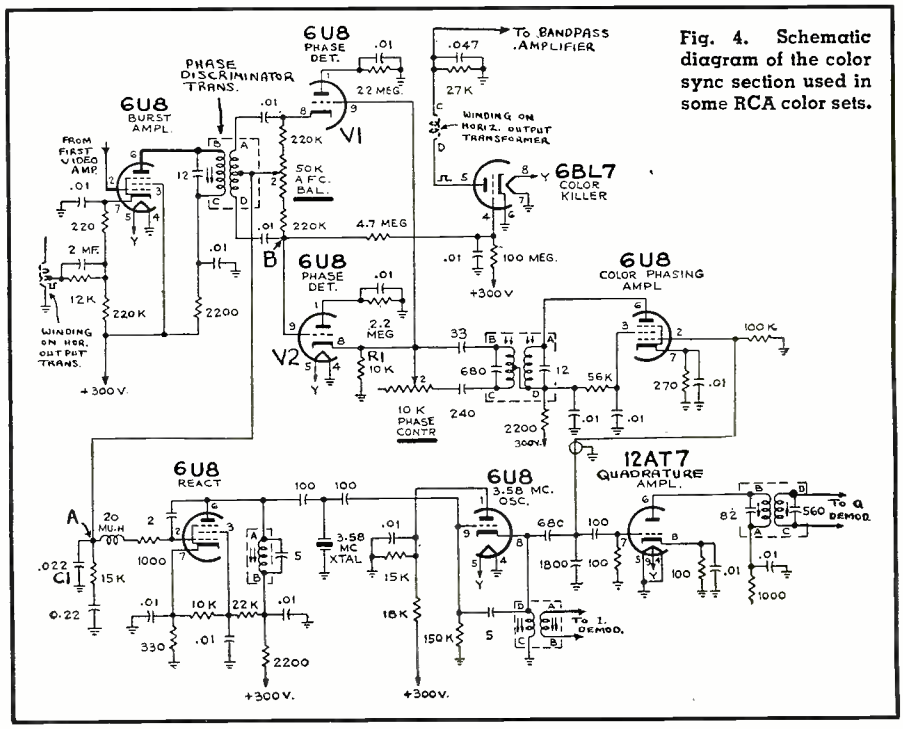


Fig. 4. Schematic diagram of the color sync section used in some RCA color sets.

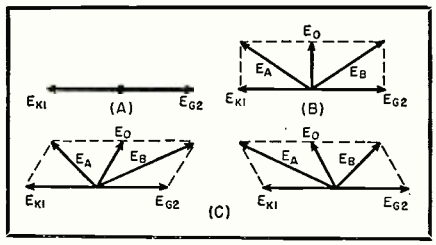


Fig. 5. Various voltage vector relationships in the phase detector circuit. (A) The incoming burst voltage applied to V_1 and V_2. (B) The combination of the burst voltage and color phasing voltage. (C) When the phasing voltage, E_o, lags (left) its normal phase, or when it leads it (right), the voltages across the phase detector tubes in Fig. 3 are unequal.

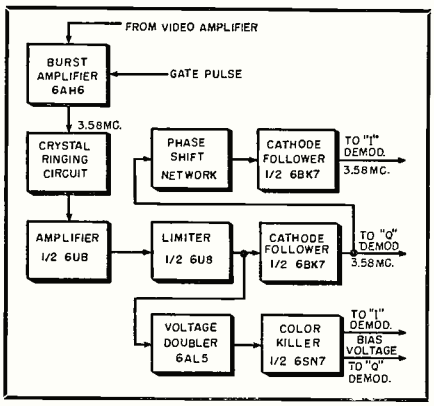


Fig. 6. Block diagram of a color sync section using a crystal ringing circuit.

voltage is strong enough to bias the color killer tube to cut-off, even when its plate receives a positive pulse from the horizontal output transformer. With no current through the tube, no voltage is developed across the plate load resistor of this tube and no bias voltage is produced for the grid of the bandpass amplifier. This enables the bandpass amplifier to conduct, which is the desired condition when color signals are being received.

Consider, now, what happens when no color signal and hence no color burst is present. The voltage at point "B" becomes slightly positive and the killer tube conducts each time its plate is pulsed positively. The flow of current through the killer tube establishes enough negative voltage across its plate load resistor to bias the bandpass amplifier to cut-off. This prevents extraneous information from reaching the color circuits and producing a random colored background.

A second type of color sync section is shown in Figs. 6 and 7. This is seen, both from its block diagram and actual circuitry, to differ in several important respects from the a.p.c. system. The most important difference lies in the use of a crystal ringing circuit as the generator of the 3.58-mc. color subcarrier signal. This circuit takes the place of the previous crystal oscillator and the phase detector network and is seen to represent a saving in parts and tubes. Its method of operation is as follows.

A quartz crystal is used which, when excited by the color burst at the start of each horizontal line, will continue to "ring" or oscillate at its natural frequency (here 3.58 mc.) for the duration of the line. A color burst from the burst amplifier activates the quartz crystal and because of its extremely high *"Q"* (hence, low loss) it continues to oscillate with very little decrease in amplitude until the next burst arrives. The trimmer condenser in series with the crystal can change its resonant frequency by several hundred cycles and thus take care of normal crystal tolerances.

The stage following the crystal is an amplifier and the stage beyond that is generally a limiter to smooth out variations in the output of the ringing circuit. Output from the limiter may be used as one of the 3.58-mc. driving voltages for the *I* or *Q* demodulators while the same output, passed through a 90° phase shifting network will provide the driving voltage for the other demodulator.

The crystal ringing method is fairly simple and when properly designed will operate satisfactorily. It does not contain any particularly critical components and so will remain stable once it has been adjusted.

A color killer network may be readily tied in with the ringing system. One approach to this is shown in Fig. 7. A portion of the oscillations developed by the crystal ringing circuit is fed to a double-diode rectifier. The circuit is a voltage-doubler and operates as follows. During the positive half of the applied wave, tube V_1 conducts and effectively charges condenser C_1 to the peak value of the wave with a polarity as indicated in Fig. 7. On the negative half cycle, the applied voltage combines with the voltage present across C_1 to yield approximately twice the peak value of the 3.58-mc. wave itself. Since the voltage is now negative, V_2 conducts and charges C_2 to approximately the same value. The voltage across C_2 is negative with respect to ground and is high enough to bias the color killer tube to cut-off. This prevents the flow of current through this tube when the plate is triggered by positive pulses obtained from the horizontal output transformer. As a result, no voltage is developed in the output circuit of the killer tube and so none can be forwarded to the grids of the *I* and *Q* demodulators. This permits the demodulators to accept color signals which is the desired action under these conditions.

Consider now what happens when no color signal is present. At these times there are no color bursts to excite the ringing crystal and so no 3.58-mc. oscillations are generated. That means that the color killer tube receives no negative voltage from the preceding bias rectifier and therefore the killer tube is able to conduct freely whenever its plate is triggered positively. This conduction leads to the development of a fairly large negative voltage in the plate circuit of the killer tube and this voltage is forwarded to the grids of the *I* and *Q* demodulators, keeping these latter stages in a cut-off condition.

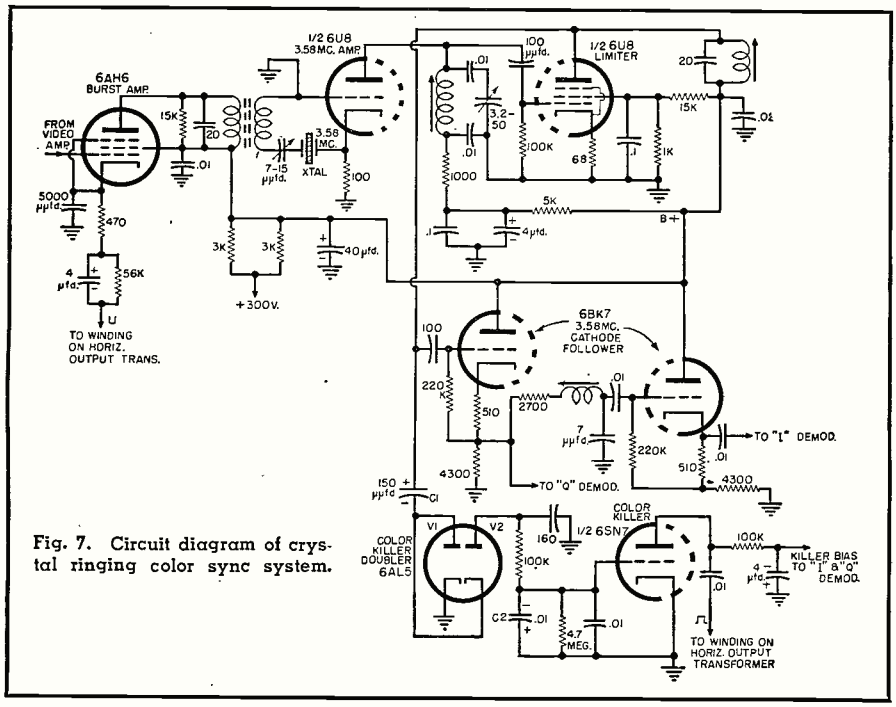


Fig. 7. Circuit diagram of crystal ringing color sync system.

Sync Separators and A.G.C.

The sync separator and a.g.c. sections of a color television receiver do not differ either in form or purpose from the same stages of a black-and-white receiver. As proof of this, the sync separator stages of a color television receiver are shown in Fig. 8. The input signal is obtained from the video detector or some point immediately thereafter and fed to the sync separator stages where as much of the video signal as possible is removed. In Fig. 8, the separated pulses then go to a phase splitter or inverter where pos-

(*Continued on page* 174)

DOT PATTERN GENERATOR FOR COLOR AND MONOCHROME

By
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RADIO & TELEVISION NEWS

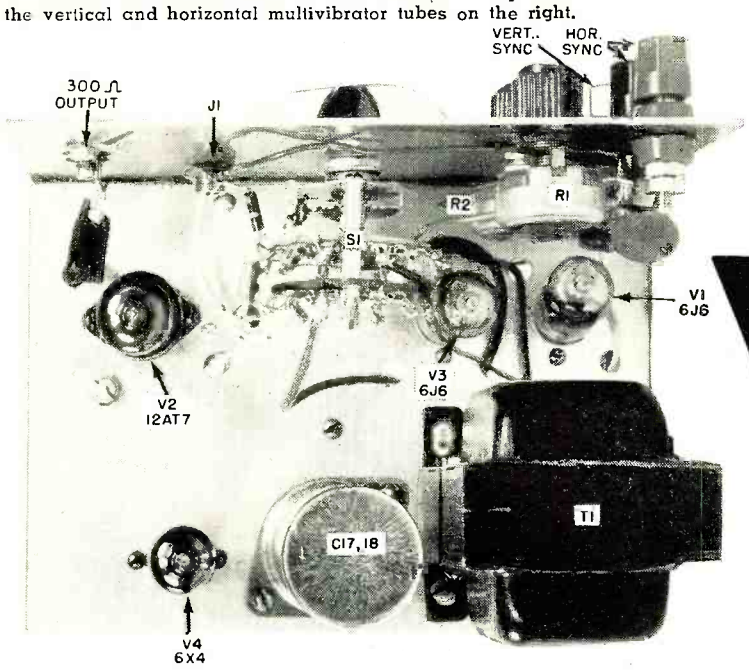


Fig. 1. Top view of the pattern generator showing the parts layout. Note how the video amplifier-r.f. oscillator tube is located on the left side of the chassis, away from the vertical and horizontal multivibrator tubes on the right.

Here's an instrument which is invaluable for color TV servicing and is easily built from standard parts.

OF GREAT IMPORTANCE in color TV receivers are the d.c. and dynamic convergence adjustments which determine correct color registry. In addition, the vertical and horizontal linearity controls must also be set much more accurately than in black and white receivers. For this reason service technicians will need a pattern generator which produces horizontal and vertical bars as well as a white dot pattern.

In this article we present a simple pattern generator which can be constructed by anyone familiar with radio and TV. All parts used are standard items and a minimum of alignment is required.

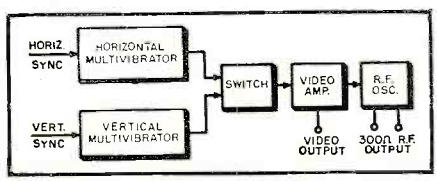
This pattern generator is useful for current black-and-white TV service work since it furnishes modulated r.f. as well as a video signal for four different patterns. A switch selects either the white dot, crosshatch or grid, vertical bar, or horizontal bar pattern. Internal or external vertical and horizontal synchronization is possible.

Circuit Operation

As can be seen from the block diagram in Fig. 2, the unit consists of four major sections. The horizontal multivibrator, running at a multiple of the horizontal scanning frequency, generates narrow vertical bars on the picture-tube screen. Operating at some multiple of the vertical scanning frequency, the vertical multivibrator produces horizontal bars on the screen. By means of a switching network, the outputs of these two pulse generators are fed to a gating and video amplifier tube. The output of this stage modulates the r.f. oscillator which covers channels 2 to 6 and has a 300-ohm balanced output. If the video signal itself is desired, it can be taken off through a separate terminal on the front panel and applied directly to the second detector or video amplifier in the TV set. For r.f. operation, a short length of 300-ohm twin-lead is connected from the pattern generator to the antenna terminals of the TV set. Any of the low frequency TV channels can be used.

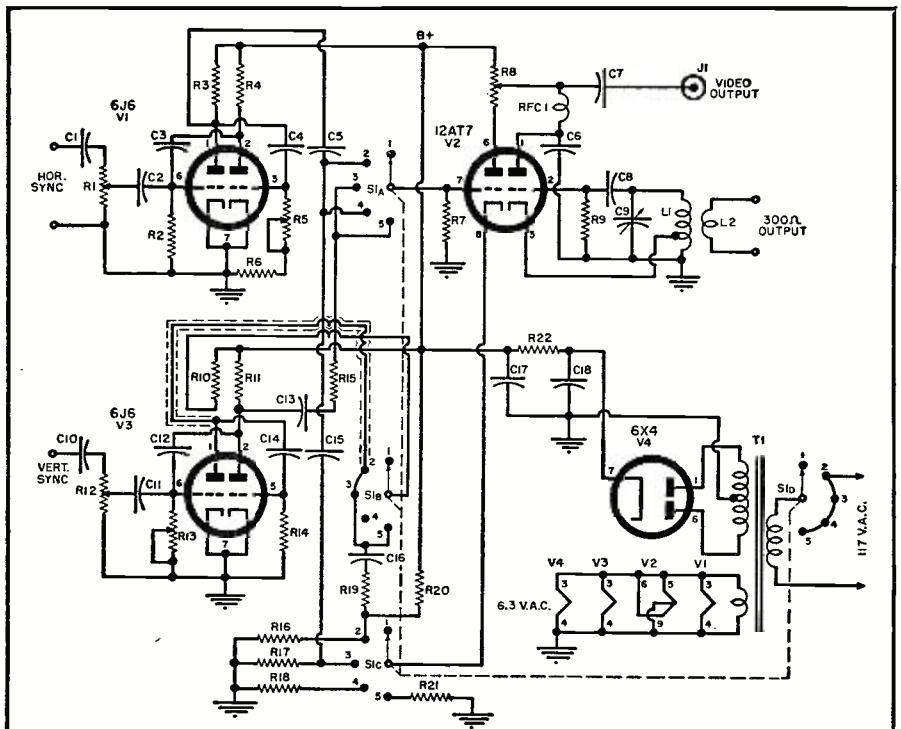
The detailed circuit diagram and parts list of the pattern generator is shown in Fig. 3. V_1 is a 6J6 used as the horizontal multivibrator and operates usually at about 157 kc. or some other multiple of 15,750 cps. The external synchronizing signal is applied to the multivibrator through C_1 and R_1 which permits adjustment of the sync pulse amplitude. Usually it is only necessary that a lead be clipped on to the wire going to the horizontal deflection yoke coils of the TV set. The flyback pulse picked up is sufficient to lock in the multivibrator and produce stable vertical bars on the screen. A simple plate-coupled multivibrator circuit is used which produces rectangular waves of unequal widths. R_5 controls the frequency of the multivibrator and allows setting it for any desired number of vertical bars.

Fig. 2. Block diagram of the pattern generator described in this article.



V_3 in Fig. 3 is the vertical multivibrator. This stage can be synchronized by means of the vertical pulse of the TV set. R_{12} allows adjustment of the sync pulse amplitude while R_{13} determines the frequency and, therefore, the number of horizontal bars on the screen. Again, a simple plate-coupled multivibrator circuit is used, producing a rectangular waveform. The coupling networks which feed the vertical pulse to the switching network introduce some differentiation and help sharpen the narrow pulse. This results in a fairly thin bar on the screen.

The switching network consists of a rotary four-pole, five-position switch. One pole or section is used as the a.c. "off-on" switch and the other three sections provide the four different patterns. Before going into details of the switching system, consider the type of



R_1, R_{12}—500,000 ohm wirewound pot
R_2, R_6, R_{16}—8200 ohm, ½ w. res.
R_3, R_4, R_{10}, R_{11}—22,000 ohm, 1 w. res.
R_5—100,000 ohm wirewound pot
R_7—47,000 ohm, ½ w. res.
R_8—10,000 ohm wirewound pot
R_9, R_{19}—15,000 ohm, ½ w. res.
R_{13}—50,000 ohm wirewound pot
R_{14}—180,000 ohm, ½ w. res.
R_{15}—270,000 ohm, ½ w. res.
R_{17}—2700 ohm, ½ w. res.
R_{18}—220 ohm, ½ w. res.
R_{20}—82,000 ohm, ½ w. res.
R_{21}—2200 ohm, ½ w. res.
R_{22}—820 ohm, 2 w. res.
C_1—.001 μfd. cond.
C_2, C_6—100 μμfd. cond.
C_3, C_8—10 μμfd. cond.
C_4—56 μμfd. cond.
C_5, C_{15}—22 μμfd. cond.
C_7—.1 μfd. cond.
C_9—5-45 μμfd. var. cond.
C_{10}—.01 μfd. cond.
C_{11}—.002 μfd. cond.
C_{12}—.0015 μfd. cond.
C_{13}—120 μμfd. cond.
C_{14}—.0056 μfd. cond.
C_{16}—.005 μfd. cond.
C_{17}-C_{18}—40/40 μfd., 350 v. elec. cond.
L_1—7½ t. #21 en. closewound ¼" dia., tapped at 1½ t.
L_2—3 t. #21 hookup wire, closewound around L_1
RFC_1—R.f. choke, 3.3 μhy., 1 w.
S_1—4-pole, 5-pos. switch (Centralab #1415 or Mallory #1325L)
T_1—Power trans. 230-0-230 @ 50 ma.; 6.3 v. @ 2.5 amp. (Stancor PC8418 or equiv.)
J_1—Output jack
V_1, V_3—6J6 tube
V_2—12AT7 tube
V_4—6X4 tube

Fig. 3. Complete schematic diagram and parts list for the dot and bar pattern generator. Easily-obtained, standard parts are used throughout this unit.

signals required for each position. Taking the last position first, horizontal bars are generated when only the output of the vertical multivibrator reaches the grid of the video amplifier. Therefore, in position 5, S_{1A} receives the differentiated vertical pulse through C_{13} and R_{15}. The latter resistor is used to avoid overloading the video amplifier grid. In position 5 the cathode of V_2, the video amplifier, goes to ground through R_{21}.

When vertical bars are desired we switch to position 4 and now only the signal from the horizontal multivibrator, V_1, is required. To avoid stray pickup from the vertical multivibrator, V_3, this stage is disabled by switch section S_{1B} which eliminates plate voltage from one half of the tube in position 4. Since more video gain is required for the weaker horizontal pulses, R_{18} is now connected as cathode resistor for V_2.

So far the switching system is quite simple, but it becomes slightly more complicated when we want to obtain a grid pattern. For this type of signal the vertical and horizontal signals should be amplified equally, without interference to each other. In switch position 3 the vertical pulse goes to the grid of V_2 through C_{13} and R_{15} while the horizontal pulse is applied to the cathode of V_2 through C_5 and C_{15}. The purpose of this is to further differentiate the horizontal pulse, and is especially effective since it feeds into the cathode resistor R_{17} which is only 2700 ohms. As a result, both the vertical and horizontal bars appear equally wide and equally strong, producing a good grid pattern.

The circuit required for the dot pattern is obtained in switch position 2. In order to produce white dots, the video signal must contain horizontal pulses only during the brief duration of the vertical pulse, and the vertical pulse should only be amplified during the period of the horizontal pulse. In other words, only the intersection of the horizontal and vertical bars should be visible. In conventional dot generators this effect is achieved by using a 6AS6 or similar gating tube and applying each signal to one of the active grids. Since 6AS6 tubes are fairly expensive and low cost as well as simplicity is desired here, we have arranged the video amplifier so that it doubles as the gating tube. The horizontal pulses are applied through C_5 to the grid of V_2 when the switch is in position 2. Vertical pulses are applied through C_{16} and R_{19} to the cathode of V_2. Note that here the vertical pulses are taken from the opposite polarity plate of the multivibrator. The reason for this is that a negative-going pulse is required to gate the video amplifier.

S_{1C} in position 2 connects the V_2 cathode to a voltage divider, R_{16} and R_{20}, which applies a fixed cathode bias of about 12 volts. This cuts off the tube and allows no signal to pass. The gating action occurs when a negative polarity vertical pulse overcomes the fixed bias and permits a short burst of horizonal pulses to pass.

The first position of the selector switch is used to shut off the a.c. power as is evident from the connection of S_{1D}. A simple, full-wave power supply is used here. It supplies 125 volts d.c. and has a current drain of about 35 ma.

The second triode section of V_2 is an r.f. oscillator, capacity tuned from 50 to 90 mc. to cover the low-band TV channels. Plate modulation is used here which permits a single amplitude control, R_8, to vary both the video output signals and the modulation percentage. The drawback of this arrangement is that changing the output control will also vary the oscillator frequency slightly. Actual tests have shown that this variation is less than 1 mc. and the TV receiver bandwidth is usually such that readjustment of the fine tuning control at the TV set compensates sufficiently. The r.f. output is obtained by means of a three-turn coil wound on the same form as the oscillator coil.

Construction

The chassis layout in Fig. 1 is simple and straightforward. A standard 5" x 7" x 2" aluminum chassis was used. There does not appear to be any critical lead length or location for either the vertical or horizontal multivibrator, but it was found necessary to shield the lead from pin 1 of V_3 to switch section S_{1B} to prevent stray pickup in the dot-pattern circuit. It is also advisable to locate the 12AT7 away from the vertical multivibrator for the same reason. In addition, the r.f. oscillator section should be isolated somewhat. In Fig. 1 is shown the r.f. output lead which consists of a piece of 300-ohm twin-lead going from L_2 to the 300-ohm terminals. Some readers may prefer to omit the terminal strip and bring out a long 300-ohm lead for direct connection to the TV set.

All resistors used are 10% values; paper and tubular or flat ceramic condensers are used throughout. No difficulty should be encountered if mica

condensers are used, but it is not advisable to connect condensers having a negative temperature coefficient into the multivibrator circuits.

When the generator is first turned on, set the two frequency control potentiometers R_5 and R_{13} to an approximate midpoint position and check the output of the video amplifier on an oscilloscope. In switch position 2, dot pattern, only a faint signal may be visible unless a sensitive, wide-band scope is used. The grid pattern, switch position 3, will appear like the scope picture of Fig. 4 when the oscilloscope is set for about 600 cps. In this illustration the large, wide pulse is the vertical multivibrator output while the smear near the base line actually consists of the higher frequency horizontal pulses.

Turning the selector switch to position 4, we obtain the horizontal pulses only. When the scope frequency is adjusted to about 25 kc., the waveform shown in Fig. 5 should be observed. Each sharp spike represents one of the vertical lines on the screen. In order to see the sharp point as clearly as in Fig. 5, the oscilloscope should have a bandwidth of at least 1 mc., otherwise a rounded waveshape similar to a sine wave will appear.

The pattern obtained in switch position 5 is similar to that of position 3, except that no horizontal pulses appear and the baseline will be free from the fuzz shown in Fig. 4. When the output amplitude control is set for maximum, the peak-to-peak voltage at the video terminal will be approximately 20 volts on all switch positions except position #2. For the dot pattern the video amplifier operates with slightly reduced gain and because of the sharp, short burst of horizontal pulses the oscilloscope picture shows a peak-to-peak voltage of about 15 volts.

The final step in adjusting the pattern generator is to check out the r.f. oscillator. To make sure it is oscillating, check the grid bias with a decoupled v.t.v.m. probe. While a 5 to 45 $\mu\mu$fd. air-trimmer type condenser is used here, a somewhat larger value may be used and plates removed to make the range. L_1, the oscillator coil, can be stretched or squeezed together to provide for full coverage from channels 2 to 6. L_2 can be varied by changing its coupling with the tank circuit. The correct coupling is obtained when approximately equal output is achieved on all channels. One way to check this is by means of a 300-ohm crystal detector, with its output connected to the oscilloscope. About 0.5 volt of signal should be obtained on the scope and this should remain substantially constant when the tuning condenser is varied over the band.

Using the Pattern Generator

Switch position 5 generates horizontal bars which can be fed directly to the video output amplifier in the TV set, or the r.f. signal can be introduced at the antenna terminals. When the horizontal-bar pattern is applied at the TV receiver antenna terminals, simply tune the set for any channel between 2 and 6 and tune the pattern generator for a good screen pattern. A typical horizontal-bar pattern is shown in Fig. 6.

In some instances it will be found that the TV set does not readily lock-in with the bar pattern or, when the pattern is applied to the picture-tube grid, no sync action at all takes place. To make the bar stand still, clip a lead from the vertical sync terminal to either the vertical deflection yoke leads, the yoke terminal, or the terminals of the vertical output transformer. This will lock the multivibrator in the generator to the receiver vertical sweep, assuring absolute synchronization. The sync amplitude control, R_{12} in Fig. 3, helps to adjust the sync signal for best lock-in.

Horizontal bars are usually used to check the vertical linearity, and the method used is the same for monochrome and color receivers. Adjust the height and vertical linearity controls until the picture is slightly smaller than the screen. Count the number of horizontal bars and expand the sweep until the top and bottom bars are just within the picture tube mask. Adjust linearity and height until the spacing between bars is equal and the same number of bars is still visible.

For checking horizontal linearity, the vertical bars shown in Fig. 8 are obtained in switch position 4. In general, the same connection as for the horizontal-bar pattern is used. For good synchronization it is helpful to clip a lead from the horizontal sync terminal to either the high voltage lead or one of the leads going to the horizontal yoke coils. Usually the capacitive pickup from such an ar-

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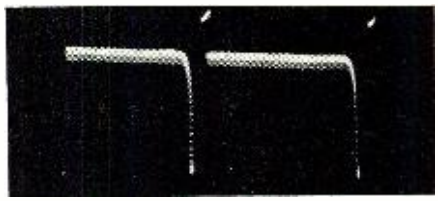


Fig. 4. Oscilloscope waveform obtained at the video output with the switch in position 3 furnishing the grid pattern.

Fig. 5. With the selector switch in position 4 the output waveform shows a sharp spike for each vertical bar.

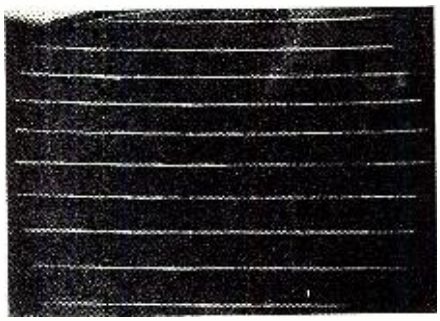
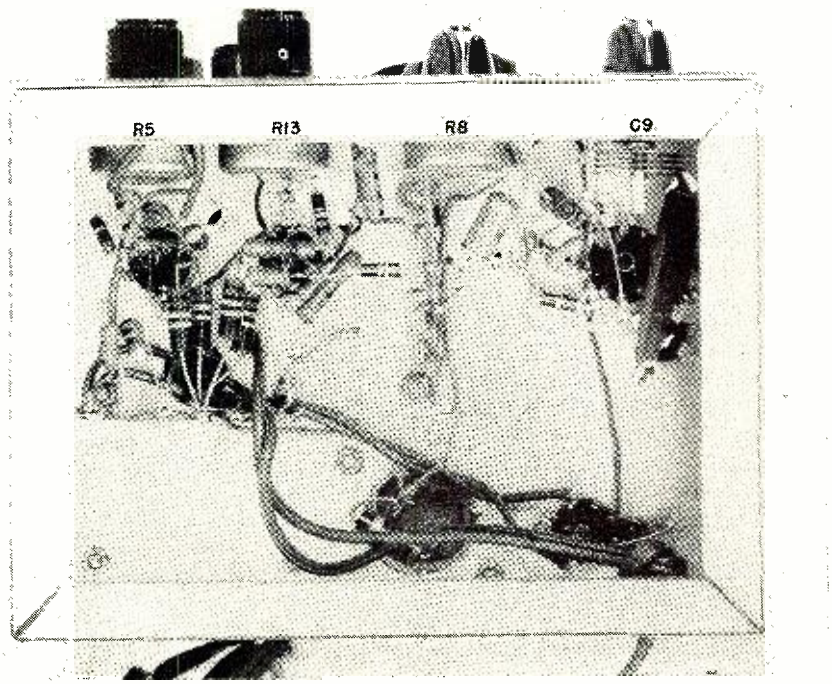
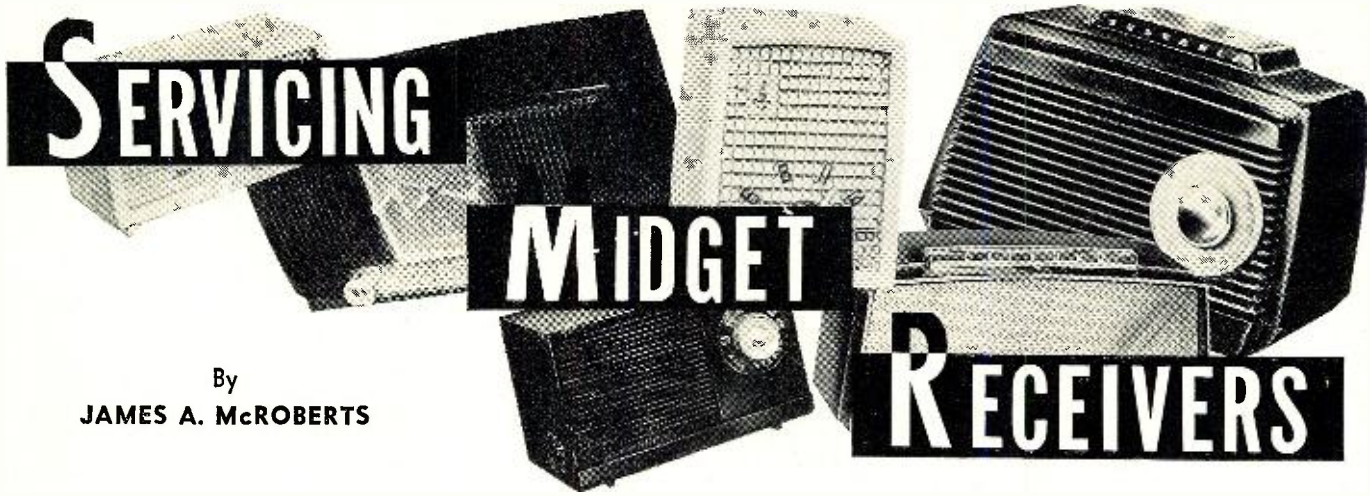


Fig. 6. Horizontal bar pattern obtainable from the generator in position 5.

Fig. 7. Bottom chassis view. Ten per-cent tolerance resistors and paper and tubular or disc ceramic condensers are used throughout, except for the oscillator trimmer and power supply electrolytic filter condensers. See the parts list.



SERVICING MIDGET RECEIVERS



By
JAMES A. McROBERTS

Small radios that have been working overtime all Summer long may need service now — here is some practical information for clearing up troubles.

QUITE a number of troubles are peculiar to the midget-type radio receiver—battery portables, 3-way portables, and a.c.-d.c. sets. All of these sets are handy to carry to the vacation spot with its usual changes in humidity. Also, the smaller sets lend themselves to mass-production techniques using the printed- and the etched-circuit arrangements. The power supply of the 3-way jobs was discussed in the article "Troubleshooting 3-Way Portables" (July, 1954 RADIO & TELEVISION NEWS). Herein, the signal part of midget receivers and peculiarities of etched and printed circuits will be considered.

Unless some specific clue to the trouble is readily apparent, the troubleshooter should handle his testing in the time-ordered and proven method; 1. Get the power supply working. 2. Next, the audio and detector. 3. Follow with the i.f. 4. Finish with the converter and r.f., if any.

Step 1 entails a rapid check of the voltages of the "B+" and "A" supplies in 3-way sets. Visual observance of the rectifier operation is adequate for a.c.-d.c. sets. A quick test for the audio is to touch the hot side of the volume control—a buzz should result. The i.f. may be tested by a signal generator set to the proper frequency and connected to the antenna. Noise should be heard as an additional clue if the i.f. is good. Failure to pass a signal with a good i.f. usually means a bad oscillator. Note that the converter is also an i.f. tube.

The procedure just outlined is presented in the block diagram of Fig. 1 for the convenience of the reader. We now turn to more specific troubles of midget receivers.

Oscillator Failure

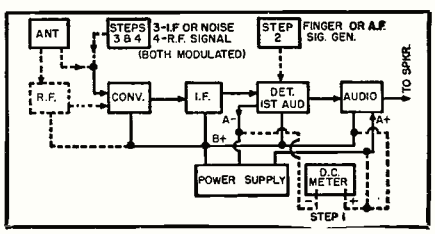
Midget sets almost invariably employ a converter as a combination mixer-oscillator. A very frequent complaint is failure of the oscillator to oscillate. Several reasons exist. The most simple cause is moisture in the oscillator coil. The cure is very simple: dry the coil in the sun, or use a blast of warm air from a fan near a radiator or a hair dryer *on low heat.*

Another frequent source of trouble is the resistor which supplies the oscillator plate (actually one section of the screen grid in most sets) with "B+" from the power supply. This resistor tends to increase in value with age, thereby lowering the oscillator plate supply voltage.

Fig. 2A shows a partial schematic of a typical converter circuit. Note that the oscillator "B+" supply is also the screen supply for the i.f. which may have a separate bypass condenser which might leak. Also, the screen bypass condenser of the converter tube may have lost some of its capacity with time—these sets are carried around in much greater extremes of climate than their home-radio counterparts—and the oscillator r.f. return through this condenser may be so greatly reduced that the tube can not oscillate. Try shunting this condenser early in the troubleshooting.

Some cases of repeated failure to oscillate after using hand-picked 1R5 converters have been cured permanently by using a separate dropping resistor for the screen of the converter with a new bypass condenser for this electrode. The value of the original dropping resistor must be increased since part of the current no longer flows through it, and the voltage on the i.f. screen must be prevented from becoming excessive. This change is shown in Fig. 2B.

Fig. 1. Block diagram of a typical midget receiver showing the conventional service steps for checking the circuits, as explained in the text.



The reader should note that the filament bypass to "B—" is part of the oscillatory circuit (Figs. 2A and 2B) and can cause loss of oscillation if the capacity decreases too much. Naturally, if the grid leak increases unduly in resistance, the circuit may not oscillate, or may "squeg" at a low frequency, that is, oscillate periodically. The grid leak resistance must be returned to the proper filament terminal in portables and 3-way sets.

Frequent Tube Failure

Frequently, some particular tube or tubes will go bad far too often in a particular set. The trouble ordinarily springs from overheating of the tube filaments and, generally, develops in sets using series operation of the signal-tube filaments. It rarely occurs in sets in which the tube filaments are in parallel, as on a 1.5-volt "A" battery. Two principal causes exist for this trouble:

1. The schematic diagrams of Figs. 3A and 3B show bypass resistors. These may open or increase greatly in value, thereby not bypassing the plate current of those tubes in the string whose filaments are closer to "A+." This unbypassed current is now added to the tubes nearer to "B—" on the filament string. Figs. 3A and 3B are equal insofar as bypassing action, but the values of the bypassed resistors are different for the two cases. One scheme bypasses each tube filament individually, while the other returns the excess current to "A—" and "B—" from each terminal requiring bypassing.

If the signal tubes are in their sockets, test with the voltmeter for the correct drop across the filaments. *Re-*

move the signal tubes to test with the ohmmeter.

2. The filament string may be bypassed to "A—" by bypass condensers which can leak or short-circuit. Fig. 3C shows such a case for a leaky condenser around the r.f. and detector tubes. These two tubes will have less than normal filament voltage across their terminals while the remainder of the filament string will have more than normal voltage across their terminals, resulting in premature failure of the latter tubes.

Disconnect the suspected condenser and check the filament voltage; don't pay any attention to oscillation which may develop while this condenser is disconnected for testing. Do not test with an ohmmeter unless you are sure that you cannot damage the filaments. Check the filter condenser from "A+" to "A—". This may leak excessively and overheat the dropping resistor for the filament string. Suspect such a case if this resistor gets too hot and the "A" voltage is low.

Printed Circuits

Many of the modern portables and midget a.c.-d.c., sets utilize a printed circuit (*Couplate*) in the audio section. Some sets, such as some *Motorolas*, use the same *Couplate* as part of the r.f. filter network into the grid of the 1st audio. Fig. 5 shows the printed circuit *Couplate* PC-91 as employed in *Zenith's* 3-way portable receiver, chassis 5L42.

These printed circuit assemblies are very brittle and must not be subjected to mechanical shock. Neither should the leads be cut too short in replacing such a unit since some allowance should be made for thermal expansion and contraction; if this allowance is not made, the result might be a broken printed circuit unit such as shown in Fig. 4. Allow at least ⅜ inch beyond the soldered joint for expansion and contraction. The wire leads should be bent at an angle prior to clipping so that the unit may be soldered into position more readily. Such is an objection to the vertical position of the unit illustrated in Fig. 4, installation would be easier if the unit were at a 45° angle to the vertical.

If a unit becomes defective, the best repair is the replacement of the entire unit. Shunting the coupling condenser between terminals 5 and 6 of the PC-91 of Fig. 5 would be good if one could be sure that the condenser in the PC-91 would remain open circuited—there is no guarantee that it will remain open however. The same logic applies to the screen and the plate resistors of this component (the 4.7 megohm and 1 meghom resistors) inasmuch as a resistor which has changed its value might change again. When such a change occurs, it may cause an intermittent, and intermittent trouble-shooting jobs are unwelcome visitors to the shop.

An entirely different state of affairs is the case of a part which has a separate terminal such as the 2.2

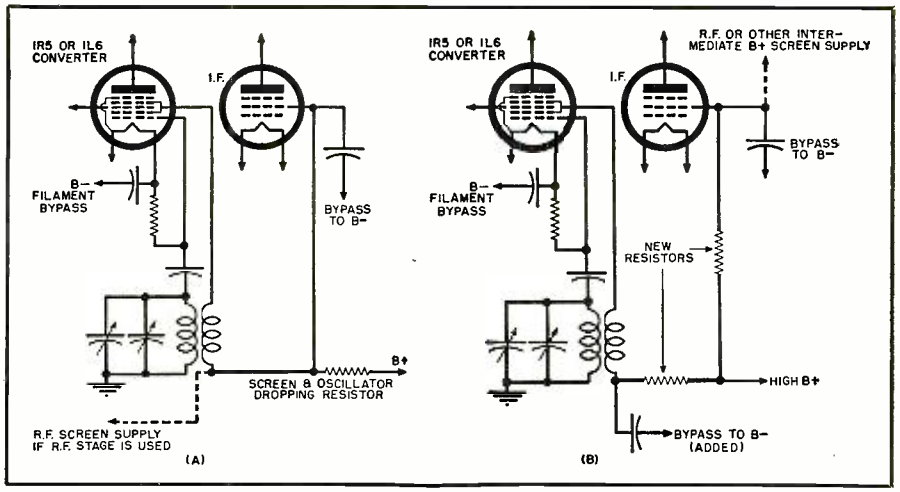
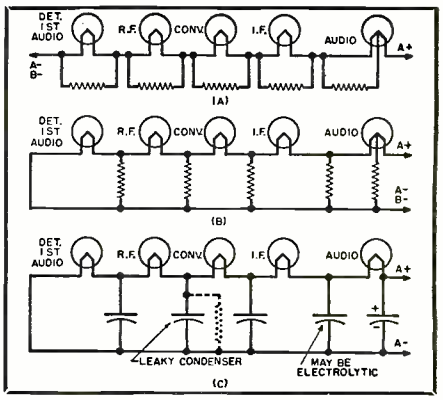


Fig 2. (A) One type of oscillator circuit for 3-way portable radios. (B) Modification of the circuit in (A) resulting in a higher voltage on the converter screen grid (which also serves as the plate for the oscillator section of tube).

Fig. 3. Various methods of bypassing the plate current around the filaments of a portable radio are shown here. (A) Bypass resistors across each filament, (B) resistors from each filament to "B—," (C) bypass condensers. One condenser in (C) is leaky and its effective leakage resistance is shown.



megohm grid resistor of the PC-91 of Fig. 5. An external resistor is entirely feasible in such an instance from terminal 6 (the grid of the output) to the plus terminal of the detector filament, with terminal 2 of the printed circuit left unconnected. Note that the grid bias of the output tube is obtained from the filament *IR* drop of 4.5 volts from the most negative terminal of the output tube filament to the plus filament lead of the detector. Care must be exercised in grid return connections in these sets.

Fig. 4 is also representative of the etched circuits often employed in midget sets. These etched circuits and other conventional types are frequently sprayed with a waterproofing compound and testing should be performed with needle probes. —30—

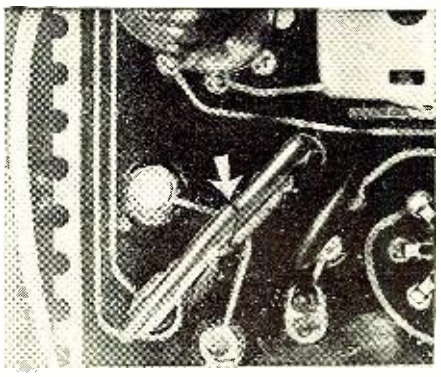
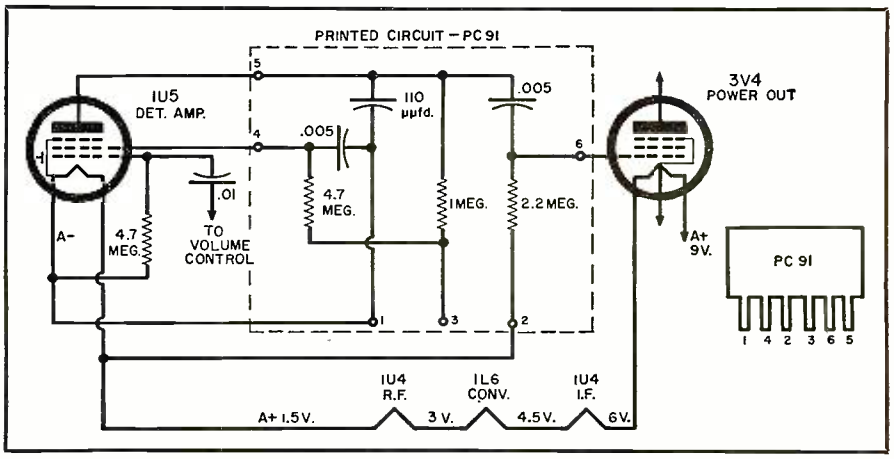


Fig. 4. Part of an etched radio circuit containing a cracked "Couplate."

Fig. 5. Partial schematic diagram of the Zenith 3-way portable 5L42 chassis showing the printed circuit "Couplate" hookup and filament wiring for the complete set.



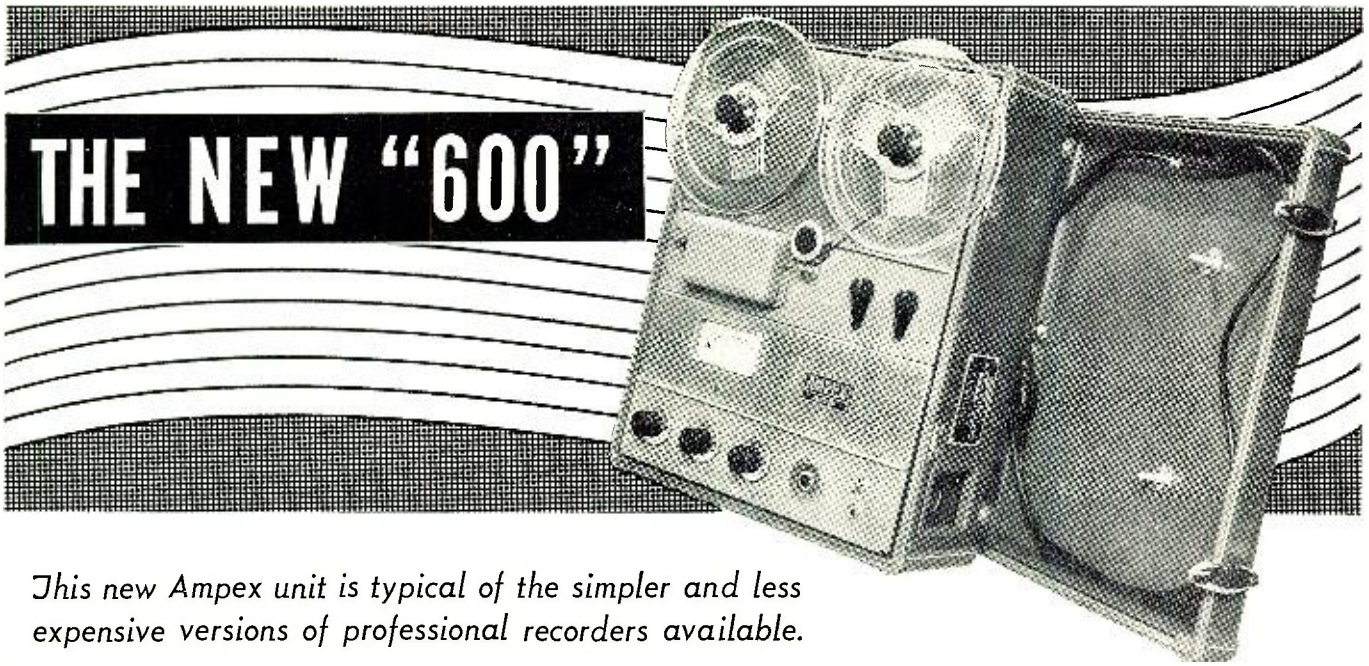
1954 TV RECEIVER SPECIFICATIONS

Continuation of the list of mechanical and electrical specifications on current model TV sets for service technicians. See next issue for additional listings.

MFR.	CHASSIS	TUBES							VIDEO I.F. FREQ: (MC.)	H.V.[4] (KV.)	U.H.F. PRO-VISION	POWER (WATTS)	SPECIAL FEA-TURES
		TUNER	I.F.[1]	VIDEO[2]	AUDIO	SWEEP[3]	P.S.	CRT					
SPARTON (Cont'd)	27D214	6BQ7 6J6	6BA6 6BA6 6CB6 6CB6	6AH6 6AL5 6AU6	6AL5 6AT6 6AU6 6AU6 6V6GT	6AL5, 6BQ6GT 6BQ6GT, 6S4 6SN7GT, 6SN7GT 6W4GT, 6W4GT 12AU7	1B3GT 5U4G 5U4G	21EP4A	26.25	14.5	Strips	260	
	29U214								26.25	14.5	11	275	
STEWART-WARNER	9300 9325	6BQ7 or 6BZ7 6J6	6CB6 6CB6 6CB6	1N64 6AU6 6T8* 12BY7	6AQ5 6AU6 6T8*	6AH4GT,6AX4GT 6BE6, 6BQ6GT 6SN7GT, 12AU7	1B3GT 5U4G	21MP4	26 41.25	14.4 14.4	Strips 11	200	5, 10
	9310	6BQ7 or 6BZ7	6CB6 6CB6 6CB6	1N64 6AU6 6T8*	6AQ5 6AU6 6T8*	6AU5GT,6AX4GT 6BE6, 6CD6G 6SN7GT, 12AU7	1B3GT 5U4G	27EP4 27NP4 27RP4	26	17.5	Strips	275	5, 10
	9370	6J6		12BY7				24CP4	26	17.5	Strips	275	5, 10
	9340	6BQ7 or 6BZ7 6U8	6CB6 6CB6 6CB6	1N64 6AU6 6T8* 12BY7	6AQ5 6AU6 6T8*	6AH4GT,6AX4GT 6BE6, 6BQ6GT 6SN7GT, 12AU7	1B3GT 5U4G	21MP4	41.25	14.4	11	200	5, 10
	9350	6BQ7 or 6BZ7	6CB6 6CB6 6CB6	1N64 6AU6 6T8*	6AQ5 6AU6 6T8*	6AU5GT, 6AX4GT 6BE6, 6CD6G 6SN7GT, 12AU7	1B3GT 5U4G	27EP4 27NP4 27RP4	41.25	17.5	11	275	5, 10
	9360	6U8		12BY7				27CP4	41.25	17.5	11	275	5, 10
	9380	6BC5 6J6	6AU6 6AU6 6AU6	1N64 6AU6	6AQ5 6AU6 6T8	6AH4GT, 6BQ6GT 6C4, 6SN7GT 6W4GT,12AU7	1B3GT 5U4G	17HP4 17RP4	26	16	Strips	200	5, 10
STROMBERG-CARLSON	621	6BQ7 or 6BZ7 6J6	6BA6 6BA6 6CB6 6CB6	6U8* 6W6	6AU6 6T8 6U8* 6V6GT	6AL5, 6AU6 6AX4GT, 6BQ6GT 6C4, 6S4 6SN7GT, 6SN7GT 12AU7	1B3GT 5U4G 5U4G	21FP4A	26.4	16	Strips	265	5, Noise Control
	621A	6BQ7 or 6BZ7 6J6	6CB6 6CB6 6CB6	6U8* 6W6	6AU6 6T8 6U8* 6V6GT	6AL5, 6AU6 6AX4GT,6BQ6GT 6C4, 6S4 6SN7GT, 6U8* 12AU7	1B3GT 5U4G 5U4G	21FP4A	45.75	16	Strips	265	5, Noise Control
	622	6AF4 6BZ7 6X8	6CB6 6CB6 6CB6	6U8* 6W6	6AU6 6T8 6U8* 6V6GT	6AL5, 6AU6 6AX4GT,6BQ6GT 6C4, 6S4 6SN7GT, 6U8* 12AU7	1B3GT 5U4G 5U4G	21FP4A	45.75	16	11	265	5, Noise Control

1. Video i.f. tubes only. 2. Includes detector and a.g.c. 3. Includes sync section and a.f.c. 4. CRT 2nd anode voltage. 5. Removable safety glass. 6. Local-fringe a.g.c. adjustment. 7. High-fidelity sound. 8. Aluminized picture tube. 9. TV-radio-phono combination. 10. Built-in antenna. 11. 82-channel tuner. 12. Adjustable dial light. *Part of tube is used in another section.

THE NEW "600"



This new Ampex unit is typical of the simpler and less expensive versions of professional recorders available.

NOW that high-fidelity tape recordings are commercially available in reasonable quantities, manufacturers of professional recording equipment are wooing the golden-eared home users with machines capable of reproducing all of the quality which is available on these professionally-recorded magnetic tapes.

Taking advantage of their experience in building quality equipment, manufacturers of such gear are now offering smaller, less expensive units for this new market. They feel that home users, for instance, will not need the heavy-duty editing facilities required by broadcasting and recording studios. Hence, machines of this class feature a 7½ ips single speed which gives full fidelity, rather than two speeds found in commercial equipment. This enables manufacturers to use a lighter, less expensive motor and eliminates the necessity for providing facilities for changing equalization to meet different tape speeds.

One example of the "new look" in professional recorders suitable for the home hi-fi market is the *Ampex* "600" shown on this month's cover and on this page.

It is a 28-pound portable unit which is housed in a regular *Samsonite* overnight case. The removal of eight screws allows it to be taken from its portable case for custom installation in the home. It may be operated in either a vertical or horizontal position.

The Model 600 has a frequency response of ± 2 db from 50 to 10,000 cps, with the curve falling off no more than 4 db at 40 cycles and at 15,000 cycles. It has a better than 55 db signal-to-noise ratio, measured at the level of 3% total r.m.s. harmonic distortion of a 400-cycle tone and flutter and wow below .25%.

Since the capstan is constantly rotating whenever the power switch is on, tape starting time is practically instantaneous, reaching full, stable playing speed in less than .1 second. The seven-inch reel capacity provides slightly more than a half-hour's continuous playing or recording time—equal to the reel size on which the pre-recorded tapes are being marketed.

Operating modes are controlled by two switches. One has positions for "play" and "record." It cannot be switched to "record" unless a separate safety button is depressed, thus preventing accidental erasure of recorded tapes. The other switch has positions for "fast forward" and "rewind." These two switches are interlocked so that tapes cannot be torn by switching between high and low speeds while the tape is engaged with the capstan.

Two inputs are provided for recording: a "line" input and a "microphone" input. Each is controlled by its own level control so that both inputs can be used simultaneously providing, in essence, a built-in mixing arrangement. The microphone input is for high impedance mike, but can be easily converted to low impedance by installing an accessory transformer. The line input can be fed from a tuner, record player, or another magnetic tape recorder unit.

The recording level is metered on a professional vu meter, which, unlike a flashing neon light, gives a quantitative picture of the recording action. Thus, the user can utilize the complete dynamic range of the machine by recording at as high a level as possible without introducing distortion due to tape saturation effects.

Since this particular unit employs three heads — separate heads being used for recording and playback — tapes can be monitored as they are recorded. A monitor selector switch connects the phone jack, the meter, and the output connector to either the incoming signal or to the signal as it is being recorded.

Like all professional-type recorders the "600" does not incorporate a speaker or audio amplifier. A separate amplifier-speaker unit, the Model 620, in a matching portable case, is available for those who want a single-package unit. This auxiliary unit contains a 10-watt amplifier and a specially-designed 8" speaker—all in a coordinated acoustic enclosure.

In order to obtain maximum compactness at minimum cost, the "600" utilizes a single synchronous motor to provide constant speed for both recording and playing back and to provide high speed for fast forward and rewind. In "record" or "play" positions the motor drives the capstan through a non-slip nylon belt. A separate belt from the capstan flywheel drives the take-up reel. Hold-back tension on the supply reel is provided through a shock-relief clutch and disc brakes. The brakes are specially designed so that wear over a period of years will be negligible and tape tension will be maintained at 8 ounces—sufficient for tape head contact and low enough to prevent tape stretch.

In the high-speed rewind and fast forward modes, the motor pulley directly engages either the take-up reel clutch or the rewind reel clutch. The shock-relief brakes are disengaged so that hold-back tension is provided only by the special hold-back brakes. This tension is only 1 ounce—low enough so that the problem of head wear during high tape speeds is circumvented without lifting the tape from the recording and playback heads.

Units such as the "600" described here are rapidly narrowing the gap between the so-called "home" and "professional" recorders, thus speeding the day when the inherent advantages of tape recordings will be within the financial range of most families who enjoy good music.

When that day dawns, tape recorders will be as much "standard" equipment in the American household as refrigerators or TV sets are now. —30—

TRANSISTORIZED MOISTURE DETECTOR

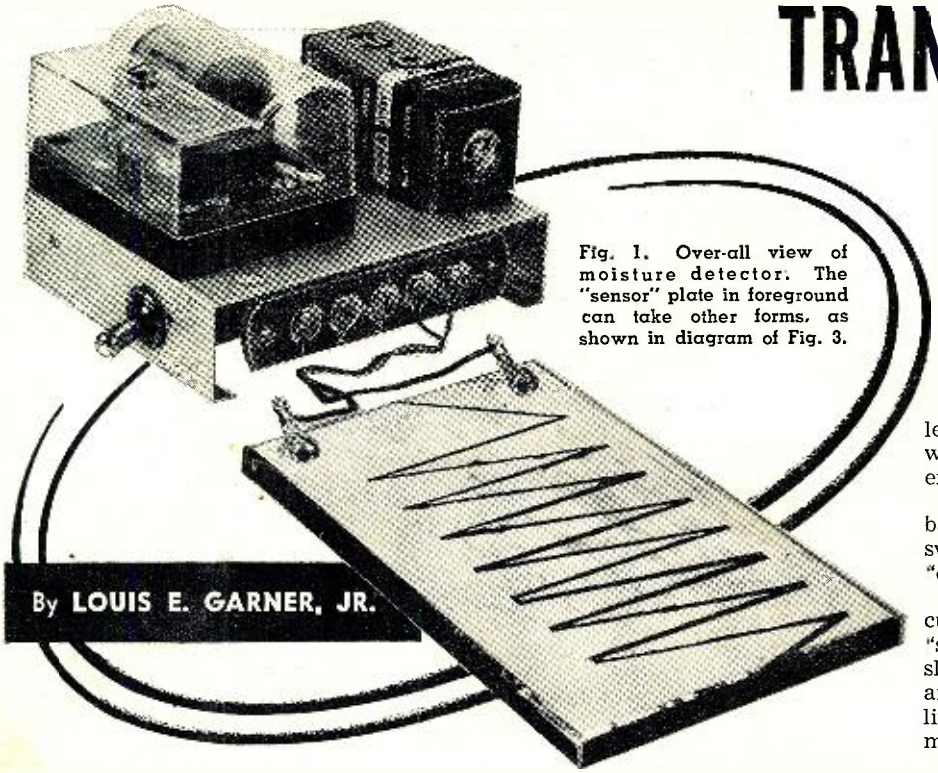


Fig. 1. Over-all view of moisture detector. The "sensor" plate in foreground can take other forms, as shown in diagram of Fig. 3.

By LOUIS E. GARNER, JR.

Construction details on a compact unit which can be used to warn the householder of unusual or dangerous leakage.

ELECTRONIC experimenters and technicians occasionally find it necessary to devise and build some type of simple moisture or rain detector. The unit may be destined for their own use, or may be built at the request of a friend, relative, or neighbor.

There is no doubt that the applications of a reliable moisture detector are quite varied . . . from closing a window with the first few drops of rain to protecting the family washing (by sounding an alarm so clothes may be removed from the line), or from detecting leaks and excessive condensation to giving a signal when "bed-wetting" occurs.

Unfortunately, many of the "rain detector" designs suggested and used in the past required vacuum tubes or thyratrons for their operation . . . making line voltage operation almost mandatory, and battery operation, at the best, expensive and cumbersome. Line voltage operation restricts the possible applications of a moisture detector considerably—outdoor use is limited, and applications involving possible body contact may be dangerous.

By *transistorizing* a moisture detector, however, low voltage battery operation becomes economically feasible, and such an instrument has virtually unlimited application. A typical transistorized moisture detector, suitable for construction by the home builder, is illustrated in Fig. 1, with the complete schematic diagram given in Fig. 2.

Since only a few components are required, the cost of the completed device is reasonable and compares favorably with vacuum-tube operated units. Wiring and assembly is straightforward and simple, and the average technician should have little or no difficulty in assembling a similar unit in an evening's time.

Circuit Description

As can be seen by reference to Fig. 2, the basic device consists of a moisture sensing element ("sensor"), a *p-n-p* junction transistor connected as a "grounded-emitter" direct-coupled amplifier, and a relay, used for controlling an external circuit.

The "sensor" consists of two pieces of aluminum foil cemented to a piece of plastic, with a very narrow separation between the conductors (from 1/16" to ⅛").

In operation, the base-emitter circuit of the transistor is normally open, and little or no collector current can flow through the relay. The relay thus remains open.

Should a drop of moisture fall on the "sensor" plate so as to contact both pieces of foil simultaneously, the base-emitter circuit is closed, and base current may flow. The electron path in the base circuit is from the negative terminal of the battery, through the power switch, S_1, through resistor R_1, through the drop of moisture on the "sensor" plate, and through the base-emitter of the transistor back to the positive terminal of the battery.

This base current flow permits a corresponding collector current flow to take place, though of much larger amplitude due to the current amplification of the transistor stage. The collector current flow closes the relay which may be used to switch on some external circuit.

A single battery, B_1, supplies both base and collector current. A power switch, S_1, is provided to turn the unit "off" when operation is not desired.

Series resistor R_1 serves to limit base current to a safe value, even if the "sensor" elements are accidentally short-circuited. The high d.c. resistance of the relay coil satisfactorily limits collector current well within the maximum ratings of the transistor.

Construction Hints

The author's model of the moisture detector has been assembled on a small standard aluminum chassis. Parts layout and wiring are clearly visible in the over-all (Fig. 1) and under-chassis (Fig. 4) views. However, this type of assembly need not be followed by another builder since the circuit is completely non-critical—leads may be made as short or as long as may be desired.

However, if the builder decides to solder the transistor directly into the circuit, as in the author's model, he should exercise care to avoid overheating the transistor leads. The transistor is quite susceptible to heat damage. Allow the transistor leads to remain reasonably long, covering them with insulating tubing, and complete the soldering as quickly as possible, using a hot, clean, well-tinned iron.

As an alternative, a socket may be provided for the transistor. Use a standard five-pin subminiature tube socket. Only three of the socket terminals are needed.

The moisture detector might easily be assembled in a standard metal utility box or *Bud* "Minibox" to provide a completely enclosed unit.

Parts Substitutions: Although comparatively few parts are required for the construction of this device, it is still possible to make a number of parts substitutions to utilize components that may already be available in the builder's "junk box."

A slide, rotary, lever, or even key-operated switch may be substituted for the toggle switch (S_1) used in the model. A key-operated switch is an especially good selection as it permits one or two persons to exercise complete control over the operation of the unit.

A type CK721 junction transistor may be directly substituted for the type CK722 shown in the schematic diagram, and will provide somewhat greater sensitivity. No other component changes are necessary.

Another relay may be substituted for the unit specified in the parts list. Choose a relay which will not require more than about 2 milliamperes coil current for operation, and with a moderately high d.c. resistance. In a few instances it may be necessary to use a higher voltage battery should a different relay be employed.

Since very little current is drawn from the battery until the moisture detector actually operates (relay closes), battery life is quite long. In some instances the battery life in the detector may approach the normal "shelf life."

Because of this, the builder may exercise wide latitude in his choice of a battery. A conventional zinc-carbon dry battery, a "wet-cell" storage battery, or a mercury battery may be used as the power supply for the unit.

Assembling "Sensor" Plate

The "sensor" plate consists, basically, of two conducting elements separated by a narrow strip of insulating material. It may be made up in any one of several ways, depending on the inclinations of the individual builder and the facilities available to him. The "sensor" plate used in the author's model is clearly visible in the foreground of Fig. 1, and has been made up using heavy-duty aluminum foil, a piece of Bakelite (lucite, polystyrene, or similar plastic will do as well), and cement.

A piece of aluminum foil was first cemented firmly to the flat Bakelite plate. A narrow strip (about ⅛" wide) of the aluminum was then cut out in a saw-tooth pattern, leaving two insulated conductors. Contact to the foil was made by means of soldering lugs held in place by small machine screws.

A variety of patterns may be used in place of the "saw-tooth" employed by the author, *provided the foil is clearly divided into two separate conducting elements.* A few possible patterns are illustrated in Fig. 3.

A "sensor" plate may also be made up by using a "sandwich" consisting of two pieces of copper or brass screening separated by a piece of plastic screening. Over-all dimensions may be as large or as small as is desired.

However, irrespective of the method chosen for assembling the "sensor" plate, care should be taken that the two conducting elements are not so close together that accidental short-circuits may easily occur (resulting in "false alarms"), nor so far apart that a single drop of moisture cannot make contact with both conductors.

Once the wiring is completed, the moisture detector may be easily checked for operation by closing the power switch (S_1), wetting the finger, and touching the "sensor" plate in the gap between the two conducting elements (there is no danger of shock). The relay should close. Remove the finger and allow the damp spot to dry, the relay should then open.

If satisfactory operation is not obtained, carefully check all connections. Look out especially for "cold-soldered" joints and errors in wiring. Make sure that the battery has been connected with the correct polarity.

If a different relay has been used in place of the unit specified in the parts list, it may be that insufficient current flows to operate the relay. This may call for a larger battery.

When using a larger battery, take care that the maximum ratings of the transistor are not exceeded. The collector voltage should not exceed 20 volts and collector current should not exceed 5 ma. In addition, a new value should be chosen for R_1. Using Ohm's law, calculate a resistance value which will not allow more than 5 ma. base current flow, even if the "sensor" elements are shorted together.

Once the moisture detector is operating properly, it may be set up to perform the desired function. Let us discuss a few typical applications:

Rain Alarm: To use the moisture detector as a rain alarm, connect the relay contacts to operate an alarm bell, buzzer, or signal light. Place the "sensor" plate on a window sill or in a similar exposed location.

For maximum response two or more "sensor" plates should be provided, simply connect the additional plates in parallel. A separate "sensor" plate may be placed on each window sill if desired.

If the builder prefers, the relay may be used to actuate a small electric motor (set up to close the open window) instead of sounding an alarm signal. Should this arrangement be employed, a small "limit switch" should be placed on the window frame to shut off the motor after the window is closed.

Such a "limit switch" may be installed quite easily by using either a *Micro-switch* or small push-button switch in series with the motor leads, arranged to open the motor circuit when the window is fully closed.

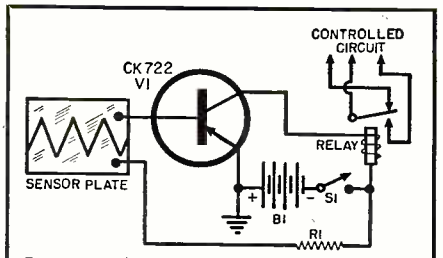
Condensation or Leakage Detector: Where condensation or water leakage is a problem, the "sensor" plate may be placed under the suspected pipes so that the first drop of water to fall will sound an alarm. Locate the "sensor" at the lowest point under the suspected pipe.

"Bed-Wetting" Alarm: To use the moisture detector in this application, a flexible "sensor" plate should be made up that can be easily slipped under bed-sheets. Such a flexible "sensor" may be obtained either by using the screen "sandwich" previously mentioned or by cementing aluminum foil to thin plastic sheeting material.

The relay may be connected to turn on a soft light or to sound a gentle bell or chime—harsh, loud, and sudden noises should be avoided.

Controlling Water Level in a Tank: The moisture detector may be easily used to maintain a constant water

(*Continued on page* 98)



R_1—*1500 ohm, ½ w. res.*
S_1—*S.p.s.t. toggle switch*
Relay—3500 or 5500 ohm d.c. coil relay (Advance Type 1200)
B_1—*6 volt battery (RCA VS068 or Mallory 302424)*
V_1—*"p-n-p" junction transistor (Raytheon CK722)*
1—4 x 3⅛" x 1" chassis (ICA #29082)
1—"Sensor" plate (made of tinfoil or aluminum foils, etc., see text)

Fig. 2. Complete schematic of moisture detector. Parts variations are possible.

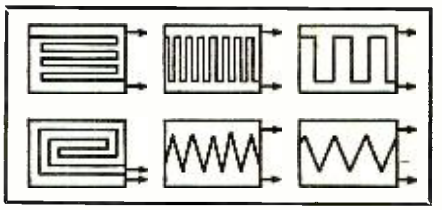


Fig. 3. Possible arrangements of "sensor."

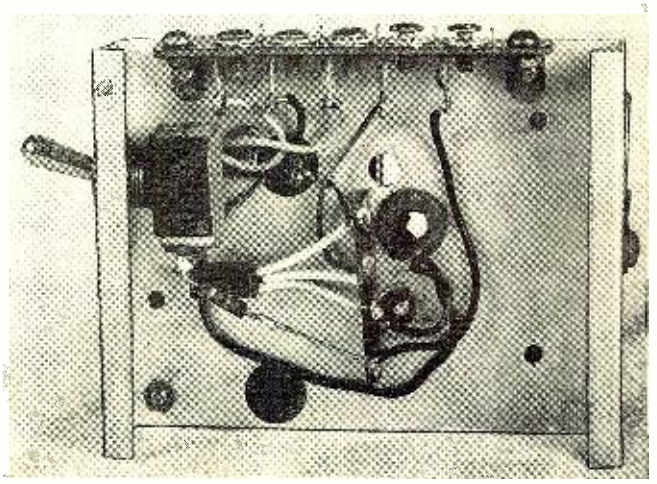


Fig. 4. Underchassis view of detector. Any parts arrangement is suitable as circuit operation is far from critical. See article

SIMPLIFIED DESIGN OF FEEDBACK EQUALIZERS

By ARTHUR J. ROSE

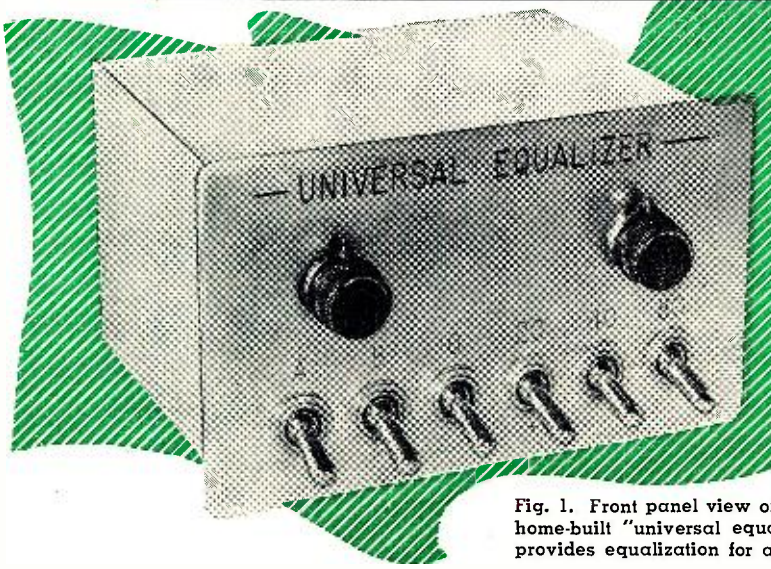


Fig. 1. Front panel view of the author's home-built "universal equalizer" which provides equalization for all type discs.

Design charts for an infinite variety of playback curves, an analysis of equalizer problems, and a suitable circuit.

EVERYONE has his own ideas about recording equalization. From the recording company brain trusts to the designer responsible for undoing the record cutter's handiwork, opinion is varied and outspoken. Consequently, high-fidelity enthusiasts are faced with a bewildering array of factual as well as fictional recording characteristics.

This problem, in part, stems from the big question mark that accompanies many curves published by other than official sources. Fortunately, this confusion is gradually disappearing and perhaps within a few years all will be an open book. This revelation is coming about as manufacturers realize the maturity of the present not-so-average record buyer and because of some persuasive arm twisting by audio equipment designers.

Of course there will be those who insist on being arty. Once the record owner is addicted to providing the "recommended" curve for some particular label, he will doubtless find that some super equalization has been applied to give a thrilling "high fidelity" effect. The orchestra sounds as if it were right inside your ear, for example.

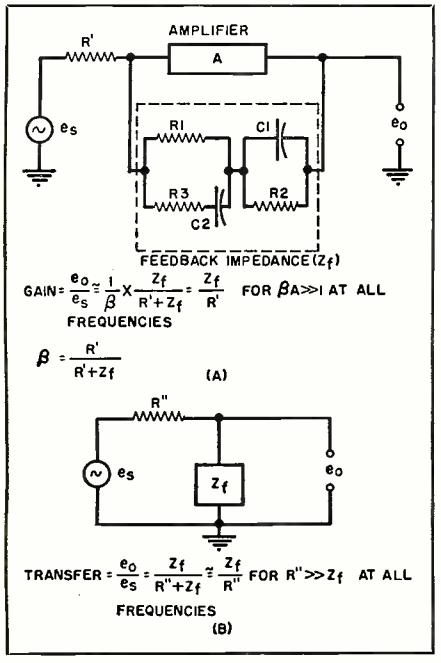
While it is true that by merely applying the mirror of the recording response as generated by the pickup one is able to obtain the coveted "flat" response, one is limited by choice rather than by technology. Almost any curve can be effected. The problem lies in the question: "What curves shall I include?" Attempts to design universal switching arrangements are complicated by sheer numbers.

One solution that comes to mind is to use two switches. One sets the low-frequency response, while the other sets the high-frequency characteristic. With, for example, six position switches, thirty-six different combinations are possible! Somewhere within this number should be the correct response for the record in question. Imagination will supply variations of the number of switches and number of positions. Thus unlimited possibilities present themselves.

It is not entirely the purpose of this article to give a horse laugh to the equalization snafu. Most people are serious as to why "such and such" a curve is ideal. Well meaning groups have met the problem with sensible middle-of-the-road solutions. It is not funny to the guy trying to get his sound system to come up to expectations—and he never will unless he properly equalizes his records.

Rather than stress the difficulties of equalizer design, straightforward design procedures will be given. Then after the reader understands the easily-made graphical and arithmetic solutions that have been worked out, he can return to the more perplexing aspects. Suggestions for designing workable equalizers will precede the description of a "universal equalizer."

Fig. 2. A feedback equalizer and its equivalent passive network. Either type may be designed using the procedure given in text.



Circuit

Throughout the ensuing discussion it will be assumed that the feedback is great enough at all frequencies concerned so that the equalizer gain is dependent only upon the degree of feedback. Aside from simplifying the analysis, three important results stem from this assumption:

a. Wide variations of tube characteristics and supply voltages can be tolerated.

b. Distortion is reduced by an appreciable amount, even at the lowest frequencies.

c. Maximum possible bass boost is realizable.

In practice, this is accomplished by using a good deal more feedback than is apparently required. With a 500 cps turnover frequency, assuming 6 db-per-octave rise, the resultant boost at 50 cps is 20 db. In a linear system this is easily done. However, it has been shown elsewhere[1] that feedback systems with less than infinite ratios of open loop gain to effective midband gain flatten out at the lower frequencies. For close to ideal results, a ratio of 80 is satisfactory.

Although subject to controversy, ratios of 20 to 1 have been used[2]. This

ratio is the basis for many passive equalizer circuits that give bass rise curves asymptotic to 26 db, reaching a maximum boost of 26 db at zero cps. In an ideal system where both recording and playback units are compensated by such a network, nothing is lost. In actual use, there is a definite loss of lower bass frequencies.

Fig. 2A shows a feedback equalizer. At midband, only R_1 of the complex feedback impedance, Z_f, is effective. Therefore, the midband gain is R_1/R'. For satisfactory operation, the ratio of open loop gain, A, to midband gain should be 80 or greater.

An equivalent passive equalizer, shown in Fig. 2B, should have R''/R_1 equal to 80 or more.

In either circuit, bass boost is produced by R_1 and C_1 and bass leveling by R_2. High-frequency de-emphasis is produced by R_1 and C_2. Introduction of R_3 lowers the slope of the de-emphasis curve and causes two other effects that will be discussed shortly.

A simplification of the feedback impedance, Z_f, in Fig. 3B shows effective networks throughout the spectrum. Equations relate circuit constants to applicable frequencies.

Ideal Equalization Curve

The exaggerated response curve of Fig. 3A shows the scope of the analysis. Were it not for f_c and f_r, the matter would reduce to the familiar simple case where R_2 and R_3 are not included. This gives a straight bass rise below the turnover frequency, f_t, and a straight treble de-emphasis above the starting frequency, f_s. Both approach 6 db-per-octave in rate. Introduction of bass de-emphasis below f_c and treble de-emphasis with less than a 6 db-per-octave rate demands consideration of the entire feedback impedance. The *RCA* "New Orthophonic" and *London ffrr* 78 curves are of the latter type, whereas the NARTB and AES are of the simpler type.

Constants for the feedback impedance for any desired curve shape are derived from the vector gain equations of the circuit in Fig. 2. These equations will be given as a matter of record. However, their solutions have been greatly simplified by plotting various parameters. As a result, circuit constants can be rapidly and easily found even by persons with a limited mathematical background. Sample problems following the derivation of the design charts will serve to illustrate this.

Impedance Equations

By virtue of the previously made assumption, the gain at any frequency is dependent only upon the feedback and therefore upon Z_f of Fig. 3B. Relative response then is merely the ratio of the Z_f's at different frequencies. For convenience, all gain is referred to the gain where Z_f equals R_1.

A further simplification is made by splitting Z_f into a low-frequency equivalent (Z_f greater than R_1), and a high-frequency equivalent (Z_f less than R_1). Interaction, although slight, will have to be considered in some cases.

Gain at low frequencies can be expressed by

$$db = 10\ log\left[1+\frac{r^2+2r}{r^2\left(\frac{f}{f_t}\right)^2+1}\right] \quad . \quad . \quad . \quad . \quad (1)$$

where: $r = \frac{f_t}{f_c} = \frac{R_2}{R_1}$

if R_3 ~ then:

$$db = 10\ log\left[1+\left(\frac{f_t}{f}\right)^2\right] \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

Plotting equation (1) for various values of the parameter r (see Fig. 4) shows responses to be expected for changing values of R_2. It can be seen that the effect of this resistance is to decrease the initial slope of the curve and then level it off below f_c. It has no effect on the turnover frequency.

In order to retain some perspective of the curves in familiar form, f_t is shown as if it were 500 cps—the most prevalent turnover frequency. For other turnovers, the boost values hold equally well, but the curves have to be relocated by shifting the frequency axis. This will give the more commonly experienced picture.

There is no particular problem associated with the bass region. Usually the turnover frequency and the frequency where leveling occurs are given. Circuit constants to give these frequencies are obtained by their defining equations.

However, when a particular response is desired and f_c is not known, then the curves are most useful. Here, one must match the desired curve with one in Fig. 4 and extract a value of r.

Quite different is the situation encountered in the high-frequency region. Here, the addition of the series resistor, R_3, has the effect of lowering the frequency at which de-emphasis starts as well as altering the curve shape. Since the exact starting frequency is more-or-less obscure, the frequency that yields a response 3 db down is used for the reference frequency, f_s. This applies, to some extent, in the bass region as the turnover frequency occurs with the response up 3 db.

Gain at higher frequencies can be expressed by $-db =$

$$10\ log\left[1+\left(\frac{f}{f_s}\right)^2\right]-10log\left[1+\left(\frac{f}{f_r}\right)^2\right]. \quad (3)$$

Here there is a subtraction of two curves. One is the de-emphasis produced by 10 *log* $[1 + (f/f_s)^2]$ and the other is a rise produced by 10 *log* $[1 + (f/f_r)^2]$. When R_3=0, the second curve disappears and a simple de-emphasis curve results. (See Fig. 6).

In terms of time constants, the high-frequency response is:

$$-db = 10\ log\ [1+\omega^2t^2] - 10\ log\ [1+\omega^2t_2^2] \quad (4)$$

where:

$$t_1 = R_1C_2 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (5A)$$

$$t_2 = R_3C_2 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (5B)$$

$$t = t_1 + t_2 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (5C)$$

$$f_s = \frac{.159}{t} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (5D)$$

These equations show how f_s is low-

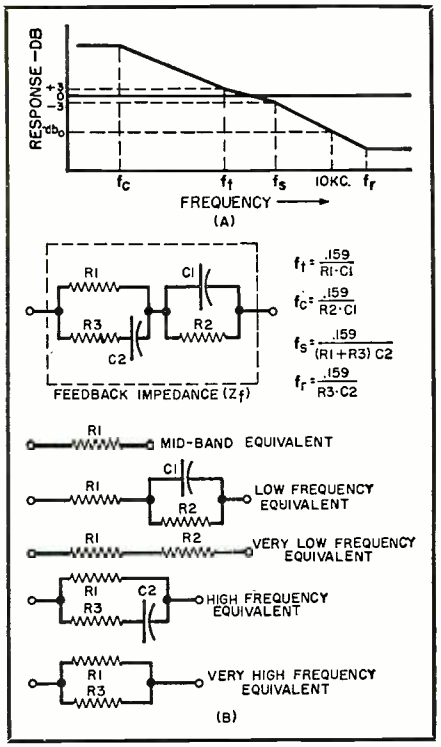


Fig. 3. (A) Idealized equalizer response curve with significant frequencies and response points shown. (B) Feedback impedance network. Equations relate components to the frequencies given in (A) of diagram.

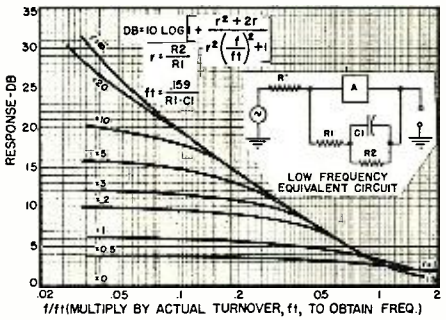
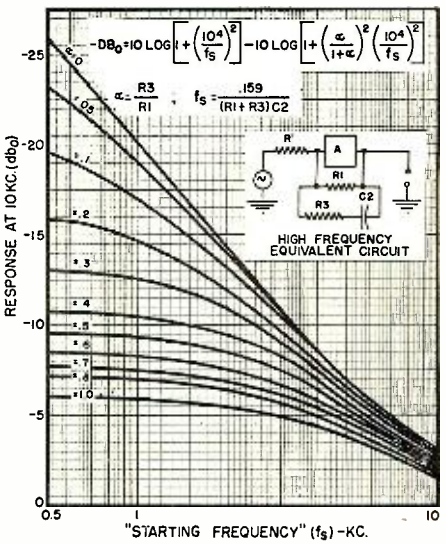


Fig. 4. Bass response curves for values of parameter r. Text describes how resistor R_2 is used to flatten the response curves.

Fig. 5. Response at 10 kc. for values of parameter α. Text describes how R_3 affects slope and shape of de-emphasis curves.



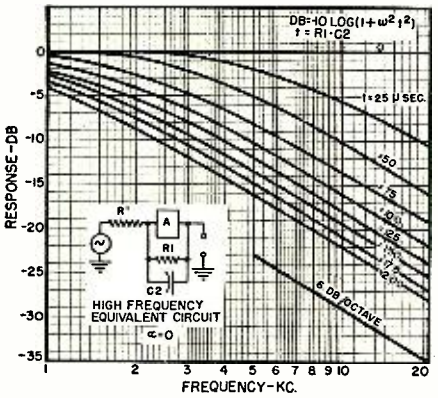


Fig. 6. De-emphasis curves when $\alpha = 0$.

ered as R_3 increases. If $R_3 = 0$, $t = t_1$. As R_3 is increased, t becomes greater by the increasing t_2. Hence f_s becomes smaller.

If a factor α is introduced such that $\alpha = R_3/R_1$ it is evident that $t_1 = t_2/\alpha$, and $t = \alpha\ t_2/(1+\alpha)$. Substituting in equations 3, 4, and 5 and combining,

$$-db = 10\ log \frac{1+\left(\frac{f}{f_s}\right)^2}{1+\left(\frac{\alpha}{1+\alpha}\right)^2\left(\frac{f}{f_s}\right)^2} \quad . \quad (6)$$

As customary in treating de-emphasis curves, the response at 10 kc. is specified. If this response, db_o, is plotted *versus* f_s for significant values of the parameter α, one obtains a useful, general guide to de-emphasis curves. This is done in Fig. 5. Constants for a particular curve are easily obtained once α is known.

Design Procedure

1. Write down all available information about curve.

2. Draw curve on semi-log graph paper.

3. Determine value of R_1 from gain considerations given earlier. 100,000 ohms is a good, all-around value (for passive network, use 10,000 ohms).

4. Find C_1. Since the bass turnover frequency, f_t, is always known:

$$C_1 = \frac{.159}{f_t R_1} \quad . \quad . \quad . \quad . \quad . \quad . \quad (7)$$

where: f_t is in cps, R_1 in megohms, and C_1 in microfarads.

5. Determine R_2 by one of the following methods:

(a) If bass curve is straight and approaches 6 db-per-octave, then $R_2 = \infty$

(b) If frequency where bass de-emphasis begins, f_c, is known, then

$$R_2 = \frac{.159}{f_c C_1} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (8)$$

or:

$$R_2 = \left(\frac{f_t}{f_c}\right) R_1 \quad . \quad . \quad . \quad . \quad . \quad . \quad (9)$$

where: f_c is in cps, R_1 and R_2 in megoms; C_1 in microfarads.

(c) If f_c is not known, match desired curve to one in Fig. 4. Interpolate if necessary. Fill in frequency scale according to turnover frequency (*e.g.*, if f_t is 800 cps, then 0.1 f_t = 80 cps, 0.2 f_t = 160 cps, etc.) Determine r from chosen curve. Then

$$R_2 = rR_1 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (10)$$

and:

$$f_c = \frac{f_t}{r} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (11)$$

6. Determine R_3 and C_2 by one of the following methods:

Case I. Curve approaches 6 db-per-octave droop. $R_3 = 0$

(a) If de-emphasis time constant, t, is known (*e.g.*, 100 microseconds), then:

$$C_2 = \frac{t}{R_1} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (12)$$

where: t is in microseconds, R_1 in megoms, C_2 in micromicrofarads.

(b) If starting frequency, f_s, is known, then

$$C_2 = \frac{.159}{f_s R_1} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (13)$$

where: f_s is in cps, R_1 in megohms, C_2 in microfarads.

(c) If response at 10 kc., db_o, is known, see Fig. 5. Find f_s for given db_o on $\alpha = 0$ curve. Proceed as in (b).

Case II. Curve is less than 6 db-per-octave. R_3 is finite.

From starting frequency, f_s, and response at 10 kc., db_o, determine suitable α from Fig. 5. Then,

$$R_3 = \alpha\ R_1 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (14)$$

and:

$$C_2 = \frac{.159}{f_s(R_1+R_3)} \quad . \quad . \quad . \quad . \quad . \quad (15)$$

where: f_s is in cps, R_1 and R_3 in megohms, C_2 in microfarads.

Typical Curve Problems

I. AES (Fig. 7A)

This curve will be defined as having a straight 400 cps bass turnover frequency and treble de-emphasis of simply −12 db at 10 kc. $f_t = 400$ cps, $db_o = -12$. R_1 is chosen as 0.1 megohm. Using Procedures 4, 5a, and 6 (Case *Ic*).

$R_2 = \infty$, $R_3 = 0$

$$C_1 = \frac{.159}{400 \times 0.1} = .004\ \mu fd.$$

From Fig. 5, $\alpha = 0$, $f_s = 2650$

$$C_2 = \frac{.159}{2650 \times 0.1} = .0006\ \mu fd.$$

II. *RCA* "New Orthophonic" (Fig. 7B)

Here there is a bass turnover frequency of 500 cps with de-emphasis starting at 50 cps. Treble de-emphasis is simply 75 microseconds. R_1 is chosen as 0.1 megohm. Procedures 4, 5b, and 6 (Case *Ia*) are used.

$R_3 = 0$

$$C_1 = \frac{.159}{500 \times 0.1} = .0032\ \mu fd.$$

$$R_2 = \frac{.159}{50 \times .0032} = 1\ \text{megohm or}$$

$$R_2 = \frac{500}{50} \times 0.1 = 1\ \text{megohm}$$

$$C_2 = \frac{75}{0.1} = 750\ \mu\mu fd.$$

III. *Columbia* LP (Fig. 7C)

For purposes of instruction, the bass section of this curve will be defined as "looking like the $r = 5$ curve of Fig. 4." The turnover frequency is 500 cps. Treble de-emphasis is 3 db down at 1590 cps and falls at a rate approaching 6 db-per-octave. $f_t = 500$, $r = 5$, $f_s = 1590$ cps.

Again choose R_1 as 0.1 megohm. Procedures 4, 5c, and 6 (Case *Ib*) are used.

$R_3 = 0$

$$C_1 = \frac{.159}{500 \times 0.1} = .0032\ \mu fd.$$

$R_2 = 5 \times 0.1 = 0.5$ megohm

$$f_c = \frac{500}{5} = 100\ \text{cps}$$

$$C_2 = \frac{.159}{1590 \times 0.1} = .001\ \mu fd.$$

IV. *London ffrr* 78 (Fig. 7D)

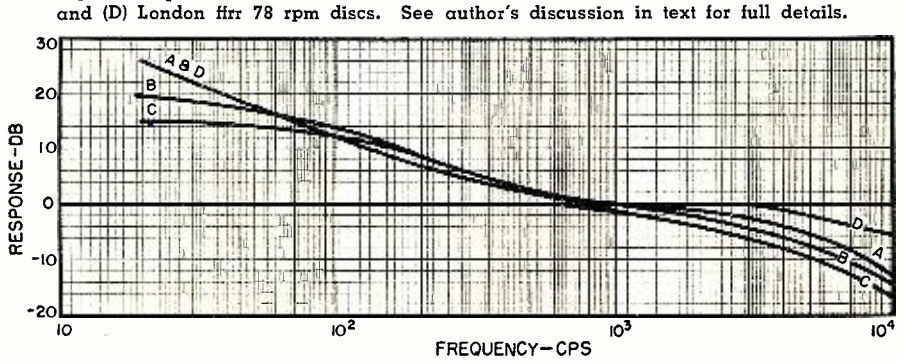
The bass curve is simply a straight 400 cps turnover and can be derived as outlined previously. However, the treble section is an example of Procedure 6 Case *II*.

De-emphasis emerges at 3 kc. and is down 5 db at 10 kc. Inspection of Fig. 7, curve D, shows 6 kc. as the 3 db down frequency. Using $f_s = 6$ kc. and $db_o = -5$, Fig. 5 gives α as 0.4.

$R_3 = 0.4 \times 0.1 = 0.04$ megohm

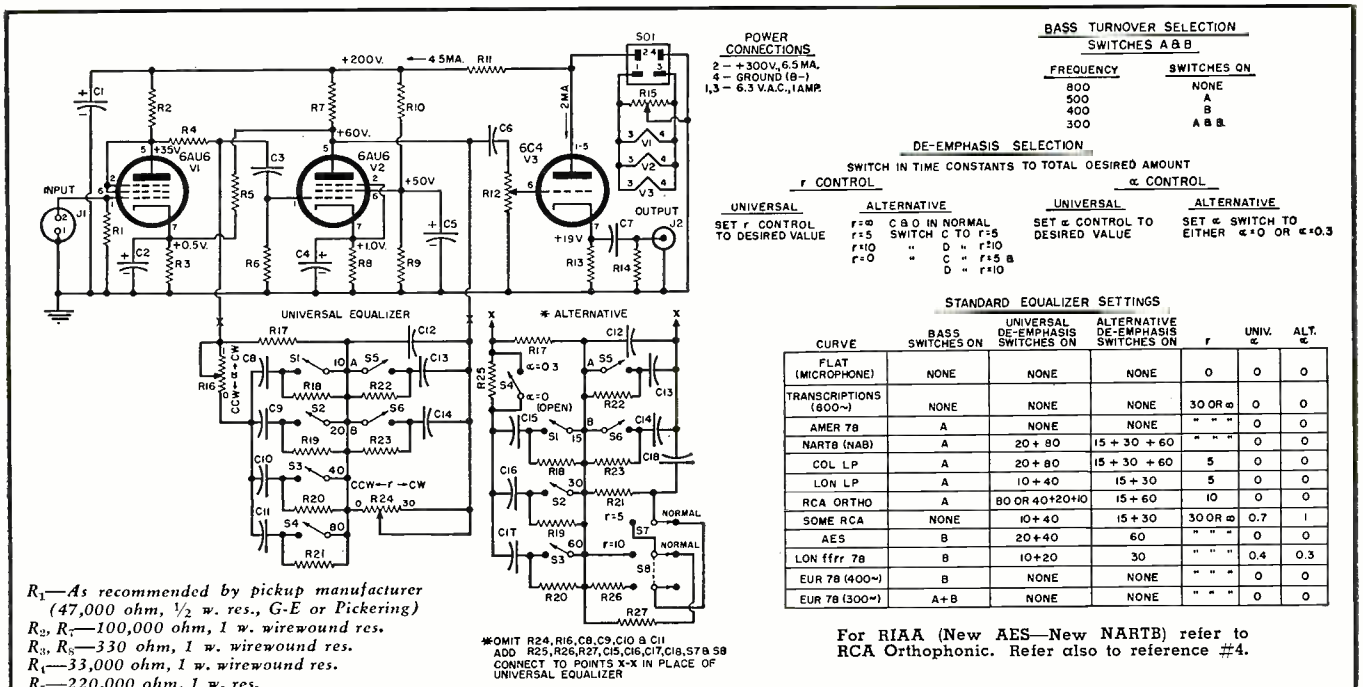
$$C_2 = \frac{.159}{6000 \times 0.14} = .00019\ \mu fd.$$

Fig. 7. Playback curves. (A) AES, (B) Columbia LP, (C) RCA "New Orthophonic," and (D) London ffrr 78 rpm discs. See author's discussion in text for full details.



Other Aids To Design

Although much time has been spent in preparing a comprehensive analysis of equalizer circuits, only the general results can be shown here due to space limitations. However, the designer can make full use of them by spending



R_1—*As recommended by pickup manufacturer (47,000 ohm, ½ w. res., G-E or Pickering)*
R_2, R_7—*100,000 ohm, 1 w. wirewound res.*
R_3, R_8—*330 ohm, 1 w. wirewound res.*
R_4—*33,000 ohm, 1 w. wirewound res.*
R_5—*220,000 ohm, 1 w. res.*
R_6—*470,000 ohm, ½ w. res.*
R_9—*47,000 ohm, 1 w. res.*
R_{10}—*100,000 ohm, 1 w. res.*
R_{11}—*22,000 ohm, 1 w. res.*
R_{12}—*1 megohm linear or audio taper pot*
R_{13}—*10,000 ohm, 1 w. wirewound res.*
R_{14}—*100,000 ohm, ½ w. res.*
R_{15}—*100 ohm, 10 w. wirewound adjustable res.*
R_{16}—*100,000 ohm linear taper pot*
R_{17}—*100,000 ohm, 1 w. wirewound res. ±5%*
R_{18}, R_{19}, R_{20}, R_{21}, R_{22}, R_{23}—*4.7 megohm, ½ w. res.*
R_{24}—*3 megohm audio taper pot*
R_{25}—*33,000 ohm, ½ w. res. ±5%*
R_{26}—*1 megohm, ½ w. res. ±5%*
R_{27}—*500,000 ohm, ½ w. res. ±5%*
Note: All resistors to be ±10% except as noted
C_1—*15 μfd., 350 v. elec. cond.*
C_2, C_4—*25 μfd., 25 v. elec. cond.*
C_3, C_{15}—*.02 μfd., 400 v. cond.*
C_5—*10 μfd., 350 v. elec. cond.*
C_6—*.05 μfd., 400 v. cond.*
C_7—*.1 μfd., 400 v. cond.*
C_8—*100 μμfd. ceramic or mica cond. ±5%*
C_9—*200 μμfd. ceramic or mica cond. ±5%*
C_{10}—*400 μμfd. ceramic or mica cond. ±5%*
C_{11}—*800 μμfd. ceramic or mica cond. ±5%*
C_{12}, C_{14}—*.002 μfd. ceramic or mica cond. ±5%*
C_{13}—*.0012 μfd. ceramic or mica cond. ±5%*
C_{15}—*150 μμfd. ceramic or mica cond. ±5%*
C_{16}—*300 μμfd. ceramic or mica cond. ±5%*
C_{17}—*600 μμfd. ceramic or mica cond. ±5%*
Note: All condensers to be ±20% except as noted
J_1—*Input jack (Amphenol 80-PC2M or equiv.)*
J_2—*RCA-type phono jack*
SO_1—*Socket (Jones P-304-AB or equiv.)*
S_1, S_2, S_3, S_4, S_5, S_6—*S.p.s.t. toggle, slide, or lever switch (Switchcraft 3001L)*
S_7—*S.p.d.t. toggle, slide, or lever switch (Switchcraft 3003L)*
S_8—*D.p.d.t. toggle, slide, or lever switch (Switchcraft 3006L)*
V_1, V_2—*6AU6 tube*
V_3—*6C4 tube*

Fig. 8. Complete schematic for a "universal equalizer" and an alternative switching arrangement. Charts show the switching operations and suitable settings for the standard playback curves.

enough time to fully understand the general equations and the significance of various interrelationships. For example, the relationship

$$\frac{\alpha}{1+\alpha} = \frac{f_s}{f_r} \quad \ldots\ldots\ldots \quad (16)$$

is useful in making a quick diagnosis of a complex dc-emphasis curve. By examining the curve, the 3 db down frequency, f_s, and the leveling frequency, f_r, can be determined. Using equation (16), α is obtained. Then R_3 and C_2 are found by solving equations (14) and (15).

In a great many cases simple de-emphasis, where $\alpha = 0$, is required. Fig. 6 shows actual response curves for this condition. C_2 for a particular response is found by solving equation (12).

It is to be pointed out that although there are but a few standard curves in which α is other than zero, the use of variable or switched resistors for R_{16} is most useful in producing modifications of de-emphasis *slope* often required to exactly equalize some recordings. This is equally true in the bass region where adjustment of R_{24} accomplishes equalization correction. See Fig. 8.

Practical Equalizers

Returning to the problem that was presented earlier, it can be readily seen that the greatest difficulty now facing the designer concerns the choice of curves he is to use and the means he should use to switch them. Before he can begin, however, he must obtain accurate definitions of these curves in terms of the factors that determine their circuit constants. This task is made difficult because of conflicting information from different sources. The equalizer recommendations given in Fig. 8 are based on the most reliable information available to the writer. However, this does not preclude conflict between these sources or between those recommended in Fig. 8 and sources available to the reader.

Once a satisfactory agreement has been reached as to the nature of the curves, the designer can turn to the problem of switching. Most widely used methods fall into two groups:

a. Single switching of complete playback curve
b. Dual switching—one switch selects the bass while the other selects the treble

A more recent innovation falls into a third category:

c. Sets of push-buttons or two position switches that individually select a complete curve and in combination give additive curves.

Following naturally from this is a scheme that the writer feels to be most flexible and one that is slated for increased popularity:

d. Dual sets of push-buttons or two position switches that give desired curves by adding separate bass and treble curves.

The distinction between methods (*c*) and (*d*) may not be too clear. Method (*c*), for example, uses a number of two-position slide switches. Each switch selects a particular complete curve such as the AES or *London*. Using more than one switch at a time adds together whatever curves are chosen and a new curve results. This method has an advantage of simplicity —2^n curves can be formed with n switches—but curves formed by addition of standard curves may be useless and there are bound to be duplications and wide gaps in the range of curves.

Method (*d*) can handle as many curves as (*c*), but each curve represents a small incremental change from the preceding one. Thus the entire range of standard curves can be included as part of a system that offers extreme flexibility. To accomplish this, several switches are assigned to the bass section only and several more to the treble. This method is the basis of a universal equalizer.

(*Continued on page* 156)

AN UNUSUAL TV PHASE DETECTOR

By
JOHN K. FRIEBORN

Analysis of a phase detector, used in some recent TV sets, which takes control voltage from the grid of a triode tube.

DURING the past few years we have become familiar with cathode-follower and grounded-grid connections of triodes in addition to the conventional grid-input, plate-output connection. No possible connection of a triode can surprise us much any more, unless, of course, someone should devise a circuit with the input applied to the plate and the output taken from the grid. Someone has!

At least four different manufacturers have used or are using a horizontal phase detector circuit in which one input signal is applied to the plate of a triode, one input signal is applied to the cathode, and the output is taken from the grid. Apparently, this all started three or four years ago, with the *Hoffman* 170 series chassis. The circuit of the horizontal phase detector and horizontal oscillator on this chassis is shown in Fig. 1.

The general function of any horizontal phase detector in a television receiver is to compare a signal from the receiver's deflection circuit with a signal corresponding to the transmitted sync pulses and to produce a d.c. voltage output whose amplitude and polarity depend upon the phase relation between the two signals. The resultant voltage controls the frequency of the horizontal oscillator.

In the circuit of Fig. 1, a saw-tooth derived from the receiver's horizontal output is applied to the plate of V_{111A} and a negative sync pulse is applied to the cathode.

The electron flow from cathode to grid determines the d.c. voltage output from the circuit. Electrons will flow even though the grid is slightly negative with respect to the cathode, because the initial velocity of the electrons leaving the cathode will overcome a slight amount of repulsion from the grid. This phenomenon produces the so-called "contact potential," which makes the grid slightly negative (and charges C_{150} slightly negative) even with no signal applied.

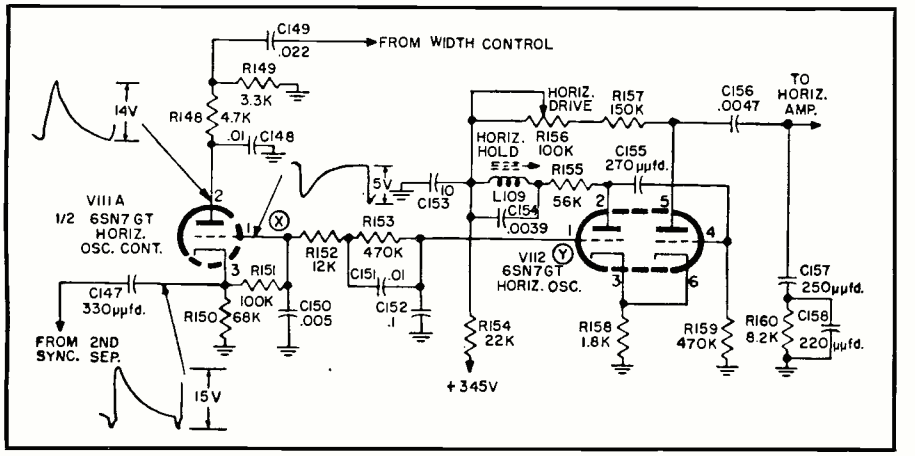
If the sync pulses are applied to the cathode, but no other signals are applied to the tube, the resulting negative potential of the cathode with respect to the grid will cause additional electron flow, charging C_{150} more negative with respect to ground. The time constant of the discharge circuit, C_{150}-R_{150}-R_{151}, is long in proportion to the interval between horizontal sync pulses; the charge on C_{150} therefore will be almost constant and nearly equal to the peak amplitude of the sync pulses.

When a signal is applied between plate and ground, some of the signal will be dropped across the tube, from plate to cathode, and some will appear across R_{150}, between cathode and ground. If the sync pulse is applied to the cathode and the saw-tooth is applied to the plate, we now have two signals appearing between cathode and ground; the amount of electron flow from cathode to grid will depend upon the combined effects of the two signals. If, at the time the negative sync pulse is applied, the instantaneous value of the saw-tooth signal is positive, the electron flow to charge C_{150} will decrease. The normal operating condition is that the sync pulse occurs approximately midway in the retrace part of the saw-tooth. The resulting charge on C_{150} and bias on the grid of V_{112A} is approximately —0.42 volt. The component values in the horizontal oscillator circuit are such that this bias sets the frequency of the oscillator to approximately 15,750 cps.

If the frequency of the oscillator is slightly too low, the saw-tooth cycle will be too long in proportion to the sync pulse cycle; the next sync pulse will occur at a more negative point on the saw-tooth retrace. The increased negative bias on the coupling tube of the multivibrator (V_{112A}) will have the same effect as would a decreased bias on the discharge tube (V_{112B}): it will cause the frequency to increase. Conversely, if the frequency originally is too high, the change in charge on C_{150} will decrease the frequency. The over-all effect of the automatic frequency control system is to adjust the frequency of the horizontal oscillator so that each succeeding sync pulse will occur at the same point in the saw-tooth retrace.

If operation of the circuit should happen to begin with the sync pulse occurring during the trace rather than the retrace part of the saw-tooth, the phase correction at first would be in the wrong direction, but the final effect would be the same. If the first sync pulse occurred slightly after the receiver's retrace and the second still later, the control circuit would not reduce the phase difference but increase it; that is, each succeeding sync pulse would be later and later with respect to the retrace. Eventually (probably within a few cycles), however, the sync pulse would occur during some portion of the following retrace. In other words, if the receiver frequency was originally slightly too high, it would be made still higher until the receiver had gained whatever part of

Fig. 1. Horizontal phase detector and oscillator circuit of some Hoffman chassis.



a cycle was required to make some part of the retrace coincide with the sync pulse. Then normal control action would begin.

In Fig. 1, R_{152}, R_{153}, C_{151}, and C_{152} form a filter to reduce the effect of noise on synchronizing, while at the same time allowing the circuit to respond as rapidly as necessary to changes in frequency.

A horizontal phase detector circuit identical to that in Fig. 1 was used in *Hoffman* 180 series chassis, but not in later series.

Similar circuits have been used in other receivers. Fig. 2 shows a partial schematic of some *Westinghouse* chassis (V-2175, V-2178, V-2192, V-2194, and V-2200 series among others). Fig. 3 shows the circuit used by *Meck* in chassis 9026, 9032, and 9033 (late 1952 or early 1953). A circuit used in *Trav-ler* chassis 36A2 and 36B2 (late 1952 or early 1953) is shown in Fig. 4. These circuits differ from that of Fig. 1 only in details. All of them have different output filters, representing their respective designers' solutions of the problem of obtaining maximum noise immunity and speed of response at minimum cost. Two of the circuits, the *Westinghouse* and the *Meck,* have slight positive voltages applied to the plate of the triode. In spite of the differences, functioning of all of these circuits is substantially as described for the circuit of Fig. 1.

Troubleshooting

Troubles in receivers using this circuit can be localized by simple checks. The following procedures should help conserve servicing time to a considerable degree.

First, manipulate the horizontal hold control. Careful adjustment should result in an upright picture, at least momentarily, without going to either limit of the control's range. If not, the trouble—at least one trouble—is in the horizontal oscillator circuit. The faulty component usually can be found by: (1) replacing the tube, (2) measuring voltages and resistances and comparing them with the receiver service data, and (3) bridging coupling and bypass condensers to check for opens. (Improper voltage at the grid of the oscillator tube input section sometimes may be caused by a short in the phase detector tube).

If the picture can be brought into synchronization momentarily, but drifts out, probably the oscillator circuit is all right, but its bias is not being corrected by the phase detector. Vary the hold control and measure the d.c. voltage between ground and the oscillator tube grid (point "Y" on the circuit diagrams). If the voltage does not vary, replace the phase detector tube and recheck.

If replacing the tube does not restore the bias variation, measure voltages between ground and each point along the line between the oscillator and phase detector grids. If the voltage varies at any of these points but not at the oscillator grid, a series component in the filter is open or a shunt component is shorted.

If the voltage does not vary, even at the phase detector grid (point "X") the trouble is in the phase detector circuit or in the circuit feeding the sync pulse or saw-tooth signal to the phase detector. Replace any sync channel tubes which have not been replaced already.

With an oscilloscope, check the sync signal input at the phase detector cathode. (Remove the horizontal oscillator tube or otherwise disable the oscillator circuit so that the sync pulse can be observed separate from the saw-tooth.) If no sync pulse is found at the phase detector cathode, trace the sync signal channel with the scope.

Check waveforms at the phase detector plate and along the line between phase detector and horizontal output circuit.

Finally, check resistances and bridge condensers in the phase detector circuit.

Although rare now, triode grid output circuits are gaining popularity.

—30—

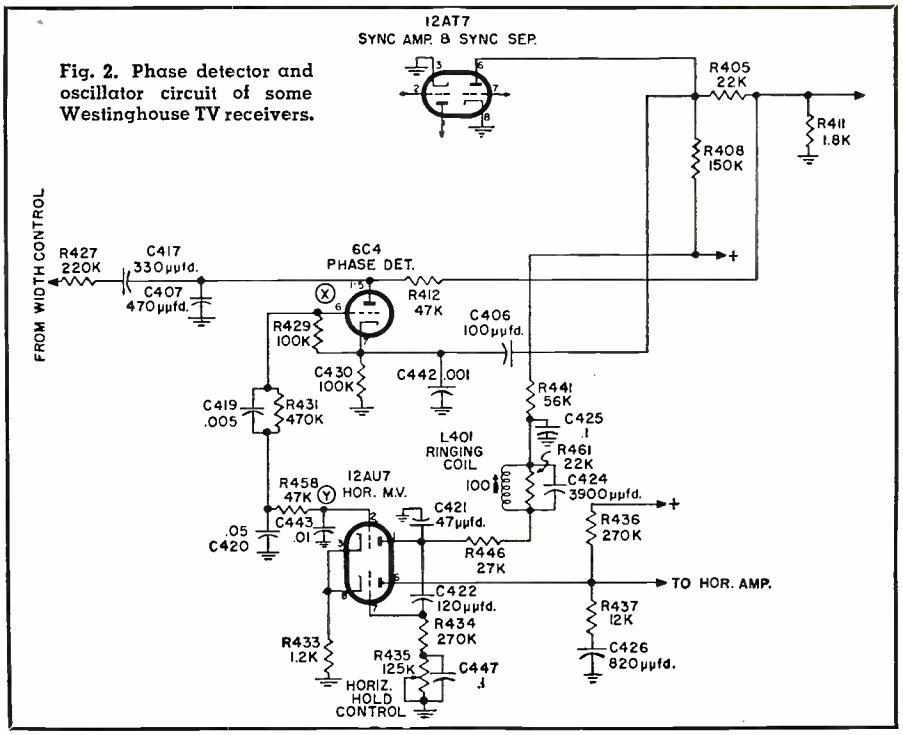


Fig. 2. Phase detector and oscillator circuit of some Westinghouse TV receivers.

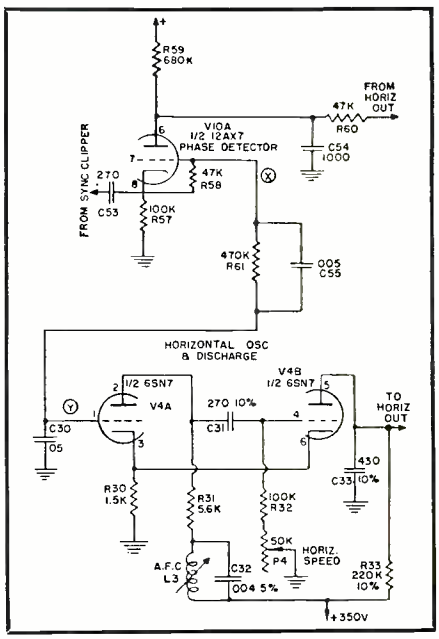
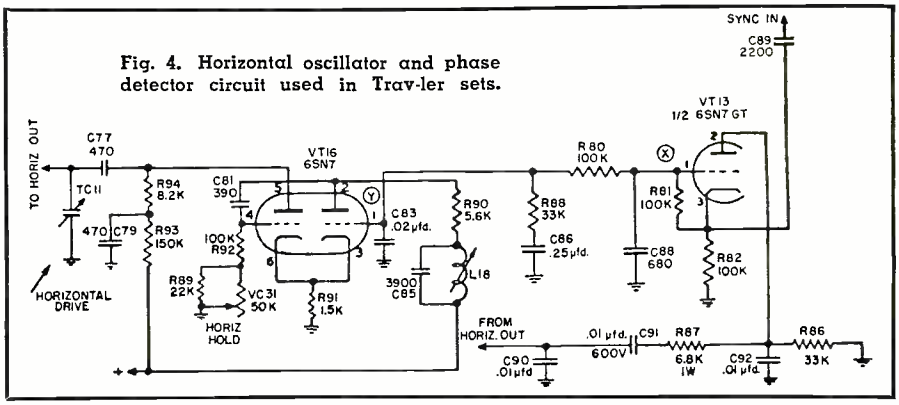
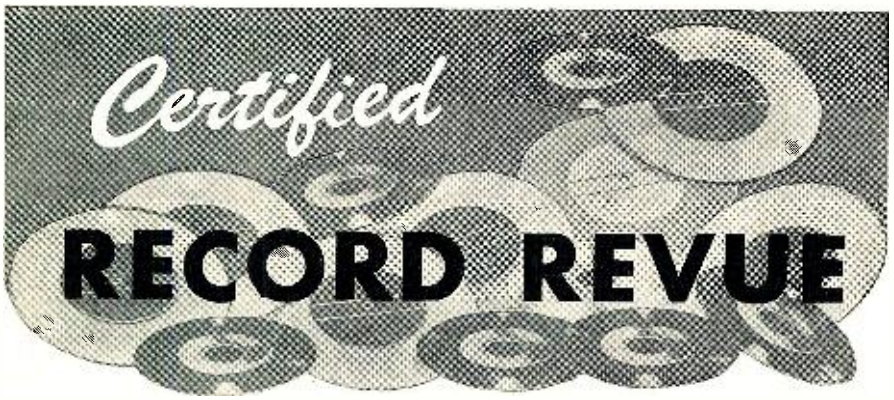


Fig. 3. Horizontal phase detector and oscillator circuit used in Meck TV sets. Note that in this circuit a positive voltage is fed to the detector's plate.

Fig. 4. Horizontal oscillator and phase detector circuit used in Trav-ler sets.





By **BERT WHYTE**

WITH this issue, the Certified Record Revue celebrates its first anniversary. It seems incredible that a year could pass so swiftly. Nevertheless it has, and it's time to pause a moment and indulge in a little "stock-taking." It seems to be a congenital disease of authors, to give forth with much flowery oratory when giving credit to those who are responsible for their success. In a way I suppose it's almost unavoidable. I heartily dislike "corn," especially insincere "corn." But how can I do otherwise than convey to you my heartfelt gratitude for your loyal and generous support which has made this anniversary possible. Believe me, even if it sounds trite, one of the biggest thrills in my life was to receive your kind letters after the appearance of my first column. It gives a fellow a nice warm feeling to know he has so many friends who like to read his stuff and who find the time to sit down and write letters about the column. Again, thank you for your kindness and support, and an especial vote of thanks to Mr. Oliver Read. A record review column in a magazine like RADIO & TELEVISION NEWS was a somewhat daring innovation, and Mr. Read's faith in the project and his encouragement has been greatly appreciated.

In a year's time, we have reviewed a great many recordings. Out of all this welter of good, bad, and indifferent recordings, one fact is significant. The *general* level of LP quality is far above that which prevailed last year. Wider frequency response, more dynamic range, better surfaces, all these have become things which are looked for as the accepted norm, rather than as an exceptional quality to be found only in the most rare of recordings. Certainly, there are many gradations of quality, even among discs which qualify as high fidelity recordings. The differentiation of these qualities is, however, more a matter of equipment, acoustical environment, and subjective listening. By and large, the *average* LP which is purchased today, has more high quality sound than the *average* music-lover's equipment is capable of reproducing. New and greater sound quality will be available in the records of the not-too-distant future. *Monogroove* stereophonic discs have been successfully demonstrated and could well be introduced as early as the spring of 1955. As these developments occur, I'll do my best to keep you informed.

As you may remember, during this past year I have campaigned for the commercial release of pre-recorded tapes, both monaural and binaural. As I pointed out, there was a certain amount of tape material on the market. Most of these tapes were, however, of such dubious quality and trivial repertoire, they found little acceptance. If you don't already know, I'm sure you will be happy to learn that pre-recorded tape is finally available from a major record company! Yessir, with the release of monaural *and binaural* tapes by *RCA Victor*, a new era in recorded music has begun! The initial release contains such diverse items as the Dvorak "5th" with Toscanini, Tchaikovsky's "5th" with Stokowski, Brahms' "2nd Piano Concerto" with Rubenstein, and other symphonic works. Strauss' "Also Sprach Zarathustra," with Reiner and the Chicago Symphony is the first work available in *Victor's* binaural editions. I think you will agree that this is a tremendous step forward in recorded music. *RCA Victor* certainly deserves credit for taking the long overdue plunge into this field. You can be sure that the other major record companies will follow suit; in fact I can practically guarantee, two other well-known companies will be in the pre-recorded tape business early in 1955! It goes without saying, I welcome this new musical medium and beginning with the next issue, pre-recorded tapes will be reviewed as well as disc recordings. In accordance with my established policy of naming the equipment used in reviewing recordings, I will apply this practice to the new pre-recorded tapes. I hope this will prove helpful and find favor with you.

By the time you read this month's column, most of you will have had your vacations and with the fall and winter before you, take a renewed interest in your hi-fi rig and the state of your record library. While you were busy enjoying the sunshine and the outdoor life, the record companies have not been idle. A lot of fine records were issued this spring and summer. Before the annual fall deluge of new recordings, you might like to know about some of this warm-weather output. Therefore, you will find more records reviewed than usual this month, but of necessity, the reviews must be shorter.

Equipment used this month: New *Weathers* A-510 FM pickup and arm, *Weathers* P-661 preamp, *Rek-O-Kut* T12H turntable, *McIntosh* 30-watt amplifier, *Jensen* "Triaxial" speaker in *Karlson* exponential slot enclosure.

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.

DELIUS
A MASS OF LIFE

Royal Philharmonic Orchestra conducted by Sir Thomas Beecham. Robina Raisbeck, soprano; Monica Sinclair, contralto; Charles Craig, tenor; Bruce Boyce, baritone; the London Philharmonic Choir. Columbia SL-197. NARTB curve. Price $11.90.

Those of you who are familiar with the Delius of "Song of Summer" and "Over the Hills and Far Away," will find a Delius made of sterner stuff in this first-time-on-LP recording. Taken from the text of Nietzsche's "Thus Spake Zarathustra," this is an emotionally supercharged work, quite unlike anything of the usual Delius serenity and pastorale-like qualities found in most of his music. This is passionate music, of great intensity, an extremely beautiful work which once heard, leaves an indelible impression. Structurally very complex, it is nonetheless a most assimilable work, easy to listen to. Sir Thomas, as the principal champion of Delius' music, lavishes affection on the score and the performance is formidable in its power. Monica Sinclair, the contralto in this recording, is easily the standout vocalist, although the others are more than competent. The London Philharmonic Choir does nobly with its difficult task, and the Royal Philharmonic is, as usual, big-toned, super-precise. Sound is quite variable, not too wide range, thick textured at times, with very heavy bass line requiring a few db cut on the NARTB curve. Strings generally smooth and occasionally some spectacular percussion effect coupled with weighty brass. If you've never cared much for Delius, give this a try for a different appraisal of the work of this tragic Briton. Good surfaces.

KATCHATURIAN
MASQUERADE SUITE

L'Orchestre de la Societe des Concerts du Conservatoire de Paris conducted by Richard Blareau. London LD9100. RIAA curve. Price $2.95.

Another "light" item for your listening while the hot weather is still with us. One of the new *London* low-price ten-inch series, it offers the best performance available on records of this rather obvious music. Blareau exercises a properly light touch which relieves the music of some of its preten-

(*Continued on page* 139)

TWO-IN-THE-HAND

By ROB WAGNER, W6WGD
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Dalmo Victor Company

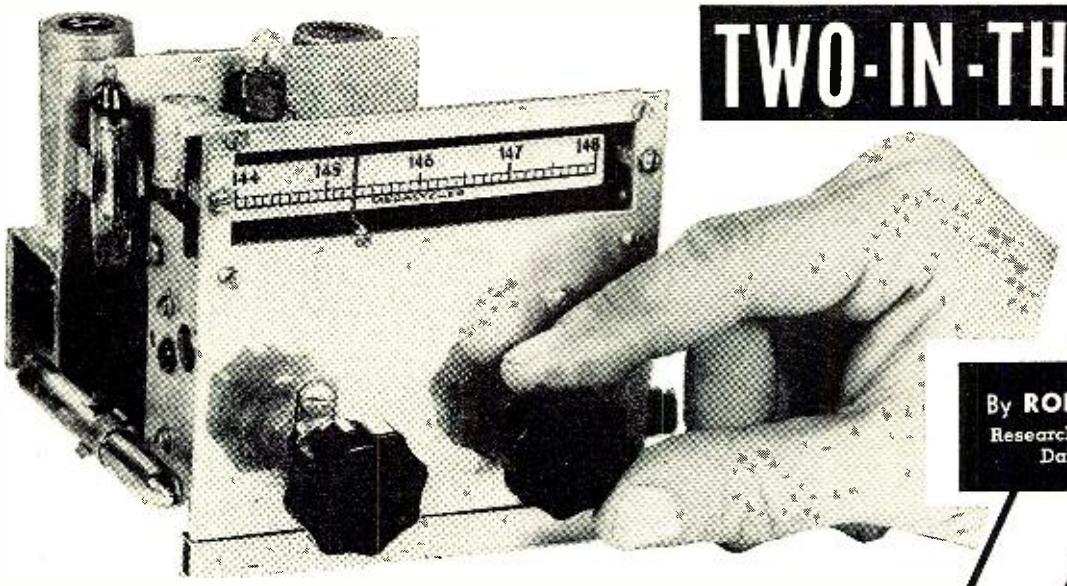


Fig. 1. Tuning the input (r.f. grid) circuit for optimum signal-to-noise ratio.

Part 2. Concluding article covers a midget double-conversion front end which features a unique permeability-tuned oscillator, balanced mixer, and the low signal-to-noise ratio necessary for copying those weak 2-meter DX stations. A 2C51 tube is used.

LAST month's midget transmitter article endeavored to show that v.h.f. mobile equipment needn't crowd the car's spare tire out of the trunk, yet can have enough power output to compare favorably with equipment requiring several times more space.

This mobile (or home-station) converter fits the same miniature category as the transmitter and incorporates a unique design feature which gives stability exceeded only by crystal control, allowing maximum performance to be built into minimum space.

The circuit consists of a low-noise, push-pull r.f. amplifier, balanced push-pull mixer, an extremely stable permeability-tuned v.h.f. oscillator, i.f. amplifier, and a crystal-controlled second mixer, giving output at 1600 kc. for third conversion within the auto radio of a standard automobile.

Before describing this equipment, I wish to thank W6YEB (Les Sebald of *United Air Lines*) for use of his basic idea (the slug-tuned 2-meter oscillator) around which a year's development work resulted in the following design.

General Description

Fig. 2, the schematic diagram, tells the story. The GL-5670 (2C51) twin-triode r.f. amplifier was tested for noise figure, and shows a satisfactory edge over the currently popular 6J6.

Various schools of thought exist as to the merits of different r.f. amplifiers; I'm not arguing with any of 'em! Neutralized push-pull, cascode, grounded-grid, and other types of low-noise amplifiers apparently perform equally well if properly built and adjusted, using the tubes best suited for each circuit. What's one man's meat is another man's amplifier, so I prefer the balanced r.f. stage, which shows a pretty fair noise figure and very good input sensitivity.

Next, the 5670 balanced mixer. The circuit has been used extensively in radar receivers for quieter conversion of weaker impulses, so its choice in the design of this circuit was a natural. The circuit employs a push-pull triode, the local oscillator signal being applied to each triode grid in-phase. Inasmuch as the output of the push-pull stage is out-of-phase with the oscillator voltage applied to the grids, oscillator tube noise cancellation theoretically occurs, resulting in a nice quiet first conversion. This theory was proved by trial of the mixer with other types; at least I haven't discovered a better one yet.

Now let's look at the "heart" of the converter, the 9002 slug-tuned oscillator. This one has proved to be the neatest thing I've ever tried insofar as stability is concerned. Mechanically, it's a bit rougher to construct than a condenser-tuned oscillator, but the work involved is really worth it. Once adjusted, the converter can be tuned to a weak signal, then dropped on the table or car floor, banged around in general, and when the tubes stop ringing—lo and behold! Don't touch that dial! The signal is still there!

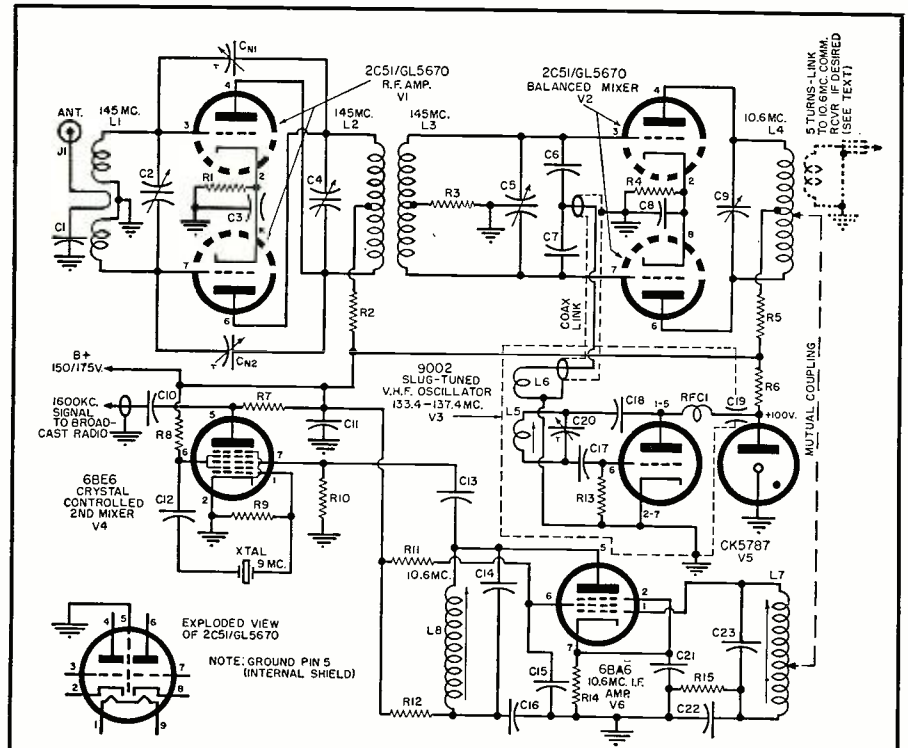
Of course, there are those who prefer crystal-controlled oscillators, and I'm not arguing with them either. However, for those who like a tunable oscillator, this one eliminates the disadvantages of broadband amplifiers and such and, if properly constructed, has the closest approximation of crystal stability.

The 6BA6 i.f. amplifier is standard, except that regular i.f. transformers were discarded in favor of "home-brewed" jobs, which not only conserved space but provided a slightly higher "*Q*" than did some commercially-available cans.

The 6BE6 second conversion stage is unique in that no tuned circuits are used. Inasmuch as gain and selectivity are not required at this stage of the converter (adequate gain before, and much selectivity after), the minimum space taken by the tube, crystal, and a few resistors and condensers helps along toward miniaturization. Fig. 5 indicates "before-and-after" size of the converter. Before (for home-station operation) chassis length was four inches. (See Fig. 9). Addition of the inch-wide i.f. amplifier and second conversion stages for mobile use still left room in the car for one wife, one and 8/9ths children, a mother-in-law, a week's groceries, tools, fishing tackle, and a carton of 4-X-150-A's.

The net result of all this is a strong, healthy 1600 kc. signal at the output plug. Further selectivity due to the car radio's low-i.f. third conversion results in a receiving system capable of separating all but zero-beat signals.

Now for a few disadvantages. In double conversion systems, it's hard to eliminate "birdies" resulting from an unpleasant admixture of beating local oscillator signals. A third oscillator (triple conversion)—though properly isolated—can cause further trouble. Only by careful experimentation can these annoying invisible "beats" be attenuated, and frankly, I haven't had the time to iron 'em out completely. Choice of the 9 mc. rock at the second mixer was made arbitrarily because it happened to be handy, and results in several inaudible birdies within the



R_1, R_2, R_4, R_{12}—150 ohm, ½ w. res.
R_3—220 ohm, ½ w. res.
R_5—10,000 ohm, 2 w. res.
R_6—3000 ohm, 10 w. wirewound res.
R_7—120,000 ohm, ½ w. res.
R_8, R_{10}, R_{15}—270,000 ohm, ½ w. res.
R_9, R_{13}—22,000 ohm, ½ w. res.
R_{11}—33,000 ohm, 1 w. res.
R_{14}—56 ohm, ½ w. res.
C_1—7-45 μμfd. silvered-ceramic trimmer (Erie N500 #TS2A-7)
C_2, C_4, C_5—2.7-10.8 μμfd. midget butterfly cond. (Johnson #11MB11)
C_3—10 μμfd. button feedthrough cond. (see text)
C_6, C_7—5 μμfd. tubular ceramic cond.
C_8, C_{10}, C_{11}, C_{12}, C_{15}, C_{16}, C_{21}, C_{22}—.001 μμfd. midget disc ceramic cond.
C_9—3-30 μμfd. air trimmer
C_{13}—390 μμfd. silver mica cond.
C_{14}, C_{17}, C_{18}, C_{23}—50 μμfd. tubular ceramic cond.
C_{19}—1500 μμfd. feedthrough cond. (Erie #362-152)
C_{20}—1.5-7 μμfd. silvered-ceramic trimmer (Erie ceramicon NPO #TS2A—1.5)
C_{N1}, C_{N2}—Neutralizing cond. (see text)
J_1—Antenna jack
Xtal.—9 mc. crystal (see text)
RFC_1—Surplus v.h.f. choke (see text) or ½" long winding of #35 en. on ¼" o.d. form
L_1—6 t. #18 en., 5/16" i.d. (spaced at center for ant. link coupling)
L_2—7 t. #18 en., 5/16" i.d.
L_3—5 t. #18 en., 5/16" i.d.
L_4—38 t. #29 en., center-tapped, on ½" dia. form (CTC)
L_5, L_6—See text
L_7, L_8—17 t. #29 en. on ½" dia. slug-tuned form (CTC)
V_1, V_2—2C51/GL5670 tube
V_3—9002 tube
V_4—6BE6 tube
V_5—CK5787 or OB-2 tube V_6—6BA6 tube

Fig. 2. Complete schematic, parts list, and coil data covering the 2-meter front end.

two-meter band. However, they're "not there" when the high-powered locals are watching television, and I've had some pretty good DX contacts in spite of 'em, even when the power boys were clobbering the local ether. The birdies have been *attenuated*, however, and are not troublesome enough to warrant immediate extinction.

With any essentially broadband front end, cross-modulation is a problem, too, although it occurs only when very strong local signals are on the band. I can live with it, because apparently only a very high-"*Q*," extremely selective front end will ease the problem. For mobile work, construction of a tuned or coaxial r.f. stage is almost out of the question. So let's take the bad with the good, the latter having the edge, and proceed with a description of each individual circuit.

The R.F. Amplifier

The 5670 is a nine-pin miniature, ideally suited to this application. Its construction (Fig. 2) allows the mechanical layout to correspond to that of the schematic diagram.

Figs. 5 and 6 illustrate how neatly this tube can be incorporated. The use of home-made neutralizing condensers C_{N1}, C_{N2} facilitates construction and adjustment.

The single-turn antenna link mounts on the reactance "tuner-outer" C_1 and the center conductor of the coaxial input receptacle, J_1, Coax feed for mobile operation was installed after having used a balanced line to the input for home-station operation; both systems proved satisfactory. Should there be standing waves on the coaxial feed line, C_1 should tune out the link's reactance and allow optimum coupling to the input circuit.

Grid coil L_1, 6 turns of #18 tinned solid hookup wire, was wound on the shank of a 5/16" dia. drill, leaving a space between the two 3-turn sections for insertion of the antenna link Both L_1 and its 7-turn counterpart, L_2, solder directly to the stator plates of their respective tuning condenser, C_2 and C_4, with short connections to the grid and plate pins of the tube socket. C_2 may be adjusted from the front panel, so that best signal-to-noise ratio may be obtained for any given signal. The plate circuits are electrically crossed over, as shown in Fig. 2, allowing neutralizing condensers C_{N1} and C_{N2} to mount directly from grid to opposite plate circuits across the bottom of the tube socket.

Rather than fool about with such devices as pieces of snipped twin-lead in an attempt to neutralize the front end, construct your own version of neutralizing condensers. Take a couple of plastic spacers from your ladder line and file a flat lengthwise along the top of each; their lengths should be about ⅞". Using #2-56 machine screws and thin, springy brass shim stock, make a compression padder similar to broadcast-radio trimmers. A clearance hole through the upper plate allows passage of a #4-40 binder head machine screw, which threads into the plastic and allows adjustment of the neutralizing capacity. The capacity will not exceed a few micromicrofarads and, considering lumped circuit inductance and capacity, should be adequate to balance out the grid-plate capacity of each half of the tube.

C_3, the cathode bypass condenser, is a surplus button feedthrough silver-mica condenser, the outer shell of which solders directly to the tube socket's center pin, the common ground return for the entire r.f. stage. The center conductors of C_2 solder directly to either cathode pin, and R_1 mounts from one cathode to ground at the socket. L_1's center tap grounds to C_3 visible in Figs. 5 and 6.

Rotors of C_2 and C_4 are not grounded; these points "float" in order to allow the inductances to seek their own electrical grounds. With rotors grounded, electrical circuit balance becomes hard to obtain, resulting in neutralization difficulties.

Adjustment of the r.f. amplifier and other stages is treated following the circuit descriptions; now let's look at the mixer.

The Balanced Mixer

As mentioned previously, the choice of the 5670 as a balanced mixer was natural as five and two. Figs 5 and 6 illustrate the loose mutual coupling between mixer input coil L_3 and r.f. plate coil L_2, necessary to maintenance of the "*Q*" and selectivity of each tuned circuit.

Speaking of "*Q*," observe that I've used butterfly tuning condensers and unloaded inductance. Heretofore, the trend in v.h.f. front ends appears to have been toward use of silver-ceramic trimmers, and tuned circuits loaded down with a half-meg or so to "broaden" the bandpass. Nix! The tuned circuits employed herein have a relatively higher "*Q*" and a response curve over the 4 mc. passband which

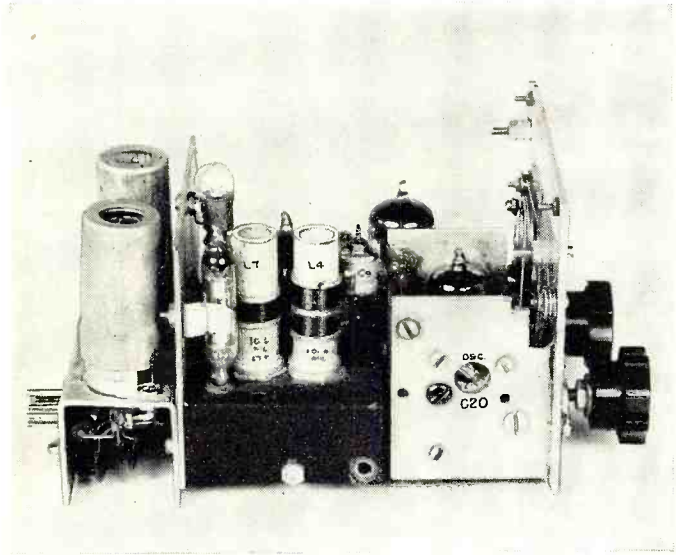


Fig. 3. Side view, with oscillator shield removed, showing oscillator bandset condenser, C_{20}, and mutual coupling between L_4 and L_7. Note size of CK5787 tube and its fuse clip mounting.

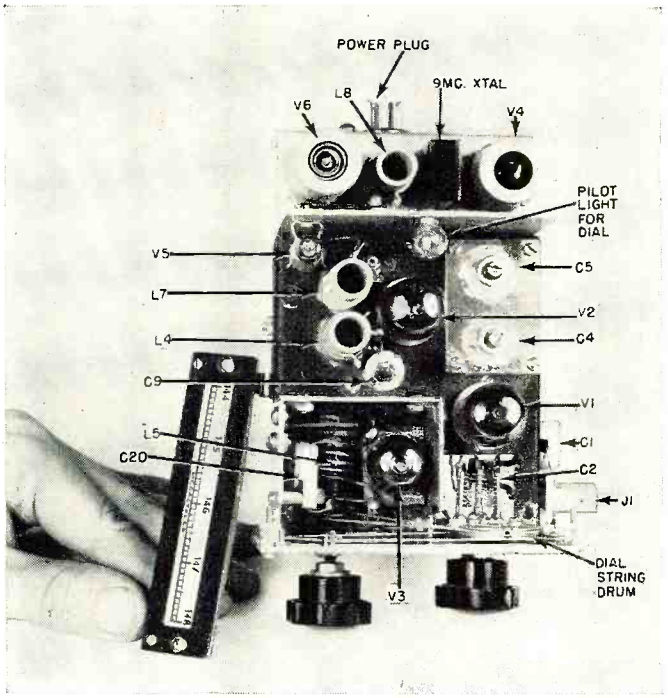


Fig. 4. Top view with the slide-rule dial removed to show details of the dial stringing and location of various parts.

leaves plenty of gain at the band edges without sacrificing what little selectivity there is in this type of miniature tuned circuit.

The rotor of C_5 returns to ground, and L_3 requires less inductance than the r.f. coils, resulting in a slightly more selective tuned circuit. R_3 provides the grid-circuit ground return, while C_6 and C_7 solder directly to the grid pins, their center junction terminating the coaxial link from the oscillator stage.

R_1 and C_8 provide cathode bias and bypassing; correct operating point for the mixer stage is determined by varying plate voltage rather than cathode potential.

The 10.6 mc. mixer plate circuit, L_1-C_9, is plainly visible in Fig. 3. Wound on a *CTC* (*Cambridge Thermionic Co.*) ceramic slug-tuned form (with slug removed), the plate coil resonates with C_9 a *Philips* 3-30 $\mu\mu$fd. air trimmer. Should this type be unavailable, substitution of the same capacity in a silvered-ceramic unit is OK, although not so easily adjusted.

Now let's consider R_5. R_5 is quite important to correct mixer operation, as it determines the tube's plate voltage, placing the operating point of the 5670 at its optimum location on the characteristic curve. After considerable experimenting with different mixer plate voltages, a noise-generator check showed the mixer to be operating at approximately a 3 db better signal-to-noise ratio using a plate supply of between 35-55 volts as compared to the signal-to-noise ratio resulting from application of higher plate voltages. The 3 db noise figure can mean a lot when the guy in East Decalomania is running an even race with the noise level!

The operating point of the tube could probably have been moved in similar fashion by varying the tube's cathode bias. However, I've built a miniature electronically-regulated variable voltage power source, and couldn't resist the chance to play with it, and the value of R_5 is the result.

So that the mixer will *mix*, we must get something besides amplified r.f. into the tube, so let's proceed with the local oscillator.

Slug-Tuned V.H.F. Oscillator

The "ultraudion" v.h.f. oscillator seems to be one of the most popular circuits for 2-meter converter application. With the 9002's cathode grounded, feedback occurs through L_5 between grid and plate, each of

Fig. 5. Bottom view of the converter with the oscillator shield removed to clarify oscillator assembly and wiring. The cigarette shown at left gives idea of oscillator's miniaturization.

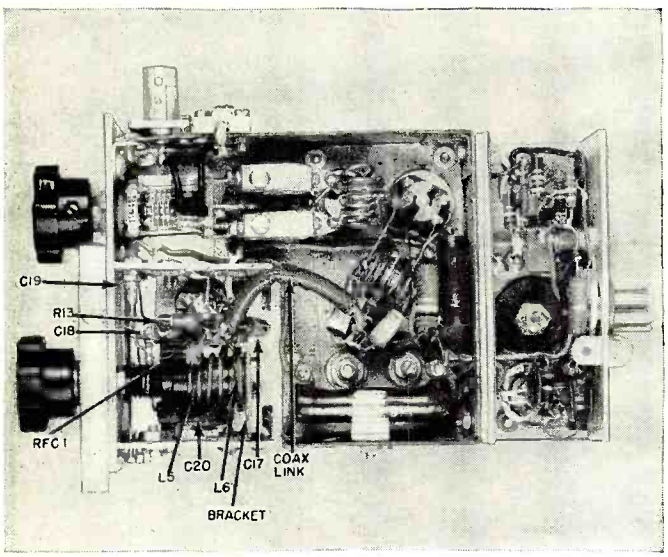
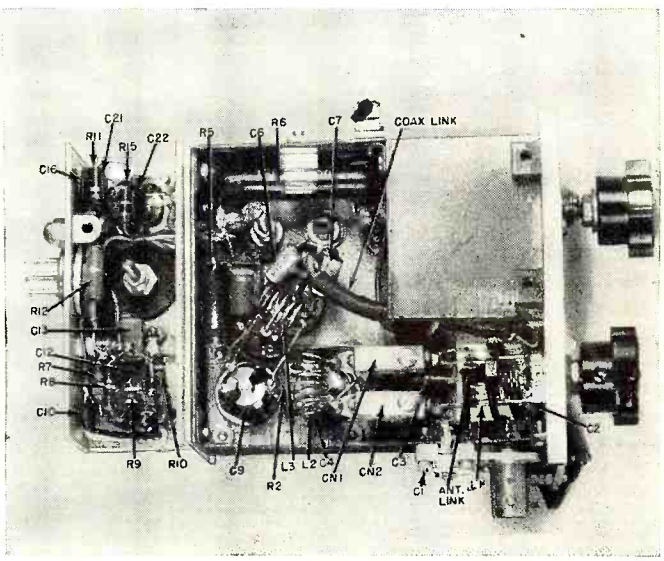


Fig. 6. Bottom view with shield in place. The home-made neutralizing condensers lie across r.f. stage. For convenience, the r.f. stage layout follows the schematic, Fig. 2, exactly.



which are blocked from d.c. by condensers C_{18} and C_{17}. R_{13} provides grid bias, and C_{20} acts as the "band setter." The two-turn link, L_6, carries oscillator voltage to the mixer grids through a short piece of low-loss coaxial cable.

The r.f. choke, RFC_1, a surplus item lifted from a piece of v.h.f. gear, prevents r.f. voltage from sneaking back into the "B+" line. Due to the converter's small size, use a *Raytheon* CK5787 voltage regulator tube to stabilize the oscillator plate voltage. This pencil-sized bottle regulates between approximately 90 and 108 volts at a total current rating of 30 ma. (For devoteés of rack-and-panel receiver construction, a VR-90 works equally as well!)

Now for the tuning method, the best I've ever used for v.h.f. Exceeded in stability only by a crystal oscillator, this system allows you to drop the converter on the table or car floor and not lose the signal to which you are listening! (I've got lots of witnesses to the "drop test" who'll back up that statement!) Unlike a condenser-tuned oscillator, there's no "pinging" when the device is jarred or shaken, because none of the components vibrate, other than the tube's elements. Try the following constructional kinks which have evolved from a year's tinkering with this oscillator and discover its advantages for yourself.

Fig. 8 shows a sectional view of the assembled parts, and Fig. 7, an exploded perspective, illustrates the individual components in order of assembly. No dimensions are given, as each potential constructor will have his own ideas as to the size of his tuner, thus only the basic idea is presented here.

Coil form (5) in Fig. 7 is made from a surplus "522" slug-tuned coil by sawing off the ridged end containing the old winding. Presto! There's your slug-tuned form, with the 8-32 threaded bearing intact within, ready to wind and mount.

The tuning slug (6) requires that a clearance hole for the 8-32 machine screw be drilled through the slug's centerline with a hand-operated drill. You can lose a few slugs during the drilling process, but a bit of practice is all it takes.

An ordinary #8-32 machine screw of sufficient length to fit your application completes the main portion of the tuning assembly. Dime-store cement (the type used to mend dishes, etc.) secures the slug to the threaded screw, and lock-nut (11) cinches against one end of the slug as shown. Dial cable pulley (7) is threaded and cemented onto the screw against the slug's other end. More about this later, but first let's see what we now have: With the 522 form offering a threaded bearing surface for one end of the screw, and the front bearing assembly (10) providing a second threaded bearing upon the panel, we have a completely vibration-proof permeability tuner which turns silently in and out of L_5, varying its frequency smoothly and effectively. The main requirements for crystal-like stability are: (*a*) positive grounding of both ends of the tuning screw, (*b*) stabilized plate voltage for the oscillator tube, and (*c*) doggoned sturdy mechanical construction of the over-all oscillator assembly. You can go me one better and insulate both ends of the tuning screw, and eliminate one possible cause of instability.

Back to item (7), the dial cable pulley. Before you make this, better determine the over-all length of your slide-rule dial. Mine happens to be 3⅜", thus I wanted a given number of dial rotations to cover the band and move the dial pointer a lateral distance of 3⅜".

In this case, one dial turn-per-megacycle was desired to result in a 4-turn vernier coverage of the two-meter band. How do you figure the relationship between your tuning knob and dial pointer? Let's go back to high school:

Circumference is equal to pi times diameter. Let dial length be represented by circumference (C) and pulley groove diameter by D. Thus, if 3⅜ equals pi D, then D equals C/π or 3⅜ divided by 3.1416. This is approximately 1.2 inches. Any length of looped string wound around this diameter of 1.2 inches will move a dial pointer 3⅜" for one rotation of that diameter. Inasmuch as we want 4 dial rotations to equal 3⅜", we divide 1.2 by 4, which comes out to about 0.3 inch, or a bit over ¼", which is close enough. Assuming that you may not wish to build a converter of such abbreviated dimensions as mine, just substitute your dial length in the equation $D = C/\pi$, divide the result by the number of turns you wish to take in covering the band, and you're in business.

Pulley (7) is made from a piece of phenolic rod, the composition of which helps to make the dial cord relatively slip-free over long periods of time. Five grooves were cut by hand, using a small 3-cornered file, which was spiralled around the rod until a "thread" took shape to the proper depth. After grooving the pulley, an 8-32 tap is run through its center, so that it can be screwed tightly onto the tuning screw, first using dime-store cement on the threads to secure the assembly.

After assembly, chuck up the tuner in your drill motor and taper the slug as illustrated by holding a file against its "inner" end at about a 15° angle. The tapered slug tends to make the bandspread coverage more linear, but to attain linearity, you'll find that patient experimentation is the only answer.

The hole in the front panel through which the tuning screw passes should be made larger than the slug's outer diameter; this facilitates quick removal of the entire slug assembly through the front panel, after removal of bearing (10). You'll find this feature helpful when experimenting with slug taper.

Bracket (2) should be very securely mounted to one wall of the oscillator shield can, for obvious reasons.

The ¼" o.d. tuning knob shaft has an 8-32 threaded center, which allows it to be screwed on and locked to the tuning screw by lock nut (13). Mine came from the shack's "hell-box" of unsorted hardware.

Oscillator coil L_5 should be wound with no smaller than #12 solid copper wire. Its 4 turns are cemented firmly upon coil form (5) leaving sufficient lead length to bend back and over the assembly to reach bandset condenser C_{20}. Oscillator component assembly is best described by reference to the illustrations.

Notice the cigarette alongside the bottom view of the oscillator in Fig. 5? It was placed in the photo to illus-

Fig. 7. "Exploded" diagram of the slug-tuned oscillator coil.

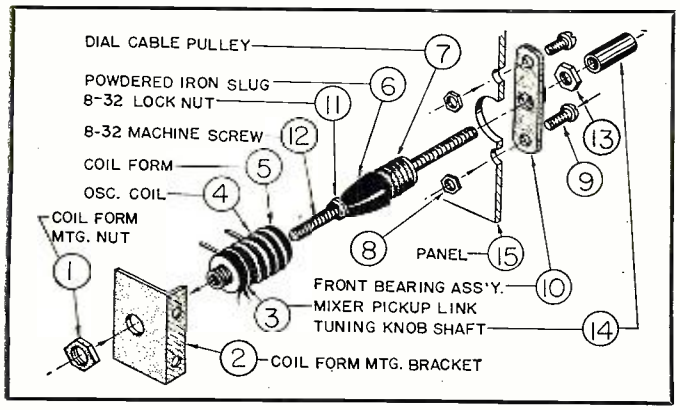
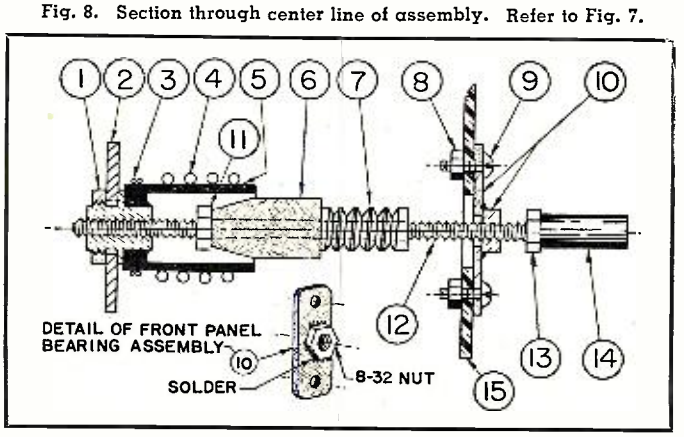


Fig. 8. Section through center line of assembly. Refer to Fig. 7.



trate the miniscule dimensions of the assembly, which is not a gag, but an attempt to keep connections as short (and consequently as vibration-proof) as possible.

The dial cord should be of the type having a nylon center and silk outer sheath. Don't try to use the flexible metal kind; in this type of rig it doesn't work out too well.

Fig. 4 shows the clearest illustration of dial cord assembly. Two small pulleys fasten securely beneath the panel's dial slot just past each end. The pulleys are made of brass, and may be purchased at your local radio supply store in a two-bit package assortment. The pulleys do not rotate, but offer a smooth, fixed guide path over which the dial cord passes, just beneath the indicator "window." The pointer, a piece of hookup wire doused with the XYL's red nail polish, clips around the dial cord which carries it across the aperture.

To eliminate slippage and loss of calibration with constant use, I've employed the a.c.-d.c. receiver trick of using a take-up reel, seen mounted above the input tuning condenser. The reel serves one main purpose: to afford a place upon which to pull tight and fasten both ends of the dial cord. It rotates on a midget roller-bearing in my converter, but assuming you haven't access to this sort of fanciness, rest assured that a #6-32 screw makes a fair center bearing. Your reel can be made from a ⅛" thick piece of aluminum, phenolic, or Bakelite, although the metal is recommended. Cut out a circle of the required diameter (the circumference of which can be no less than the length of your dial scale), tighten a machine screw through its center, and chuck it into your drill motor. The motor held in the bench vise makes an improvised lathe, and a flat file held against the rotating edge of the metal forms the disc. A smaller file cuts a flat groove around the circumference, leaving a thin rim on each side to act as cord retaining walls. Refer to the interior of the XYL's table-model radio for further instructions!

The cable makes two complete loops around the dial drive pulley, as seen in Figs. 4 and 5, making it essentially slip-free during rotation. A bit of experimenting shows the easiest way to assemble the arrangement, the main requirement being to pull the entire system taut, using the reel as an anchor for each end of the dial cord. The #2-56 machine screws cinch down the cord's ends against the reel's rear surface.

The slide-rule dial was hand-drawn and lettered on a translucent piece of paper held between the front aluminum escutcheon and a piece of steel-wool roughened plastic. The pilot light (Fig. 4) illuminates the dial evenly from behind, presenting a nice "commercial" effect. Details in Fig. 5 should help in clarifying the assembly.

Tricks involved in getting the oscillator to tune the band will be discussed in the following section; now let's peek at the last two stages. If you're interested in using some of the preceding ideas for a home-station converter to work into your communications receiver, stop here. Run a link from L_4 to that BC-348 or HRO; it works like a bomb! I used just this much (Fig. 9) for several months into an HRO with excellent results. For those interested in mobile applications, the following circuits may be of some interest.

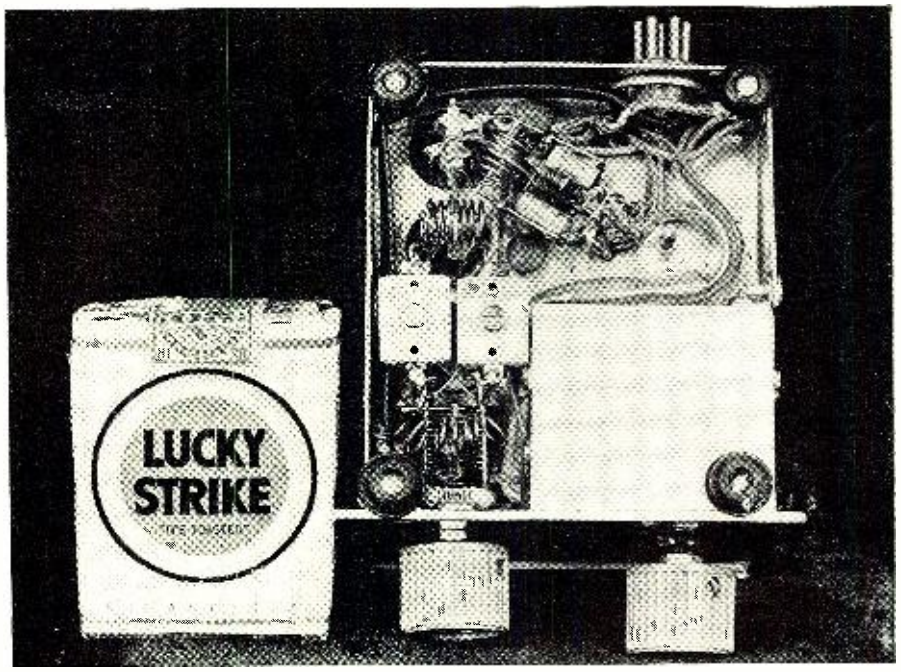


Fig. 9. Original size of converter as used in home-station operation. A 300 ohm balanced input and cut-down broadcast trimmers were used in this model.

The I.F. Amplifier

The 6BA6 constitutes a conventional amplifier stage, except that I wound my own i.f. "transformers." This was necessitated by space requirements, in addition to the fact that most of the smaller commercially-available i.f. cans appeared to have less *"Q"* than the amount desired for this design.

The coil dimensions given in the parts list of Fig. 2 result from experiments conducted with a *"Q"*-meter, and show a better figure of merit than was obtainable with some manufactured units of comparable size. Little need be said about this stage other than if it is constructed with the values and voltages shown, its operation should be satisfactory.

Second Conversion Stage

Let's say we've got the 10.6 mc. equivalent of a 144 mc. signal coming from the i.f. amplifier through C_{13} to the control grid of the 6BE6 converter tube. The 9 mc. crystal replaces a resonant tank circuit between oscillator grid (1) and injection grid (6), which once again comprises an ultraudion circuit. Now we have two different signal frequencies boiling around inside the tube: 10.6 and 9.0 megacycles. Mix 'em up, and take your pick of their sum or difference frequencies appearing at the 6BE6 plate. In this case, it's the difference frequency of 1.6 mc. (1600 kc.) for presentation to the car's BC set.

Now if we wanted gain out of this stage (which we don't need), or selectivity (we get plenty of that within the car radio's third conversion), we could put a tuned circuit in the plate of the 6BE6. Don't bother! All we want is the difference frequency of 1600 kc. appearing at pin #5 on the tube socket.

The aforementioned birdies have been attenuated by limiting the injection grid's potential to about 7 volts with R_8. It would seem that a 9 mc. crystal oscillator running with 7 volts on the plate will have pretty limited harmonic output; this is true, but even though infinitesimally small, the harmonics are still there, mixing with those of the 9002 oscillator.

If we must live with 'em, at least let's keep them quiet as possible, so that even though inaudible, a strong local signal will modulate 'em as little as possible. The direct 16th crystal harmonic, however, falls right on 144 mc., which provides a handy band-edge marker for constant checking of dial calibration.

The output side of C_{10} is taken through the power input plug into a coaxial cable and to the car radio's antenna terminal.

Further isolation of those pesky harmonics could possibly be obtained by using a selective tuned circuit in the control grid circuit of the 6BE6; this step is recommended for those builders whose size limitations place fewer restrictions on the number of components utilized.

(*Continued on page* 171)

"CONCERT HALL

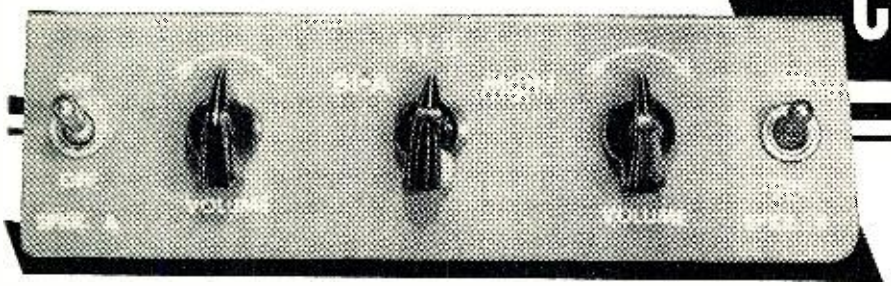


Fig. 1. Front view of the stereo selector panel which permits three separate setups with the two speakers used in the system.

Improve auto radio reception by installing a synthetic "stereo" system. Two quality loudspeakers are required.

THE family automobile of today is a vital factor in our way of life. We live in it summer and winter. It has most of the conveniences of one's living room: comfortable settees, cigarette lighters at one's fingertips, ashtrays at one's elbow, a day bed if you so desire it, heating systems for the winter, air conditioning systems for the summer, unit refrigeration for picnicking convenience, telephone service if needed, and, of course, radio for entertainment purposes.

This latter item, the auto radio (system) is of great concern to the music lover and the high fidelity enthusiast, for compared with the performance of the elaborate home systems with which these people are familiar, the usual auto radio is more than somewhat deficient. Why? The more obvious answers stem from the following conditions. Space limitations militate against an audio output section on the auto radio comparable to those usually found in the home high-fidelity apparatus. Available loudspeaker area on the dashboard severely restricts the size of the reproducer that may be designed into the auto radio system. Baffle *enclosure* space on the dashboard is also at a premium. These apparently restrictive conditions, however, need not cause us to despair. These millstones around the neck of improved audio reproduction may perhaps be converted to keystones . . . keystones to a different approach to the attainment of high fidelity in the automobile.

Let us then explore a method of bringing to the wayfaring traveler a unique system of *mobile* high fidelity, comprised of a multiple speaker system integrated with a special control and distribution unit (Fig. 1), which will, in a great measure, convert the comparatively small "living room" of an automobile into a miniature "Concert Hall on Wheels."

High fidelity in sound reproduction may mean many things to many people, but the cornerstone of all high-fidelity systems is faithfulness of reproduction of the original sound. This reproduction must add nothing to, nor take anything away from the original sound; the reproduction must be clean, it must be realistic—it must have "presence." These attributes are met in widely varying degrees by many speakers now on the market. It is not our present intention to analyze what makes a good high-fidelity speaker. This subject was treated in detail in a previous article.[1] It goes without saying that the better the loudspeaker, the better will be the sound system.

Our present purpose is, however (assuming that true high-fidelity speakers are to be used in the system), to discuss another criterion of high fidelity that transcends the capabilities of a *single* speaker. Specifically, we refer to an attribute applicable to speaker *systems* only, and that is "acoustic perspective"—or to use a term suddenly come into prominence, "3-D" sound. Now "3-D" sound, or more accurately, stereophonic sound, is not new. Walt Disney's "Fantasia" was one of the early popular demonstrations of stereo sound.

There are at present many systems of stereo sound. An analysis of these systems will make it evident that although they may all differ in detail, they have one element in common. This unifying factor is the *spatial separation of two or more speakers,* within the auditory environment, where the *individual* speakers of the system carry only specially channelized *portions* of a "total" sound picture. Such channelized transmissions for the home are, at present, available through "binaural" radio broadcasts, tape recordings, and discs. But where we are limited to single channel reception, as is presently the case for automobile radios, what are the prospects of stereo expansion of this single-channel sound?

A *limited* measure of stereo enlargement of single channel sound may be obtained in one's living room, for instance, by the simple expedient of spatially separating two speakers, each speaker carrying the same identical program content. Now, although this arrangement is feasible in one's home, some practical reconsideration must be given to the problem of its application to the comparatively small "living room" space of an automobile. Fortunately, we will find that this re-examination will lead us into a different and more effective solution of stereo sound for the automobile *for single-channel transmission* than is possible simply by spatially separating two loudspeakers.

We will start with the basic assumption that we are going to use high-fidelity speakers, and that we are going to use them in some stereophonic manner, a manner to be determined by the particular conditions prescribed by the internal geometry of the car. Now the maximum spatial separation of two speakers within a car would obtain between the front and rear of the car, naturally. This places the occupants of the car squarely *between* the two speakers. This condition immediately puts a very special prerequisite on the two-speaker system arranged for acoustic spatial spread within the car. The sound output level of the two speakers becomes *individually* very critical.

Let us assume that the two speakers, front and rear, are both radiating *equal* sound energy. The front seat occupants, situated approximately five times closer to the dashboard than to the rear of the car, would effectively hear only the dashboard speaker. And conversely, the rear seat occupants, being so much closer to the rear, would effectively hear their rear speaker only. In both instances, therefore, the acoustic spread would be entirely lost. We might then suggest some form of volume balancing device between the two speakers. Although the final form of the present system being discussed has such a device, it alone is not enough to provide the proper acoustic perception of their spatial separation.

What other characteristic does sound have, in addition to volume level, upon which we may operate? There is, of course, the *frequency* of the sound. Now whereas the two speakers may not be individually separatable when they both play the same note, an entirely different condition would prevail if one speaker were to reproduce, say, a tone of 100 cps, and

1. *Cohen, Abraham B.: "Hi-Fi Loudspeaker Design,"* RADIO & TELEVISION NEWS, *Dec. 1952.*

ON WHEELS"

By
ABRAHAM B. COHEN
University Loudspeakers, Inc.

the other speaker were to reproduce a tone of perhaps 5000 cps. These two notes, respectively a typical bass fiddle note and a piccolo note, are so distinctively separated in their frequency and tonal characteristics, that they would be instantly spotted as originating at the two different places when the separate speakers were located forward and rear. This spatial localization of the two separate sound sources on this frequency basis becomes especially effective where the listener is located *between* the speakers as is the case in a two-speaker system in an automobile.

Now the writer realizes full well that true stereo sound is an entirely different matter than just separation of various bands of frequencies, and that such a procedure is only an expediency by which it is attempted to pull single-channel transmission up by its own bootstraps into the level of multi-channel transmission necessary for true stereo sound. However, it might be suggested that this expedient not be dismissed too lightly. If we get down to basic concert-hall techniques relative to the actual physical grouping of the musical performers, be they instrumentalists or vocalists, we will learn that the many "standard" seating arrangements for these groups are in themselves *geometric segregations on a frequency-band basis.*

Consider the piano keyboard. The bass notes are on the left, the treble notes are on the right. Now examine a typical symphony orchestra set-up (Fig. 2A). On the left are the violins, first and second, but both limited to the same frequency range encompassing the treble and upper middle tones of the musical spectrum. As we scan toward the right we find the flutes, clarinets, and to the rear of these, the trumpets, and the french horns. These are all mostly in the middle frequency section of the musical spectrum. Then further to the right we find the bassoons, violas, and to their rear the trombones. These instruments in general encompass the middle frequency regions with extension into the upper bass notes. As we finish our panoramic inspection to the right we will find the percussion instruments, (drums, tympani), then the cellos, and to their rear are the bass viols, all instruments limited to the lower bass portion of the musical spectrum. This panoramic inspection shows us that the symphony orchestra is practically a giant keyboard, like that of a piano, but with the "treble" frequencies on the left hand in this case, and the "bass" frequencies on the right hand. The reason for this development may no doubt be found in the musical histories, and we may even guess at the reasons, but these reasons are not our present concern. We are concerned with the fact that these arrangements *do* exist and we are desirous of reproducing these "geometric-frequency" arrangements in our own acoustic environment, the automobile interior. We will leave to the next (and last) portion of this article the actual construction and installation of the system for this special case, and we will assume for the moment that the system is already in place and differentiating the program content properly, and in such a manner, that the treble tones come to us from the forward speaker, and the bass tones arrive from the rear shelf speaker.

To be perfectly factual in this matter, we must point out, however, that there will be no sharp line of demarcation in the musical spectrum where the one speaker abruptly stops "making music," and the other speaker starts. *Fortunately,* there is an area in this middle section where, due to the design of the control system involved, the output of the bass speaker tapers off at the same time that the treble speaker output begins to build up. Therefore when the musical program content consists of these middle tones, both front and rear speakers will produce *approximately* the same volume output and the same frequency output.

Now what may we expect from such a system? The first immediate effect upon the car occupant is that he suddenly becomes the "center of musical gravity," if you please, of the music around him. Since he is physically "captured" in the car *between* his speakers as illustrated in Fig. 2B, he finds himself musically in the same position as does the conductor of a

(*Continued on page* 163)

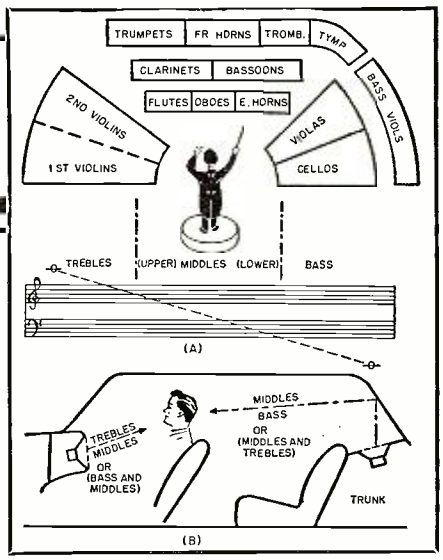
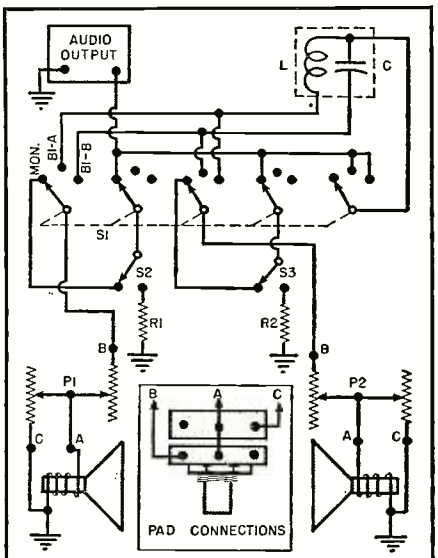


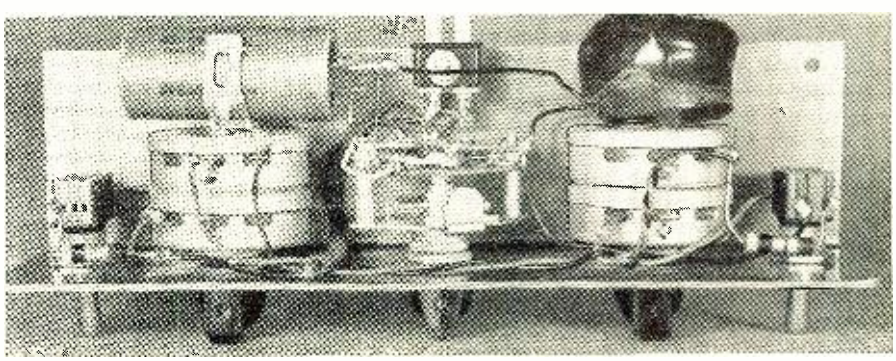
Fig. 2. (A) Seating arrangement of a symphony orchestra where instruments are geometrically segregated on a frequency-band basis. (B) The "Concert Hall on Wheels" system puts the car's occupant in the musical center of gravity, corresponding to conductor's position in front of an orchestra.



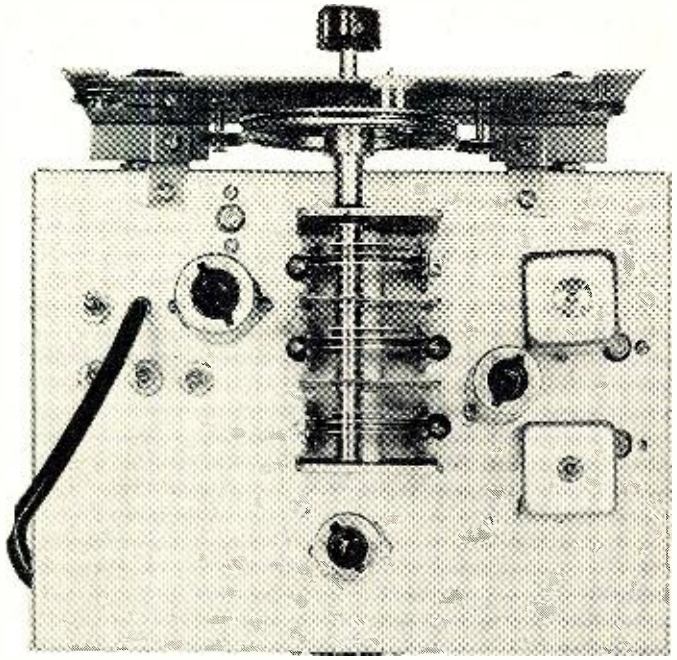
R_1, R_2—3 ohm, 5 w. wirewound res.
C—15 μfd., 110 v. a.c. elec. cond. (Mallory motor-starting type)
P_1, P_2—4 ohm "L" pad (Mallory-Yaxley Type L4)
S_1—5-pole, 3-pos. wafer sw.
S_2, S_3—S.p.d.t. toggle sw.
L—340 t. #19 en. airwound. ½" dia., ¾" long

Fig. 3. Schematic of the stereo control.

Fig. 4. Rear view of the control showing the most advantageous placement of parts.



AN ECONOMY V.F.O.



Top view of the author's home-built v.f.o. It is built on a chassis measuring 6" x 8" x 2". All parts are standard.

By J. T. GOODE, W6LVT

Construction details on a stable unit covering 80, 40, 20, 15, 10, and 2 meters with enough output to drive a final amplifier except on 2 meters. Standard parts are used.

THERE is nothing new in the design of variable frequency oscillators. The desire to have a v.f.o. is quite understandable, and they are available on the market. It would then seem that anyone interested could purchase what he wanted and the subject would be closed.

Your author was presented with this problem and came up with the following answers.

Number one, they are not cheap and number two, they did not cover all bands. Also they would not drive a final amplifier. These limitations constituted a challenge to correct this situation.

If a v.f.o. could be designed that was stable, covered multiband operation (80-40-20-15-10-2 meters), and had sufficient output to drive a final amplifier with the exception of 2 meters, there would be something new in v.f.o. design.

With these specifications in mind and a pair of 6146's in parallel running at 150 watts' input becoming the final amplifier, the v.f.o. to be described was designed. The 2-meter transmitter required 8 megacycle drive to replace the crystal but plugged directly into the crystal socket.

In creating a v.f.o. to meet the specifications another very desirable feature was worked out. All parts and coils are commercially available, at a total cost of approximately $20.00. Two v.f.o. units were constructed in eight hours and this included punching the chassis, mounting all parts, and wiring. In construction, TVI was taken into consideration.

In designing a v.f.o. several factors must be considered. The lower the frequency of the base frequency oscillator the greater the stability, on the other hand this requires frequency multiplication which will complicate the design.

By selecting a base frequency of 1750 to 2060 kc. the 80, 40, 20, 15, 10, and 2 meter bands could be covered. At this base frequency stability could be obtained easily with negative coefficient capacity correction and a standard broadcast oscillator coil.

The amount of drift was so low that checking it with a BC-221-AH frequency meter was inaccurate due to calibration points at one kc. intervals and the drift of the BC-221-AH. After this error was established a *Hewlett-Packard* frequency counter was used to check the frequency drift. The drift was as follows.

The v.f.o. turned on cold, frequency 3500.6 kc.; after ten minutes operation—3499.1 kc.; after thirty-eight minutes—3499.8 kc.; after one hour—3499.8 kc.; and after one hour and forty-five minutes—3501.4 kc.

The maximum drift took place in the first ten minutes of operation and this drift was not severe. After this time the drift was very slow which indicated that negative compensation was taking effect causing the drift to reverse. In actual use the v.f.o. is not operated constantly resulting in a reduction of drift. To date in all-band operation no station contacted has mentioned a noticeable drift.

In view of the fact that the frequency measured was twice the oscillator frequency, the drift is actually in cycles.

Another design factor in a v.f.o. is the detuning effect of the amplifier being driven by the v.f.o. This detuning effect results from the necessary coupling between the two units and can cause calibration error depending on the tuning of the final amplifier. While this error may be small, it is undesirable.

In the v.f.o. described this detuning effect is negligible. This was accomplished by operating the base oscillator 1750 to 2060 kc. and doubling in the plate circuit. This circuit, in turn, drives another stage which operates as an amplifier or multiplier stage. All tuned circuits are ganged, resulting in the same tuning at all times.

No switching is used in the oscillator circuit which improves stability when the switch contact problem is considered. All band changing takes place in the plate circuit of the amplifier multiplier.

Voltage regulation is used on the oscillator screen and plate only. The amplifier multiplier stage does not require voltage regulation and the plate voltage can be increased or decreased to give desired output. The oscillator

plate and screen voltages are regulated at 150 volts. This low voltage reduces current drain which, in turn, reduces coil heating which is a drift factor.

While it is common to rate power output in watts, another type of measurement was made which will make it easier for the reader to judge whether this v.f.o. has sufficient output for his particular application. The measurement is in grid current through a 10,000 ohm resistor. For each grid ma. ten volts of bias is developed across the resistor. For example, 10 grid ma. result in 100 volts of bias. Seven grid ma. give 70 volts of bias.

The output of the v.f.o. was fed directly into the grid of a 6V6GT tube. Connected to the grid was an r.f. choke, 10,000 ohm resistor, and milliammeter. Output measurements are given in Table 2.

The v.f.o. furnished sufficient output to drive a pair of 6146's on 80, 40, and 20. 15-meter operation requires tripling in the final from 40 meters. 10-meter operation requires doubling from 20 meters.

The output at 8 mc. is ample to drive the grid circuit in place of an 8 mc. crystal. This same output can replace 24 mc. crystals. Tuning of the v.f.o. and 2-meter transmitter remain the same. The crystal oscillator stage simply becomes a tripler stage when the v.f.o. output is plugged into the crystal socket.

In some crystal oscillator circuits the crystal is operated above ground for regeneration purposes. In this case it may become necessary to modify the circuit for proper connection to the v.f.o.

There is a d.c. blocking condenser in the v.f.o. so no d.c. appears in the output cable. It will always be necessary to have a grid resistor in the stage being driven. Most crystal oscillator circuits have such a resistor and will require no modification for connection to the v.f.o. In no case is a grid blocking condenser needed. On the other hand if one is in the circuit it need not be removed. The only effect, if any, would be a slight reduction in grid drive.

By screwing a metal cover to the bottom of the chassis, the unit is completely shielded with the exception of the variable condenser. The tubes should have shields. No TVI was experienced when the v.f.o. was operated ten feet from a TV receiver and both units connected to the same wall plug.

All parts are commercially available but it was necessary to modify two of the coils. This modification takes about two minutes per coil. Simply unwind 30 turns from one coil and 33 turns from another coil. (See parts list accompanying diagram). If a grid dip oscillator is available, coils L_3, L_4, L_5, and L_6 can be wound on coil forms to tune to frequencies specified in the parts list.

Coils L_1 and L_2 should be those specified since the negative correction takes care of drift. Another type of oscillator coil was tried resulting in a drift of 1 kc. per minute for twenty minutes and was still drifting when unit was turned off, despite the same amount of negative correction. This undoubtedly was due to coil heating.

80 METERS	40 METERS	20 METERS	15 METERS	10 METERS	2 METERS
3.500	7.000	14.000	21.000	28.000	144
3.550	7.100	14.100	21.250	28.400	145
3.600	7.200	14.200	21.300	28.500	146
3.650	7.300	14.300	21.450	28.800	147
3.700		14.350	21.600	29.200	148
3.750		14.400		29.600	
3.800				29.700	
3.850					
3.900					
3.950					
4.000					
		PHONE BANDS			
3.800-4	7.2-7.3	14.2-14.3	21.25-21.45	28.5-29.7	144-148

Table 1. Dial calibration points for the 80, 40, 20, 15, 10 and 2-meter bands.

The circuit is straightforward and uses a minimum of parts. The oscillator is a 6AQ5 with the grid circuit tuned to the 160-meter band using the screen grid as a plate. The plate circuit is tuned to cover the 80-meter band. These two circuits are gang tuned and tracked, resulting in constant grid drive to the 5763 amplifier multiplier stage, over a frequency range of 3495 to 4120 kc. With this tuning range and frequency multiplying 40, 20, 15, 10, and 2 meters can be covered without switching the oscillator frequency. For 80-meter operation the plate circuit of the 5763 is ganged and tracked with the oscillator frequency.

On bands other than 80 meters the plate circuit of the 5763 is fixed tuned for the center frequency of each range covered.

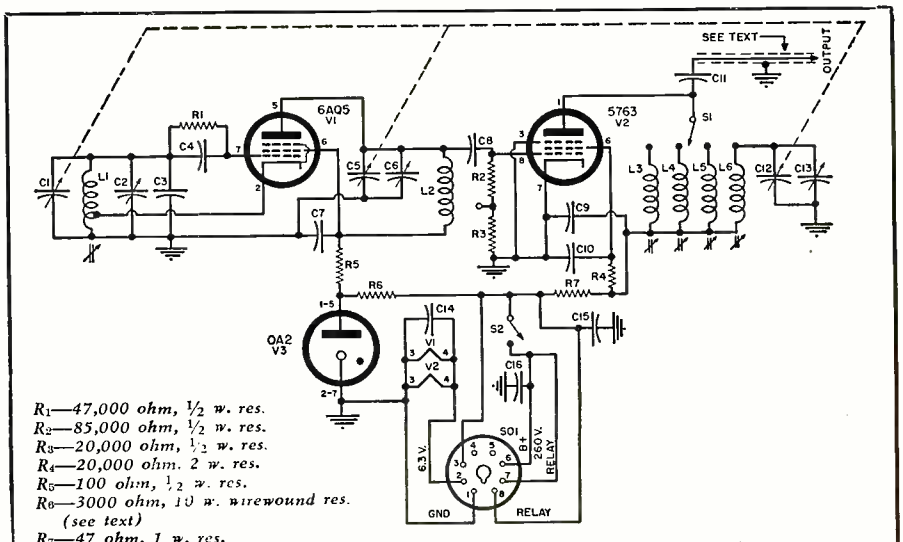
C_1-C_5-C_{12} is a three-gang FM variable condenser. C_2, C_6, and C_{13} are 75 $\mu\mu$fd. air trimmers. C_4 is the oscillator grid condenser and R_1 the grid leak. L_1 is a broadcast-type tapped oscillator coil, with an adjustable iron core. L_2 is a receiver short-wave antenna coil with an adjustable iron core. This coil has an antenna winding which is not used and is not shown on the circuit diagram. This holds true for coils L_3, L_4, L_5, and L_6.

The tap between R_2 and R_3 is a test point used during alignment adjustments.

R_4 is the screen dropping resistor for the 5763. C_7, C_9, and C_{10} are r.f. bypass condensers. C_8 is the grid coupling condenser and C_{11} is the plate blocking condenser which removes d.c. from the output cable.

L_6 is the 80-meter coil and is tracked from 3500 to 4000 kc. L_5 is the 40-meter coil and is tuned to 7150 kc. This same coil is used for 15-meter

Complete schematic of v.f.o. As shown, circuit is designed for high-impedance output. For use with low impedance outputs, see text for the required variations.



R_1—47,000 ohm, ½ w. res.
R_2—85,000 ohm, ½ w. res.
R_3—20,000 ohm, ½ w. res.
R_4—20,000 ohm. 2 w. res.
R_5—100 ohm, ½ w. res.
R_6—3000 ohm, 10 w. wirewound res. (see text)
R_7—47 ohm, 1 w. res.
C_1-C_5-C_{12}—3-gang, 6-26 $\mu\mu$fd. variable cond. (Miller 1461)
C_2, C_6, C_{13}—75 $\mu\mu$fd. air trimmer
C_3—10 $\mu\mu$fd., negative-coeff. cond. (N750)
C_4, C_8—50 $\mu\mu$fd., zero-coeff. cond.
C_7, C_9, C_{10}, C_{11}, C_{14}, C_{15}, C_{16}—.003 μfd., 600 v. disc cond.
S_1—S.p. 4-pos. bandswitch
S_2—S.p.s.t. switch (see text)
SO_1—Octal socket
L_1—1750-2060 kc. coil (Miller A-321-C)
L_2—3500-4120 kc. coil (Miller B-320-A)
L_3—2 m.—8-8.222 mc. coil (remove 33 t. from Miller B-5495-A unit)
L_4—10 & 20 m.—14-14.35 mc. coil (Miller C-5495-A)
L_5—15 m.—7-7.3 mc. coil (remove 30 t. from Miller B-5495A unit)
L_6—80 m.—3500-4000 kc. coil (Miller B-5495A)
Dial—Miller 152 (see text)
V_1—6AQ5 tube
V_2—5763 tube
V_3—0A2 tube

operation. L_4 is the 20-meter coil and is tuned to 14,175 kc. This coil is also used for 10-meter operation. L_3 is the 2-meter coil and is tuned to 8111 kc.

R_5 and R_7 are decoupling resistors in the "B plus" leads. C_{14}, C_{15}, and C_{16} bypass condensers reduce r.f. leakage of the power leads connected to the v.f.o. These condensers are necessary only if TVI is a problem.

The output cable is 72-ohm coaxial line. Its length is 16 inches. Since the capacity of the line is part of the plate circuit, this length is important. The length is maximum to obtain tracking with coil L_6. The length could be shortened and the difference in capacity corrected by trimmer C_{13}. The iron cores in L_3, L_4, and L_5 will compensate for some variation in cable length.

Switch S_1 is a single-pole, four-position bandswitch. Switch S_2 can be a single-pole, single-throw toggle switch or a multiple-contact bandswitch. The latter type switch makes possible additional switching such as "standby," "transmit," "tuning," and "relay."

V_3 is a 0A2 voltage regulator tube. R_6 is the dropping resistor. The actual value of this 10-watt resistor will depend on the "B plus" voltage applied to the v.f.o. If conserving current drain is desirable this resistor should be adjusted to cause a current drain of approximately 12 ma. through the VR tube. With a supply voltage of 300 volts, a 3000-ohm resistor will cause a current drain of approximately 30 ma. which is the maximum rating of the 0A2. As the supply voltage is reduced the current drain will drop.

The power socket, SO_1, is an octal tube socket. Connections to this socket are shown on the circuit diagram for relay operation. The connection to pin number three is a matter of convenience with this pin being used as a tie point.

There are several things to consider when selecting a dial. If the v.f.o. is to be used by zero beating other stations, the slide-rule dial shown on the v.f.o. is satisfactory and is commercially available. The cost of such a dial is considerably less than a mechanically driven dial.

Those desiring considerable bandspread for each band calibration should use mechanical bandspread dials.

The location of parts on the chassis can be determined by checking the circuit diagram and the photographs. The chassis is a standard size 6" x 8" x 2". Bottom covers are available.

Test equipment necessary for alignment is as follows: frequency meter, d.c. voltmeter, and grid-dip meter. An all-band receiver with "R" meter could be used if a grid-dip meter is not available.

Set trimmers C_2 and C_6 at half capacity and C_{13} at minimum capacity. Place the bandswitch in the 80-meter position. Connect the output cable to the grid circuit of the stage to be driven by v.f.o. A milliammeter should be placed in this circuit. A test circuit can be temporarily wired as described earlier. Connect a 0-50 d.c. voltmeter from the junction of R_2-R_3 to ground, positive ground.

Set the frequency meter on 3495 kc. Close the variable condenser and adjust the iron core of L_1 to zero beat. Adjust the iron core of L_2 for maximum reading on the voltmeter. If a 20,000 ohm-per-volt meter is used the voltage reading should be approximately 20 volts. A 1000 ohm-per-volt meter will give a lower reading. Maximum reading is all that is required.

Open the variable condenser and set the frequency meter to 4120 kc. Adjust C_2 for zero beat. Adjust C_6 for maximum reading on the voltmeter. It will be necessary to repeat this adjustment several times since one adjustment affects the other. Always adjust the iron cores on the low-frequency end of the dial and trimmer condensers on the high-frequency end of the dial.

When the desired frequency range is set the voltmeter should indicate maximum over the entire tuning range. Some minor adjustments of the iron core of L_2 and trimmer C_6 may be required to accomplish this.

Next close the condenser and adjust the iron core of L_6 to give maximum output reading on the grid meter of the driven stage. Open the variable condenser and adjust trimmer C_{13} for for maximum reading. Repeat this adjustment several times until the output reading is constant over the entire band. Due to the capacity of the output cable, trimmer C_{13} will tune at approximately minimum capacity.

At this stage of adjustment the oscillator is now set for all bands and the amplifier multiplier stage is set for 80 meters.

Next set switch S_1 for 40-meter operation. Adjust the frequency meter to 7150 kc. Tune the variable condenser to zero beat. Adjust the iron core of L_5 for maximum reading on the grid meter of the driven stage. 40 meters is now set. Check with grid dip oscillator to see that L_5 is not adjusted to some harmonic other than 7150 kc.

Set switch S_1 for 20-meter operation. Adjust frequency meter to 14,200 kc. Tune variable condenser to zero beat. Adjust iron core of L_4 for maximum reading on grid meter of the driven stage. The tuning range of this coil is great enough to tune to the third, fourth, and fifth harmonic of 3500 kc. The 20-meter band uses the fourth harmonic. Use the grid dip oscillator and adjust this coil to approximately 14,200 kc. and then use the grid meter indicator for final adjustment.

Set switch S_1 for 2-meter operation. Adjust frequency meter to 8111 kc., tune variable condenser for zero beat. Adjust iron core of L_3 for maximum reading on grid meter of driven stage. Again use grid dip oscillator to in-

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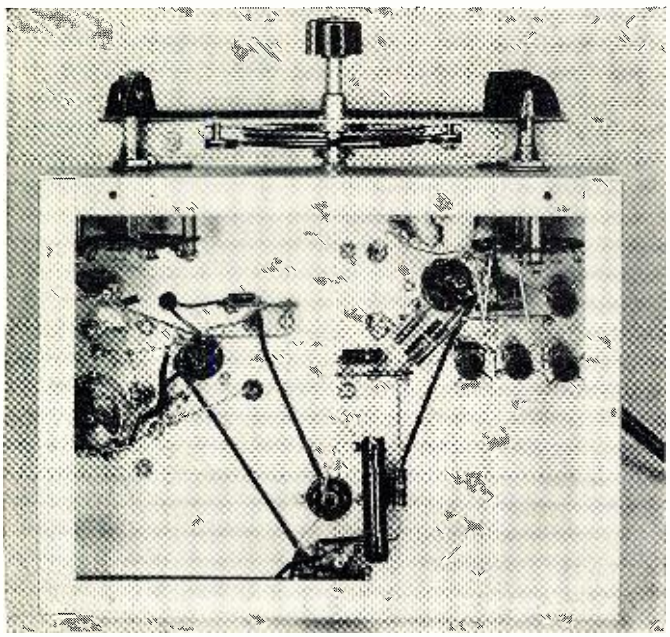


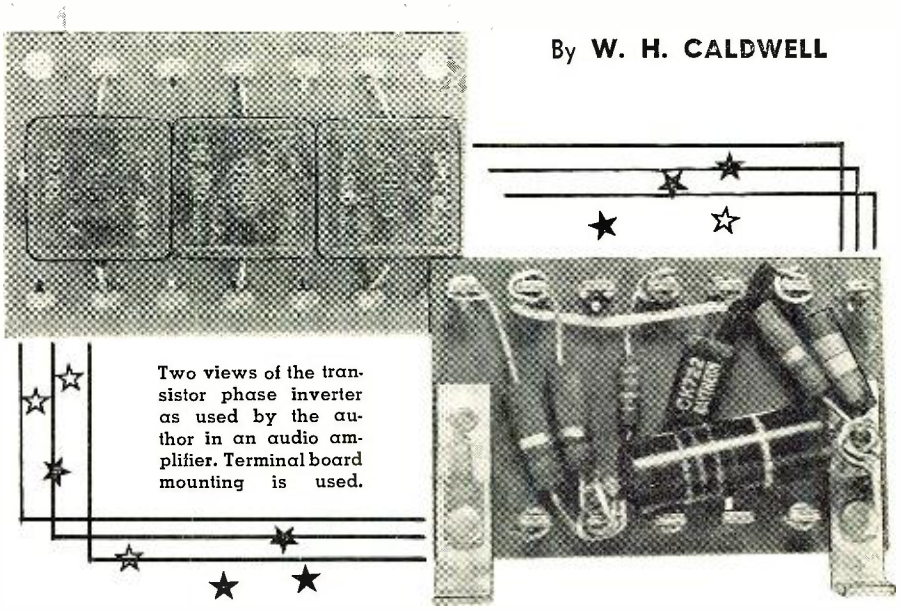
Underchassis view of v.f.o. The band coils can be seen near center at right and connected to band-change switch at top.

Table 2. Output measurements of v.f.o. The measurements were made using 260 volts on the plate of the amplifier-multiplier stage. The plate voltage was increased to 280 volts causing the output at 14.2 mc. to increase from 7 to 8 ma. This stage can be operated at 300 volts, resulting in a still greater increase. The plate current drain of the v.f.o. running 260 volts is approximately 50 ma., not including the voltage regulator tube. This tube should be adjusted to pull approximately 15 ma.

80 METERS		20 METERS (Double freq. for 10 m.)	
3500 kc.	11 ma.	14.0 mc.	6 ma.
3750 kc.	12 ma.	14.1 mc.	6.5 ma.
4000 kc.	12 ma.	14.2 mc.	7 ma.
		14.35 mc.	6 ma.
40 METERS (Triple freq. for 15 m.)		**8 MC. OUTPUT (for 2 m. xmtrs. using 8 mc. crystals)**	
7000 kc.	10 ma.	144 mc.	8.5 ma.
7100 kc.	11.5 ma.	145 mc.	10 ma.
7200 kc.	11.5 ma.	146 mc.	10.5 ma.
7300 kc.	10.5 ma.	147 mc.	10 ma.
		148 mc.	9.5 ma.

A TRANSISTOR PHASE INVERTER

By W. H. CALDWELL



Two views of the transistor phase inverter as used by the author in an audio amplifier. Terminal board mounting is used.

Details on a novel application of transistors of interest to experimenters. It may be used in audio amplifier circuits.

A PHASE inverter is a circuit which provides coupling between the output of a single-ended stage and the input to a push-pull stage. A phase inverter provides two outputs which are 180 degrees out-of-phase, so that when one grid of the push-pull stage is driven positive, the other is driven negative.

Phase inverter coupling can be provided by a transformer, a vacuum-tube stage, or by a transistor stage.

The transformer stage is the simplest to use. It requires no power for operation, and provides a voltage gain. There are several disadvantages to the transformer, however. It has a limited frequency response, and is sensitive to hum pickup from the magnetic fields of power transformers. In some applications the weight of a transformer is a serious disadvantage.

These difficulties led to the development of the vacuum-tube phase-inverter circuit. The vacuum-tube stage is insensitive to power transformer hum fields, has an excellent frequency response, and is lighter in weight than most transformers. Its disadvantage lies in its requirement of heater and plate power, and, in some designs, in hum pickup from the heater of the tube.

These drawbacks led to the transistor phase-inverter development. The transistor stage has the same advantages as the tube stage, with respect to frequency response and insensitivity to power fields, with the further advantage of lighter weight. In addition, the transistor stage needs no heater power, so there is no hum pickup from this source.

The transistor circuit uses a base input, with an emitter-follower output to provide isolation, and a collector output for phase reversal. The equivalent circuit is given in Fig. 1A.

The two loop equations are:

$$R_e(I_b - I_c) = E \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

and:

$$I_c(R_c + R_L) = E - R_m I_b \quad . \quad . \quad . \quad . \quad (2)$$

Solving equation (1) for I_b gives:

$$I_b = \frac{E}{R_e} + I_c \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

and substituting in (2):

$$(R_c + R_L)\, I_c = E - \frac{R_m}{R_e} E - R_m I_c \quad . \quad . \quad (4)$$

$$\frac{I_c R_L}{E} = \frac{R_L(R_e - R_m)}{R_e(R_c + R_L + R_m)} = -1 \quad . \quad . \quad (5)$$

Equation (5) must equal minus one to give phase inversion at unity gain in the collector branch of the circuit. Therefore:

$$R_L(R_m - R_e) = R_e(R_c + R_L + R_m) \quad . \quad (6)$$

Choosing R_e=27,000 ohms from d.c. considerations, and using a CK722 transistor with collector resistance, R_c=500,000 ohms, and mutual resistance, R_m=200,000 ohms; then, substitution in equation (6) gives the load resistance, R_L=120.000 ohms.

Add a dropping resistor for operating from 250 volts, add coupling and bias resistors, coupling and bypass condensers, and the circuit of Fig. 1B is derived.

The photographs show a compact terminal-board mounting of the circuit. The phase inverter serves to drive push-pull 6V6 tubes in an audio amplifier. The unit serves as a good project to introduce the experimenter to transistor techniques. The design was discussed in some detail to show how it can be adapted to other transistors.

The variations in the gain of the circuit, especially in the collector branch, with different CK722 transistors depends on how close tolerances the manufacturer holds on the characteristics of the transistor. There are, however, two aspects of this circuit which favor uniformity of performance. One is the use of the transistor to provide unity gain, so that there is no multiplication of variations. The other factor is the large amount of degeneration introduced in the emitter branch of the circuit. Of five CK722 transistors used in the circuit, the maximum variation was found to be less than ten per-cent.

The gain in the emitter branch is constant to within two per-cent for various CK722 transistors. The balance between collector and emitter is quite good, and can be made as close to unity as desired by adjusting the collector load resistor, although this is not necessary for most applications.

The maximum signal level that the

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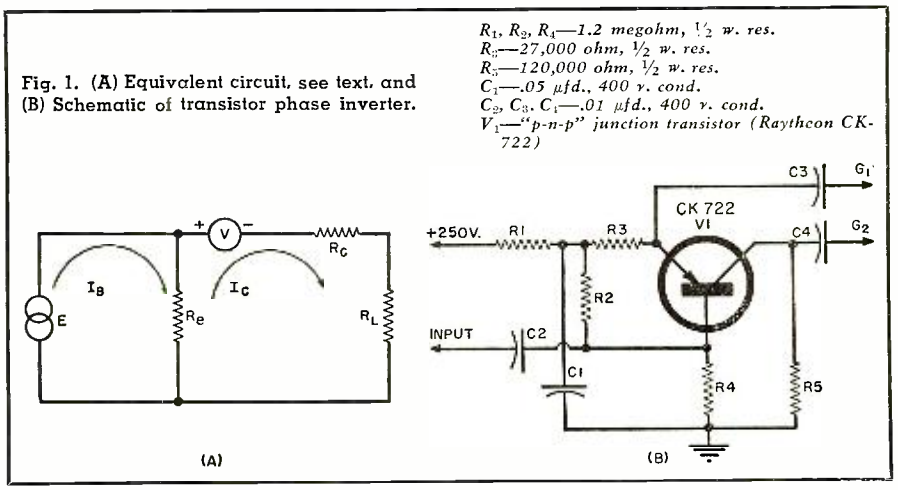


Fig. 1. (A) Equivalent circuit, see text. and (B) Schematic of transistor phase inverter.

REDUCING TURNTABLE RUMBLE

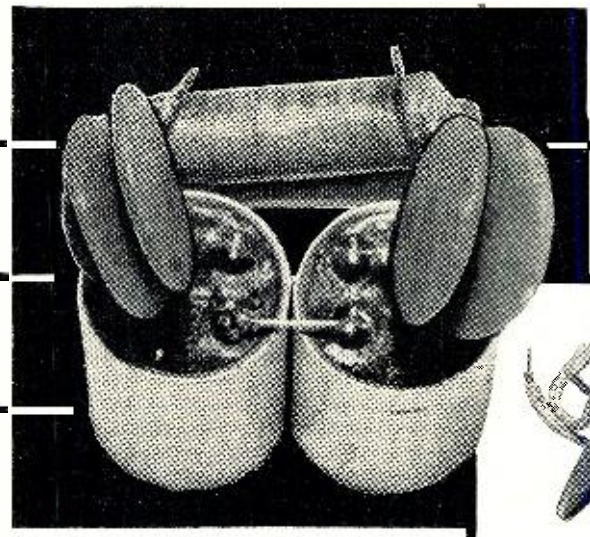


Fig. 1. High-pass rumble filter with a sharp cut-off characteristic at 30 cps.

Fig. 2. Rumble filter enclosed in shield can, constructed from condensed milk or similar container, provides hum reduction.

By **ROY B. LANG, JR.**

Cut out rumble, flutter, and other low-frequency noise in hi-fi audio systems with this high-pass filter.

ADVANCES in the design of speakers, output transformers, record pickups, and the circuitry around them have made audio systems quite efficient at frequencies extending as low as 20 cycles per second. Record manufacturers have kept abreast of these new developments and many recordings made today will cover the full range of the audio spectrum. This gives recorded music a realism which it never had in the past—but not without presenting a serious problem. For example, any system which will take a 30- to 40-cycle note from a recording and faithfully reproduce it is just as effective in converting any low-frequency mechanical disturbances into sound. For this reason, when the designer is ready to choose a turntable to be used in his high-fidelity system, he must face the question of convenience and particularly cost *vs* performance.

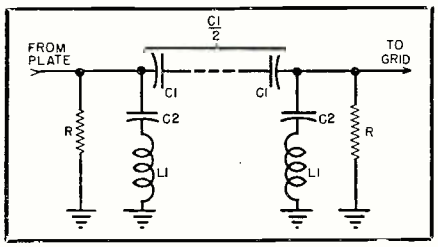


Fig. 3. Generalized circuit for the high-pass rumble filter. The values of the various components depend on the cut-off frequency desired and can be determined from equations in the text.

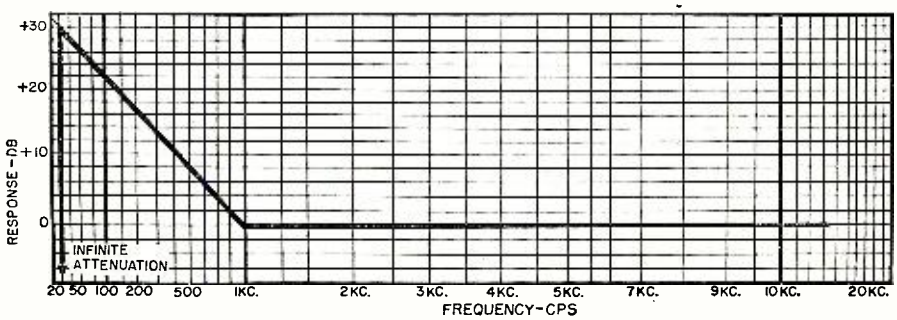
A commercial transcription table will provide superior performance with a minimum of rumble of the type caused by mechanical vibrations in the motor and drive assembly. The average person, however, will probably compromise with the more economical and convenient three-speed changer. Although these changers are usually well designed and constructed from quality materials, their selling price places a practical limit upon the accuracy of armature balance and bearing tolerances in the drive motor assembly. This results in a certain amount of mechanical vibration which, in turn, is converted into rumble and speaker cone flutter at the listening end of the system.

Occasionally, a system may suffer a continual fluttering of the speaker cone at some frequency between 20 and 30 cycles-per-second. Besides being on the threshold of audibility, flutter interferes with the normal cone action for frequencies above 30 cycles. Fortunately, flutter frequency is consistent, and at the extreme low end of the musical scale, therefore, the problem is well suited to the application of a high-pass filter. In order to minimize attenuation of the hard-won bass response of the system, it is desirable to determine the frequency of the cone flutter accurately and then design a filter which will sharply attenuate the flutter signal as well as other spurious signals below flutter frequency. Fig. 4 shows the form taken by the response curve of an amplifier incorporating an ideal high-pass filter. Of course, such a perfect filter is out of the question, but an approximation of the curve shown in Fig. 4 would reduce the disturbance to something less than an objectionable level.

An accurate measurement of flutter frequency may be made with a calibrated "strobelight" and a "modulationless groove" record. The latter is a record made on a standard recording blank with no signal applied to the head during cutting. This special record is played with the gain of the system set high enough so that the speaker cone flutter is very noticeable. While the cone is oscillating, the "strobelight" is focused on the cone and the flashing frequency adjusted until some convenient reference point (the voice-coil leads, for example) on the cone seems to stand still. It is then a simple matter to determine the flutter frequency. Besides this method of checking flutter, there are test records available which will determine flutter, although not as accurately as the "strobelight" will.

If a calibrated "strobelight" is unavailable, the filter should be designed to give maximum attenuation at 24 cycles because the motor characteristics from one changer to another are similar enough so that the flutter fre-

Fig. 4. An ideal high-pass filter would give this type of amplifier response.



quency varies no more than a few cycles.

The filter described in this article and shown in Figs. 1 and 2 was designed for a system using a well-known European three-speed changer, but was found to work equally well with a system using a very popular American-made changer. The type of filter chosen to do the job was a pi-section filter composed of two series m-derived half-sections put together. The schematic is shown in Fig. 3, and the values of the various components may be determined by the following equations:

$$f_c = \frac{f_f}{\sqrt{1-m^2}} = 1.25 f_f = 30 \text{ cps}$$

where f_c is the cut-off frequency of the filter, f_f is the frequency of maximum attenuation or flutter as determined by the "strobelight" (24 cps), and m is 0.6. (The latter value has been empirically determined and gives an attenuation characteristic that most nearly approximates the ideal shown in Fig. 4.)

$$\frac{C_1}{2} = \frac{1}{2m(2\pi f_c)R} = \frac{4420}{R} \ \mu\text{fd. (approx.)}$$

where R is the characteristic impedance of the filter network.

$$C_2 = \left(\frac{m}{1-m^2}\right)\frac{1}{2\pi f_c R} = \frac{4976}{R} \mu\text{fd. (approx.)}$$

and

$$L_1 = \frac{R}{2\pi f_c m} = 0.00884R \text{ hy. (approx.)}$$

The resistance R, which appears in Fig. 3 and the preceding equations, is the characteristic impedance of the filter, and may be determined only when the value of the inductors at cut-off frequency is known. The filter must be terminated with this resistance in order to prevent wave reflections back through the network.

Because the rumble filter described in this article was highly successful with two different makes of three-speed changers, the author recommends the filter circuit shown in Fig. 6. The response curve for the recommended filter is shown in Fig. 5. The cut-off frequency for the filter is 30 cps with maximum attenuation occurring at 24 cps.

The inductors used in the circuit of Fig. 6 were *UTC* type O-13. There may be some difficulty in getting the same type of inductances and, if a substitution must be made, it would be wise to test the new inductors in a series-resonant circuit for the values of "Q" and L at the cut-off frequency, f_c. Such a test circuit is shown in Fig. 7. A trial and error method of determining the value of capacitance needed may be used in place of a decade condenser box.

For determining the inductance by means of this test setup, change the capacitance in the circuit until a maximum voltage drop is obtained across the resistor, indicating resonance in the circuit. The inductance L_x is then equal to $1/(4\pi^2 f_c^2 C)$. The "Q" of the coil can then be obtained from the equation "Q" $= 2\pi f_c L/R$, where L is the value of the inductance just measured, R is the d.c. resistance of the coil, and f_c is the cut-off frequency.

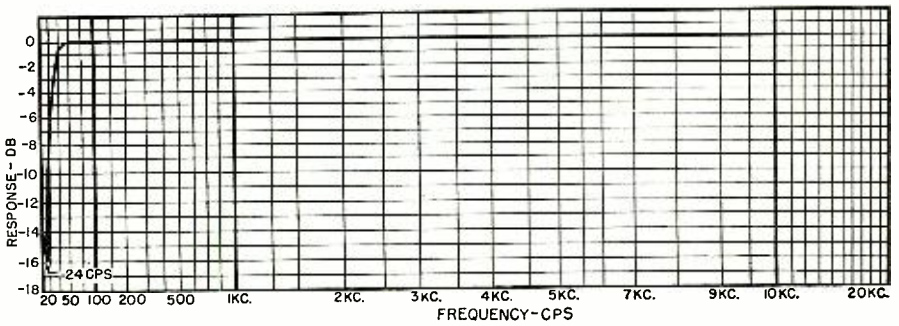


Fig. 5. Bandpass characteristic of the rumble filter shown in Fig. 6.

If it is convenient, the inductances used in the filter should have equal values of "Q"—the higher the better. It may be most convenient to get the inductors first and then calculate their "Q" and L at the desired cut-off frequency. The values of the other components are easily calculated after this. Although the use of a specific inductor is cited here because it is ideally suited to this application, it is entirely possible that other inductors may be used with equal efficiency.

Originally, the rumble filter was intended to be placed in the output circuit of the second stage in the preamplifier. However, the hum pickup here was very noticeable without magnetic shielding. A small condensed milk can which had been emptied and then opened by melting the solder over a stove was just large enough to hold the filter and provided an excellent magnetic shield. (See Fig. 2.) This reduced hum to a very low level. Later, the filter was transferred to the input stage of the main amplifier where it worked just as effectively and with no hum whatsoever. Fig. 8 shows the schematic of that part of the main amplifier circuit containing the rumble filter.

The addition of the filter changed the over-all frequency response curve of the amplifier, as shown in Fig. 9. The dotted line shows the original response characteristic. This response is in some respects far removed from the ideal—but flutter was reduced to a negligible amount over normal operating volume levels with no noticeable difference in the audible bass response of the system. —30—

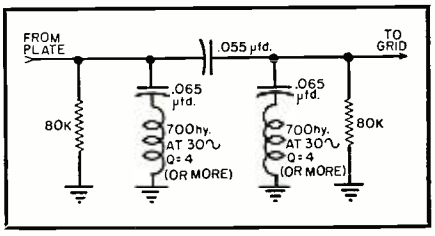


Fig. 6. Schematic diagram of the high-pass rumble filter. Other values for the components may be used but they must be determined from the equations in the text.

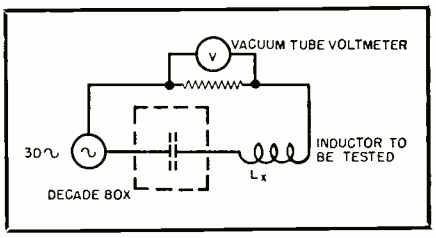


Fig. 7. Test setup for determining the "Q" and inductance of an inductor for use in the filter at the cut-off frequency.

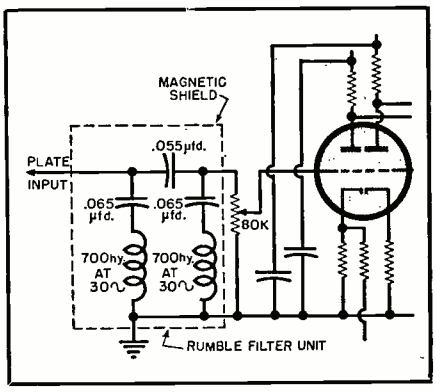
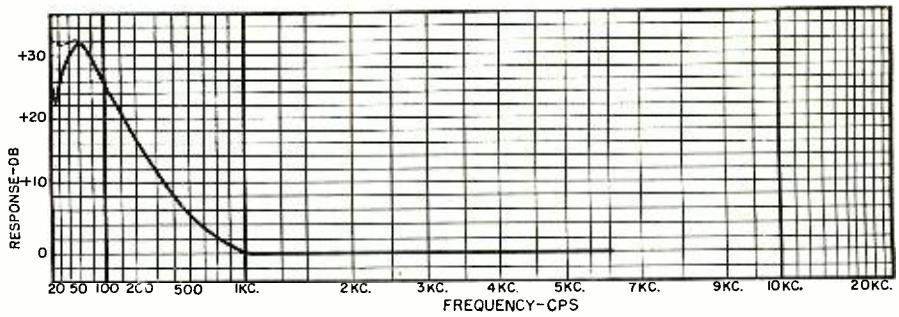


Fig. 8. Schematic of filter as installed in an amplifier input circuit. This rumble filter is also effective when put in the phono preamplifier circuit.

Fig. 9. Actual amplifier frequency response curve with the rumble filter added.



REGULATING THE SPEED OF RECORD PLAYERS

By **HERMAN BURSTEIN**

The simple devices described here may be incorporated in many of the popular three-speed record changers.

DUE to the latitude of practical manufacturing tolerances and often because of voltage variations, three-speed changers are sometimes inaccurate at one or more speeds. Whereas professional standards call for a maximum deviation of .3 per-cent from required speed, errors as high as 5 per-cent and more are sometimes found in commercial changers. Trained ears, and often untrained ones, are offended by the resulting departure from correct pitch in reproduced music.

It has been found that the speed of a *Webster* three-speed changer can be corrected by varying the tension on the spring between the mainplate of the changer and the link bearing the idler wheel which moves the turntable. When the turntable and idler wheel are removed, this spring is exposed to view. Increasing the spring tension (shortening the spring) serves to decrease speed and *vice versa.*

While changing the length of the idler link spring will achieve reasonable accuracy for one given speed, say 33⅓ rpm, this may not achieve the same degree of improvement for the other two speeds. In fact, the other speeds may become less accurate. Therefore the writer has installed in his *Webster* changer a simple device for varying, at will, the tension of a spring connected to the idler link. With a few modifications, this device may be used with almost all three-speed changers.

First the idler link spring was removed. Then a short piece of strong nylon fishline was tied to the idler link hole where the spring was previously attached, see Fig. 1. The line was passed through the hole in the mainplate where the other end of the spring was formerly hooked, underneath the mainplate, and tied to a small swivel of the type used for fishing lures. The swivel in turn was connected to one end of a fairly stiff spring and the other end of the spring was inserted in a hole drilled through the end of a thumbscrew mounted at the rear of the changer, see Fig. 2.

A hole for the thumbscrew was drilled through the rear rim of the mainplate so that the screw lies on a horizontal plane, with its threaded end pointing to the front of the changer. The screw passes through the hole and threads onto a nut, on the other side of the rim (the inside). This nut is kept in place and prevented from turning by the pressure of a small piece of metal bolted to a closely adjoining hole.

Turning the thumbscrew in one direction or another increases or decreases the tension on the spring attached to it, correspondingly changing the degree of pull on the idler link exerted through the swivel and fishline, and altering the speed of the changer within a small but sufficient range. (It was found that the original idler link spring was not rigid enough to provide the desired degree of speed variation in a few turns of the thumbscrew, so a spring of greater rigidity was substituted.)

In order to facilitate frequent speed checks, an NE-45 neon lamp was installed on the changer. A candelabra base for the lamp was affixed to the rear of the mainplate by means of the *Phillips* screw which secures one of the changer's mounting springs. Current for the lamp is taken from the a.c. leads between the phonograph "on - off" switch and the motor (see Fig. 2) so that the NE-45 is lighted whenever the phonograph is on. Thus, the lamp not only provides proper light for observing a strobe card but also serves as a safeguard against failure to shut off the phonograph. Current consumption is negligible, for the NE-45 uses only about ¼ watt. A 6 or 7 watt bulb may be used if it is found that the NE-45 does not provide enough light.

As previously stated, professional standards call for a maximum frequency deviation of .3 per-cent. When using a strobe card this means that not more than 21 bars (or dots) per minute should appear to pass a given point. This is true for all speeds. The following explanation of the strobe card principle will help the reader understand how the standard of 21 bars is calculated. A speed of 33⅓ rpm is assumed for purposes of explanation.

A neon lamp on 60-cycle current flashes 120 times per second—60 times positive and 60 times negative—or 7200 times per minute. If the phonograph turntable revolves exactly 33⅓ times per minute, the lamp flashes 216 times per revolution (7200 divided by 33⅓). Conversely, each flash corresponds to 1/216 revolution of the turntable. Inasmuch as the 33⅓ section of a strobe card has 216 bars (or dots), each flash illuminates a bar that has arrived in exactly the same position that was occupied in the preceding flash by the bar ahead of it. This, aided by persistence of vision, produces the illusion of the bars remaining stationary. However, if the turnable is fast, each bar moves more than one bar distance during the interval between flashes, so that the bars appear to be moving clockwise. Similarly, a slow turntable causes the strobe card bars to seem to move counterclockwise.

Returning to the fact that the neon lamp flashes 7200 times per minute and illuminates 7200 bars during this period (33⅓ revolutions x 216 bars in the case of a 33⅓ strobe card), a .3 per-cent error in turntable speed is .003 x 7200 bars, or 21.6 bars.

It will be noted that the 78 rpm section of the strobe card does not contain the same number of bars as the 33⅓ section. For testing 78 rpm, the strobe card uses 92 bars. When the neon lamp flashes 7200 times per minute, it still illuminates 7200 bars on 78 rpm because 92 x 78 equals approximately 7200. As before, a .3 per-cent error in turntable speed at 78 rpm would cause approximately 21 bars to appear to pass a given point.

In much the same manner, a strobe card may be used for checking 45 rpm turntable speed. For this use, the strobe card contains 160 bars (or dots) in a circle. —30—

Fig. 1. Top view of the modified record changer showing a fishline substituted for spring in hole of the idler pivot.

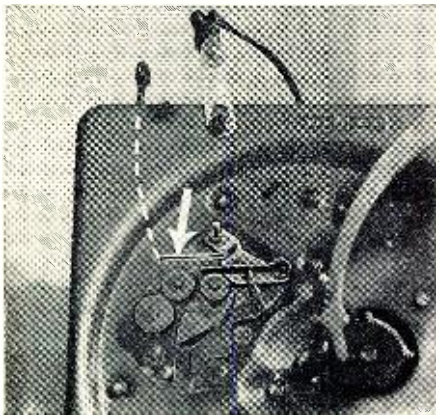
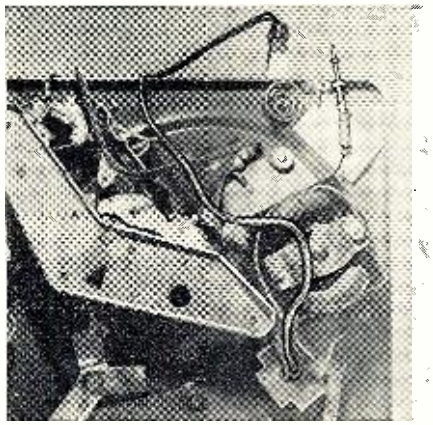


Fig. 2. Bottom view of changer showing thumbscrew assembly and neon lamp connection to "on-off" switch near motor.



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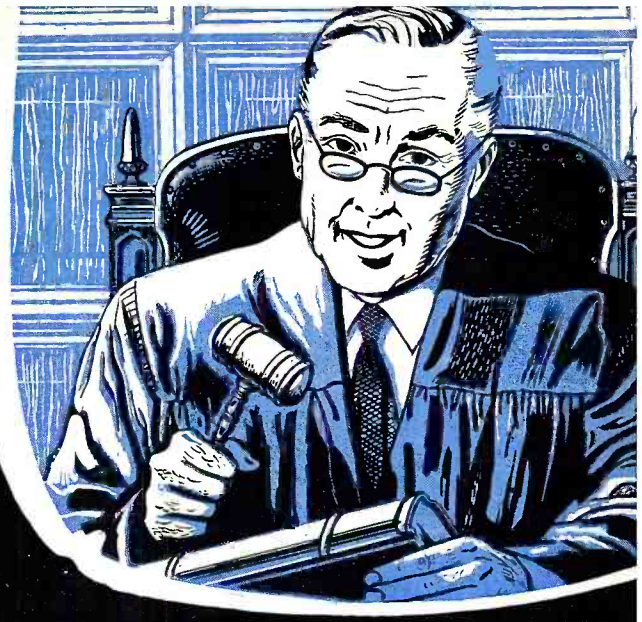

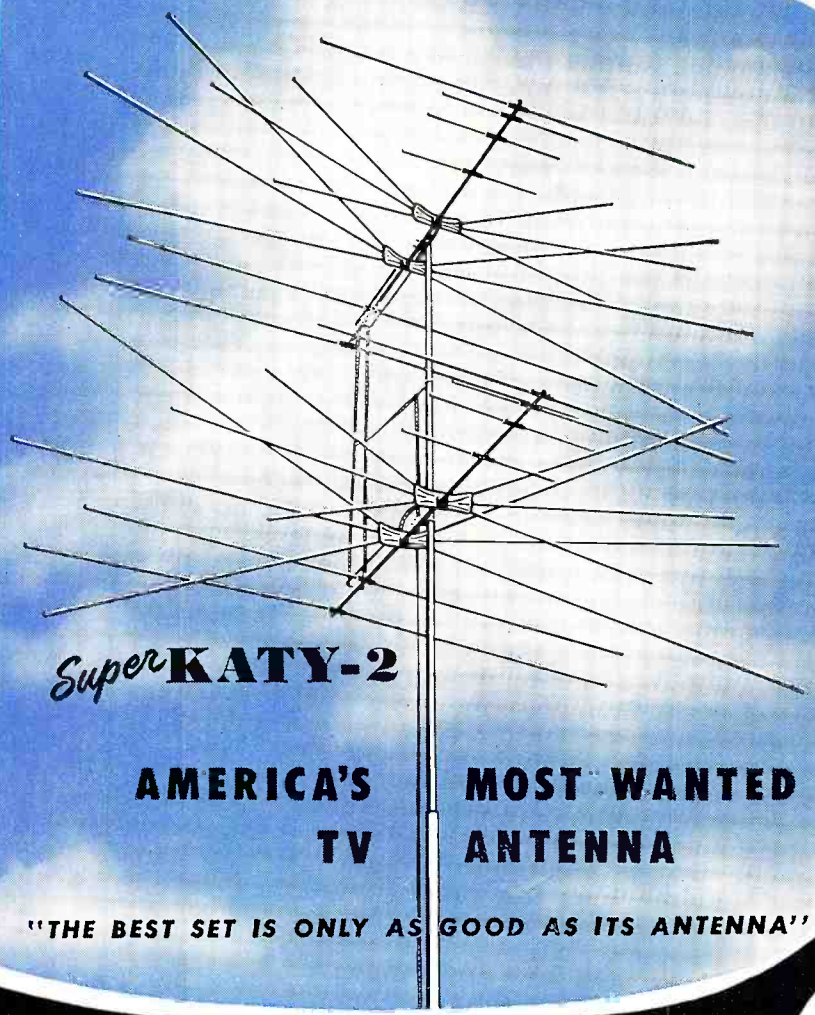

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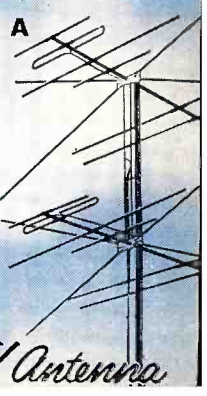

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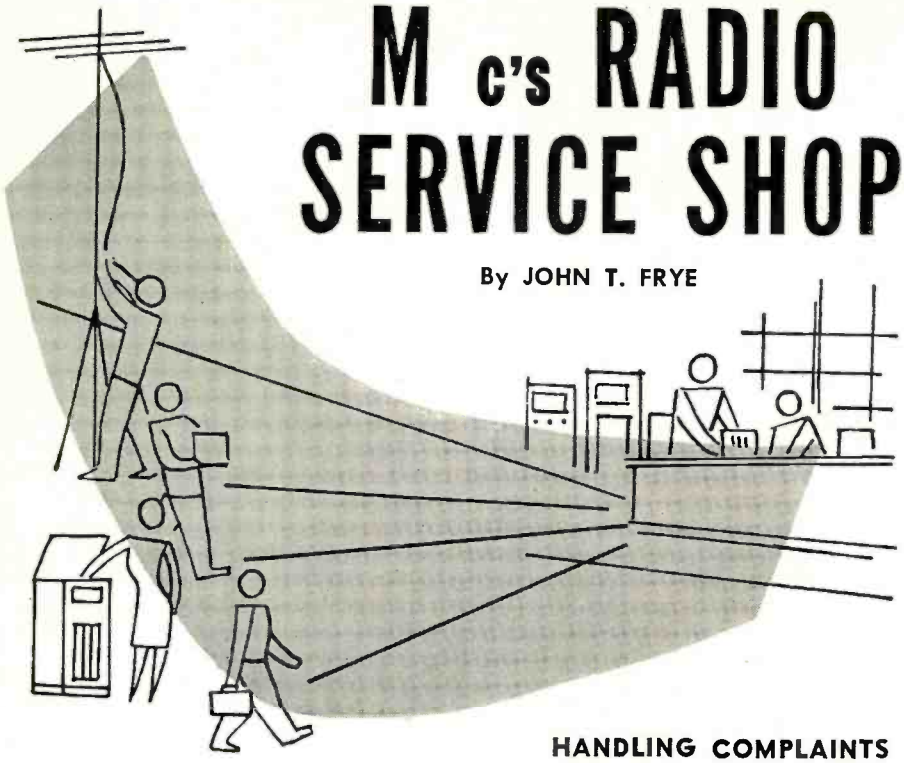
Mac's RADIO SERVICE SHOP

By JOHN T. FRYE



HANDLING COMPLAINTS

ON THE way back from his lunch hour, Mac took a short cut and quietly ducked in the back door of his service shop. As he stepped inside, he could hear his assistant, Barney, talking with a customer out front. Mac's forehead creased in a frown as he listened.

"Now I hope you're satisfied, Mr. Carney," the youth was saying. "You've got a tube for nothing, just as you wanted, even though you didn't have it coming."

"I got it because you weren't able to wiggle out of giving it to me," the customer said angrily as he slammed out the door.

"Man, those characters kill me!" Barney complained bitterly as he came back into the service department. "A week ago we put a new 50C5 in that joker's set, and today a 35W4 went out. In his book, that's our fault; so we owe him a new tube for free. Finally I got so fed up with his bellyaching I gave him the tube to shut him up. Was that OK?"

Without answering Mac seated himself on the service bench stool and waved Barney to his favorite perch on the end of the bench. "I think it is high time we had a little heart-to-heart on the general subject of handling complaints," the older man said. "I was listening to that little skirmish you had with Mr. Carney, and I think the technique you displayed leaves a little something to be desired."

"Guess you're right," Barney readily admitted. "I was too soft. I should have tossed him out of the store."

"Overlooking the fact that Brother Carney outweighs you by at least sixty pounds and could play you like an accordion, that's not exactly what I had in mind," Mac answered; "but let's examine the whole thing from the beginning:

"In the first place, we may as well face the fact that every service shop is bound to have some complaints. This would be true even though Marconi himself did the service work and the angel Gabriel sat in the front office to handle public relations. In fact, we may go a step further and admit that some of these complaints will be justified—at least from the point of view of the average customer who knows from nothing about electronics."

"Let's not admit any more than we have to," Barney cautioned.

Mac grinned and went on: "You know as well as I that sets have a fiendish ability to perform perfectly on the test bench and then to misbehave most shamefully as soon as they are in the customer's house. Quite often there are natural explanations for this perverse behavior. In many cases a difference in the line voltage present at the shop and at the customer's home is at fault. For example, the oscillator of a three-way portable will often quit dead when the line voltage falls below a certain critical value but will run merrily all day long on a line voltage that is only two or three volts higher. There are other cases in which an output tube that is being worked right up to the limit of its voltage ratings will start secondary emission from the screen if the line voltage rises five volts, and you know how much trouble that can cause. Finally, we are both familiar with the host of changes that can take place in a TV set when the line voltage hops up or down a few volts. Yet most customers think the line voltage is identical in all parts of a city.

"Still worse, though, is the fact that the voltage can be all right and yet individual house wiring can have a pronounced effect on reception in a set, especially if that set uses a built-in loop antenna. I have seen many cases where switching on a certain house circuit will produce very noticeable changes in the strength of a received signal. Part of this may be due to a condition wherein adding or subtracting one circuit from the house wiring can throw the whole wiring system in and out of resonance with a broadcast signal or change the position of standing waves on that system. In other cases the various wires and grounded conduit in the ceiling and walls may exert a shielding effect on the loop antenna such as is produced by the girders of a steel bridge on a car antenna. At any rate, I know of two houses in which a loop antenna receiver will not work satisfactorily. If the set is put on an extension cord and taken outside, the signal comes up the instant you step across the threshold; but inside the house, reception is very weak. The only solution is to install an outside antenna.

"And finally there is the plain cussedness of inanimate objects — and every true technician believes devoutly in this—that causes a receiver to fail between the time the service technician switches it off and the time the set owner turns it on. The technician who has not had this embarrassing, hard-to-explain experience happen to him has not been in the game very long."

"On the other hand," Mac continued, "there are many complaints that are not justified at all."

"Go on!" Barney urged eagerly. "This is the part I like."

"Well, all of us have customers who seem to think that once we have worked on a set and collected a service charge we are obligated to keep it running from that day forth without any further compensation."

"Yeah," Barney agreed. "Those guys remind me of something I was just reading. It seems that if you save a man's life in China his life then becomes your sole responsibility, and you are supposed to feed and care for him the rest of his days—or yours. Those customers you are talking about try to apply the same line of reasoning to their sets."

"The thing to do with these people is to impress on their minds the real facts of your service guarantee. Make it clear you only stand behind your *own* work, and even here your guarantee is for a reasonable length of time and not for life. Point out that when the radio was bought brand-new, it was very likely guaranteed for only ninety days. Compare that with the full one-year warranty most service shops put on any parts they install. Above all, however, make it crystal clear that your guarantee applies only to the parts you replace and not to the whole set."

"A big trouble there is that widely

(*Continued on page* 92)

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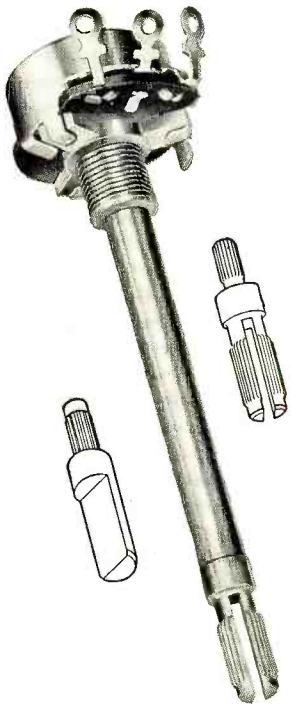

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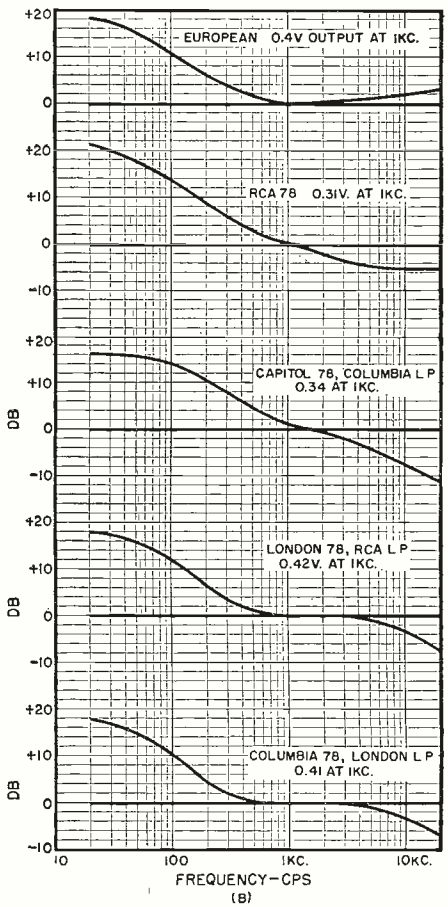
Miniature Preamp

(*Continued from page 41*)

equalizer. The deviation is the output of the second stage V_{1B}. In the original the outputs are separated into positions for the standard (78 rpm) records and for the LP's (both 33 and 45 rpm). The output for the 78's is divided down for the lower output voltage while that for LP is not. Component-wise the circuit follows the *Scott* circuit but the feedback networks are made in the style of the *Centralab* "Couplate." These five "Couplates" are special units and are not currently available. They are shown in connection with this piece of equipment merely to demonstrate the adaptability of printed circuits to the audio field. There are five of these circuits. The components which these replace are shown within the dotted lines at the lower left-hand corner of Fig. 4. Fig. 2 is the schematic for these five plates with the component values indicated. From this diagram the reader can see just how many connections and components are saved by using printed circuitry.

Response curves for the complete unit are shown in Fig. 6. The input was fed into J_1 at 1 mv. and the output was read at J_3. Gain was maximum throughout. These curves include the total response for the unit

Fig. 6. Gain vs frequency of the equalizer with input at J_1 equal to 1 mv. See text.



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0Z4O		6AF4	1.76	6F7	1.59	6Z4/84		12BZ7	1.19	35Z4	.69
1A5GT	.79	6AG5	.99	6F8G	1.59	7A4	.95	12F5GT	.69	35Z5	.59
1A7GT	.79	6AG7	1.49	6G6G	.95	7A5	1.19	12H6	.89	35/51	.79
1B3GT	.95	6AH6	1.89	6H6GT	.89	7A6	.89	12J5GT	69c	36	95c
1B5	29c	6AJ5	2.95	6J5GT	.59	7A7	79c	12K7GT		37	
1H4		6AK5	.89	6J6	.79	7A8		12K8	.89	38	88c
1H5GT	.59	6AK6	1.19	6J7G	.69	7B4	.89	12Q7GT	.89	39/44	
1J6GT	59c	6AL5	69c	6J8G	1.19	7B5	.89	12S8	.89	41	
1L4		6AQ5		6K5GT	.69	7B6	.89	12SA7GT	.69	42	69c
1L6	1.29	6AQ6	.79	6K6GT	.59	7B7	89c	12SC7	.95	43	
1LA4	1.19	6AQ7	1.19	6K7GT	.69	7B8		12SF5GT	.69	45	
1LA6	1.19	6AR5	.79	6K8GT	1.19	7C4	1.29	12SF7	.95	45Z5	.69
1LC5	.69	6AT6	.59	6L5G	.95	7C5	.89	12SG7	.89	46	89c
1LC6	1.19	6AS5	.89	6L6G	1.39	7C6	79c	12SH7GT		47	
1LD5		6AU5GT	1.29	6L6GA		7C7		12SJ7GT	69	50A5	.95
1LE3	1.19	6AU6	.59	6L7	1.19	7E5		12SK7GT		50B5	69c
1LH4	1.19	6AV6GT	.89	6N6G	1.29	7E6	79c	12SL7GT		50C5	
1LN5	1.19	6AV6	.59	6N7GT	1.19	7E7		12SN7GT	.95	50C6G	1.29
1N5GT		6AX4	.69	6P5GT	.69	7F7	.89	12SQ7		50L6	.79
1P5GT	79c	6AX5	.79	6Q7GT	.59	7F8	1.49	12SQ7GT	69c	50X6	.69
1Q5GT		6AX6	.69	6R7GT	.69	7G7	1.19	12SR7GT		50Y6	.95
1R5		6AY5GT	.89	6S4	.59	7H7	.95	12Z3	.95	57	79c
1S4	.95	6B4G	1.29	6S7GT	1.19	717	1.19	14A7	95c	58	
1S5		6B8GT	1.19	6S8GT		7K7		14AF7		70L7	1.49
1T4	69c	6BA6	.59	6SA7GT	69c	7L7	.79	14B6	89c	70L7GT	
1U4		6BA7	.89	6SC7		7N7	.69	14B8		71A	79c
1U5	.59	6BC5	.69	6SD7GT	.99	7Q7	.79	14C5	1.19	75	
1V		6BD5GT	.89	6SF5	.59	7R7	1.19	14C7	95c	77	.69
1X2A	89c	6BE6	.59	6SF5GT	.59	7S7	1.19	14F7		78/6D6	.95
2A6		6BF5	69c	6SG7	69c	7V7	.79	14F8	1.29	80	.69
2A7		6BF6		6SH7		7W7	1.19	14H7		83	1.49
2B3	.89	6BG6G	1.89	6SH7GT	.69	7X6	.95	14Q7	.95	84/6Z4	.69
2B7	.89	6BH6	69c	6SJ7	.79	7X7	79c	14W7	1.19	85	.79
2E5	.89	6BJ6		6SJ7GT	59c	7Y4		14X7	1.19	VR90	$1.19
2X2/879	.79	6BK7	1.19	6SK7GT		7Z4	.89	19BG6G	1.89	VR105	
3LF4	1.29	6BL7	.79	6SL7GT	.69	12A7	1.49	19T8	.89	VR150	
3Q4	.69	6BN6	1.19	6SN7GT	.79	12A8	.69	24A	.69	VT51	29c
3Q5GT	.89	6BQ6G	1.19	6SQ7	59c	12AH7	1.49	25AC5GT	1.19	VT52	
3S4	.69	6BQ6GT	1.19	6SQ7GT		12AL5	59c	25BQ6	1.19	117L7	1.49
3V4	.95	6BQ6GTA	1.19	6SR7GT		12AT6		25BQ6GT		117N7	1.89
5T4	1.29	6BQ7	1.29	6SS7	.99	12AT7	.89	25L6GT	.59	117P7	1.89
5U4G	.69	6BZ7		6T8	.89	12AU6	.69	25W4GT	.69	117Z3	.59
5V4G	.89	6C4	.59	6U5		12AU7	.79	25Z5	.69	117Z6	1.19
5W4	59c	6C5GT		6U6GT	69c	12AV6	.59	25Z6GT	.69	715B	5.00
5W4GT		6C6	69c	6U7G		12AV7	.89	32L7GT	.95	807	1.49
5Y3GT	.49	6CB6		6U8	.89	12AW6	1.19	26	59c	866A	1.49
5Y4G	.59	6CB6A	1.29	6V3	1.29	12AX4	.69	27		1299	49c
5X4G	97c	6CD6	1.89	6V6GT	.69	12AX7	.69	35A5	.95	1619	
5Z3		6CD6G		6W4GT	.59	12AY7	1.89	35B5		2051	.95
6A7	.89	6CF6	1.19	6W6	.69	12BA6	.59	35C5	69c		
6A8GT	1.29	6D6/78		6X4	59c	12BA7	1.19	35L6			
6AB4	.69	6D8G	1.19	6X5GT		12BE6	69c	35W4	.59		
6AB7	1.19	6E5	.69			12BF6					

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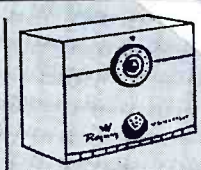

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10-10	450V.	.45	25-	50V.	.19
20-	450V.		50-	50V.	.25
20-20	450V.	.49	100-	50V.	.29
30-	450V.	.45	20 mfd.	150V.	.35
30-30	450V.	.59	20-20	150V.	.45
40	450V.	.49	30	150V.	
40-40	450V.	.69	30-30	150V.	.49
60	450V.		40	150V.	.49
60-40	450V.	.89	40-20	150V.	
80	450V.	.69	40-40	150V.	.49
			50-30	150V.	

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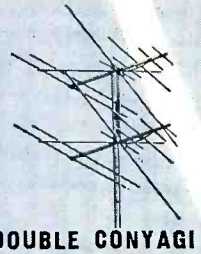
VOLUME CONTROLS WIT SWITCH. 2" shaft, 1 meg ½ meg, ¼ meg.	3
SINGLE ION TRAPS	1
DOUBLE ION TRAPS	ea. 2
OUTPUT TRANSFORMER— for 50L6, 29c; for 6V6, 3	



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24" & 27" Rectangular Kits Contain 90° yoke.

RESISTOR KITS

Insulated ½, 1 a 2-watt assortment most used Value I. R. C. Ohmite Stackpole, Speer.

100 for.. **$2.9**

BIG SCREEN TV

90° matched unit deflection kit for 24 and 27 inch rectangular picture tubes. A newly designed combination of horizontal output flyback transformer and wide angle deflection yoke for 90° applications. Flyback transformer develops 18.5 k.v. with 280 volts of B supply. Only a single 6CD6 driver and a 6AX4 damper need be used to fully deflect the 90° sweep. AGC-AFC wiring is incorporated. Yoke is housed in a non-rigid shell so that expansion and contraction will not injure the windings. Complete with matching network and wire leads. Complete kit, including 6CD6G, 6AX4GT, schematics and instructions for conversion procedure, $38.45 value, only **$17.95** net.

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Replace GLO BAR sistors in ALL G television. Also us in Motorola, Hoffm Sears, Pathe, Te tone. 1 kit will place any temp. s sitive resis- tor. Net.... **$1.4**

300 OHM TWIN LEAD

55 Mil, 100 ft.	$1.59
1000 ft.	9.85
20 Ga., 80 Mil, 100 ft.	1.89
1,000 ft.	16.95

UHF TUBULAR 300 OHM LINE

1,000 ft.	$29.50
100 ft.	$3.95

All Channel Foam Line, 100 ft. for $6.95. 50 ft. for $3.95

FOUR CONDUCTOR

Rotor Cable Clear or Brown. Very Special,

1,000 ft.	$14.95
100 ft.	$1.95

TV MASTS AND HARDWARE

Bargain Chimney Mount	$1.89
$1.49 Net. Vent Mount	
Stainless Steel Chimney Mount. Net	$2.50
Twin lead ins	each 3c
Mortar nail insulator	each 8c
Mast ins	each 15c

Ten foot mast. Seamless, expanded end, sturdy enough for the largest arrays. Only ..... each **$2.39**

5 ft. DURABLE MAST, heavy gauge 1¼ diam, with interlocking end. Slip two sections together for a ten-footer. 5 sections = 25 ft. Each section $1.25

Flyback Transformer TV Horizontal output, universal replacement, 14,500 V.

2.49 ea.

70 degree cosine yoke with 4 leads and network

2.95 ea.

BRAND NEW TV PICTURE TUBES

All Tubes Have Daylight Type Dark "A" or "B" Faces

SIZE	PRICE	SIZE	PRICE	SIZE	PRI
7JP4	17.95	16KP4 16"	21.95	20CP4 20"	27.9
8BP4	18.95	16LP4A 16"	24.20	20DP4 20"	
10BP4B 10"	14.95	16RP4 16"	21.95	20HP4 20"	29.
12JP4 12"	17.95	16TP4 16"		21AP4 21"	30.
12LP4B 12"		16WP4A 16"	22.20	21EP4 21"	
12UP4A 12"	19.40	16YP4A 16"		21FP4 21"	31.9
14BP4 14"	20.40	17BP4A 17"	22.95	21MP4 21"	
14CP4 14"		17CP4 17"	25.40	21WP4 21"	36.9
14GP4 14"	21.90	17GP4 17"	26.90	21YP4 21"	
14HP4 14"		17HP4 17"		21ZP4 21"	31.
15AP4A 15"	22.50	17LP4 17"	26.90	24AP4 24" mo	53.
16AEP4 16"	22.50	17TP4 17"	26.90	24CP4 24"	62.5
16AP4A 16"	22.60	19AP4B		24DP4 24"	
16DP4A 16"		19DP4B	28.80	27EP4 27"	78.
16EP4A 16"	22.20	19FP4B		27GP4	
16GP4B 16"	24.20			27LP4	79.9
16JP4A 16"				27NP4	
				27RP4	

THESE ARE **BRAND NEW PICTURE TUBES**

15 MONTH GUARANTEE ON ALL TYPES
SEND 25% DEPOSIT AND WE WILL SHIP FROM STOCK IMMEDIATELY

TERMS: 25% DEPOSIT with order, balance C.O.D. ALL shipments F.O.B. Chicago. ORDERS LESS THAN $5.00—$1.00 SERVICE CHARGE. CABLE ADDRESS: CONTULAB. These prices supersede all previously advertised prices, subject to change

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and should not be compared precisely to the curves published by manufacturers. The output voltages at 1 kc. are listed on the curves and thus are the levels taken for 0 db. Generally they run at .40 volt out and thus show that the over-all gain at 1 kc. is .40/.001 or 400. This is 52 db. At the low-frequency point (20 cps) the boost amounts to 20 db in most curves and the total is then about 70 db. These figures are representative of the requirements for most power amplifiers. Since the output of most magnetic cartridges is actually on the order of 10 mv. or more at the maximum gain setting, the curves would result in about 4 volts output—far more than required for living room listening unless the neighbor's living room is included in your audio system.

The photograph, refer to Fig. 5, illustrates wires that are used to connect the unit to the required external power source; "B+", heater, and ground. The jack, J_1, is shown with J_2 directly below it. The screwdriver adjustments for the level sets are to the right and above the respective inputs. The output jack, J_3, can be seen at the extreme lower right of the photo. The dual knobs, labeled "gain" and "Compentrol" control those functions while the dummy dual knob labeled "selector-equalizer" controls that switching function. The arrow in Fig. 5 points to the "European" record setting and is switched clockwise through all the remaining functions of the selector.

The five equalizer plates are visible in Fig. 5 at the sides of the equalizer switch.

The plates at the rear of the switch are the .1 μfd. ceramic condensers, C_5, C_6, C_7, C_8, C_{10}, and C_{13}. Note that the switch is actually a 2 to 12 position one and since, in this case, only six positions were used the remaining terminal points were put into service as tie points for "B+", filter resistors, and other components that would have otherwise required extra terminal points.

The reader will note that the chassis is not crowded so there is no need to "cheat" on the assembly. Those who want to duplicate this construction using components for the not-available equalizer plates will have to use a slightly larger chassis since obviously something will have to give.

It is hoped that the prospective builder will be pleased by the quality of reproduction as well as by the ease of operation. It is left for him to incorporate whatever additional inputs, a.c. switching, etc. he desires. It is left for the manufacturer of equipment to determine whether his customers want gadgets and controls or simplicity along with their listening pleasure.

REFERENCE

1. Wiener, R. & Nelson, N.: "The Compentrol—A Compact Loudness Attenuator." RADIO & TELEVISION NEWS, *November 1953.*

—30—

EXTENDING COIL CALCULATOR RANGE

By ELBERT ROBBERSON

ONE of the handiest aids the experimenter or engineer can have around the lab is the Allied "Coil Winding Calculator." This device has one disadvantage and that is in not continuing its scale to include windings of spacings greater than 1/10th inch.

This factor prevents calculations being made for coils of wire any heavier than about #10 and completely rules out one of the most popular ham coil conductors, copper tubing. By means of a simple modification, however, the range may be increased to include coils of winding pitches as low as 3 turns-per-inch.

The scales are logarithmic, so intervals of a given length are halved in value, going to the left on the scale. This means that calibrations may be transferred to the unmarked portion of the rule from the part already marked, as long as this relation is kept in mind.

First mark a card opposite the graduations for 15, 20, 25, 30, 35, 40, 45, and 50 turns-per-inch. Then move the card to the left so the 50 turn mark is opposite 10 turns on the calculator scale. Transferring graduations from the card to calculator body will now give points for spacings of from 3 up to 10 turns-per-inch.

Now, remove the slide, insert a strip of sheet metal in its place for backing and, with a razor blade, extend the window to the new 3 turn mark. Reassemble, and the calculator may now be used for figuring any sized coil. —30—

The calculator window, backed by a steel strip, may be extended by using razor blade.

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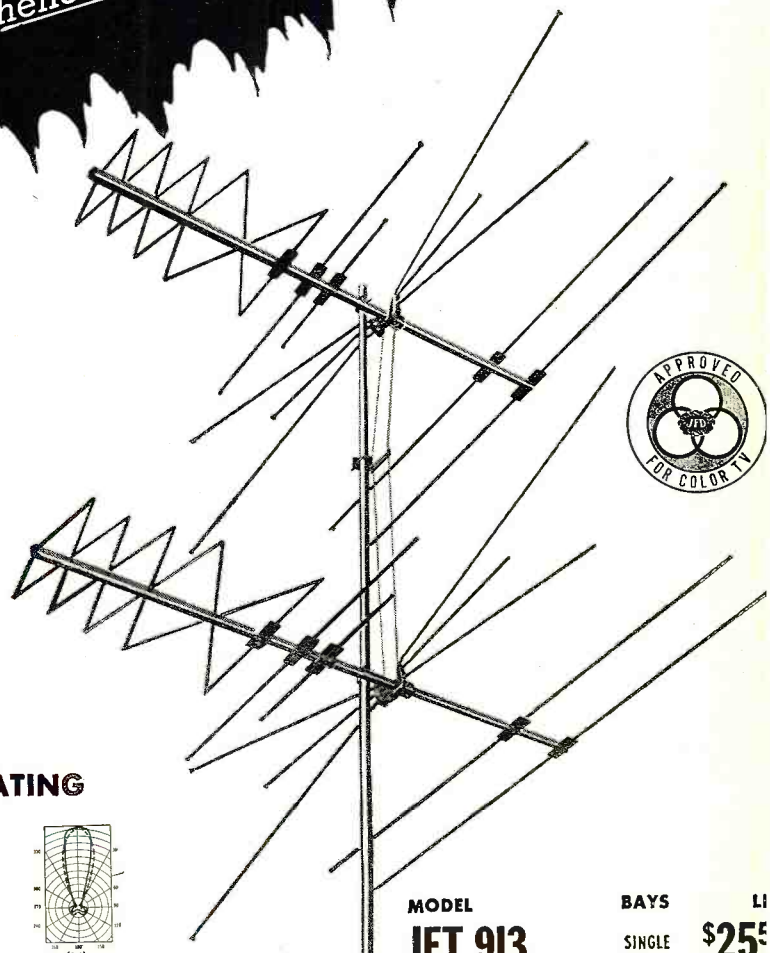
JET-HELIX

a radical new flat plane helical concept for VHF-UHF



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delivers highest gain!

outstanding front to back ratio!

sharpest picture clarity!

greatest fidelity color reception!

finest snow-free, trouble-free performance!

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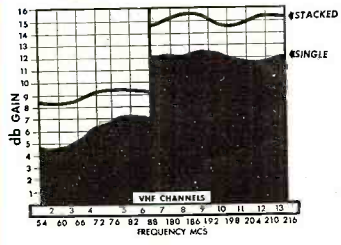
IT ALL ADDS UP TO A NEW HIGH IN S/N RATING

S/N FIGURE OF MERIT * JFD JET-HELIX—57.85%		
ANTENNA A	ANTENNA B	ANTENNA C
43.15%	31.85%	38.5%

*The S/N Figure of Merit sums up the major individual characteristics of an antenna in one concise value. Write for S/N Figure of Merit engineering folder No. 299 for complete details.

THE JET-HELIX IS BETTER BY AN AVERAGE OF 44.5%



- The Microwave Helix design delivers record-shattering power and performance—highest signal magnitude on all channels with the least possible amplified noise!
- Only the Jet-Helix has been exhaustively pre-tested in the field by JFD engineers!
- Only the JFD Jet-Helix comes to you backed by the greatest consumer advertising support in antenna history—literally pre-selling the Jet-Helix for you!
- Yes, compare its Alcoa Aluminum construction, compare its pre-assembled convenience—compare the JFD Jet-Helix by any standards known—and you *must* agree—here is the New Star of Antennas—the JFD Jet-Helix!

THE JET-HELIX IS THE *ONE* ANTENNA THAT OUTPERFORMS ALL OTHERS IN FRINGE AREAS ON BOTH VHF—UHF

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JET 913 S	STACKED	$52[illegible]
JET 913 S-5	HALF WAVE STACKED	$55[illegible]

DO NOT CONFUSE WITH OTHER SIMILAR ARRAYS! THIS ANTENNA IS RADICALLY NE[illegible]

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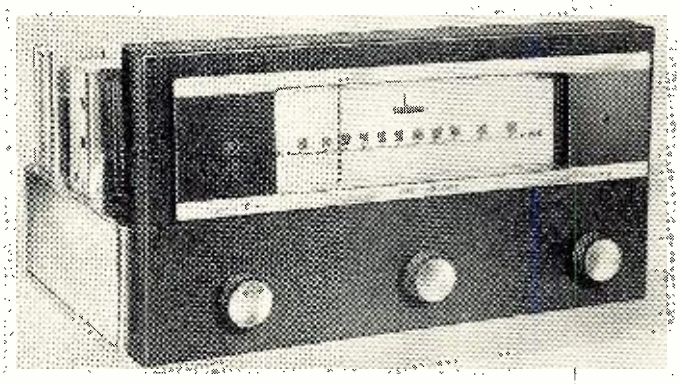


Front panel view of the Craftsmen C900 FM tuner. The chassis measures 13½" x 7⅛" x 8¾". The knobs and control shafts extend 1½" from the front of chassis.

THE C900 FM TUNER

By **L. J. HERMANN**
Applications Engr., Radio Craftsmen, Inc.

Engineering details on a new Craftsmen tuner that uses photo-etched coils in a unique circuit design.

ONE of the interesting and unique features of the new *Craftsmen* C900 FM tuner which recently appeared on the market is the use of photo-etched coils for the i.f. and discriminator circuitry.

This feature, combined with a cascode r.f. circuit, amplified a.f.c., and a new intermediate frequency, is responsible for the unusual sensitivity of the tuner. The C900 has a sensitivity of 1 μv. for 20 db quieting and 2 μv. for 30 db quieting. Frequency response is $\pm$ .5 db from 20 to 20,000 cycles with .1 per-cent intermodulation distortion at 75 kc. peak station modulation.

Each of the i.f. coils and the discriminator is photo-etched on glass-filled melamine, a material that is extremely stable under wide ranges of temperature and humidity. The accuracy of the photo-etching process allows complete control of transformer coupling and eliminates annoying phase shift. In addition, the high capacity of the photo-etched coils minimizes tube variation and eliminates the need to realign the tuner when an i.f. tube is changed.

The r.f. stage uses a double-triode cascode circuit designed around the 6BK7A. The antenna input circuit has been optimized for use with standard 300-ohm twin-lead but 72-ohm shielded lead can be used without circuit modification, if desired.

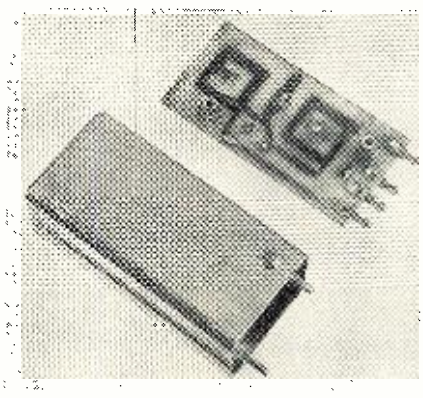
A new i.f. of 20.6 mc. has been selected to remove oscillator radiation from the FM band, thus allowing any number of the units to be attached to the same antenna without interaction. Only one spurious image is present within the entire FM band with the i.f. chosen and that is 80 db below the desired station level.

Another feature is a newly-designed a.f.c. circuit utilizing a d.c. amplifier. This circuit provides a correction factor of 30 db and assures accurate tuning to the center of the FM carrier. In addition, the a.f.c. has sharp cut-off skirts so that it does not extend over too great a tuning range, an important feature of any FM tuner.

The three front-panel controls are a.f.c., on-off-volume, and tuning. Ten tubes, including a rectifier, are used in the circuit. Two 1N64's serve as the FM detector. —30—

Initial step in preparing the photo-etched i.f. coils used in the FM tuner described.

The individual photo-etched i.f. coil completely wired and ready to be slipped in can.



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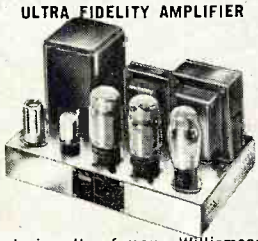
1 craftsmen
C800A
DELUXE AM-FM TUNER

Latest production with higher sensitivity and improved tone balance. Incorporates Craftsmen's famous AFC, Phono Pre-Amp and Record Compensator.
Net $159.50

2 craftsmen
C500A
ULTRA FIDELITY AMPLIFIER



Featuring the famous Williamson Circuit with superior KT66 Output Tubes. Full 15 watts 20 to 20,000 cps within 1/10 of 1 db. Distortion so low it can hardly be measured.
Net $99.50

3 GARRARD
"TRIUMPH" RC80 AUTOMATIC
3-SPEED RECORD CHANGER

The standard of excellence the world over. Plays all records, 33⅓, 45, 78 rpm records in 7", 10" and 12" sizes. Quiet, smooth-running 4-pole motor, weighted turntable. Automatic shut-off after last record. Muting switch cuts out sound during change cycle. Net $49.50
SPECIAL '45' SPINDLE for Garrard "Triumph" Changer Net $3.50

4 Electro-Voice
12 TRXB TRIAXIAL SPEAKER

Advance design full range easy to mount 12" TRIAXIAL 3-WAY SPEAKER SYSTEM. Electro-Voice laboratory research has combined Woofer, Middler and Tweeter into a near-perfect instrument for sound reproduction. Clearly and realistically reproduces all tones and overtones with unexcelled balance.
Net $59.70

5
GENERAL ELECTRIC
RPX-050 TRIPLE-PLAY
VARIABLE RELUCTANCE
MAGNETIC PICKUP

For finest phono reproduction of all types of records. Considered by many engineers and music lovers the finest pickup at any price! Furnished mounted in changer ready for use. Supplied with genuine General Electric Double Sapphire Needle. Net $8.20

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Complete, Matched PHONO-RADIO SYSTEM

ALL BRAND NEW famous name components • **ALL** current models and production • **ALL** Fully Guaranteed • Supplied with **ALL** TUBES • Warranty Cards • Instructions • Indoor Antenna • GE Dual Sapphire Needle • **ALL** Cables and Plugs • Your '5-STAR' System consisting of ALL ITEMS ILLUSTRATED and DESCRIBED ABOVE . . . comes ready to plug together and play!

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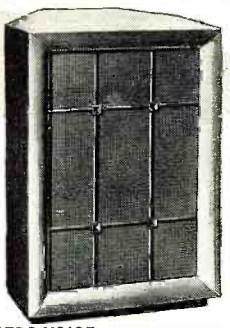

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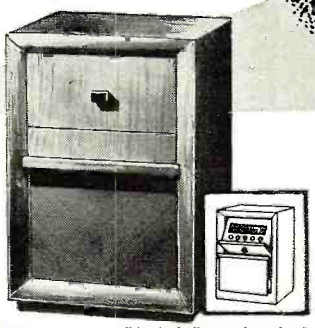

ELECTRO-VOICE *ARISTOCRAT* SPEAKER CABINET WITH KLIPSCH LICENSED FOLDED HORN
Companion Speaker Cabinet for the PEERAGE Equipment Console. Corner enclosure designed to match the characteristics of the Electro-Voice 12TRXB Speaker. The patented KLIPSCH principle provides a full octave of added bass without boominess and greater speaker power handling capacity. 29½" high, 19" wide, 16½" deep.
In MAHOGANY Net $66.00 • **In BLONDE** Net $72.00

ELECTRO-VOICE *PEERAGE* EQUIPMENT CONSOLE
Fashioned by furniture craftsmen. In Beautiful Blonde Korina or Tropical Mahogany Veneer, hand-rubbed finish. Supplied all cut out to house C800A Tuner, C500A Amplifier and RC-80 Changer. Tilting tuner compartment opens to easy-to-operate angle. Record changer mounts in drawer directly below tuner panel on roller slides for smooth operation. 29¾" high, 20½" wide, 18¾" deep.
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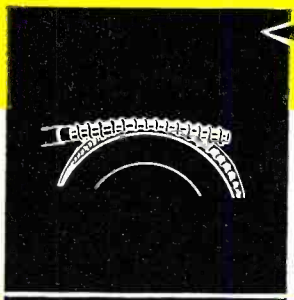
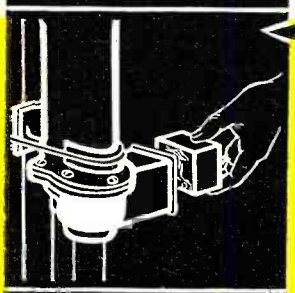


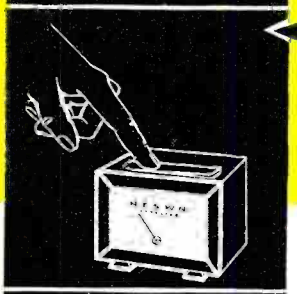
1 Flexible Worm Gear

Actually comes in contact with more gear teeth than *straight-bar* worm gear. This means no-slip gear control, no back-lash, no binding; longer life.



2 Motor Easily Removed

Motor instantly removed from housing — faster, easier to replace than cartridge types. Lowest servicing cost, because motor is separate from gear train.

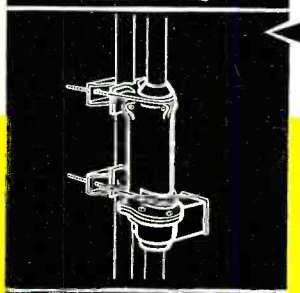


3 Electrical and Mechanical Stops

Hair-line accuracy. No over-shooting. No drifting or coasting. Perfect tuning

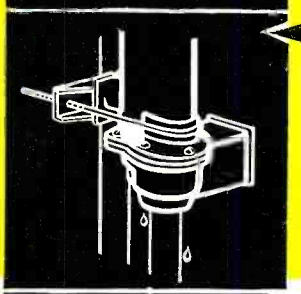
4. Lightweight — Strong

All-aluminum die castings, steel reinforced. Built-in guy wire anchors.



5 Straight-Thru Mast Mounting

Both rotating and stationary masts go completely through rotor. Grips 12" section of rotating mast, for greatest resistance to horizontal thrust.



6 Weatherproof

Straight-Thru design permits water to drain freely. Weather cannot interfere with performance of rotator.

7. Extremely High Torque

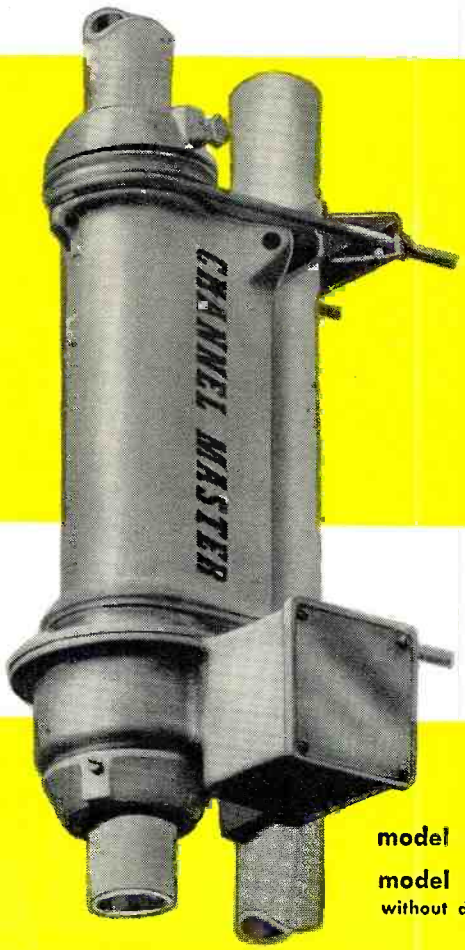
Will turn any 4-bay antenna in wind with ease.

8 Built-in Chimney Mount

And — rotor takes up to 1⅝" mast.

9. Built-in Thrust Bearing

3-race ball bearing. Takes heaviest loads without strain.



the new rotator with these 10 superior features

model no. 9521

model no. 9520
without directional indicator.

10. Midget Control Cabinet

— a beauty!

Beautifully styled. Smallest cabinet on the market, only 2¾" x 4". Blends harmoniously with any type of home decor. Fingertip control bar. An eye-appealing sales clincher!

Write for complete technical literature.

RECEPTION FROM ALL DIRECTIONS!

CHANNEL MASTER'S all-new

SELECTENNA

coupling system

A truly revolutionary Channel Master development that permits *unlimited antenna combinations* with only *one* transmission line!

No moving parts — No motors
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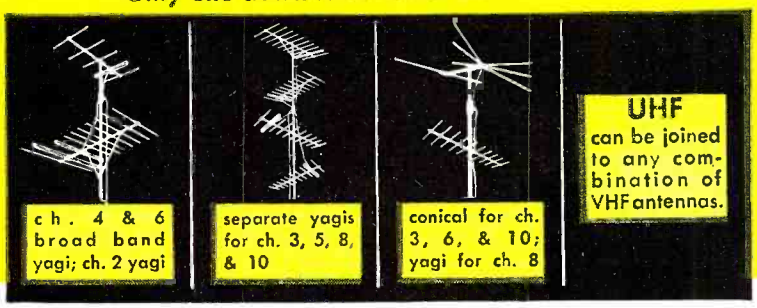
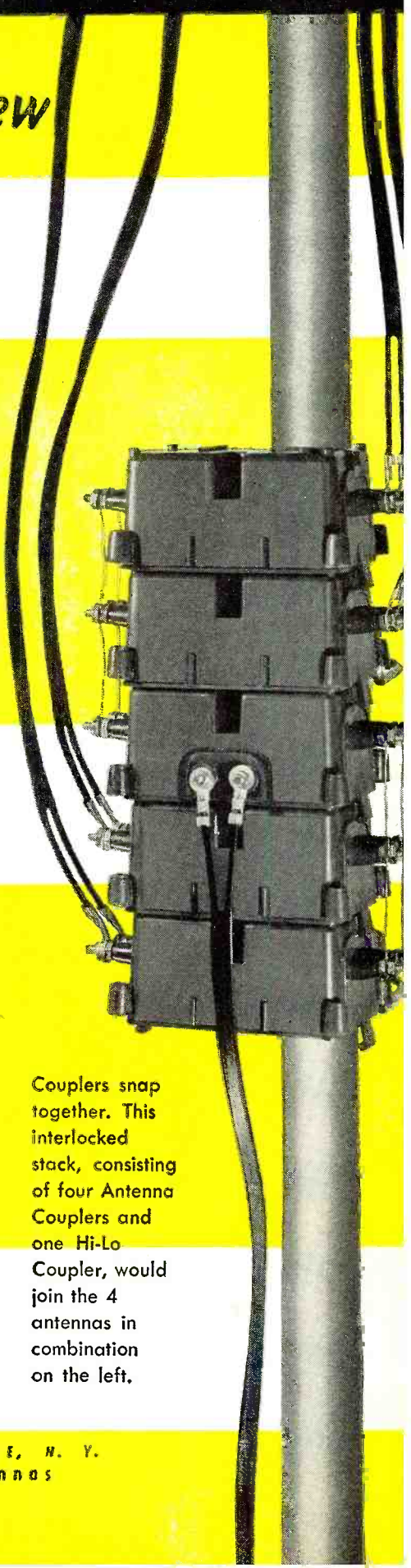
- For the *first time*, you can tie together any combination of antennas, including separate antennas operating on the SAME BAND.
- Ideal for areas currently using rotators, manually-operated selector switches, and "omni-directional" antennas.
- System is installed quickly, economically — one filter needed for each channel. UHF easily added.

TYPICAL COMBINATIONS — *never before possible!*
Only one down-lead to the set.



DOES NOT OBSOLETE THE ROTATOR —
but gives the installation man a new approach to an old problem. Choose the system that provides the better answer to each individual installation.



Couplers snap together. This interlocked stack, consisting of four Antenna Couplers and one Hi-Lo Coupler, would join the 4 antennas in combination on the left.

CHANNEL MASTER CORP. ELLENVILLE, N. Y.
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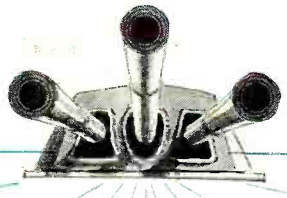
a new HORIZON *in high fidelity*



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AM-FM TUNER $169.95 (SIZE: 16½" x 7¾")

Never before a tuner so versatile!

You can enjoy full-band AM!

You can listen to matchless, drift-free FM!

You can hear **both** at the same time, using dual sound systems!

You can receive revolutionary new binaural broadcasts as they are made available in your area! Two gain controls and separate tuning condensers are provided — one for AM, one for FM!

Exclusive Mutamatic FM Tuning eliminates all hiss and noise between stations, so annoying when tuning conventional tuners! Stations leap out of velvety silence — stay locked in automatically! Superior design eliminates drift.

An exceptional capture ratio rejects all unwanted signals up to 80% of the strength of the desired signal. The FM sensitivity proves the name — "the Criterion" — by which all other tuners are judged.

HORIZON *10*

10-WATT AMPLIFIER $79.95 (SIZE: 14½" x 4")

Incorporating the revolutionary new unity-coupled circuit in a 10-watt amplifier design, the HORIZON 10 offers performance never before achieved at such a moderate price!

The built-in preamp-control unit offers a choice of 3 inputs, 3 record equalization curves, a loudness control and separate bass and treble controls.

Harmonic distortion is less than .5%; intermodulation distortion, less than 2% at rated output. Frequency response is ±1 db, 20 cps to 20 kcs.; power response, ±2 db, 20 cps to 20 kcs. Hum and noise are better than 70 db below rated output on high-level input, better than 50 db on low level input.

HORIZON *20*

20-WATT AMPLIFIER $84.95 (SIZE: 14½" x 4")

To surpass the present high level of amplifier design, National proudly introduces new power amplifiers with a revolutionary new output circuit employing unity coupling.

With unity coupling, the output transformer is no longer required to supply the coupling between output tubes for distortion cancellation as in normal push-pull circuits. Instead, the transformer supplies only the impedance matching between the tubes and the speaker system, thus eliminating impulse distortion created by transformers. Music is reproduced with an unclouded transparency — at all listening levels — never before achieved!

The HORIZON 20 is a 20-watt amplifier with a total harmonic distortion of less than .3% and total intermodulation distortion of less than 1% at full rated output. Frequency response is ±.1 db 20 cps to 20 kcs.; ±1 db 10 cps to 100 kcs. Power response at rated output is ±.15 db, 20 cps to 20 kcs. Hum and noise is 80 db below rated output.

HORIZON *5*

PREAMPLIFIER-CONTROL UNIT $49.95

The HORIZON 5 achieves a new high in frequency response (±1 db, 20 cps to 100 kcs) and voltage output (up to 10 volts) — a new low in distortion (less than .2% harmonic, .3% intermodulation)!

Four inputs, 7 record equalization curves, a loudness-volume control and bass and treble controls are provided.

Entire unit slips quickly, easily into either the tuner or 20-watt amplifier.

IATIONAL CO., INC., 61 SHERMAN ST., MALDEN 48, MASS.

AN OUTBOARD BASS-BOOSTER

By **ALLAN M. FERRES**

Add a bass boost circuit to your equipment without changing existing wiring. Power for booster comes from the amplifier.

"EVERYTHING sounds fine, but I'd like just a little more bass."

Sometimes this comment is heard after a custom installation is completed, and if you hesitate to dig into factory-made equipment to correct the trouble, this booster will produce the required additional bass with a minimum of effort on your part. It is simple to demonstrate and often can be sold to old customers after other repairs or adjustments have been made on their sets.

The circuit is simple and the few parts required can be mounted in an aluminum can 2 x 2 x 4 inches, small enough to fit into a corner of the amplifier or tuner compartment of almost any set. The booster uses a 6C4 triode as a resistance-coupled amplifier with an *RC* frequency-response-correcting network in the grid circuit. The tube furnishes just enough gain to compensate for the loss in the network so that the mid- and high-frequency amplification is zero. The booster can be connected to the input of the power amplifier so as to increase the bass response for all the signal inputs or connected to the output of the record player, AM-FM tuner, or TV set, if only one of these requires the additional bass. In order to reduce the number of parts, no controls are included.

Power to operate the booster is obtained from the power amplifier of the installation, either by means of an adapter plug, placed under a 6V6, 6L6, 6K6GT, or similiar tube, or by running flexible leads to the underside of a socket. The plate voltage is taken from the screen pin of the tube. The ground connection is obtained from the shield of the output lead, so no other lead need be run to the chassis. If motorboating is experienced due to poor voltage regulation of the output tube's screen supply, then the plate voltage for the booster can be picked off some other well-filtered high-voltage point in the circuit.

C_X is mounted to a dual tie point, one lug connected to R_2 and R_3 and the other lug grounded. After the booster is installed, various values of C_X should be tried until the desired bass response is obtained. Fig. 1 shows the response that is obtained with values from .01 to .05 μfd. If less boost is required after the proper value of C_X is selected, C_X can be shunted with a resistor, the value being determined by test. 100,000 to 470,000 ohms are typical values.

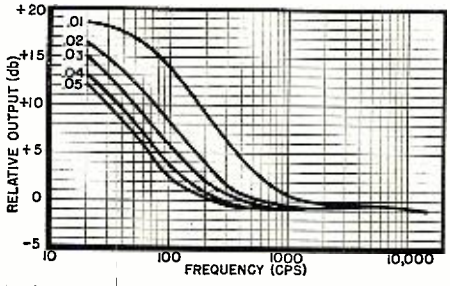
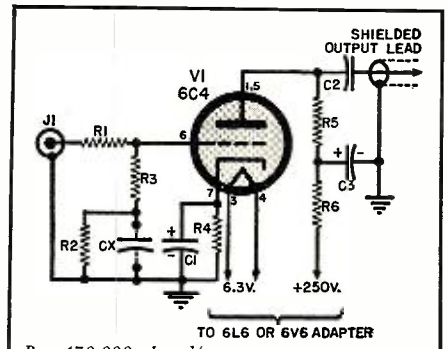


Fig. 1. Response of booster with different condenser values from .01 to .05 μfd. The zero level is .775 volt in this instance.



R_1—470,000 ohm, ½ w. res.
R_2—1 megohm, ½ w. res.
R_3—33,000 ohm, ½ w. res.
R_4—4700 ohm, ½ w. res.
R_5—270,000 ohm, ½ w. res.
R_6—47,000 ohm, ½ w. res.
C_1—50 μfd., 25 v. elec. cond.
C_2—.1 μfd., 400 v. cond.
C_3—20 μfd., 450 v. elec. cond.
C_X—.01 to .05 μfd., 200 v. cond. (See text)
J_1—RCA-type phono jack
V_1—6C4 tube

Fig. 2. Complete schematic of the outboard booster. It may be mounted in a 2"x2"x4" can, fitting into the equipment cabinet.

The booster should be mounted so that only a foot or two of output cable is required in order to prevent a loss of high-frequency response. Only .15 amp. at 6.3 volts and 1 ma. at 250 volts are required to operate the unit, which will not overload the power amplifier power supply. —30—

A new dimension in price and performance

WALSCO Scotty

3.77 LIST

GUARANTEED FOR 1 YEAR

Greatest Antenna Value in America

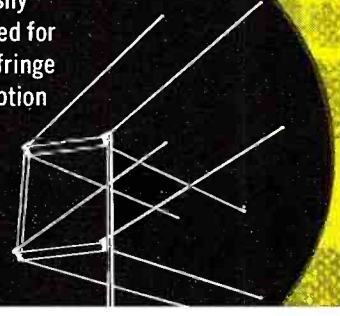
The new "Scotty" has every quality feature necessary for crystal-clear reception in metropolitan and surburban areas. Good gain and directivity on all VHF channels. Used effectively for UHF, or as a combination antenna. Tested and approved for color reception.

COMPARE

WALSCO "Scotty"	3.77
Antenna B	7.50
Antenna C	4.86
Antenna D	5.40
Antenna E	4.60

Place your order today

Easily stacked for semi-fringe reception



Walsco ELECTRONICS CORPORATION

3602 Crenshaw Boulevard, Los Angeles 36, California

Export Distributor:
AD AURIEMA, Inc., 89 Broad St., New York 4, N.Y.

International SHORT-WAVE

Compiled by KENNETH R. BOORD

SHORT-WAVE reception continues good and dial twirlers will find many rewarding contacts these days.

Albania — ZAA, 7.852A, Tirana, noted with *English* 1700-1730A; in French 1645. (Cox, Dela.) Has *English* also 1400-1430. (Pearce, England)

Algeria—Radio Algeria, 6.160, heard through heavy QRM 1638 with Arabic. Fair level in Dela. (Cox)

Anglo-Egyptian Sudan—Radio Omdurman varies around 4.992 now in parallel with 6.437, heard 1350 in Arabic. (Fairs, England, *via* URDXC)

Angola — CR6RA, 11.862, Luanda, noted at good level 1620. (Cox, Dela.)

Argentina—Radio Splendid, 9.320AV, Buenos Aires, noted with news in Spanish 1900. (Niblack, Ind.)

Australia — VIM4, 4.920, Brisbane, Queensland, closes 0830 with "God Save the Queen." (*Malmo DX-aren,* Sweden) VLX9, 9.660, noted 0400 at weak level in Md. (Zahner) The DX session beamed to British Isles, Europe on *Sun.* is now 0200 over VLA9, 9.58. (Balbi, Calif., others)

Azores—Ponta Delgada is still noted on 11.925 at 1400-1500 in Portuguese; heard on 4.845 with news in Portuguese 1630. (Pearce, England)

Belgium — Brussels, 15.335, noted closing in French 1244, good level in N. C. (Ferguson) Is strong in *English* to North America, 11.85, at 2000-2200 closedown. (Crowell, Pa., Stanley, Conn., others) Noted closing 2200 on 9.144 at strong level, then with transmission for Africa. (Grennell, Ohio) On *Mondays,* when HCJB, Quito, Ecuador, is *silent,* Brussels can be heard on 9.745A closing 1845 in Portuguese. (Niblack, Ind.)

This young ham-SWL is Bob Weggel, W9ZZJ, of Rhinelander, Wisconsin. Bob uses a WRL "Globe Scout" transmitter which runs 40 watts on phone and 50 watts on c.w. His receiver is a Hallicrafters S-19 and his antenna is a half-wave zepp 25 feet above ground, fed with 72-ohm twin-lead. Bob has worked 22 states on the 75-meter band alone, the most distant being Georgia, Kansas, Texas, Wyoming, New Hampshire, Massachusetts, Rhode Island, and New York. Bob is a 16-year-old high school junior.

Bolivia—CP38, 9.444A, La Paz, noted at fair level with religious session in Spanish 2115-2130 closedown. (Cox, Dela.; Ferguson, N. C.) CP5, 5.970, opens 0600 with the slogan, "La Voz de Bolivia, La Paz." (*N.Z. DX Times via* Winch, Calif.)

Brazil—ZYY9, 4.973, Sao Luiz, excellent 2200; "Emissora Continental," 3.295, excellent 2130. (Cox, Dela.) *Radio Gazeta,* Sao Paulo, has been heard in Sweden on 6.135A. (Radio Sweden)

British Guiana—ZPY, 3.255A, noted 2015 with BBC relay. (Cox, Dela.)

British New Guinea — VLT6, 6.130, Pt. Moresby, noted relaying ABC news 0430, R6. (Zahner, Md.)

Bulgaria—Radio Sofia, 7.671, good level in *English* 1620. (Cox, Dela.) Excellent on 9.700 to North America 2300. (Braunstein, Conn.) Excellent on this channel 2000-2030 in *English.* (Ellentuch, N. Y., others)

Canada—CHOL, 11.72, CKLO, 9.63, are good level 2130 with news. (Hatter, N.Y.)

Canary Islands — EA8AB, 7.505A, Tenerife, noted 1550 with music; announcements in Spanish; poor level, CWQRM. (Cox, Dela.)

Cape Verde Islands—CR4AA, 7.398V, Praia, good level with native songs 1610 tune-in. (Cox, Dela.)

Ceylon—Radio Ceylon, 11.770, noted 2030-2330, good level; 7.190 parallels. (Hardwick, N. Z.) Is heard on 17.810 at 0415-0615 in *English.* (Radio Australia) Noted over 6.006 at 0745 with news, music. (Sanderson, Australia) Latest schedule for VOA relays over *Radio Ceylon* is 0830-1230 to India-Pakistan, 7.235, 11.875.

Chile — CE1174, 11.74, Santiago, noted 2250 at good level with popular American recordings with *English* lyrics. (Niblack, Ind.)

China—Radio Peking, 15.053A, noted in Chinese 2038 and still coming through well at 2117 tune-out but was somewhat weaker then. (Ferguson, N.C.) Noted in Sweden on 9.040 in Chinese 1740. (*Nattugglan,* Sweden)

Colombia—HJFQ, 5.018, Manizales, is heard as early as 1700 at fair level; HJAB, 4.788, Barranquilla, is excellent around 2125; HJDW, 5.055, Medellin, fair with music 1720; HJGB, 4.815, Bucaramanga, fair 2130; HJFH, 4.875, Armenia, fair 2150; HJAP, 4.931, Cartagena, fair 2155; HJCW, 4.945, Bogota, excellent 2200. (Cox, Dela.) HJCF, 5.965, Bogota, strong 0600. (Cushen, N.Z.)

HJKH, 5.070A, Sutatenza, has resumed *English* on *alternate Sats.* for listeners in Australia, New Zealand at 0530-0545. (Cushen, N.Z.; Radio Australia, others)

Costa Rica—Due to an electricity shortage, the schedule of TIFC. 9.647A, San Jose, continues to be Mon.-Sat. 0600-1300, 1700-2300; Sun. 0700-1300, 1700-2300, according to the station. (Bellington, N.Y.) Often noted with organ melodies around 2200. (Calos, Calif.)

Czechoslovakia—Prague uses 11.76 now parallel 9.55 with *English* to North America 1930-2000, 2300-2330. (Ferguson, N.C.; Niblack, Ind.; Roesener, Ill.; Parsons, Pa., Foster, Ill., others)

Denmark—OZF5, 9.52, Copenhagen, has improved signal opening first daily transmission to North America 2030. (Ellentuch, N.Y.; Foster, Ill.; Stanley, Conn., others) Good 2200-2300 in second beam to North America. (Gilcher, Ohio, others)

Dominican Republic—HI2A, 6.048AV, Santiago, is currently being logged as early as 1830 through heavy QRM. (Niblack, Ind.) HI2G, 9.590, noted with weak signal in Spanish 1000-1030. (Stanley, Conn.) HI2T, 9.735, noted opening 0700 with strong signal in Spanish. (Foster, Ill.)

Egypt—Radio Cairo noted on 12.030A at 1600 in Arabic. (Parsons, Pa.) Heard 1730 in parallel with 7.049A. (Saylor, Va.) Cairo now uses 17.725 instead of 15.315 at 0700-1000 to Far East in Arabic, *English,* Udru, Indonesian. (*WRH;* Pearce, England)

El Salvador—YSAXA, 11.950A, San Salvador, logged 1855-1900 on a Friday with *"English by Radio"* (Spanish-*English* lesson). (Niblack, Ind.) Good around 1745. (Foster, Ill.)

Ethiopia—Radio Addis Ababa, ETAA, 15.054A, is heard from as early as 1240 to 1430 closedown. Frequency varies

(*Continued on page* 149)

(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.

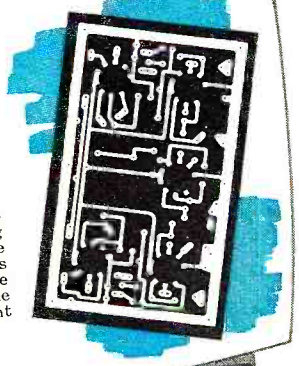
NEW 1955

Heathkit

Engineering Features

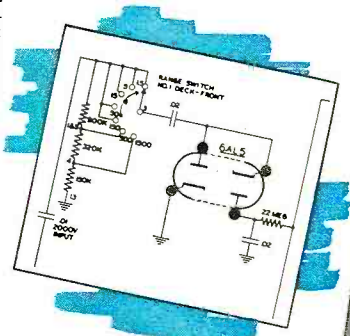
New PRINTED CIRCUITS

One of the many tremendous improvements in the new 1955 Heathkits is the use of an etched metal process printed circuit board. Printed circuits will be used in Heathkits whenever they will affect construction simplification, performance stabilization, and lend themselves to instrument design. Now for the *first* time a kit instrument company offers the advantages of modern printed circuit instrument construction technique. For the *first* time consideration has been given toward reducing kit assembly time. Also this is the *first* time that printed circuit boards have been hand soldered on a volume basis. Offered only by Heathkit, the pioneer and leader in kit instrument design.



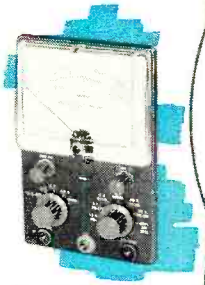
New PEAK-TO-PEAK VTVM CIRCUIT

New 6AL5 full wave rectifier in AC input circuit permits full scale peak-to-peak measurements. Seven ranges — upper limits 4000 volts peak-to-peak. Just the thing you TV servicemen have needed in making TV circuit voltage checks. Precision resistor voltage divider limits AC RMS level to 150 volts. Prevents overloading the rectifier—extends upper limit AC RMS ranges to 1500 volts—further protects meter and circuitry against AC flash-over or arcing. Another definite example of continuing Heathkit design leadership in the kit instrument field.



New HIGH READABILITY PANELS

New 1955 Heathkits feature complete panel redesign. Sharp white lettering applied to the beautiful charcoal gray panels, provide a new high in readability. Lettering is easy-to-read open style and panel calibrations are vividly clear against the pleasing soft gray background. New knobs of exclusive Heathkit design.



New 3" UTILITY SCOPE

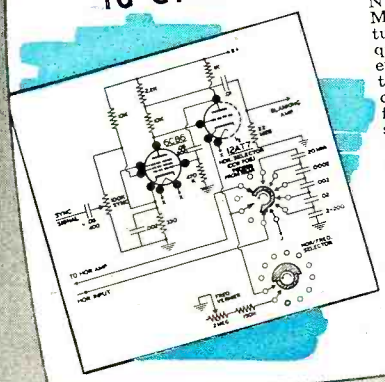
The new 3" Scope is a "natural" for the well rounded line of Heathkit instruments. Small in size, 11¾" deep, 6½" wide, 9½" high, yet big in performance. Just think of the value an Oscilloscope for $29.50. Brilliant intensity, sharp focusing, wide positioning range. An ideal portable Scope for the TV serviceman—a second shop scope—modulation monitor for you hams (deflection plate terminals in rear of cabinet). Performance to spare for all general scope applications. See specifications on following page.

New STYLING *New* COLOR

New styling and coloring is responsible for tremendous improvement in Heathkit appearance. The new instrument panel color combination is high definition white lettering in a soft charcoal gray panel. Cabinet color is a lighter feather gray. The satin gold baked enamel cabinet for the WA-P2 Preamplifier is further indicative of the modern pacesetting trend in Heathkit styling.

New SCOPE SWEEP CIRCUIT 10 CYCLES — 500 KC

New 1955 Heathkit Model 0-10 Scope features a new wide frequency range sweep generator covering 10 cycles to 500,000 cycles. This coverage is available in five virtually decading sweep ranges and is five times greater than the sweep frequency range usually available. Excellent retrace time characteristics, actually less than 20% at 500 KC. Use of the free running Heath circuit provides a larger margin of stability and a new high in Heathkit Scope performance.



Continuing PROGRESS FUTURE LINE EXPANSION

The outstanding improvements featured in the 1955 Heathkit line are representative of the progress characterized by Heath Company operation. Long range planning will provide a continuing succession of new kit releases to further expand the Heathkit line which already represents the world's greatest selection of electronic kits. The innovations in the 1955 line, are representative of additional new models scheduled for release for the coming years.

SEE THE INSTRUMENTS ON THE FOLLOWING PAGES

HEATH COMPANY • • Benton Harbor 15, Mich.

Mac's Service Shop

(*Continued from page 76*)

different causes can produce the same symptom in a receiver," Barney suggested. "An open voice coil, a shorted condenser, an open resistor, or a defective tube could all result in a receiver that would seem exactly the same to the customer. It's not like a car. There any fool can plainly see that engine trouble, transmission trouble, or differential trouble are entirely separate things."

"That's a good point," Mac applauded, "and it should always be kept in mind. On the other hand, we get some complaints in which there is obviously no connection between the original trouble and the new complaint. For example we repair a set that is completely dead because of an open voice coil and two or three weeks later the customer returns with the set that is now humming badly because of a filter condenser that has suddenly opened up. He argues that since he had the set repaired only a short time ago, you should take care of this new difficulty at no charge. Often he will try to justify this attitude that he secretly realizes is unreasonable by saying the set never acted right since it was repaired but that he simply has not had time to bring it back or call you on the telephone.

"In a few cases a customer will have the gall to return a set that he says significantly is 'dead again' when that set shows definite evidence of misuse. I mean things like two or three tubes that are rattling around loose out of their sockets and a cabinet that is badly cracked from the set's being dropped, or a speaker cone that someone's little darling has punched so full of holes that it looks like a colander."

"What can you do with people like that?"

"The best insurance against complaints, justified or otherwise, is to keep a complete record of every set that passes through the shop. When a set comes in, write down exactly all the troubles the customer mentions. Record what measures you took to correct them. If new parts were put in, describe them by make, part number, and use. List your charges. If your customer forgets every other detail of the transaction, he will remember this! Possibly you recommended that a slightly noisy control be replaced or that a low hum be reduced with new filter condensers, but the customer did not want to go to this expense. Be sure and note that the recommendations were made. Put down the date when the work was done. It will amaze you the way time shrinks in some customers' minds. A repair job done over a year ago will be described as work you did 'a month or so ago.'

"Then when a customer comes in with a complaint, pull out this card immediately and compare the facts on it with what he tells you. If the new

NEW *Heathkit*
5" PUSH-PULL
OSCILLOSCOPE KIT
PRINTED CIRCUIT

First color television service Oscilloscope with necessary high sensitivity and full 5 megacycle bandwidth.

New 5UP1 CR tube

New printed circuit construction, all components mounted on high insulation surface resulting in uniformly low circuit capacities.

New type wide frequency range Heath sweep generator, 10 cycles to 500,000 cycles.

New cabinet styling and color harmony—charcoal gray panel with high readability white lettering.

New electronic positioning controls for instantaneous, definite positioning without bounce or overshoot.

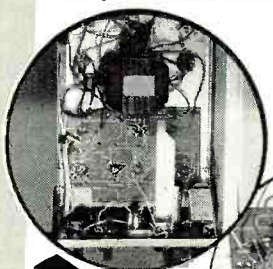
The new 1955 Heathkit Model O-10 is the first truly color television kit oscilloscope with necessary high sensitivity and bandwidth. Outstanding instrument appearance is the result of new modern styling and color harmony. The **first** kit constructed oscilloscope to offer a labor-saving printed circuit board. New sweep generator with frequency range five times greater than previous models. Additional major improvements are a new high voltage power supply, improved vertical and horizontal electronic positioning control action, extreme horizontal amplifier sensitivity for trace magnification over three times CRT face width.

NEW SWEEP GENERATOR: The first sweep generator outside of expensive Laboratory units to go above 100 KC. Yet this new Heathkit has five times the frequency range with stable, locked-in traces. Complete range 10 cycles to 500,000 cycles. The generator has such excellent synchronization characteristics, that the results closely approximate a triggered sweep and under most conditions, the trace is locked to a multiple of sync frequency throughout the entire control range. Sweep multi-vibrator is direct coupled pentrode-triode and frequency determining capacitors are not part of multivibrator circuit.

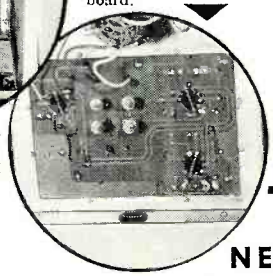
MODEL O-10

$69.50

Shpg. Wt. 27 lbs.



Simplified, standardized construction technique of vertical and horizontal amplifier construction made possible through the use of a single *printed circuit* board.

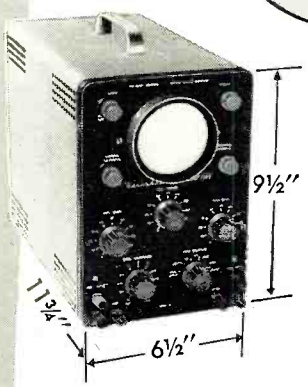


Clean, open, under chassis construction and wiring. Possible only through use of pre-cabled wiring harness, and simplified printed circuit boards.

SENSITIVITY AND BANDWIDTH: Operating characteristics of the newly designed vertical amplifier provide a high degree of sensitivity (25 millivolts per inch) and excellent bandwidth characteristics 5 cycles to 5 MC (down only 5 db). Only the new Heathkit Oscilloscope has the necessary sensitivity for full 5 megacycle bandwidth for color servicing. Uniformly high level operation with a high degree of stability is assured through the use of new printed circuit board construction. Printed circuits reduce the assembly time, error possibility, and provide rigid mounting for all components.

New horizontal amplifier provides trace width three times the diameter of the CR tube. This new amplifier together with DC positioning, allows greater magnification of trace for observation of small transients and step portions of TV sync pulses.

OTHER OUTSTANDING FEATURES: Retrace amplifier—Z axis modulation—peak-to-peak voltage calibrating source with calibrated grid—all plastic molded condensers for long trouble-free life and drift elimination—voltage regulated power supply—new wiring harness for neat professional appearance—new cabinet styling and color harmony. Combinations of design and performance features available only in the new Heathkit O-10 Oscilloscope.



NEW *Heathkit*
3" PRINTED CIRCUIT
OSCILLOSCOPE KIT

MODEL OL-1

$29.50 Shpg. Wt. 15 lbs.

New compact utility Scope—lightweight—portable for service work.

Deflection plate terminals—ideal for ham transmitter modulation monitoring.

New easy-to-build printed circuit board with high insulation factor.

New Heathkit instrument styling—charcoal gray panel with high readability white lettering.

New Heath twin triode sweep generator 15–100,000 cycle sweep.

Here is the newest addition to the line of Heathkit Oscilloscopes. Just the instrument you servicemen, hams, students, and experimenters have been asking for. A general purpose low priced utility scope to be used in everyday work. Through the use of a 3" 3GP1 CRT it has been possible to reduce the cabinet size and weight so that the instrument is a compact portable unit especially useful for TV servicemen to carry on home service calls and as an extra shop utility scope. At this low price every ham can afford an oscilloscope for transmitter modulation monitoring. Convenient slide switch controlled terminals at rear of scope cabinet.

PRINTED CIRCUIT: This new Heathkit uses a prefabricated printed circuit board to standardize amplifier and sweep generator assembly. Cuts building time in half, eliminates major portion of wiring, and insures exact duplication of engineering pilot model. Condensers, resistors, and tube sockets are mounted directly on the board and soldered in place.

DESIGN FEATURES: Cathode follower input circuits in both vertical and horizontal amplifier—electronic positioning control for wide range of vertical or horizontal spot deflection—Heath twin triode sweep generator—provisions for external and internal sync—external and internal sweep—60 cycle line sweep—Chicago power transformer—4 section electrolytic filter condenser—plastic molded bypass and coupling condensers. Tube lineup 4—12AU7 horizontal and vertical amplifiers, 12AX7 sweep generator, 6X4 low voltage rectifier, 1V2 high voltage rectifier, 3GP1 CRT. Cabinet size 11¾" deep x 6¼" wide x 9½" high. A terrific instrument value at $29.50.

NEW *Heathkit*
5" PRINTED CIRCUIT
OSCILLOSCOPE KIT

MODEL OM-1

$39.50 Shpg. Wt. 24 lbs.

Printed circuit board construction for accurate trouble-free assembly.

Twin triode Heath sweep generator 15–100,000 cycle range.

By popular request we are again offering a 5" full sized general purpose Oscilloscope using a 5BP1 CRT. All of the necessary design features for servicemen, students, experimenters, hams, etc. This fine oscilloscope value features printed circuit board construction for easy assembly and reduced wiring time. Also features the new Heathkit styling and color harmony with the charcoal gray panel and white lettering for high readability.

SWEEP GENERATOR: Sweep generator range using Heath twin triode circuit 15–100,000 cycles in four positions. Provisions for external as well as internal sweep and external or internal sync in addition to 60 cycle line sweep. Easy positive synchronization.

Heavy duty power supply using TV type 1V2 high voltage rectifier assures adequate accelerating potential for good trace definition. Deflection plate direct terminal connections available on rear of cabinet. Useful in transmitter modulation checking.

Good performance, simplified operation, and easy assembly are all characteristics of this new model Heathkit Oscilloscope.

HEATH company
BENTON HARBOR 15, MICHIGAN

complaint bears no relation to the old, point that out as tactfully as you can. If the parts you put in before can be checked easily, such as tubes, identify them in your record and in the set and test them *first* while the customer is looking on. If they are bad, replace them promptly and cheerfully. If they are good, the customer can see for himself that the parts you put in are not responsible for his present trouble.

"More important than what you do, however, is the way you do it. To get into the proper frame of mind, try to imagine just how the customer is feeling. In the first place, he is unhappy because the device he had repaired is on the blink again. Quite likely he is secretly ashamed of having to tell you he thinks you did not do a good job. Probably his wife has nagged him into bringing the set back. Remember, though, that when a man has to do something of which he is not proud, he bolsters his resolution with anger and stubbornness. At such a time he is doubly quick to resent the slightest reflection on his motives or behavior. A man with a service complaint is a man with a chip on his shoulder.

"That is why it's especially important that you do or say nothing to give the impression you consider the complaint unjustified—at least not until you have had a chance to check the facts. Receive the complaint as cheerfully as you did the original service job. Thank the customer for bringing the set back to you. If he makes any small apology, quickly assure him you *want* any sets that are not completely satisfactory returned. Then, if at all possible, make an immediate check to see what the trouble is. Always give a returned set precedence over any other receivers you may have in the shop.

"To sum it all up, the first thing to do with a complaint is to determine with all possible speed if it is justified or not. If it is, correct the trouble at once with no charge to the customer. If it is not, try to demonstrate to the customer through your records and checks made in his presence that there is no connection between the work you did and his present trouble. Try to maneuver him into a position where he will say that they are entirely separate things. It is much better for him to say this than for you to do so. If he will not listen to reason, you are forced to decide whether you want to placate him by yielding to his unfair demands or to stand fast. Personally, I prefer to stand fast. While I know that it is supposed to be a good business practice to assume 'the customer is always right,' I simply can't force myself to become a party to a fraud through weakness. If I do give in after I have explained that the fault is not mine, the customer has every right to doubt my sincerity."

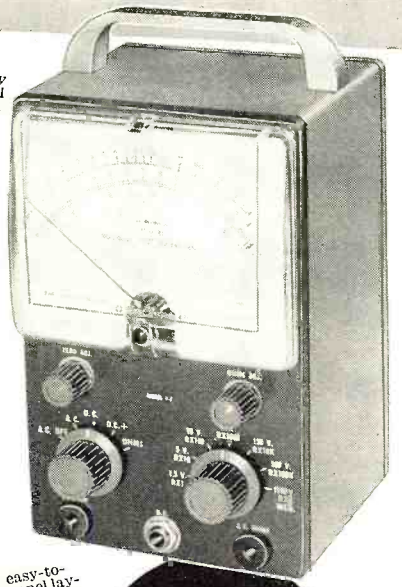
Mac paused briefly and then concluded, "There are two points that should be kept constantly in mind in dealing with complaints. First, there are these wise words of Voltaire:

NEW Heathkit VACUUM TUBE VOLTMETER KIT

PRINTED CIRCUIT DESIGN

New charcoal gray baked enamel panel with high readability white lettering. New soft feather gray cabinet, subdued pilot light indicator.

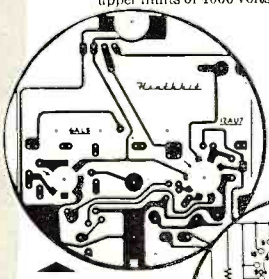
New printed circuit board for faster, easier construction—exact duplication of Lab development model.



Another outstanding example of continuing Heath Company pioneering and leadership in the kit instrument field. A new **printed circuit** VTVM. New peak-to-peak circuit—new styling and new panel design. A prewired, prefabricated printed circuit board eliminates chassis wiring, cuts assembly time in half, assures duplication of Engineering pilot model specifications, and virtually eliminates possibility of construction error.

CIRCUIT:

A 6AL5 tube operated as a full wave AC input rectifier permits seven peak-to-peak voltage ranges with upper limits of 4000 volts P—P. Just the ticket for you TV servicemen. Voltage divider in the 6AL5 input circuit limits applied AC input to a safe level. This circuitry and the isolation of the meter in the cathode of the 12AU7 bridge circuit affords a high degree of protection to the sensitive 200 microampere meter.



Full wave rectifier in AC input circuit. Read peak-to-peak and RMS volts with upper limit of 4000 P—P and 1500 volts RMS. Voltage divider input circuit.

RANGES:

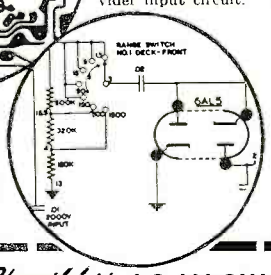
Seven voltage ranges. 1.5, 5, 15, 50, 150, 500 and 1,500 volts DC and AC RMS. Peak-to-peak ranges 4, 14, 40, 140, 400, 1400, 4000. Ohmmeter ranges X1, X10, X100, X1000, X10K, X100K, X1 meg. Additional features are a db scale, a center scale zero position, and a polarity reversal switch.

New easy-to-read open panel layout. Off-on switch now incorporated in the selector switch.

MODEL V-7

$24.50

Shpg. Wt. 7 lbs.



The first kit instrument to offer a labor-saving, error-free *printed circuit* board. Your instrument an exact wiring replica of Engineering development model.

IMPORTANT FEATURES:

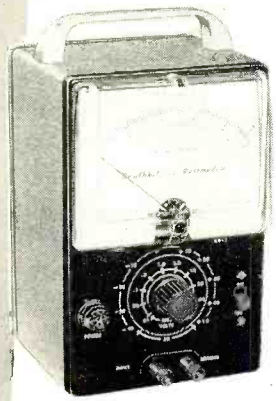
High impedance 11 megohm input—transformer operated—1% precision resistors, 6AL5 and 12AU7 tube—selenium power rectifier— individual AC and DC calibrations—smoother improved zero adjust control action—new panel styling and color—new placement of pilot light—new positive contact battery mounting —new knobs—test leads included.

The new V-7 also sets the pace as a kit instrument style leader. Smart, good-looking charcoal gray panel and soft feather gray cabinet. High readability panel with sharply contrasting white calibrations. The pleasing, eye catching, modern styling is in harmonious balance with the outstanding circuit design improvements. Easily the best buy in kit instruments.

New peak-to-peak meter scale—new color harmony—new knobs.

Heathkit AC VACUUM TUBE VOLTMETER KIT

MODEL AV-2



$29.50 Shpg. Wt. 5 lbs.

Extreme sensitivity has been emphasized in the design of the Heathkit AC VTVM. Ten full scale RMS ranges are .01, .03, .1, .3, 1, 3, 10, 30, 100, and 300 volts. Frequency response is substantially flat from 10 cycles per second to 50 KC with input impedance of 1 megohm at 1 KC. Will accurately measure as low as 1 millivolt at high impedance. Total db range is —52 db to +52 db. An excellent kit for measuring the output of phono cartridges and the gain of amplifier stages. Use it also to check power supply ripple, as a sensitive null detector, and for compiling frequency response data. Features one knob operation, 200 microampere Simpson meter and precision resistors.

Heathkit 30,000 VOLTS DC PROBE KIT

Measure up to 30,000 volts DC with the Heathkit VTVM and the 336 high voltage Probe. Precision resistor provides multiplication factor of 100. Can be used with any 11 megohm input VTVM. Housed in a Polystyrene two color sleek plastic probe body for safety of operation.

No. 336

$4.50

Shpg. Wt. 1 lb.

Heathkit PEAK-TO-PEAK PROBE KIT

No. 338-C

$5.50

Shpg. Wt. 2 lbs.

Peak-to-peak values not exceeding 80 volts at a DC level of not more than 600 volts, can now be read directly by using 338-C Probe with previous model Heathkit VTVM's or any VTVM with 11 megohm input resistance. Probe construction features a modern printed circuit board for easy assembly. Frequency range 5 KC to 5 MC.

Heathkit RF PROBE KIT

The Heathkit RF Probe will permit the measurement of RF voltages up to 250 MC with an accuracy of ±10%. The limits are 30 volts AC and a DC level of 500 volts. Designed for any 11 megohm input VTVM. Modern styling, Polystyrene aluminum housing, Polystyrene insulation, and printed circuit board for easy assembly.

No. 309-C

$3.50 Shpg. Wt. 1 lb.

Heathkit AUDIO WATTMETER KIT

Read audio power output directly without using external load resistors with the new Heathkit Audio Wattmeter. Built-in non-inductive load resistors provide impedances of 4, 8, 16, and 600 ohms. Flat response from 10 CPS to 250 KC. Full scale power ranges are 0–5 MW, 0–50 MW, 0–500 MW, 0–5 W and 0–50 W. Model AW-1 will operate continuously at 25 watts and has a duty cycle of 3 minutes at 50 watts. Total db range in five positions is —50 db to +48 db, using the standard 1 milliwatt 600 ohms.

MODEL AW-1

$29.50

Shpg. Wt. 6 lbs.

HEATH company

BENTON HARBOR 15, MICHIGAN

'We cannot always oblige, but we can always speak obligingly.'

"Second, there is this: if you are going to accede to the complaining customer's wishes, you should do it promptly, cheerfully, and in all good humor. If matters deteriorate to the point where he feels he has *forced* you to make an adjustment, any good will that could have resulted from your act has gone glimmering."

—30—

N. Y. SERVICING CLASSES

FREE courses in radio and television servicing will be conducted by Milton Wendroff and Robert Schwartz at the Queens Evening Trade School, 47th Avenue and 37th Street, Long Island City 1, N. Y. Anyone over 17 years of age who wishes to upgrade himself (beginners and advanced), and is presently employed in some phase of radio or TV, is eligible. Classes meet two nights a week from seven to nine p.m.

Registration is September 13th and 14th, from seven to nine p.m. in the school auditorium. —30—

LICENSE EXAMS

THE FCC wishes to call attention to the new radio amateur rules recently put into effect concerning the opportunity presented to amateur clubs and associations to assist new amateurs and the Commission by establishing examining committees within their membership to undertake these examinations as an adjunct to their amateur activities.

All Novice and Technician class operator examinations must be given and Conditional examinations will continue to be given by volunteer examiners. These examiners must be 21 years of age to give the amateur theory test and to give the code test must (a) hold Extra, Advanced, or General amateur privileges or (b) have, within five years, held a commercial radiotelegraph ticket or (c) must, within five years, have been employed in U. S. service as an operator of a manually-operated station.

FCC field engineers will help clubs in setting up examining committees for such license testing. —30—

S-40A TIP

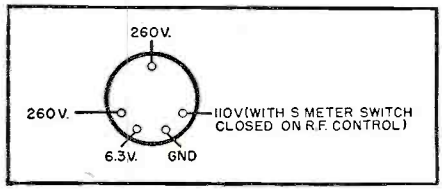
By B. W. WELZ

CONVERTERS, preselectors, etc. that require external power can be used effectively with the Hallicrafters S-40A ham receiver without tearing into the receiver to get at the power supply.

These receivers are equipped with an "S-meter" socket on the rear of the chassis. The socket has terminal points for 260 volts d.c., 110 volts d.c., and 6.3 volts a.c. The socket connections are shown in Fig. 1.

In order to utilize any of these voltages merely use a five-prong tube socket wired as desired. —30—

Fig. 1. How "S-meter" socket on S-40A receiver can be used for external power.



NEW Heathkit TV ALIGNMENT GENERATOR KIT

Here is the most radically improved Sweep Generator in the history of the TV service industry. The basic design follows latest high frequency techniques which result in a combination of performance features not found in any other sweep generator.

SWEEP:
Sweep action is obtained electronically through the use of a newly developed controllable inductor, thereby eliminating all moving parts with their resultant hum, vibration, fatigue, etc. Frequency coverage entirely on fundamentals, is continuous from 4 MC to 220 MC at an output level well over a measurable .1 volt.

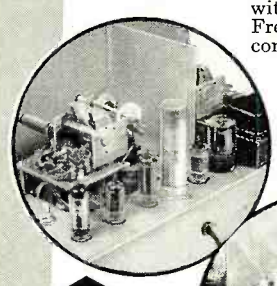
Controllable inductor sweep oscillator with output entirely on fundamentals.

Triple marker system 4.5 MC crystal controlled—3 sets of low loss, low capacity shielded cables included.

Electronically operated smooth continuously variable sweep circuit. No vibration, hum or noise.

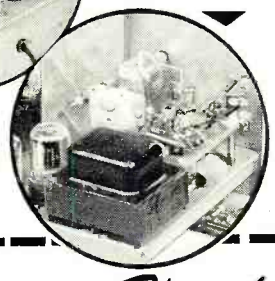
Frequency coverage: 4 MC—220 MC continuous including FM spectrum. RF output well over .1 volt.

MODEL TS-3
$44.50
Shpg. Wt. 18 lbs.



Triple marker system. 4.5 MC crystal controlled marker—continuously variable marker—provisions for external marker.

MARKER:
The same instrument incorporates a triple marker system with a crystal controlled reference. A variable marker provides accurate coverage from 19 to 60 MC on fundamentals, and 57 to 180 MC on calibrated harmonics. A separate fixed crystal controlled 4.5 MC marker can be used for checking IF, bandpass, calibration, reference, etc. Provisions are also made for external marker use. A 4.5 MC crystal is supplied with the kit.



Automatic amplitude control circuit—constant output voltage regulated power supply.

POWER SUPPLY:
The transformer operated Power Supply features voltage regulation for stable oscillator operation. Three sets of shielded cables are furnished with the kit. Sweep range is completely and smoothly controllable from zero up to a maximum of 50 MC, depending upon base frequency.

Here is a TV Sweep Generator that truly no serviceman can afford to be without for rapid, accurate, TV alignment work.

NEW Heathkit SIGNAL GENERATOR KIT

MODEL SG-8
$19.50 Shpg. Wt. 8 lbs.

The new Heathkit service type Signal Generator, Model SG-8 incorporates many design features not usually found in this instrument price range. Frequency coverage is from 160 KC to 110 MC in five ranges, all on fundamentals, with useful calibrated harmonics up to 220 MC. The RF output level is well in excess of 100,000 microvolts throughout the frequency range. The oscillator circuit consists of a twin triode tube, one-half 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, thereby eliminating oscillator frequency shift usually caused by external loading.

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

Heathkit LABORATORY GENERATOR KIT

MODEL LG-1
$39.50
Shpg. Wt. 16 lbs.

The new Heathkit Laboratory type Signal Generator definitely establishes a new performance standard for a kit instrument. An outstanding feature involves the use of a panel mounted 200 microampere meter calibrated both in microvolts and percent modulation, thereby providing a definite reference level for using the Signal Generator in design work, gain measurements, selectivity, frequency response checks.

DESIGN:
Additional design features are copper plated shield enclosure for oscillator and buffer stages resulting in effective double shielding. Fibre panel control shaft extensions in RF carrying circuits, thorough AC line filtering, careful shielding of the attenuator network, voltage regulated B plus supply, selenium rectifier, etc.

RANGES:
Frequency coverage from 150 KC to 30 MC all on fundamentals in five separate ranges. Output voltage .1 volt with provisions for metered external or internal modulation. Output impedance termination 50 ohms. Transformer operated power supply.

Investigate the many dollar stretching features offered by the LG-1 before investing in any generator for Laboratory or Service work.

NEW Heathkit BAR GENERATOR KIT

MODEL BG-1
$14.50 Shpg. Wt. 4 lbs.

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 without waiting for transmitted test patterns. Panel switch provides "standby—horizontal and vertical position." The oscillator unit uses 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 also provide an indication of horizontal and vertical sync circuit stability as well as overall picture size. Operation is simple and merely requires connection to the TV receiver antenna terminal. Transformer operated for safety.

HEATH company
BENTON HARBOR 15, MICHIGAN

Moisture Detector

(*Continued from page 53*)

level in a tank. The "sensor" plate is not used in this application. Instead, a special "sensor" unit is made up by mounting two metal rods or tubes a short distance apart (¼" to ½") in an insulating block.

The "sensor" is then mounted on the side of the tank so that the rods project downward to the desired level. The insulating block, to which terminal connections are made, should be so located as not to be dampened by the inlet pipe.

A solenoid-operated valve is placed in the inlet pipe, with the solenoid connected in series with the "normally-closed" terminals of the moisture detector relay.

As long as the water level stays below the two rods, the relay is open and the solenoid valve is actuated, permitting water to flow through the inlet pipe and into the tank. As soon as the water level reaches the predetermined point and makes contact with the "sensor" rods, the relay is pulled closed, opening the solenoid circuit and permitting the inlet valve to close.

When the water level drops below the two rods, as when water is drawn from the tank, the moisture detector relay again drops out, permitting the valve to operate.

Note that this application differs from those previously discussed in that the relay is normally held closed. This places a small, but constant, current drain on the battery.

Because of this, and in any application where a current drain may exist for comparatively long periods of time, a periodic "battery inspection and test" schedule should be set up and followed.

Sump Pump Control: In this application the rod type "sensor" element is also employed. Mount the rods in the sump at the desired level (slightly above the intake of the pump).

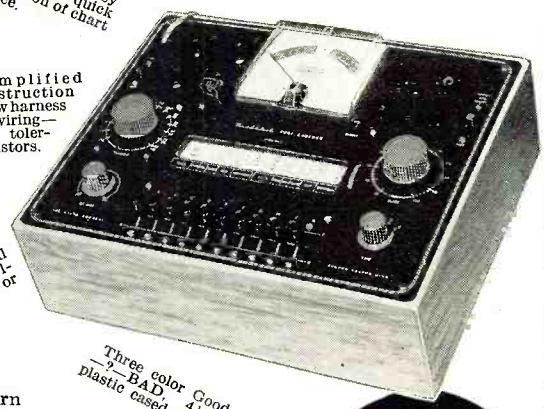
Connect the moisture detector relay contacts to operate the sump pump motor when the relay is closed.

There is very little current drain from the battery unless water collects in the sump to a sufficiently high level to make contact with the "sensor" rods. When this happens, the moisture detector relay closes, turning on the sump pump motor. The relay will stay closed, and the motor will continue to operate, until the water level drops below that of the "sensor" rods.

General Suggestions: Whenever the moisture detector is used to control a motor, solenoid, or other circuit, make sure that the relay contact ratings are not exceeded. If the current requirements are greater than can normally be handled by the relay employed, use the moisture detector relay to control another, heavy-duty, power relay.

If desired, a 100,000 ohm rheostat may be connected in series with R_1. This rheostat may be used as a *sensitivity* control and will permit some degree of operational adjustment. —30—

Heathkit TUBE CHECKER KIT



The Heathkit TC-2 Tube Checker was primarily designed for the convenience of radio and TV servicemen 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 Ioctal, 7 and 9 pin miniatures, 5 pin Hytron, and a blank socket for new tubes. Built-in neon short indicator, individual 3-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 features of the TC-2.

Results of tube tests are read directly from the large 4½" Simpson 3-color meter. Checks emission, shorted elements, open elements, and continuity. Wiring procedure has been simplified through the use of multi-wired color coded cable providing a harness type installation between tube sockets and lever switches. This procedure insures standard assembly and imparts a "factory built" appearance to the instrument. New Construction Manual furnishes detailed information regarding tube set-up procedure for testing of new or unlisted tube types. No delay necessary for release of factory data.

MODEL TC-2
$29.50
Shpg. Wt. 12 lbs.

Heathkit PORTABLE TUBE CHECKER KIT

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 of the detachable cover.

MODEL TC-2P
$34.50
Shpg. Wt. 15 lbs.

Heathkit REGULATED POWER SUPPLY KIT

MODEL PS-2
$33.50 Shpg. Wt 15 lbs.

Here is a source of regulated D.C. voltage for circuit development work. Power supply voltage and current drain to the circuit under test are constantly monitored by the 4½" panel mounted meter. Separate 6.3 volt at 4 ampere A.C. filament source available. The regulated and variable output voltage will be constant over wide load variations, and hum ripple will not exceed .012% at 250 volts under a 50 MA load. Completely isolated circuit, standby switch, and other desirable features, make the Model PS-2 extremely useful in a wide variety of applications.

Heathkit TV PICTURE TUBE TEST ADAPTER

The Heathkit TV Picture Tube Test Adapter used with the Heathkit Tube Checker Kit, will quickly check picture tubes for emission, shorts, etc. and determine tube quality. Consists of standard 12-pin TV tube socket, four feet of cable, octal socket connector, and data sheet.

No. 355
$4.50 Shpg. Wt. 1 lb.

Heathkit DECADE RESISTANCE KIT

MODEL DR-1
$19.50
Shpg. Wt. 4 lbs.

Twenty 1% resistors are decaded in 1 ohm steps to provide any value between 1 ohm and 99,999 ohms. Sturdy ceramic switches with silver plated contacts insure reliable service. Use the Decade Resistance in bridge circuits, meter multipliers, calibrations, or any application requiring a wide range of precision resistance values.

Heathkit AUDIO GENERATOR KIT

Here is an Audio Generator with features generally found only in the most expensive instruments. Sine wave coverage from 20 cycles to 1 Megacycle—response flat ±1 db from 20 cycles to 400 Kc—continuously variable and step attenuated output. Because the output voltage is relatively constant over wide frequency ranges, the AG-8 is ideal for running frequency response curves in audio circuits. Once set by means of the attenuator, this voltage may be relied upon for accuracy within ± 1 db. Instrument features low impedance 600 ohm output circuit and distortion less than .4 of 1% from 100 CPS through audible range.

MODEL AG-8
$29.50
Shpg. Wt. 11 lbs.

Heathkit DECADE CONDENSER KIT

The Heathkit Decade Condenser provides a ready source of capacity values from 100 mmf to .111 mfd inclusive in capacity steps of 100 mmf. Silver plated contacts on husky ceramic switches, assure positive contact for each switch position. Precision silver mica condensers ±1% accuracy for close tolerance accurate work.

MODEL DC-1
$16.50
Shpg. Wt. 3 lbs.

HEATH company
BENTON HARBOR 15, MICHIGAN

NEW *Heathkit* HIGH FIDELITY PREAMPLIFIER KIT

Here is the exciting new Heathkit Preamplifier with all of the features you Audiophiles have asked for and at a down-to-earth price level. Beautiful satin gold baked enamel finish, striking control knobs and arrangement, attractive custom appearance and entirely functional design.

DESIGN:

Uses three twin triode tubes in a shock mounted chassis, 2-12AX7 and 1-12AU7. Features tube shielding, plastic sealed color coded capacitors, smooth acting controls, good filtering, excellent decoupling, low hum and noise level, and all aluminum cabinet. Special balancing control for absolute minimum hum level. Cathode follower, low impedance output circuit for complete installation flexibility.

SPECIFICATIONS:

Provides five switch selected inputs, 3 high level, and two low level, each with individual level controls—4 position LP, RIAA, AES, and early 78 equalization switch—4 position roll-off switch, 8, 12, 16 with one flat position. Separate tone controls, bass 18 db boost and 12 db cut at 50 CPS, treble 15 db boost, and 20 db cut at 15,000 CPS. Power requirements from Heathkit Williamson Type Amplifier power supply 6.3 volts AC at 1 ampere, and 300 volts DC at 10 MA. Over-all dimensions 12 9/16" wide x 5 7/8" deep x 3 5/8" high.

APPLICATION:

The new Heathkit WA-P2 Preamplifier has been designed to operate with any of the Heathkit Williamson Type Amplifiers and is directly interchangeable with the previous Model WA-P1 Preamplifier unit. Order your kit today and enjoy completely smooth control over the operation of your Hi-Fi system. Obtain the exact tonal balance of bass and treble with the precise degree of equalization you want. Note that the design of the WA-P2 accommodates the newly established RIAA curve.

MODEL WA-P2
$19.75
Shpg. Wt. 7 lbs.

HAM EQUIPMENT

Heathkit AMATEUR TRANSMITTER KIT

The Heathkit AT-1 Transmitter has established a high reputation and has been enthusiastically accepted by hundreds of experienced operators as well as beginners. Power input up to 35 watts for the novice and suitable as a standby exciter for your higher powered rig later on.

Model AT-1 can be crystal or VFO excited and operates on 80, 40, 20, 15, 11 and 10 meters. The pre-wound coils with the oscillator and amplifier are switched simultaneously by the rugged band switch. Meter switch allows a reading of the final grid and plate current on the panel mounted meter. Modulator input and VFO power sockets are provided as well as a key jack for CW operation. Other features include a crystal socket, standby switch, key click filter, AC line filter, good shielding and a 52 ohm coaxial output. The 425 volt, 100 milliampere power supply and 5U4 rectifier are more than adequate for the 6AG7 oscillator multiplier and 6L6 amplifier doubler.

MODEL AT-1
$29.50
Shpg. Wt. 16 lbs.

Brand NEW

HEATHKIT VFO KIT

The new Heathkit VFO is the perfect companion to the Heathkit Model AT-1 Transmitter and it has sufficient output to drive any multi-stage transmitter of modern design. Good mechanical and electrical design insures operating stability. Coils are wound on stable, heavy duty, ceramic forms using Litz or double cellulose wire coated with Polystyrene cement and baked for humidity protection. Variable capacitor of differential type construction, especially designed for maximum bandspread. Kit is furnished with a carefully precalibrated scale which provides well over two feet of scale length. Smooth acting vernier reduction drive and illuminated dial provides easy tuning and zero beating.

Power requirements 6.3 volts AC at .45 amperes, and 250 volts DC at 15 mils. Just plug it into the power receptacle provided on the rear of the AT-1 Transmitter. Seven band coverage 160 through 10 meters with 10 volt average RF output. Uses 6AU6 electron coupled Clapp oscillator and OA2 voltage regulator.

MODEL VF-1
$19.50
Shpg. Wt. 7 lbs.

Heathkit GRID DIP METER KIT

The invaluable instrument for Hams, servicemen 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 CL and Q of components, and determining RF circuit resonant frequencies. The variable meter sensitivity control, headphone jack, 500 microampere Simpson meter, continuous frequency coverage from 2 MC to 250 MC. Prewound coil kit and rack included.

LOW FREQUENCY COILS:

Low frequency range extended to 355 KC by the use of two additional coils. Complete with dial correlation curves. Set 341-A for GD-1B and set 341 for GD-1A. Shipg. wt. 1 lb. Price $3.00

MODEL GD-1B
$19.50 Shpg. Wt. 4 lbs.

Heathkit ANTENNA IMPEDANCE METER KIT

MODEL AM-1
$14.50
Shpg. Wt. 2 lbs.

Determine antenna resonance and resistance, transmission line surge impedance, and receiver input impedance. Works with one-half and one-quarter wave lines, half wave and folded dipoles, harmonic mobile and beam antennas. Resistance type SWR bridge —100 microampere meter—frequency range 0-150 MC—impedance range 0-600 ohms.

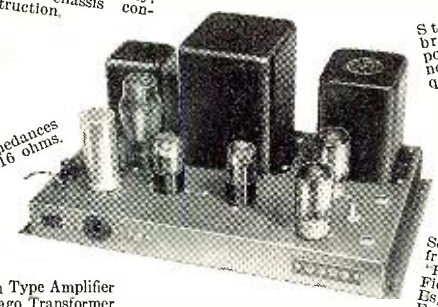
Heathkit ANTENNA COUPLER KIT

For the Heathkit AT-1 Transmitter or any comparable Amateur Transmitter. Will handle power up to 75 watts at its 52 ohm coaxial input. Matches a wide range of antenna impedances with its L type tuning network and neon indicator. A tapped inductance provides coarse adjustment and a transmitting type variable condenser sets it "right on the nose." Will operate on the 10 through 80 meter bands.

MODEL AC-1
$14.50
Shpg. Wt. 4 lbs.

HEATH company
BENTON HARBOR 15, MICHIGAN

New LOW PRICED HEATHKIT SINGLE UNIT Williamson Type High Fidelity AMPLIFIER KIT



Here is the newest Heathkit Hi-Fi Amplifier at the lowest price ever quoted for a complete Williamson Type Amplifier circuit. The W-4 Model has been designed for single chassis construction, and only for the new Chicago Transformer Company Model BO-13 "super range" high fidelity output transformer. This transformer, a new development in the Hi-Fi field, is being offered at substantial saving over transformers of comparable quality. It is outstanding in performance and on the basis of our tests, we find it equal in every respect to transformers used in the W-2 and W-3 Heathkit series.

LOW PRICES:

Through utilization of a single chassis with resultant economy obtained through elimination of duplicate sheet metal fabrication, connecting cables, plugs, sockets, and a new Chicago "super range" output transformer, a 20% price reduction has been made possible without sacrificing kit quality.

COMPONENTS:

The new Heathkit W-4 uses the same heavy duty power transformer and choke. It has all of the features of previous models including individual jacks and a wire wound control to balance the output tubes—plastic high quality capacitors and the exact circuitry previously utilized in Williamson Type Amplifiers. Intermodulation distortion and harmonic distortion are both at the same low level as in the W-2 and W-3 models.

CONSTRUCTION:

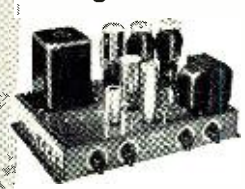
Here is the opportunity for even the economy minded Hi-Fi enthusiast to enjoy all of the advantages offered through Hi-Fi reproduction of fine recorded music. Simplified step-by-step Construction Manual completely eliminates necessity of electronic knowledge or special equipment. Assemble this Amplifier in a few pleasant hours.

COMBINATIONS AVAILABLE

W-4M with Chicago "super-range" transformer only. Single chassis main amplifier and power supply. Shipping weight 28 lbs. Express only **$39.75**

COMBINATION W-4 with Chicago "super-range" transformer only includes single chassis main amplifier and power supply with WA-P2 preamplifier kit. Shpg. wt. 35 lbs. Express only **$59.50**

NEW Heathkit 20 WATT High Fidelity AMPLIFIER KIT



MODEL A-9B

$35.50

Shpg. Wt. 24 lbs.

In keeping with the progressive policy of the Heath Company, further improvement has been made in the already famous Heathkit High Fidelity 20 Watt Amplifier. Additional reserve power has been obtained by using a heavier power transformer. A new output transformer designed and manufactured especially for the Heath Company, now provides output impedances of 4, 8, 16 and 500 ohms. The harmonic distortion level will not exceed 1% at the rated output.

FEATURES:

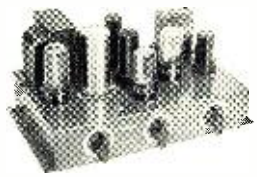
Outstanding features of the Heathkit 20 watt Amplifier include frequency response of ±1 db from 20 CPS to 20 KC. Separate (boost and cut) bass and treble tone controls. Four switch selected input jacks and a special hum balancing control. Flexibility is emphasized in the input circuits and proper equalization for all input devices is incorporated.

TUBE LINEUP:

12AX7 magnetic preamplifier and first audio amplifier. 12AU7 two stage amplifier with tone controls. 12AU7 voltage amplifier and phase splitter. Two 6L6 push-pull beam power output and 5U4G rectifier.

The Heathkit Model A-9B is excellent for custom installation and is designed for outstanding service at a very reasonable cost.

Heathkit SIX WATT AMPLIFIER KIT



MODEL A-7B

$15.50

Shpg. Wt. 10 lbs.

An outstanding value, this economically priced 5 watt Amplifier is capable of performance expected only in much more expensive units. Only 2 or 3 watts output will ever be used in normal home applications and Model A-7B will be more than adequate for this purpose.

SPECIFICATIONS:

Two switch selected inputs are available for crystal and ceramic phono pickups, tuner, TV audio, tape recorder, and carbon type microphone. Model A-7B features separate bass and treble tone controls, push-pull balanced output stages, output impedances of 4, 8, and 15 ohms, and extremely wide frequency range ±1½ db from 20 CPS to 20 KC. Not just a souped up AC-DC job. Full wave rectification, transformer operated power supply and good filtering, result in exceptionally low hum level.

MODEL A-7C

Provides a preamplifier stage and proper compensation for the variable reluctance cartridge and low level microphone. $17.50

Heathkit WILLIAMSON TYPE AMPLIFIER KIT

Here is the famous kit form Williamson Type *high fidelity* Amplifier that has deservedly earned highest praise from every strata of Hi-Fi music lovers. Virtually distortionless, clean musical reproduction, full range frequency response, and more than adequate power reserve.

OUTPUT TRANSFORMERS:

This outstanding Williamson Type Hi-Fidelity Amplifier is supplied with the famous Acrosound TO-300 output transformer. This quality transformer features the popular "ultra-linear" output circuit for clean maximum power level. Separate chassis for amplifier and power supply.

SPECIFICATIONS:

Frequency response within 1 db from 10 cycles to 100,000 cycles. Harmonic distortion at 5 watt output less than .5% between 20 cycles and 20,000 cycles. IM distortion at 5 watts equivalent output .5% using 60 and 3,000 cycles. Output impedances of 4, 8, or 16 ohms. Overall dimensions for each unit 7" high x 5½" wide x 11½" long.

CONSTRUCTION MANUAL:

This fine kit is supplied with a completely detailed step-by-step Construction Manual and the only effort required is the assembly and wiring of the pre-engineered kit. Even the complete novice can successfully construct this Amplifier and have fun building it.

COMBINATIONS AVAILABLE:

W-3 Amplifier Kit (Includes Main Amplifier with Acrosound Output Transformer, Power Supply and WA-P2 Preamplifier.) Shipping weight 37 lbs. Shipped express only..... **$69.50**

W-3M Amplifier Kit (Includes Main Amplifier with Acrosound Output Transformer and Power Supply.) Shipping weight 29 lbs. Express only **$49.75**

HEATH company
BENTON HARBOR 15, MICHIGAN

Heathkit COMMUNICATIONS RECEIVER KIT

Separate BFO oscillator tube and circuit.

Continuous coverage 550 KC—35 MC on 4 Bands.

MODEL AR-2

$25.50

(Less Cabinet)

Shpg. Wt. 12 lbs.

Phone—standby—CW panel switch.

RF gain control with AGC on-off switch.

Electrical bandspread tuning with logging scales.

An excellent example of typical Heath Company ability to produce top quality kit merchandise at ridiculously low prices, is the AR-2 Communications Receiver. Here is a transformer operated all-wave receiver with all of the desired features and none of the disadvantages commonly encountered in so-called "economy sets."

Receiver employs high gain miniature tubes and IF transformers, chassis mounted 5½" PM speaker, headphone jack, slide rule dial with Ham Bands plainly identified, and easy tuning with direct planetary drive. Continuous frequency coverage from 550 KC to 35 MC on 4 Bands, with electrical bandspread tuning and logging scales. Other features are RF gain control with AGC on-off switch—phone-standby-CW panel switch—prewound coils in a shielded turret assembly and copper plated chassis and shielding.

Uses 12BE6 mixer-oscillator, 12BA6 IF amplifier, 12AV6 detector-first audio, 12A6 beam power output, 12BA6 BFO oscillator, and 5Y3 rectifier. A lettered control plate is provided for the cabinet of your choice or you can order the optional Heathkit cabinet featuring the full size aluminum panel.

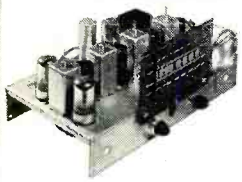
RECEIVER CABINETS

Proxylin impregnated fabric covered plywood cabinet available for BR-2 and AR-2 receivers. Includes aluminum panel, flocked reinforced speaker grill and protective rubber feet.

For BR-2 Receiver, Cabinet 91-9
Shipping weight 5 lbs. **$4.50**

AR-2 Receiver, Cabinet 91-10
Shipping weight 5 lbs. **$4.50**

Heathkit FM TUNER KIT



MODEL FM-2

$22.50

Shpg. Wt. 8 lbs.

Here is an FM Tuner that can be operated with your Hi-Fi Amplifier or through the "phono" section of the ordinary radio. Completely AC operated to eliminate problems usually encountered in "economy type" AC-DC tuner circuits. Features 8 tube circuit with separate mixer and oscillator, 3 double tuned IF stages followed by a limiter discriminator providing maximum sensitivity and selectivity across the full FM frequency band of 88 MC to 108 MC. The tuning unit is factory assembled and adjusted, thus eliminating tedious critical "front end" alignment problems. The attractive slide rule dial and vernier tuning combine to make the Heathkit FM-2 Tuner simple to operate.

Heathkit BROADCAST BAND RECEIVER KIT

MODEL BR-2

$17.50

(Less Cabinet)

Shpg. Wt. 10 lbs.

The Model BR-2 Broadcast Band Receiver is designed especially for the beginner without any sacrifice of quality. This receiver features a transformer operated power supply, high gain miniature tubes, sharply tuned IF transformers, new rod type built-in antenna, and a trouble-free planetary tuning system. Exceptional performance with unusually high sensitivity, good selectivity, and excellent tone quality from the 5½" PM chassis mounted speaker. Can be used either as a receiver, tuner, or phono amplifier. Uses 12BE6 mixer-oscillator, 12BA6 IF amplifier, 12AV6 detector, 12A6 beam power output, and 5Y3 rectifier.

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HEATH COMPANY
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WALNUT 5-1175

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QUANTITY	ITEM	MODEL NO.	PRICE

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On Express orders do not include transportation charges—they will be collected by the express agency at time of delivery.

ON PARCEL POST ORDERS insure postage for weight shown.

ORDERS FROM CANADA and APO's must include full remittance.

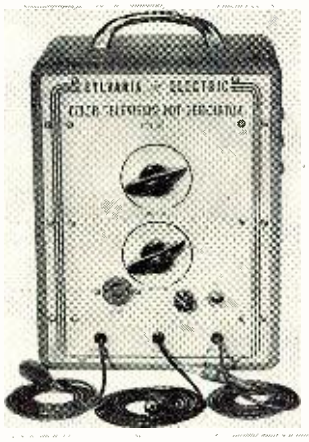
WHAT'S Happening in Radio

The products described in this column are for your convenience in keeping up-to-date on the new equipment being offered by manufacturers. For more complete information on any of these products, write direct to the company involved.

COLOR DOT GENERATOR

Sylvania Electric Products Inc. has announced a new TV service instrument for color TV convergence adjustments.

The new instrument, the Model 506 color television dot generator, is designed for use in adjusting static and



dynamic convergence of 3-gun color tubes. The instrument produces a pattern of small rectangular white dots on the tube screen, each dot being about ¼" long and 2 or 3 vertical scan lines high. Nominally, the pattern of dots is 16 horizontally by 12 vertically, although the exact number can be changed somewhat by the synchronizing controls.

For full details on this new piece of test gear write the company's Electronic Equipment Sales Dept., 1221 W. Third St., Williamsport, Pa.

TRANSISTORS FOR A.G.C.

Tetrode grown-junction transistors suitable for use in audio amplifier a.g.c. circuits have been announced by *Texas Instruments Incorporated,* 6000 Lemmon Ave., Dallas 9, Texas.

These germanium, hermetically-sealed units have two base layer connections allowing introduction of feedback. The amplification factor of the tetrode through the amplifier section is guaranteed to be .95 or better. Output signal attenuation of over 20 db can be secured with less than 100 μa. applied to the second base lead.

Detailed information on the new Type 700 units is available in bulletin form from the company.

TINY ELECTROLYTICS

Illinois Condenser Company, 1616 N. Throop St., Chicago 22, Illinois has added a new line of miniature and subminiature electrolytic condensers to its line.

Designated as the Types MT and SMT, these low cost, low current drain units are especially designed for use with transistors, printed circuits, hobby models, etc. where small size and lightweight components are required.

They are manufactured in a capacity range of ½ to 100 μfd. and from 3 to 75 volts. They are available in case styles of ⅛", 3/16", ¼", and ⅜" diameters. Lengths range from ½" to 1¼".

"SCOTCH" ELECTRICAL TAPE

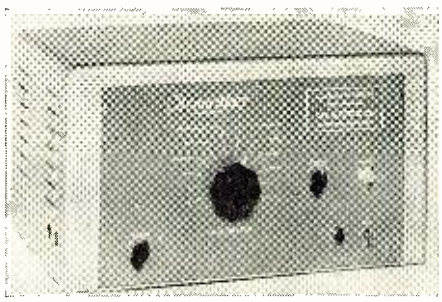
Minnesota Mining and Manufacturing Co., St. Paul 6, Minn. has recently introduced its *"Scotch"* plastic electrical tape in a convenient new roll size for use in radio, TV, appliance, and instrument manufacturing and repair fields.

The new tape is ⅜" wide and combines convenient size with good insulation and holding properties. Because of its thin, 7-mil backing and its new narrow width the tape provides a higher degree of conformability, making a tight, neat-appearing splice wrap.

COLOR SIGNAL GENERATORS

Kay Electric Company, Pine Brook, N. J. is now offering two signal generators for the presentation of full-fidelity NTSC standard colors.

Known as the "Multi-Chrome Chromabar" and "Uni-Chrome Chromabar,"



the former is for multiple presentation simultaneously while the latter is for single color presentation. Both generate green, yellow, red, magenta, blue, cyan, white, and black. Other colors, gray shades or "I" and "Q" may be had at additional cost.

MINIATURE TRANSFORMERS

Audio Development Company, 2833 13th Ave. South, Minneapolis, Minn. is in production on a new line of miniature hermetically-sealed transformers and chokes.

Suitable for use in circuitry such as geophysical and transistor applications, these compact transformers and chokes measure only ¾"x15/16"x1⅞".

Available drawn in both standard steel and *Mumetal,* they are obtainable in a practical range of specifications.

Write the company's Industrial Sales Division for full details on this line.

FLYBACK TESTER

TeleTest Instrument Corp., 30-01 Linden Place, Flushing, Long Island, N. Y. has introduced a new flyback tester, which tells exactly what condition any flyback is in, according to the

company. This unit will test good as well as faulty units.

The instrument checks not only continuity but also yokes, width coils, and linearity coils for shorted turns. Flybacks are checked under full operating voltage conditions.

The unit is portable and compact and comes equipped with a leather carrying strap. The dial is clear and easy to read while the control panel is simply and efficiently designed.

SIMPSON TUBE CHART

Simpson Electric Co., 5200 W. Kinzie St., Chicago 44, Illinois has announced the availability of a new tube chart for its Model 1000 plate conductance tube tester. The chart is available from the factory for $2.00.

The new chart shows all of the new tubes produced since the last chart was introduced in May of last year. On November 1, 1954, the company will issue its free supplement showing all the tubes added since this new chart was issued.

PROBE-INSPECTION LIGHT

Moore Manufacturing Company, Swedesboro, New Jersey is marketing

a new tool which combines a probe and inspection light in a single unit.

With the mirror and plastic probe removed the handle of the instrument provides a powerful insulated-top flashlight. When the probe is inserted the light is beamed to the probe tip which offers a flood of light at the tip end. When the mirror is slipped on the probe, the illuminated reflector permits ready inspection of tight wiring.

NEW TUBES FOR TV

CBS-Hytron of Danvers, Massachusetts has announced the availability of three new tubes designed for use as horizontal deflection amplifiers in television receivers.

These tubes, which are interchangeable with 6BQ6GT, 12BQ6GT, and 25BQ6GT, are the 6CU6, 12CU6, and 25CU6 respectively. The 12CU6 and the 25CU6 are now available for series-string operation and are particularly useful for low-cost, transformerless television sets which employ several tube heaters in series across the 117 volt a.c. line to eliminate the need for a filament transformer.

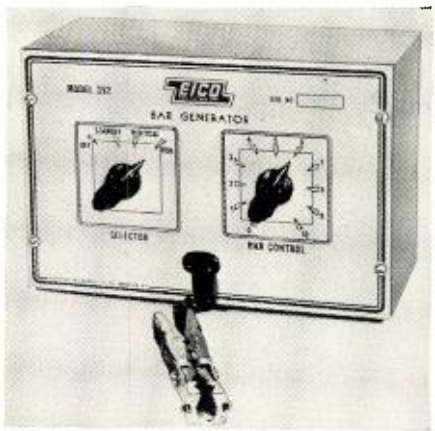
The 6CU6 features heavier-gauge plates with large radiating fins, vents in beam plates, plate aligned for maximum radiation of heat from the grids, etc.

Data sheets on these new tubes are available from the manufacturer.

TV BAR GENERATOR

Electronic Instrument Co., Inc., 84 Withers Street, Brooklyn 11, N. Y. has just introduced a bar generator for TV servicing which is currently available in both kit and factory-wired form.

The new *Eico* Model 352 is portable,



lightweight, and simple to operate. It provides a series of vertical or horizontal bars on the TV screen when connected to the antenna terminals of any TV set. Since these bars will be equally spaced on a correctly adjusted set, a quick indication is obtained of the picture linearity in the set under test. The instrument also indicates over-all picture size and vertical and horizontal sync circuit stability.

The instrument operates on channels 3, 4, or 5 and provides 16 vertical bars and 12 horizontal bars.

REPLACEMENT FLYBACKS

The *Stancor Division* of *Chicago Standard Transformer Corporation,* Addison and Elston, Chicago 18, Illinois has added exact replacement fly-

backs for *Motorola* and *Muntz* sets to its line.

The model A-8239 is a replacement for *Motorola* Nos. 24K792753 and 24K-701099 and can be used in over 100 *Motorola* chassis and models.

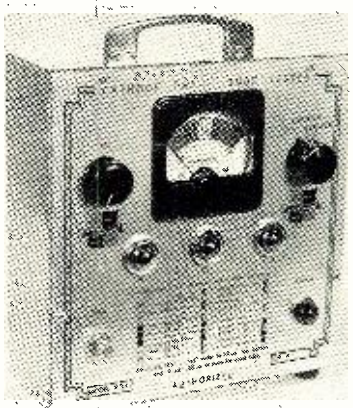
The A-8240 replaces *Muntz* part #TO-0036.

Bulletin 491, covering these units, is available without charge from the company.

CR TUBE TESTER

Authorized Manufacturers Service Co., 919 Wyckoff Ave., Brooklyn 27, New York has introduced a lightweight, portable cathode-ray tube tester for service applications.

Known as the Model 101, the unit is



so designed as to provide positive test indication for continuity and emission within 90 seconds. All phases of potential trouble and breakdown are outlined on the front panel. No additional computations are required. Complete facilities are available for testing opens, shorted elements, leakage, cathode emission, and gaseous tubes. Tests can be made with the CRT in carton, TV set, cabinet, or on the bench.

COMPACT TUBE TESTER

Seco Manufacturing Company of 5015 Penn Avenue South, Minneapolis, Minn. has developed a portable model grid circuit tube tester which can be housed in the technician's tube caddy for service work in the customer's home.

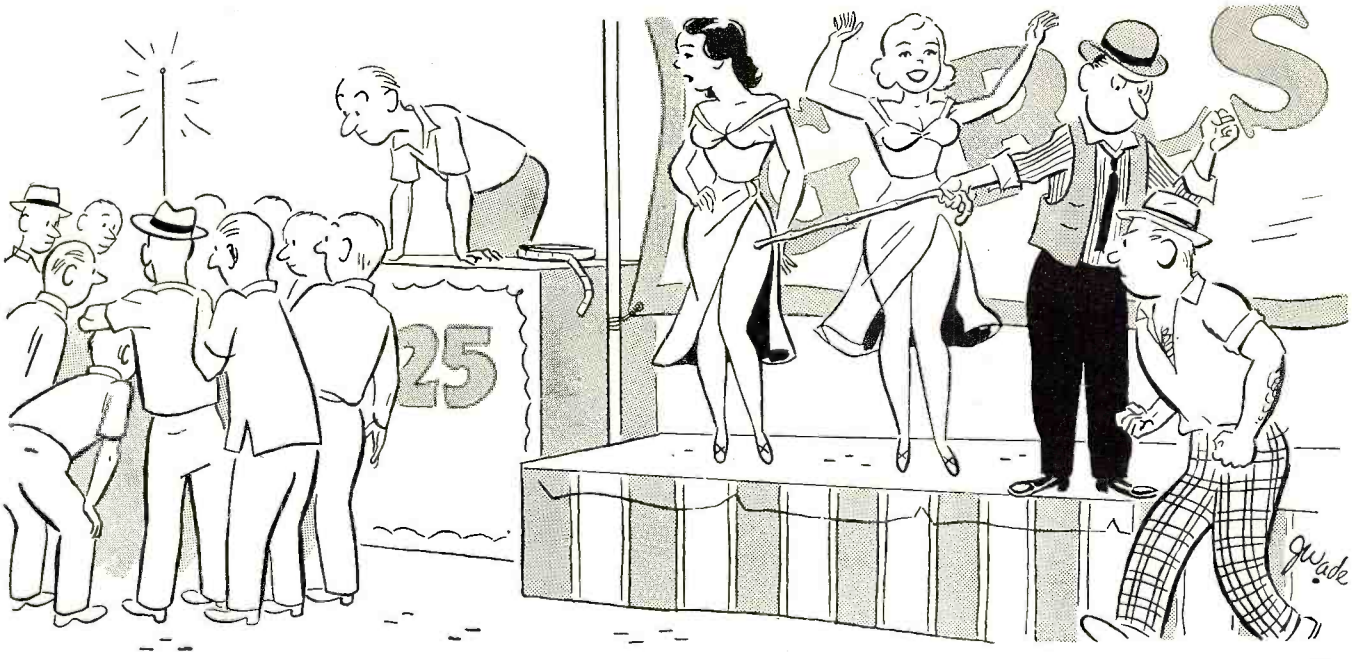
The device isolates a.g.c. tube malfunctions and employs an electric eye to reveal faults such as control grid emission, grid-to-cathode or cathode-to-heater shorts and gaseous conditions in tubes.

Additional information on the Model GCT-3 is available from the company.

SUBMINIATURE RELAY

American Telasco Ltd. of Huntington, N. Y. is marketing a new subminiature relay which is designed especially for applications requiring small size, light weight, high sensitivity, thermal and shock stability, and fast reaction time.

The new P-100 relay weighs only 1 ounce, has over-all dimensions of $1\frac{3}{16}$" x ⅞" x $1\frac{1}{16}$", 3500 ohms resistance, and sensitivity of less than 20 mw.



"Get that guy with his WALTER ASHE "Surprise" Trade-in out of here!"

JOHNSON VIKING II TRANSMITTER KIT. Net $279.50. Wired and tested. Net $337.00

JOHNSON VIKING RANGER TRANSMITTER-EXCITER KIT. Less tubes. Net $179.50. Wired and Tested. Net $258.00. Set of tubes for Ranger $23.92

BARKER & WILLIAMSON TRANSMITTER. Net $442.50

Always the center of attraction for the economy minded, "Surprise" allowances continue to pile up evidence that you just can't beat Walter's trade-in deal on used test and communication equipment. Get your trade-in working today. Wire, write, phone or use the handy coupon below.

HELP, FELLAS!

I bought too many new Hallicrafters SX-71 receivers, and now the boss says I've got to sell 'em or else!

All fresh stock, brand new, and in factory-sealed cartons.

WE CAN HELP EACH OTHER

Just drop me a line at once, here at Walter Ashe, and I'll give you the longest trade in the country on one of these SX-71's. I guarantee you'll be pleasantly surprised. So what say?

Sincerely yours,
JOHNNY SHONTZ

CENTRAL ELECTRONICS SINGLE SIDEBAND EXCITERS

MODEL 10B MULTIPHASE EXCITER KIT. 10 watts peak output. Net $129.50. Wired and tested. Net $179.50

MODEL 20A MULTIPHASE EXCITER KIT. 20 watts peak output. Net $199.50. Wired and tested. Net $249.50

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1125 PINE ST. • ST. LOUIS 1, MO.

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1125 Pine Street, St. Louis 1, Missouri

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for _____
(show make and model number of new equipment desired)

☐ Send New Free 1955 Catalog.

Name _____

Address _____

City _____ Zone _____ State _____

Send for your copy today

The relay is housed in a protective plastic case which helps to provide high thermal and shock resistance. It is equipped with a six-pin plug which fits a molded or laminated socket supplied with the relay. Polarity may be reversed by reversing the relay in its socket.

U.H.F. TEST UNIT

Granco Products Inc., 36-17 20th Ave., Long Island City 5, New York is currently marketing a u.h.f. signal-gain generator which has been de-

signed for engineers, research workers, and service technicians doing u.h.f. work.

The Model SU-200 is compact, lightweight, and is equipped with a carrying case for portability. The generator features coaxial tuning elements, continuous and precise tuning over the entire u.h.f. band, calibration in both frequency and channel designations, balanced detector meter circuit and gain control, and simplified operation. The frequency range is 440 to 910 mc. with an accuracy of ± 2%.

PORTABLE TUBE TESTER

Radio City Products Co., Inc., Easton, Pa. is now in production on a new, compact portable tube tester, the Model 327P.

Although the tester contains a 4½" rectangular meter with an easy-reading scale, it is ultra-compact in size and light in weight so that it can be carried out on the job or used on the bench. It will test all radio and television receiving tubes. All CR picture tubes, including color tubes, can be tested by means of adapter cables which are available separately.

The oak case measures 9½" x 11" x 5½".

V.T.V.M.

Chicago Industrial Instrument Co., 536 West Elm Street, Chicago 10, Ill. recently introduced a new "Unidial" v.t.v.m., the Model 541.

A single control is used to select both range and function. A special circuit feature permits the use of regular test leads from 50 cycles to 100 mc. An isolation cartridge snaps on the regular probe when necessary.

The instrument has a 4½" fan meter for long scale length in a small space. The company will supply full specifications on request.

VOLTAGE BOOSTER

The *Regency Division* of *I.D.E.A.,* 7900 Pendleton Pike, Indianapolis 26, Ind. is marketing a new voltage booster that can maintain a 117 volt power supply to any TV set irrespective of line voltage variations from 90 to 130 volts.

The VB-1 is an autotransformer with tapped primary so it can be used in high voltage areas to decrease the line voltage or in low voltage areas to increase the line voltage. Indicator lights on the switch side of the booster reveal the proper operating position of the voltage switch.

TUBE TESTER

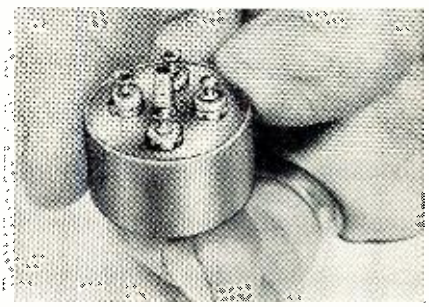
Vidaire Electronics Mfg. Company, 576 W. Merrick Road, Lynbrook, N. Y. has added a new technician's tube tester to its line of TV accessories.

Known as the "Adapt-Test," the new unit has dual sockets with 20 inches of lead extensions that bring all socket voltages out into the open. Used with any voltmeter, the technician can reach remote and inaccessible tube sockets on any chassis. Test points are clearly numbered for easy identification.

Currently the unit is available in three models—the AT-1 for all octal tubes, the AT-2 for 7-pin miniatures, and the AT-3 for 9-pin miniatures.

MINIATURE TRANSFORMERS

The development of a new line of miniature transformers has been an-



nounced by *Torwico Electronics, Inc.,* 961 Frelinghuysen Ave., Newark 5, N. J.

Currently available with outputs of 3 va. and 6 va., one typical unit in the line measures 1" o.d. x ¾" high. It weighs about 1½ ounces. Electrical ratings are an input of 115 volts, 400 cycles; power output of 6 va.; regulation of 10 per-cent; and heat rise of 40 degrees C, class A.

Miniature transformers with special ratings are also available from this same manufacturer.

TV ACCESSORIES

American Electronics Co., 1203-05 Bryant Ave., New York 59, N. Y. is in production on a line of television accessories for the service technician.

(*Continued on page* 146)

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by the leader...

TRANSAMERICA ELECTRONICS CORP.

EVERY TUBE GUARANTEED 6 MONTHS

Branded — Bulk Packed in Original Mfr's. Nested Cartons or Individually Boxed

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0A2	$ .87	1T4	.46	6AS5	.62	6L6GA	.99	7A4	.45	12A6	.49	12SF7GT	.68	35Z5GT	.45
0A3/VR75	.97	1U4	.46	6AT6	.36	6N7	.95	7A5	.55	12A7	.98	12SG7	.70	36	.35
0A4G	.60			6AU6	.40							12SH7	.70		
0B2	.74	1U5	.40	6AV5GT	.79	6Q7	.49	7A6	.65	12AH7GT	.85	12SJ7	.55	37	.35
0B3/VR90	.90	1X2	.55	6AV6	.36	6R7	.49	7A7	.65	12AL5	.40	12SK7GT	.49	39-44	.35
		2A3	.90			6S4	.39	7AD7	.90	12AT6	.35			42	.40
0C3/VR105	.95	2A5	.49	6AX4GT	.57	6S7G	.55	7AG7	.55	12AT7	.62	12SL7GT	.49	43	.53
0D3/VR150	.85	2A6	.49	6B7	.93	6SA7	.40	7AH7	.55	12AU6	.36	12SN7GT	.50	45Z3	.40
0Z4	.53	2A7	.60	6B8G	.29							12SQ7GT	.53		
1A4P	.35			6BA6	.38	6SC7	.75	7B4	.44	12AU7	.59	12SR7	.49	46	.45
1A5GT	.40	2B7	.62	6BA7	.55	6SD7GT	.38	7B5	.55	12AV6	.44	12Z3	.39	47	.85
		2X2	.39			6SF5GT	.45	7B6	.55	12AV7	.64			49	.38
1A7GT	.45	2X2A	1.14	6BC5	.49	6SF7	.58	7C4	.55	12AX4GT	.55	14A4	.65	50L6GT	.61
1AB5	.38	3A4	.44	6BE6	.37	6SG7	.40	7C7	.65	12AX7	.55	14A5	.57	50X6	.62
1B3GT	.67	3A5	.90	6BF5	.69							14A7	.53		
1C5GT	.40			6BG6G	1.15	6SH7	.60	7E5	.59	12AY7	.72	14AF7	.59	50Y6GT	.57
		3A8GT	.59	6BH6	.45	6SH7GT	.50	7E6	.40	12BA6	.47	14B6	.45	56	.47
1C7G	.37	3B7	.39			6SJ7	.54	7F7	.64	12BA7	.59			57	.53
1D7GT	.75	3D6	.38	6BJ6	.41	6SK7	.39	7F8	.90	12BD6	.46	14B8	.63	58	.56
1E7GT	.35	3LF4	.71	6BK7	.89	6SL7GT	.49	7G7	.80	12BE6	.45	14C5	.80	70L7GT	1.00
1F4	.40	3Q4	.48	6BL7GT	.65							14C7	.65		
1F5G	.44			6BN6	.79	6SN7GT	.48	7H7	.56	12BH7	.60	14E6	.65	71A	.52
		3Q5GT	.48	6BQ6GT	.75	6SQ7	.37	7J7	.75	12C8	.34	14E7	.80	76	.42
1H4G	.40	3S4	.46			6SR7	.45	7K7	.80	12F5GT	.35			77	.53
1H5GT	.38	3V4	.50	6BQ7	.88	6ST7	.48	7L7	.77	12H6	.45	14F7	.65	78	.43
1J6G	.59	5T4	1.25	6C4	.35	6T8	.57	7N7	.57	12J5GT	.39	14F8	.90	81	1.10
1L4	.45	5U4G	.49	6C5	.39							14H7	.57		
1L6	.61			6C6	.54	6U7G	.45	7Q7	.57	12J7GT	.57	14N7	.67	82	.67
		5V4G	.76	6C8G	.85	6U8	.59	7R7	.59	12K7	.53	14Y4	.67	83	.77
1LA4	.59	5Y3G	.38			6V6	.38	7S7	.83	12K8	.55			84	.52
1LA6	.75	5Z3	.33	6CB6	.42	6W4GT	.41	7V7	.87	12Q7G	.57	19	.45	85	.57
1LB4	.77	6A6	.45	6CD6G	1.05	6W6GT	.41	7W7	.85	12S8GT	.60	19BG6G	1.15	89Y	.29
1LC5	.59	6A7	.80	6D6	.67							19T8	.75		
1LC6	.75			6D8G	.95	6X4	.35	7X6	.57	12SA7GT	.62	22	.40	117L7GT	1.17
		6A8	.65	6E5	.76	6X5	.35	7Y4	.40	12SC7	.68	25AV4GT	.80	117Z3	.38
1LD5	.49	6AB4	.42			6X8	.70	7Z4	.45	12SF5	.48			117Z4GT	.73
1LE3	.75	6AB7	.71	6F6	.45							25BQ6GT	.75	117Z6GT	.70
1LG5	.75	6AC5GT	.95	6F7	.90							25L6GT	.40	2051	.93
1LH4	.75	6AC7	.68	6F8G	.69							25W4GT	.45		
1LN5	.55			6G6G	.63							25Z5	.60	9001	1.47
		6AF4	.89	6H6	.49							25Z6GT	.40	9002	.98
1N5GT	.61	6AF6G	.75											9003	1.30
1P5GT	.56	6AG5	.47	6J5	.38							26	.42	9006	.67
1Q5GT	.55	6AG7	.90	6J6	.50							27	.37	803	2.95
1R4	.81	6AH6	.88	6J7	.49							32L7GT	.95		
1R5	.47			6J8G	.90							35C5	.37	807	1.25
		6AK5	.59	6K6GT	.39							35L6GT	.45	814	3.50
1S4	.55	6AL5	.35											836	7.95
1S5	.40	6AQ5	.39	6K7G	.38							35W4	.43	866A	1.45
1SA6	.48	6AQ6	.36	6K8G	.64							35Y4	.44		
		6AQ7GT	.68	6L6G	.39							35Z3	.40		

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★ 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.

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Acoustic Measurements

(*Continued from page* 39)

the 15-by-30 foot attic room mentioned previously, are shown to illustrate the sort of results to be expected.

Figs. 1 and 3A were taken off an 8-inch cone of the high-fidelity type having a curved cone and a soft plastic edge suspension. The 2 cubic-foot enclosure was an old cabinet made of 1" thick wood throughout, padded inside and totally enclosed. The microphone was located 1 foot away, on axis. The solid curve shows response flat within ± 5 db from 95 to 9500 cycles, which is pretty good for this combination. There is a certain appearance of regularity about the major peaks at 1300, 2300, 4000, and 6000 cycles that point toward a possible cavity resonance in the enclosure or nearby; perhaps the padding is not good enough.

The enclosure had double doors on the front. Closing one of the doors produced the curve shown in dotted lines in Fig. 1. The general level has dropped above 500 cycles and the response is very much rougher, with three 20 db dips at 1250, 3000, and 5000 cycles.

While the effect of closing one door had an obvious effect on the musical quality—it sounded "thinner," it was not hard to become accustomed to. Identification of what was wrong was difficult from a listening point of view because there was little change in the over-all balance between highs and lows, no boomy bass or distortion which are the landmarks we look for in judging sound quality. On a dark night in some places, a rough response like this might be passed off as high-fidelity sound; it would be fatiguing, but the frequencies seem to be there. Yet measurements show clearly what is wrong.

Resonant cavities always produce such a series of dips. Too-heavy grille cloth reflects sound enough to produce these cavity effects. This effect, indeed, is worse than the absorption of highs by the cloth. An unpadded enclosure, of course, introduces a terrific series of lumps in the response.

Fig. 3A shows curves taken from the same speaker, where changes were made that affect the bass response. Only the bass portion is drawn. The solid curve (1) is the normal speaker as in Fig. 1. There is a small difference in the 60-130 cycle region due to moving the cabinet out of the corner into the middle of the room, and the smaller detail in the curves between 130 and 600 cycles is different, but not more than 1 or 2 db.

The upper dotted curve (2) is the same set-up driven by a high-impedance source to remove the effect of damping of the triode amplifier. The source was simulated by connecting a 100-ohm resistor in series with the voice coil and resetting the amplifier level. The bass peak at 120-130 cycles is now 5 db higher. If the speaker

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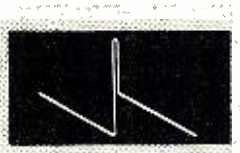

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were a cheap job with a stiff-edge cone, instead of one with a soft plastic suspension, the bass peak would be 15 or 20 db.

The lower dotted curve (3) was taken with the back of the cabinet removed, other conditions being as in curve (1).

Below the cone break-up frequency, curves are much smoother and easier to plot, so that experimentation with enclosures for best bass is relatively easy.

Obviously, this speaker system does not have good bass. It was used for illustrative purposes only. Critics may say, and correctly, that the curves of Fig. 3A really show that you can't get blood from a turnip. While this particular 2-cubic-foot box is not alleged to be anything but a box, no ordinary bass-reflex or closed baffle this size is much better. To get low frequencies you have to use a speaker system designed for it.[3]

Fig. 3B is presented for comparison. It is an ordinary table-model radio with a 4-inch speaker and plastic cabinet, the speaker being fed from the same triode amplifier as was used in the previous curves. Microphone distance and amplifier level were the same as for the other curves, so that an estimate is gained of the relative efficiency of the 4-inch cone and the higher-quality 8-inch unit. The final drop-off here is at about 160 and 6500 cycles. Average output between 200 and 1000 cycles is around 8 db lower than that of the large speaker. Level is up to the 8-inch only between 1200 and 3000 cycles. Fed from the pentode in the radio, this speaker undoubtedly would have shown much more output in the 200-cycle range. Below 300 cycles the speaker output was, incidentally, quite distorted, the harmonic content running around 50 to 100 percent even at ordinary listening level. This is about typical of table-model radios.

Accessories

Oscilloscope observation of the microphone signal is a very useful adjunct to the measurement of the overall response. The creation of phony bass by harmonic distortion in both speakers and amplifiers is an old procedure, but not dead. Careful listening to sine-wave signals from a speaker will show, with practice, whether the output is mainly the fundamental frequency or not. However the scope will give a surer picture. It will also show up clearly the maximum sound level the speaker system will deliver at low frequencies without waveform distortion.

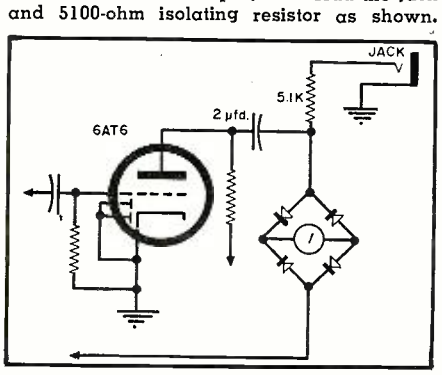

Fig. 4. Modification of audio voltmeter kit to accommodate a scope jack. Add the jack and 5100-ohm isolating resistor as shown.

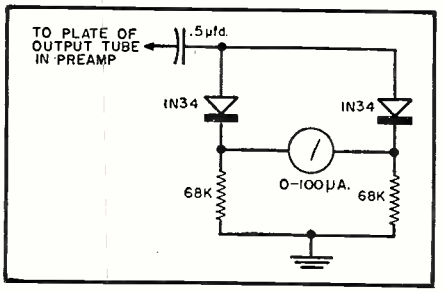

Fig. 5. Rectifier-voltmeter circuit to be added to a flat preamp for measuring mike output. Sensitivity is 5 v. full-scale.

Since the mike output is too low for most oscilloscopes, it is convenient to make the audio voltmeter do double duty as a preamplifier. In a *Heathkit* AV-2 meter, the modification diagrammed in Fig. 4 will work. Merely install a phone jack in the front panel, and connect the center spring of the jack to the output circuit through a 5100-ohm isolating resistor. When the meter reads full-scale the output at the jack will be about 1 volt. Phones or other low-impedance loads cannot be used out of this jack without causing errors in the meter reading, but an oscilloscope input has no effect. There is some waveform distortion at the zero-axis (not on the peaks) due to the full-wave rectifier circuit in the meter, but this has negligible effect for general scope monitoring.

If an audio voltmeter is not available but some other gear is, it is possible to make a meter suitable for rough measurements out of a flat preamplifier having a gain of about 1000. Merely connect to the output the rectifier-meter circuit shown in Fig. 5, making sure that the over-all response is flat and that the amplifier does not overload before the meter gets to full scale.

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3. Olson, Harry F.: "Cabinets for High-Quality Direct Radiator Loudspeakers," RADIO & TELEVISION NEWS, *May 1951.* —30—

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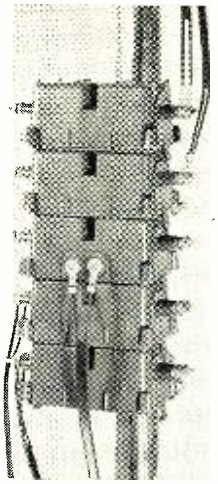
A NEW ANTENNA COUPLING SYSTEM

By **HAROLD HARRIS**
Vice-President, Engr., Channel Master Corp.

Here's a promising new method for obtaining good TV on alternate channels from different directions.



FROM the earliest days of TV, the range of transmission has exceeded theoretical predictions and, as a result, practically every community which can receive TV can receive it from more than one channel and from more than one direction. Until now, the problem of receiving TV from a number of different directions has been met by three general methods:

1. The use of a rotator in conjunction with a broadband antenna. This, by far, is the most common approach to the problem.

2. The use of two or more yagis, independently oriented in conjunction with a manually operated antenna selector switch located at the set.

3. The use of so-called omni-directional antennas, consisting of a series of straight or conical dipoles which can be connected in different combinations by a manually operated antenna selector switch at the set.

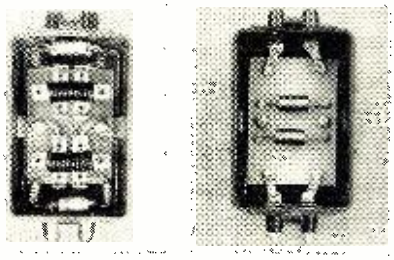
The purpose of this article is to describe a new method of solving this problem. This method, developed by engineers at *Channel Master Corporation,* and called the "SelecTenna Coupling System," permits up to seven separate v.h.f. yagi antennas to be coupled on the mast to a single transmission line, provided there is at least one channel separation between them (or the guard band between channels 4 and 5). This method eliminates the use of compromise antenna types, extra tuning equipment, and the extra manual operation at the set when switching channels.

The system consists of a series of very narrow bandpass filters, having a 300-ohm impedance at resonance and an impedance of several thousand ohms off resonance. The number of filters used bears a general relationship to the number of channels to be received.

Let us illustrate the most simple installation problem of this type. Assume that channels 2 and 4 lie in different directions and that reception is desired from each of them. The ideal solution would be to couple the channel 2 and channel 4 yagi antennas together and run one lead down to the set. However, very serious difficulties arise when we attempt to do this.

When the channel 2 and channel 4

Fig. 1. "SelecTenna" coupler system in use and some views of individual couplers. The couplers snaplock together when mounted onto the mast. Only one downlead goes to the TV set. The coupler (bottom left), with its bottom removed, is for the high band channels, the other (bottom right) is for the lows.



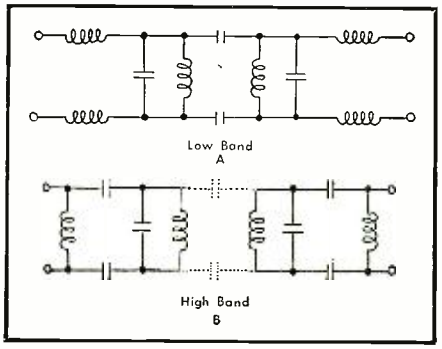
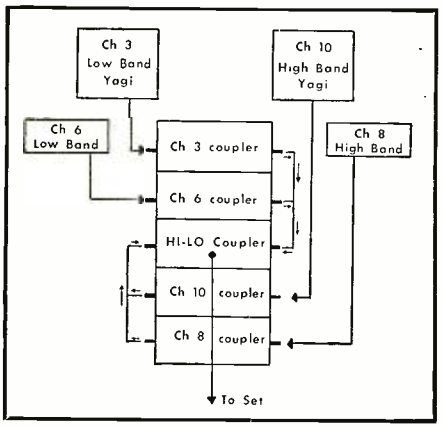


Fig. 2. Schematic diagrams of the couplers for high- and low-band frequencies.

Fig. 3. Block diagram of a typical antenna setup using couplers. The actual coupler arrangement is shown in Fig. 1.



antennas are tied together through a length of transmission line, serious losses occur because one antenna shunts the other. In addition, spurious channel 2 pickup from the channel 4 antenna is introduced, and this further degenerates the performance of the channel 2 antenna. The same thing is true if we consider the effect of a channel 2 antenna on channel 4 reception.

The ideal solution would be to put a bandpass filter, one channel wide, in series with each antenna. This filter would have a 300-ohm impedance at resonance and an impedance of several thousand ohms on either side of its selected channel. This system would then permit the channel being received to go through its respective filter unimpeded. The other filter isolates the inoperative antenna and keeps it from interfering with the one in operation. The outputs of the bandpass filter for each channel would be tied in parallel and one line could be brought down to the set.

Fig. 2A shows the bandpass filter circuit for the low band; Fig. 2B shows the circuit for the high band. In operation, these two circuits are virtually the same. Capacitive isolation is used instead of inductive isolation in the high band because it was found that the required value of inductance resonated with the distributed capacity of the coils at high-band frequencies. An inductance was also put across the high-band terminals to compensate for stray capacitances resulting from the size of components, hardware, and placement of parts. This inductance corrects the skirt impedance off resonance, and prevents it from being low in magnitude and from appearing capacitive.

The physical layout was extremely critical, and in order to get condensers of the proper "*Q*," metal stampings were used on the high-band couplers as condenser plates. Fig. 1 shows the physical placement of components for the high- and low-band couplers.

The circuits are completely symmetrical, therefore, it makes no difference which end is used for the input and which is used for the output.

Since it is not possible to maintain the high impedance of the high-band couplers on low-band frequencies, it is necessary to use a high-low coupler of special design when coupling high- and low-band antennas through this system.

Fig. 3 shows the case where four separate yagis are used—two for the high band and two for the low band. The combined outputs of the low band and the combined outputs of the high band are fed into a high-low coupler and combined. The single coupler transmission line carrying all four channels runs from the high-low coupler to the set.

It should be noted that the channels of higher frequency on both the high band and low band should be the ones closest to the line—or high-low coupler —running directly to the set.

—30—

Metal Locator

(*Continued from page 37*)

with respect to keeping grid and plate leads well separated to prevent feedback.

Initial Adjustment

After the instrument is completed and switched on, the receiver may be aligned with a test oscillator or signal generator set to 175 kc. The high side of the generator output should be connected to the grid of V_1 through a series resistor of at least 1000 ohms. For this adjustment, make sure that the transmitter is switched off. Set the sensitivity control, R_2, at about half-range. Use meter M_1 as the alignment indicator, as the i.f. transformer trimmers and condenser C_2 are adjusted for peak response.

If a test oscillator is not available, switch the transmitter on, and run a length of insulated wire temporarily between the transmitting and receiving loops. Pass the wire around the circumference of each loop to obtain good coupling. Set trimmer condenser C_9 in the transmitter to about one-half maximum capacitance. Then align the receiver section, in the conventional manner, using the transmitter in this fashion as the test oscillator.

Whichever method is employed to align the receiver, the transmitter must be set exactly to the receiver frequency. This is done in the manner just described with a length of insulated wire temporarily coupling the two loops, and tuning C_9 for maximum swing of meter M_1 or for loudest headphone signal. When the coupling lead is removed, the meter should not show a deflection greater than about 1/5 full-scale due to direct transmission between the loops, unless a mass of metal is in their immediate vicinity.

Operation and Use

After the instrument is aligned, it is ready for use. Hold the locator so that the receiver loop is not too close to the operator's body. Stand with the locator over a fairly large metallic area, such as a flat sheet or large pan. The meter should increase deflection and the headphone signal should rise. Adjust C_9 for peak meter swing and loudest headphone signal.

Walk over an area known to have no buried metallic objects, noting the "deadness" of the instrument. Now, try it over a known buried pipe or other metallic mass, noting the change in meter and headphone indications. It has been observed that the meter occasionally will show a sharp downward, instead of upward, deflection over some types of buried metal.

Generally, the meter will be the more sensitive indicator. However, it is a good idea to have both meter and headphones in the circuit, since

the phones free the operator's eyes for watching traffic and other items.

Possible Improvements

Since the present instrument was completed, two possible improvements have been suggested. One is the addition of a 3S4 audio output stage after V_3 to boost headphone volume, if the additional battery drain seems justifiable to an individual builder. The second is provision for grounded electrostatic shields for the two loops. Capacitance effects gave this author no trouble. However, the loops might be shielded by wrapping them first with insulating tape, and on top of this winding tightly a layer of metal foil. The foil winding must not be completed—a gap of about ⅛ inch can be left between the beginning and ending of the winding—to prevent "shorted-turn" effects. -30-

An Economy V.F.O.

(*Continued from page* 70)

sure coil is tuned to correct harmonic.

The next step is to calibrate the dial. See Table 1. Since the base oscillator frequency remains the same on all bands, the calibration is greatly simplified. Draw five straight lines across calibration card, spacing these lines approximately ¼-inch apart. Each line can be calibrated for a separate band. The 2-meter calibration will be located on the opposite end of the dial from the other bands so one line can be used for 2 meters as well as one of the other bands.

The first step in calibrating the dial is to close the variable condenser and mark the pointer position. Whenever the dial is removed and then replaced, close the condenser and set pointer at this mark.

Set the frequency meter to 3500 kc. Zero beat the v.f.o. You now have a calibration point at 3500 kc. on 80, 7000 kc. on 40, 14,000 kc. on 20, 21,000 kc. on 15, and 28,000 kc. on 10 meters. Next set frequency meter on 3550 kc. and zero beat the v.f.o. Check points as follows: 3550 kc. on 80, 7100 kc. on 40, 14,200 kc. on 20, 21,300 kc. on 15, and 28,400 kc. on 10 meters.

Two-meter calibration starts at 4000 kc. Set frequency meter to 4000 kc. Zero beat the v.f.o. This gives a calibration point of 4000 kc. for the 80-meter band and 144 megacycles for the 2-meter band.

Repeat this operation until all bands are calibrated as desired.

The v.f.o. is designed for high-impedance output. Low-impedance output can be made with the following modification.

Three-turn pickup coils are wound around the "B plus" ends of coils L_3, L_4, L_5, and L_6 using number 18 wire. The windings require insulation between coils. A layer of *Scotch* tape between the windings will be satisfactory.

One end of each pickup coil is con-

nected to ground. Switch S_1 is changed to a two-pole, four-position bandswitch. The other end of the pickup coil windings connects to contacts on the added section of switch S_1. The output cable now connects to the pole contact on switch S_1. The output cable is no longer connected to the plate circuit of the 5763 and condenser C_{11} is eliminated. Trimmer C_{13} should be connected to the plate of the 5763 and disconnected from L_6.

The alignment procedure would remain the same.

Those not interested in 2-meter operation can increase the bandspread on all bands by adjusting the frequency range from 3495 to 4005 kc. This requires no change in parts other than eliminating coil L_3.

Since receiver coils are used throughout, the color code on coil L_2 is not standard. The green lead should connect to the plate of the 6AQ5 and the black lead goes to "B plus." The red and blue leads are not used and should be cut off. The color code for coil L_1 is correct. Coils L_3, L_4, L_5, and L_6 are supplied with lugs only. The pickup winding on these coils is not used but need not be removed.

The drift compensating condenser, C_3, is a 10 $\mu\mu$fd. unit. Due to tolerances it is possible the drift characteristic will vary between units. If this difficulty develops the value of this condenser can be changed.

Frequency drift can be corrected in two ways. Change the value of C_3 slightly using the same negative coefficient or use the same value and change the negative coefficient. The one thing to remember is the capacity value of C_3 should be a small amount of the total capacity across L_1. Any change in this condenser will require recalibration. Check drift before calibrating the dial. —30—

HALLOCK REPORTS

By C. HOWARD BOWERS

ONE of the busiest individuals we have contacted in this series of career sketches is Mr. J. H. Hallock, engineer-in-charge of the Federal Communications Commission office in Portland, Oregon —and a real old time wireless operator.

We have found in most wireless men an inherent dislike for much hustle and bustle, but this man Hallock is all over the shop with the many duties and obligations of his territory. He did stand still long enough, however, to tell us that he first started with wireless experimenting back in 1906 at Portland, Oregon and that his first transmitter was a "rhumkorf coil" with a "wehmult interrupter" and for a more perfect description we quote Mr. Hallock, "The resultant spark tone was a cross between a sore-throated frog and a Jersey bull with the heaves!" After some months of no contacts he progressed to a 2 kw. closed-core transformer, plate glass condensers, and an open spark gap. The noise of this contraption was more startling than its signal strength, however he was in business and eventually contacted two or three of his, not-too-far, pals. The project eventually wound up in a "blaze of glory" when a large portion of the roof burned off, for which he naturally disclaimed all knowledge!

Mr. Hallock, known to his many friends as "Joe," broke into "big time" wireless in 1909 at the old United Wireless Company station "DZ" Portland, Oregon and, although this job carried no pay, it was very attractive because of the fact that the first trick operator was a stately blond in her twenties—and who t'heck wanted pay anyway? This company, blond and all, was taken over by Marconi Wireless Company about 1911, but by then Joe was day operator for the old Continental Wireless Company, also at Portland, and was busy putting ten on a line until they too folded.

Our "try anything once" friend, along with his pal Cliff Watson (see Feb. 1954 issue, page 186), soon made their way to San Francisco and the possibility of a sea-going wireless job. Cliff Watson was no more affluent than our Joe and for some three weeks they enjoyed the free-lunch in Gene Casserley's Bar on lower Market Street, augmented by an occasional short beer to maintain prestige! Came the day however, when two schooners needed operators and Marconi's marine superintendent, L. Malarin (30, these many years) wanting to be fair about the choice of jobs, said, "Boys, let's flip for it. Heads, Hallock gets his choice and tails, Watson gets his choice!" Some choice! So started Joe's experience on ships from 1911 to 1915; "SS J. B. Stetson," "SS Chehalis," "SS Rosecrans," "SS J. B. Chanslor," "SS Humbolt," "SS Santa Rita," "SS Admiral Schley," "SS Nevadan," and then to the old shore station "PC" at Astoria, Oregon.

After some special assignments with the old Radio Division of the Department of Commerce, Washington, D. C. (1916-1918) Joe was called by the Navy as a Chief Special Mechanic, Radio, and made assistant chief engineer in building a 1000 kw. arc station near Bordeau, France—largest arc transmitter ever built. In 1922, after World War I, Mr. Hallock and his former associate formed the Hallock & Watson Radio Service, for sales, engineering, and broadcast manufacturing and, according to the former, they had the first broadcast license in Portland, Oregon.

After this venture, our subject old timer handled announcing activities for station KGW/KEX Portland, Oregon where he did sports and special events for the Red and Blue nets of NBC. In 1935 he returned to the Federal Radio Commission at Washington, D. C., later known as the Federal Communications Commission, where in 1942-1944 he was identified as Chief of the Security Section, in charge of physical surveys of communication facilities with recommendations for anti-sabotage protection. That was his most important assignment, and he has been with the Commission ever since.

Mr. Hallock aptly expresses himself by saying, "Since 1919 I have been married to the same wife. (She's very patient.) Also, have a son who is quite normal; that is, he has no interest in radio!"

We hail Mr. Hallock as a scholar, a gentleman, and a judge of good communication. We wish him continued success. —30—

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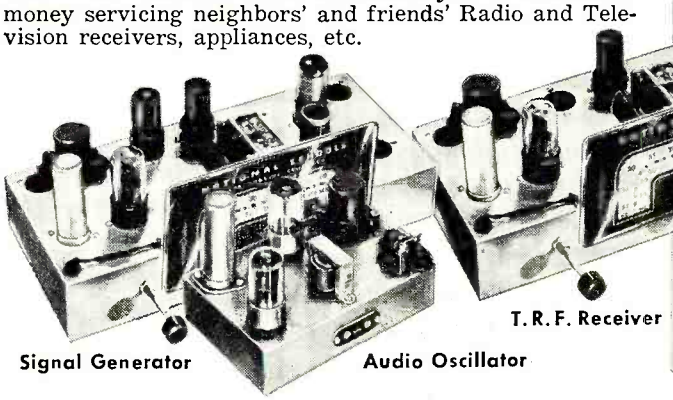

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Spot Radio News

(*Continued from page 24*)

If prompt action had been taken to establish a new allocation table and the u.h.f. channels opened when there were less than a million TV sets operating, Dr. Du Mont declared, there . . . "would not have been the suppression of the 'courage and daring' of the two smaller networks."

Reviewing the properties of the higher bands, Dr. Du Mont pointed out that the optimistic side of the u.h.f. picture has not been properly presented. During the approximately nine years of commercial TV, he said, available transmitter power for the lower band stations has increased from a fraction of a kilowatt in '38 to 50 kilowatts this year. But, during the two years of high-band TV, power from a transmitter has increased only from 1 to 12 kilowatts, permitting an effective radiated power of about 250 kilowatts; but one-quarter of the output permitted under the present rules. However, it was pointed out, given the proper incentive, manufacturers will shortly achieve the maximum power allowed under the law; it has already been announced that a high-gain antenna, which would be available soon, would almost double the power output now available.

Analyzing receiver characteristics, the CRT pioneer said that early v.h.f. chassis had noise figures of about 20 db, and as late as three years ago the industry average was approximately 14 db; this year the figure has been improved and now is between 5 and 10 db. Last year, noise figures for u.h.f. sets averaged about 20 to 24 db; this year it's about 14 to 18 db. However, it was noted, it has been found possible to build a receiver with a noise figure of less than 7.5 db; but such a set would cost from $175 to $200 more than current models. We all know, said Dr. Du Mont, that with the proper incentive, most in industry could produce u.h.f. chassis with noise figures as low as the v.h.f. models, and mass production would lead to smaller costs and lower prices for the finished product.

The receiving antenna was also carefully surveyed in the Du Mont report. To illustrate the effectiveness of antennas on the low and high bands, two conditions for channels 4 (approx. 70 mc.) and 52 (approximately 700 mc.) were posed. Using simple dipoles in equal strength fields from stations on such channels, it was explained, the u.h.f. antenna would pick up only 1/100 the power that the very-high antenna would pick up; however, the high-band antenna would only be 1/10 as long as the v.h.f. antenna, Dr. Du Mont explained. Because of this small size, he added, it is a relatively simple matter to increase the capture ability of the antenna. For example, a commercially available u.h.f. antenna, such as the double di-fan with reflectors, has a power gain greater than 10. Using this antenna, in equal fields, the ultra-high model will therefore receive 1/10 the power of the v.h.f. antenna. The FCC has recognized this differential, Dr. Du Mont added, and has therefore compensated for it by permitting 10 times the power on channel 52 as on channel 4.

The remaining factor in the system is the propagation path, the Senate committee was told. This, it was said, is a complex factor, with many variables to worry about. For instance, between the transmitting and receiving antennas, the signal may be refracted in the earth's atmosphere and ionosphere; it may be reflected from natural and man-made irregularities in the terrain, and it may be diffracted or bent over and around obstacles on the earth's surface. Furthermore, the signal at the receiving site is generally a resultant of many signals which have arrived over many different paths. Because of these peculiarities, most of the propagation information has been obtained by experiment. According to diffraction theory, the report said, it was predicted that as the frequency is increased the tendency for waves to bend over and around obstacles is decreased; measurements proved this to be so. Accordingly, u.h.f. coverage in rough terrain will be found to be more spotty than v.h.f. coverage. But, it is not true that the v.h.f. signals fill in valleys and u.h.f. signals do not; both signals, it was revealed, are attenuated when they are required to bend over hills and the difference in the amount of bending has frequently been exaggerated.

Dr. Du Mont's brief also stated that, according to theory, the u.h.f. signal should suffer less from man-made interference than the v.h.f. signal. This also has been proven in practice; commutator interference from rotating machinery, diathermy, electric razors and other similar items, all cause considerable interference on low-band v.h.f. and virtually none on u.h.f.

The absence of multipath effects on the high bands was described as possibly the most significant difference between high- and low-band reception. This, it was said, did not jibe with theory and came as a complete surprise to several investigators. Almost, without exception, declared Du Mont, engineers and the public alike have expressed amazement at the clarity and sharpness of u.h.f. pictures.

Reviewing the influence of multipath effects on black-and-white, and color, Dr. Du Mont said that such effects are viewed as smear and ghosts on black-and-white pictures, and on color, contamination of the color is added. During recent experimental color tests on the low- and high-bands, it was found that transmissions on the u.h.f. bands were substantially superior to those delivered by a low-band transmitter.

THE GENERAL ECONOMIC PLIGHT of telecasters in the early days of TV,

revealed in a few briefs during the first few days of the hearings, were re-emphasized by many v.h.f. broadcasters, in answer to dollar complaints made by u.h.f. operators.

One broadcaster said that many v.h.f. stations have been struggling for years. In his case, almost four years passed before any profits appeared. Currently, he added, there are stations in New York and Los Angeles where red ink still flows.

Describing the experiences of *Westinghouse*, a spokesman said that . . . "along with other pioneers in the early days of radio and again in the early days of TV . . ." the company faced . . . "exactly the same problems being presented to the Senate Subcommittee by u.h.f. protagonists. The problem then and now is an adequate number of sets in the hands of the public and attractive programming which the advertising industry is willing to support."

INDEPENDENCE DAY was celebrated in an unusual way at the Limestone Air Force Base, Limestone, Maine, when the nation's tiniest TV station, with an eight-watt output, capable of providing reception to 15,000 living within a three-mile radius, was officially dedicated.

Conceived by General Curtis E. LeMay, Commander, Strategic Air Command, as an entertainment medium for personnel at isolated bases, the unique operation is geared to provide live telecasts and film recordings of major network programs.

Studios and transmitter facilities are housed in a television shack, ten by thirteen feet, constructed atop a four-story base hospital. Presently ten hours of network programs are provided every day. In addition, those on the base hear three live newscasts daily and twice-daily weatherman reports. Regularly-scheduled flying safety programs are also carried, as well as religious telecasts produced by Air Force chaplains and their staffs. It has been estimated that there are about 1000 TV sets on the base.

Describing Air Force policy on the operation of these morale TV stations, Colonel Bertram C. Harrison, Commander, 42nd Bombardment Wing, said: "We will operate television stations only in areas where it is not possible to receive TV programs from commercial outlets. We do not intend to compete with private industry. Our sole purpose is to provide television entertainment to our people when it is not available from privately-owned stations."

The first program from this station was actually presented last Christmas. The Limestone base was selected as the initial site because of its isolated position, a few miles from the Canadian border.

Participating in the official previewing ceremonies were Colonel Jackson W. Lewis, Commander of the base; Colonel William B. Campbell, Deputy Commander, 42d Bombardment Wing;

Major Peter O. E. Bekker, Information Services Officer at the base, and Second Lieutenant Charles Hughes, technical director of the station, and formerly a staff member of a Washington TV station.

A METHOD OF CONVERTING solar light into electrical energy has been developed by the Wright Air Development Center, near Dayton, Ohio. The conversion powers of the ARDC generator were described as so great that a wafer-thin slab of crystal, four feet by fifteen feet, either resting on or built into the roof of the house, could supply enough current to operate all of its lights, stove, refrigerator, and other appliances, 24 hours a day.

The secret, spokesmen said, was in the use of cadmium sulfide, a yellow powder used as a pigment in paint, which when processed into crystal form permits a direct conversion of light into electrical impulses.

Attached to opposite sides of the crystal are electrodes or terminals; one, made of silver, is the positive, and the other made of indium, a soft metal normally used as an alloy in some bearings, is the negative.

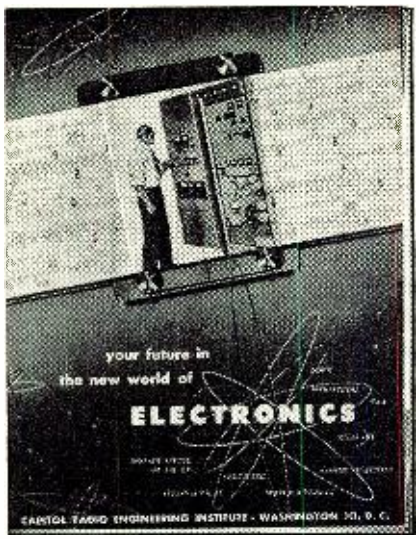
In use, light striking the crystal-electrode interface induces a direct current electrical potential, which is carried out by means of the electrodes. If the electrodes are connected to a motor or some other electrical device, the current will flow as though it were produced by a generator; Actually, this is an electrical generator driven by the sunlight; it is technically known as a barrier-layer cell.

The amount of current is determined by the area of the electrode attached to the crystal. In the pilot model, a one-eighth square inch area produced one-third volt. The barrier-layer cell, as developed by the ARDC scientists, is said to differ from the thermocouple method of inducing electrical energy, in that the latter requires a hot and cold junction and utilizes heat rather than light.

HARASSED by the Senatorial investigation, which has stymied filings and procedures, the hearing division of the Commission has released few grants. As this column was being prepared, channels listed on page 128 were authorized for, in the main, v.h.f.; only one u.h.f. grant had been approved.

A HIGH-SPEED DIGITAL COMPUTER, designed to serve as an experimental nucleus for a complex data-processing network, which can solve problems involved in automation or control of air traffic, has been completed by the Bureau of Standards. Known as the *Dyseac*, and utilizing dynamic electronic circuitry techniques which involve the performance of all logical operations by diode gating, electrical delay lines are used for all incidental pulse storage and transformer-coupled pulse amplifiers use only one tube type for all amplification.

Circuitry has been reduced to stand-



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Today there are over 97,000 radio-equipped police cars; an even larger number of taxis are radio equipped (at least 87,000); 32,000 civilian planes have radio; 35,000 American ships have radio.

Today there are over 120,000,000 radios in use. There are 28,000,000 TV sets and 381 TV stations in operation. Color TV is coming into its own. Countless positions must be filled—in development, research, design, production, testing and inspection, manufacture, broadcasting, telecasting and servicing. To fill these posts, trained men are needed—men who somewhere along the line take time to improve their knowledge, their skills. Men who, today, perhaps, take two minutes to send for a booklet.

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ardized packages; only two types of etched-circuit plug-in packages are required as basic building blocks, thus simplifying design practice, construction, and maintenance.

Single basic circuit serves as a low-impedance pulse driver, a flip-flop, and for a number of gating functions. Each tube package consists of an amplifier, pulse transformer, and a number of diodes.

THIS CENTURY should be known as the *Century of Electronics* rather than the *Era of Atomic Energy*. So said radio's grand old man, Dr. Lee de Forest, recently during an AIEE luncheon meeting in Los Angeles.

Reviewing the import of the electron tube, he said that electronics is now a billion-dollar per year industry, which is continuously increasing in scope and utility. Today, the engineering audience was told, electronics is used to sound ocean depths, locate schools of fish, and in diathermy and encephalography, it is an indispensable tool of the medical staff. The electron, he added, completely controls aviation.

When, last year, a representative of a tube company presented him with its billionth tube, he was flabbergasted, for he said, little did he realize in 1906 that the world's supply of two triodes in his possession would eventually grow to such proportions. Frankly, he declared, he wasn't aware of the ". . . dynamite he had in his pocket."

In his opinion, the *Century of Electronics* is a more apt description of the present age, because without complex electronic devices, nuclear developments would be impossible. The fast expanding future of electronics, Dr. de Forest added, is . . . "unlimited and unpredictable in every human field." . . . . . L.W.

NEW TV STATIONS ON THE AIR

(As of August 25, 1954)

The following new stations bring the lists published in previous issues up to date.

STATE, CITY	STATION	CHANNEL	FREQUENCY RANGE (IN MC.)	VIDEO WAVELENGTH (IN FT.)	VIDEO POWER (IN KW.)
Florida					
West Palm Beach	WJNO-TV	5	76-82	12.74	100
Missouri					
Sedalia	KDRO-TV	6	82-88	11.8	16.2
St. Louis	KWK-TV	4	66-72	14.61	100
New York					
Buffalo	WGR-TV	2	54-60	17.8	100
North Carolina					
Asheville	WLOS-TV	13	210-216	4.65	170
Pennsylvania					
Harrisburg	WCMB-TV	27	548-554	1.79	77.6
Tennessee					
Old Hickory (Nashville)	WLAC-TV	5	76-82	12.74	100
Utah					
Salt Lake City	KUTV	2	54-60	17.8	27.5
West Virginia					
Charleston	WCHS-TV	8	180-186	5.43	316
Wisconsin					
Marinette	WMBV-TV	11	198-204	4.93	115

KBID-TV, channel 53, Fresno, California; KDZA-TV, channel 3, Pueblo, Colorado; KFXD-TV, channel 6, Nampa, Idaho; WRAY-TV, channel 52, Princeton, Indiana; KFAZ, channel 43, Monroe, Louisiana; WBKZ-TV, channel 64, Battle Creek, Michigan; WFTV, channel 38, Duluth, Minnesota; KMBC-TV, channel 9, Kansas City, Missouri; WBES-TV, channel 59, Buffalo, New York; KNUZ-TV, channel 39, Houston, Texas; and WTOV-TV, channel 27, Norfolk, Virginia, have gone off the air. WKJF-TV, channel 53, Pittsburgh, Pennsylvania, has been temporarily suspended.
KDYL-TV, channel 4, Salt Lake City, Utah has changed its call letters to KTVT (TV).

The frequency of the video carrier = 1.25 + channel lower freq. limit. Total number of TV stations now on the air in U.S.: 390 (126 of which are u. h. f.)

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)
Arizona	Phoenix	.....	3	60-66	100
Minnesota	Minneapolis	.....	9	186-192	316
Missouri	Jefferson City	KRCG	13	210-216	86.3
Ohio	Mansfield	.....	36	602-608	17
Wisconsin	Milwaukee	WTVW	12	204-210	251

NEW CALL LETTER ASSIGNMENTS

Alabama	Munford	WEDM	9	186-192
Arkansas	Ft. Smith	KNAC-TV	5	76-82
California	Stockton	KOVR	13	210-216
Michigan	Flint	WJRT	12	204-210
North Carolina	Durham	WDTV	11	198-204
Ohio	Youngstown	WFMJ-TV	21	512-518
Utah	Salt Lake City	KTVT	4	66-72
Washington	Seattle	KCTL	20	506-512
West Virginia	Oak Hill (Beckley)	WDAY-TV	4	66-72

*ERP=(effective radiated power, kw.) . . =Call letters to be announced

Transistor Phase Inverter

(*Continued from page 71*)

phase inverter will handle is ten volts peak, which is sufficient for push-pull 6V6 tubes in class A operation. The minimum signal level is determined by the noise factor of the transistor. The transistor phase inverter may be excessively noisy, if used directly from a low-output microphone; a minimum signal level of —40 db should be obtained, by a vacuum-tube stage, if necessary, for good performance.

For good frequency response the phase inverter should be used with high-impedance input and output circuits, and the shunt capacity should be kept low. Short, direct wiring to other stages should be used. If the phase inverter must be used with an input circuit or output circuit of low impedance, the input or output coupling condensers may be increased, if it is desired to improve the low-frequency response.

A voltmeter of 20,000 ohms-per-volt or better, or a v.t.v.m. should be used in measuring the voltages. The base voltage, measured at the junction of R_2 and R_3 is + 70 volts above ground. Emitter voltage, at the junction of R_3 and C_3 is + 72 volts. Collector voltage, at the junction of R_6 and C_4 is + 18 volts.

R_1C_1 form a decoupling and voltage-dropping network to supply + 90 volts at the junction of R_1 and C_1. The input signal is fed through C_2 to the transistor base at the junction of bias resistors R_2 and R_4. The emitter current flowing through load resistor R_3 develops the in-phase output voltage, which is coupled through the blocking-condenser C_3 to one grid G_1. Collector current flowing through R_5 gives the phase-reversed output, which is coupled through blocking condenser C_4 to the other grid, G_2, of the push-pull stage.

It would appear that the transistor will find increasing use as a phase inverter in audio amplifiers of the push-pull class, provided that transistors are available at a price competitive with the triode.

When this happy day dawns, we can expect to see not only smaller and more compact amplifiers but units of unparalleled reliability. —30—

TV INTEGRATOR ACTION

By ED NOLL

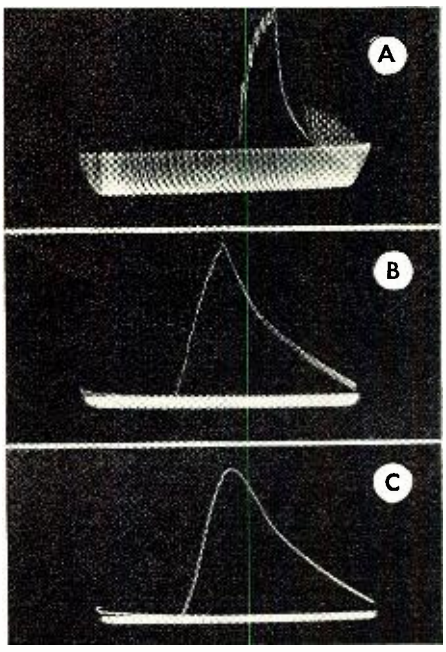
A KNOWLEDGE of the functions of the integrator circuit in TV can be best understood by seeing it in action. The vertical synchronizing interval is a small time portion of the total vertical field period, however, if the oscilloscope is set on the 600 cycle range the vertical interval is discernible and can be spread out over a substantial portion of the screen. A heavy bright base line will be present because the beam will sweep back and forth along this line nine times for each field. Only on every tenth sweep does the vertical sync interval arrive and deflect the pattern vertically, see Fig. 1C.

The set of integrator waveform photographs shown in Fig. 1 demonstrates the functions of the triple-section type. As the scope is moved progressively along the integrator notice how the vertical is emphasized more and more above the horizontal sync components. This action shows the reduction of the horizontal so it can not interact with the precise firing of the vertical and impair interlace. Likewise, any noise impulses are attenuated progressively by each section of the integrator, improving the noise immunity of the vertical deflection system.

Fig. 1A demonstrates much about the operation of the vertical synchronization system. It shows clearly the charge and discharge activity during the vertical sync interval. Along the base line we can observe the charge and discharge of the integrator during the horizontal sync intervals showing a constant level. Right at the very center of the horizontal group you can see the charge and discharge periods of the leading set of equalizing pulses.

Finally the first long duration vertical sync pulse arrives and the voltage rises sharply on the integrator. It continues to rise for the six vertical sync pulses because of their long duration and short spacing. Notice that this voltage has an over-all exponential rise just as with any condenser charge. At the end of the vertical interval notice how quickly the equalizing pulse interval with short duration and wide spacing quickly discharges the integrator exponentially. Horizontal intervals carry the charge back to the base line eventually. It is important to note that the trailing set of equalizing pulses do the bulk of the discharge work. —30—

Fig. 1. Waveforms obtained at successive stages of a 3-stage TV vertical integrator. (A) Input section of the integrator, (B) second section, and (C) output section. Notice how the horizontal sync components are decreased.



A NEW SLANT ON TVI

By **DAVID T. GEISER,** W1ZEO

Describes a set of antenna and line filters which, with careful screening, cut down annoying TV set radiation.

THERE is a word, "bilateral," which describes components that have identical characteristics in each direction of current flow. This word also applies to TVI. Amateurs can interfere with television receivers; television receivers can (and do) interfere with amateurs.

The writer has not been troubled with his transmitter causing TVI; it was debugged long ago. Recently, however, he purchased a television set. Having heard what a broadcast set sounded like close to a television receiver, he was somewhat prepared for what he heard on 75 meters. Every 15,750 cycles there was a rough "S9+" harmonic on the HQ-129X. Between these harmonics was a fire-siren whine of the video, averaging between "S6" and "S7." There could be little amateur operation, except with local stations, until this condition was cleared.

The local dealer from whom the set had been conditionally purchased was given the bad news. The writer was referred to W1JXY, who is the local authority on 17-inch "transmitters." He suggested making sure that the antennas of the HQ-129X and the TV set were as well isolated and selective as practicable (they were), and recommended removal of the television lead-in at the TV set to check the path as to radiation or power-line conduction. Disconnecting this lead reduced the interference of the HQ-129X to "S2." Naturally, the next thing to do was to install a high-pass filter where the TV antenna leads entered the cabinet. Unfortunately, the cabinet was not at the same r.f. potential as the chassis, so grounding the filter to the metal cabinet (with a fiber back) made the interference peg the meter on the ham receiver. The high-pass filter was necessary in spite of this discouraging step. All that had happened was that the antenna and the cabinet were at the same (under 30 mc.) potential, so they were both radiating. The power line acted as the ground.

A trip was made to the local hardware store for copper screening and, in the best transmitter style, a shielded back was made for the TV receiver. (If the cabinet is wood or plastic, it will probably be necessary to shield the top, bottom, and sides also.) Installation of the shield reduced the interference to about "S9," although little hope had been held for even this much improvement. Constructed by a pessimist, the shielded back (see Fig. 1B) also had mounting provisions for line filters, so line filters were installed.

Now the transmitter (beg pardon, TV receiver) was moderately shielded, and all leads were filtered. Absolutely no interference could be picked up on the station receiver between 550 kc. and 30 mc. This looked so good that the home broadcast sets were brought close, plugged into the same power outlet as the TV set, and turned on. With the cabinets a foot or more apart, no noise could be picked up from the TV set. With one set resting on the TV receiver, noise could be picked up, but this was not perceptible on local stations.

Checking, each of these features were found necessary: the back had to be shielded, a high-pass antenna filter was needed, and the power line required low-pass filters. The work was not elaborate or complete; paint was not scraped from the back edge of the metal cabinet, so only point-bonding of the shielding was obtained. The results, however, were adequate and the work stopped when satisfaction was reached. What r.f. leakage remained was coming out of the front of the cabinet but, as described, was negligible.

Although inexpensive commercial filters were used by the author, filters designed for home construction are

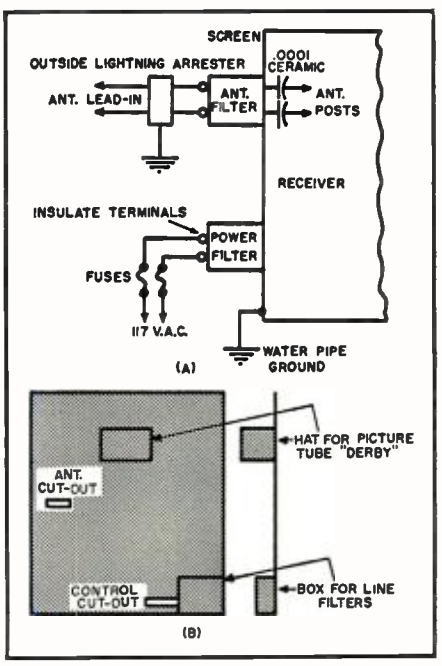


Fig. 1. (A) Filter setup used to cut down on TV set interference radiation. (B) Layout for the copper screen used for shielding the back of the TV set.

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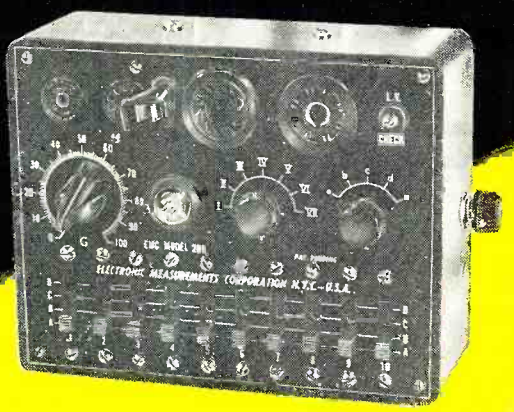

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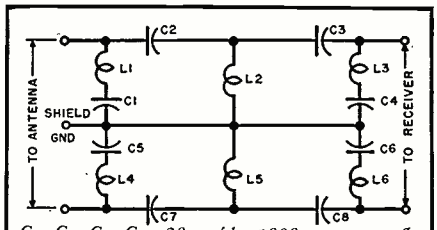


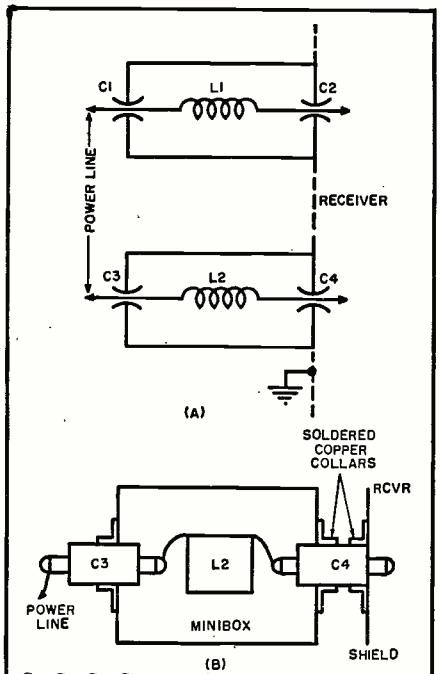
C_1, C_4, C_5, C_6—20 μμfd., 1000 v. zero-coeff. cond. (Sprague NPO 5TCC-Q2)
C_2, C_3, C_7, C_8—15 μμfd., 1000 v. zero-coeff. cond. (Sprague NPO 5TCC-Q15)
L_1, L_3, L_4, L_6—10 t. #18 en., ½" dia., ½" long (see text)
L_2, L_5—6 t. #18 en., ½" dia., approx. ½" long (see text)

Fig. 2. Schematic diagram and parts list for the antenna high-pass filter.

shown in Figs. 2 and 3. The high-pass antenna filter shown in Fig. 2 contains series *m*-derived sections rather than shunt sections and thus, does not require the power-frequency blocking condensers recommended in Fig. 1A. Attenuation with shielded construction is good. Zero coefficient condensers, of the type specified in the parts list of Fig. 2, insure low insertion loss, good balance, easy adjustment, and a degree of stability not usually found in commercial television antenna high-pass filters. The lengths of L_1, L_3, L_4, and L_6 should be adjusted to grid dip with C_1, C_4, C_5, and C_6 respectively at 41 mc. Similarly, the length of L_2 and L_5 should be adjusted to grid dip with C_2, C_3 and C_7, C_8 respectively at 93.4 mc.

Figure 3A shows the line filter. The constants given for the home-made filter give adequate attenuation for the degree of shielding used on the television receiver. Figure 3B shows constructional details necessary for maximum filter effect, although in most cases this degree of care will not be required.

Fig. 3. Schematic diagram, physical layout, and parts list for line filter.



C_1, C_2, C_3, C_4—.1 μfd., 250 v. cond. (Sprague 48P9 "Hypass")
L_1, L_2—#18 d.c.c. closewound to 1½" long, 1½" dia.

Figure 1A outlines certain installation precautions. If the power wiring of the set is not fully understood, it is best to include the ceramic blocking condensers to prevent power shorts *via* the antenna filter if a commercial unit rather than the home constructed one is used. Other factors of safety should not be overlooked, particularly the installation of grounds, fusing, insulation, and the lightning arrester.

The wife and children can now watch TV without interference from my transmitter; I can ham without the TV set interfering with the station receiver. It's bilateral. —30—

FISH "SCANNERS"

By SYDNEY H. COOKE

TO INCREASE the size of their catches, Pacific Coast fishermen and operators have adopted electronic instruments almost as fast as they have come from the laboratory. Today we find direction finders, automatic pilots, radiotelephones, and echo sounders as standard equipment aboard West Coast high-line fishing vessels.

The new Minneapolis-Honeywell "Sea Scanar" was recently installed on the salmon-herring seiner "Pacific Sunrise"—one of the 114-unit fleet of The Canadian Fishing Co. Ltd.

Test fishery is now underway with this sweeping sounder which gives the distance, angle, and depth of the school of fish—thus locating the school and the extent of its density. The range of the instrument is down, ahead, and 180 degrees to the port and starboard. The standard echo sounder normally indicates only those objects which the ship is passing over not objects ahead of the ship or to the left and right of its path.

The "Sea Scanar" works like a searchlight, sweeping to port and starboard for whale while the echo sounder functions similarly to locate "bottom." The whale, of course, would give an indication of a "bottom."

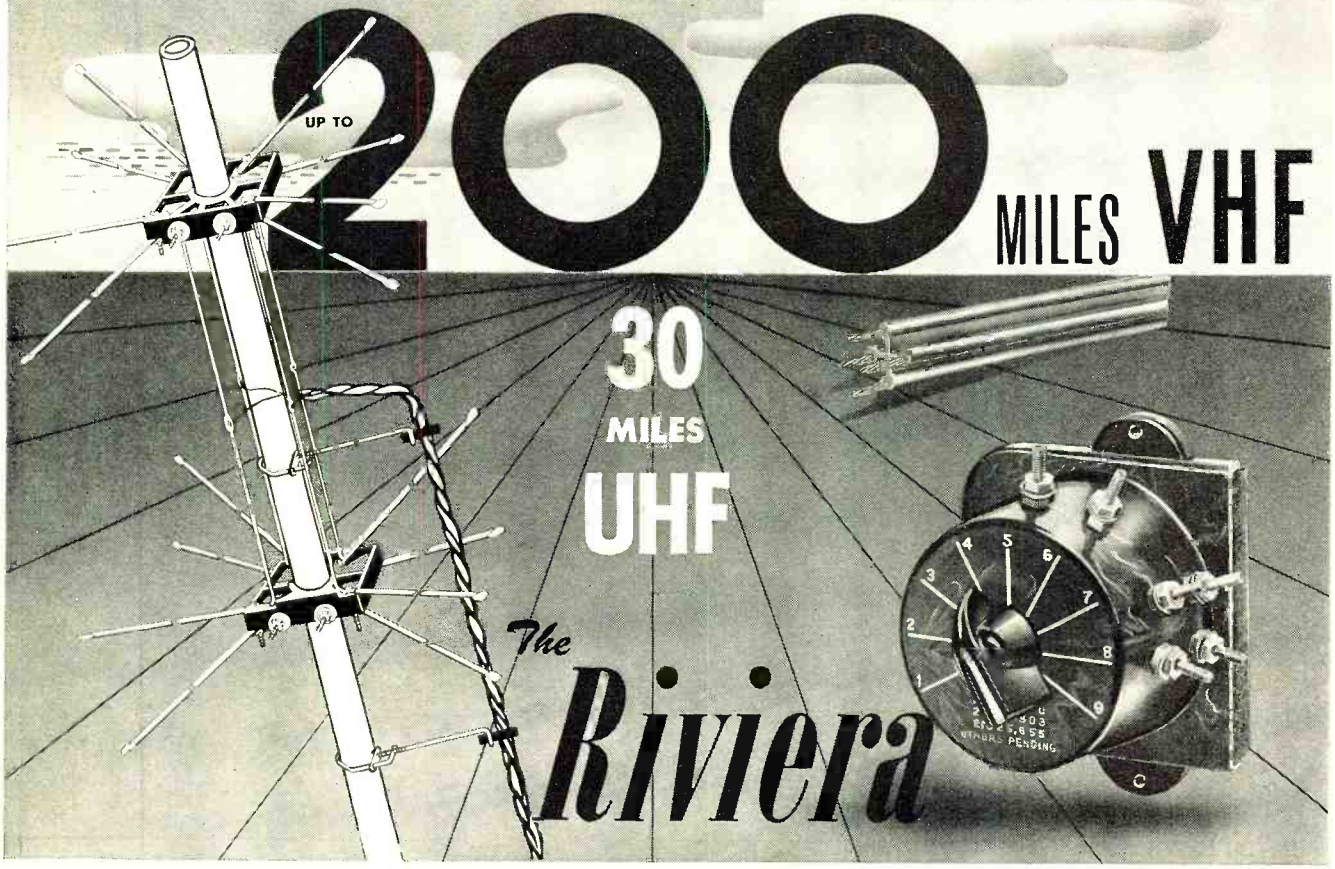
Different problems arise in scanning for whales than those encountered when locating schools of fish. The limited range imposes some difficulties in whaling. For example, at the range of 1600 feet the indication of the whale gets fuzzy on the tracer. Scanning is better at 800 or 400 feet—a range which is considered too close for whaling operations. Whalers would like to see the range increased to 1600 feet which is the normal distance for whaling operations. They would also like a gyro-compensator under the instrument to take care of the roll of the vessel in the trough of the sea out in the open Pacific. A whale coming bow on is clearly indicated, but coming broadside, the beam jumps every wave and shows a blurb in the tracer or nothing at all.

Last season, during the whaling operations of the British Columbia Packers Ltd., which operate a fleet of 78 fishing vessels and packers, a similar unit was installed on the whaler "Nahmint" with Capt. Harry Simpson in command and Victor Gagen as mate and harpoon gunner.

Out of a catch of some 539 whales during the season, the harpoon gunner estimates that three of this catch would not have been found without the scanner unit. —30—

NEW PATENTED RADAR ANTENNA

OPENS NEW HORIZONS TO TV VIEWERS



ALL DIRECTIONS • ALL CHANNELS • 2—83

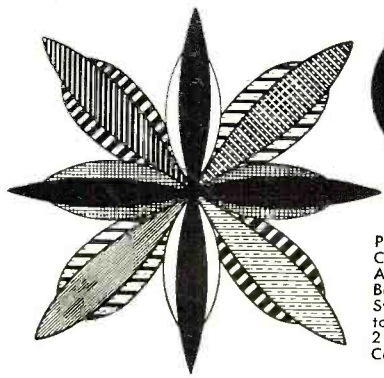
COLOR AND BLACK-WHITE *without* ANY ROTORMOTOR

These are the reasons why the "Riviera" is by far the most powerful VHF antenna on the market today!

1. Utilizes 16 elements 60" long, ½" diameter.
2. Utilizes a specially designed, extra low loss four conductor air-dielectric POLYMICALENE transmission line which has up to 50% less loss when wet than the finest conventional transmission lines.
3. The "Riviera" encompasses an electro-magnetic capture volume of well over 650 cubic feet, many times more than conventional antennas.
4. The antenna works on the revolutionary principle that the approaching wave front is elliptically rather than horizontally polarized.
5. The new specially designed 9 position electronic orientation switch, aside from changing directivity, maintains a consistently better impedance match over the entire UHF-VHF spectrum.
6. The above features combine to give the "Riviera" antenna greater usable gain at the TV set antenna terminals than the best of any competitive antennas using rotor motors.

This new wonder antenna, called the "Riviera", is already making history. Beyond any question of a doubt, and on an *unconditional money back guarantee*, it will positively outperform in the field under actual installation conditions, any and all competitive antennas on the VHF channels, with or without rotor motors.

POLAR PATTERNS



only **$49.50** LIST PRICE

Price includes: Complete Stacked Array • Stacking Bars • 9 Position Switch • Switch-to-set Coupler • 2 Stand-offs, 7½" • Complete instructions

The polar directivity response patterns show the major lobes of the "Riviera" antenna on VHF. It shows the fullness of coverage in all directions of this remarkable, patented antenna as it is turned through each of the nine switch positions. Each degree of shading constitutes a different switch position. This excellent directivity response, which can be switched at will, plus the extremely high gains, clearly indicate why the Riviera is such a superior performer.

ALL CHANNEL ANTENNA CORP.
47-39 49th STREET, WOODSIDE 77, N. Y. EXETER 2-1336

IN UHF-VHF DISTRICTS . . . USE
The NEW Super 60
100 MILES VHF • 60 MILES UHF

Dot Pattern Generator

(*Continued from page 47*)

rangement is sufficient for stable sync. The sync control, R_1 in Fig. 3, regulates the sync pulse amplitude. It is important to set the horizontal frequency control to get a stable, fixed number of vertical bars as shown in Fig. 8. The procedure for adjusting horizontal linearity is similar to that outlined for the vertical sweep section. Pincushioning or other yoke distortion will appear as bent, bulging, or wavy vertical bars.

For a rapid check of both vertical and horizontal linearity the grid or crosshatch pattern can be used. As Fig. 9 shows, this type of pattern tends to accentuate any non-linearity and therefore allows more accurate adjustment. Just compare the squares in the center of the screen with the squares at the sides or corners. In Fig. 9, it is apparent that the horizontal sweep is compressed at both sides while the vertical sweep is expanded at the bottom and compressed at the top.

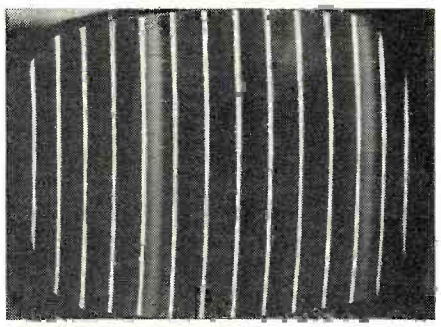
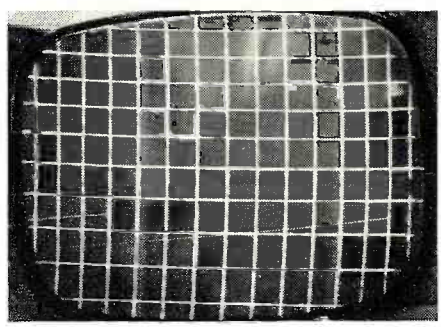


Fig. 8. Vertical bar pattern with the generator selector switch in position 4.

The great utility of the pattern generator described here lies in the fact that it produces white dots as shown in Fig. 10. This white-dot pattern is of great help in adjusting convergence on shadow-mask type color picture tubes such as the 15GP22 and its larger cousins, as described in the July 1954 issue of RADIO & TELEVISION NEWS. The dot pattern will produce white dots only when proper convergence is achieved. When convergence is off, two or three colored dots will appear.

The dot signal can be introduced

Fig. 9. Grid or crosshatch pattern used for linearity adjustments, position 3.



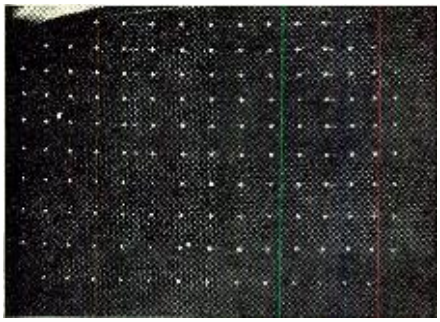


Fig. 10. White dot pattern for color TV convergence adjustments, switch set at 2.

either through the antenna or through the video stages, as with the other patterns. To obtain only the desired dots, set the video gain controls for maximum and adjust the brightness control until the screen is completely black, except for the white dots.

Because it is possible to synchronize the pattern generator to the receiver sweep circuits, rather than the other way around, the video signal can be applied anywhere in the video circuit without loss of sync. This permits signal tracing the video section of receivers and also allows using the generator instead of a station signal for channels 2 through 6. When an intermittent defect appears and some doubt exists as to whether it is in the antenna or in the receiver, use the r.f. signal from the generator to see whether the intermittent is really in the set or not.

To use the signal-tracing method of troubleshooting in the r.f. or i.f. section, just connect the pattern generator, set for horizontal bars, and use a crystal detector with earphones to trace the loud buzz through the various stages. Since the video signal for horizontal bars is about 600 cps, it provides a low-frequency buzzing which can be easily identified through earphones or any signal tracing equipment. The amplitude of the video signal can be controlled by the output control, R_s in Fig. 3, but the r.f. amplitude has to be adjusted either by the receiver gain control or else by the amount of detuning or the method of coupling. In many instances the author found that it is merely sufficient to bring a clip lead from the generator r.f. terminals near the TV receiver to obtain strong, stable patterns. —30—

ST. LOUIS "HAMBOREE"

THE annual Egyptian-St. Louis area "Hamboree" and picnic will be held, rain or shine, on Sunday, September 19, at the Egyptian-St. Louis Radio Club Grounds, 1 mile east of the Mississippi River on the south side of U.S. highway 66.

An interesting and varied program has been planned by the committee. Food and drinks will be available on the grounds. Admission will be free to out-of-town hams.

For further information contact either W9AIU, the club station at Granite City, Ill., or WØWPS, the committee chairman. —30—

MANUFACTURERS' LITERATURE

The various listings presented in this section are for your convenience. The bulletins, unless otherwise indicated, are available to all our readers. For prompt attention write directly to the manufacturer for this literature.

RMS CATALOGUES

Radio Merchandise Sales, Inc., 2016 Bronxdale Ave., New York 62, N. Y. is making available two new, up-to-date catalogues.

Catalogue 55-S, which is a supplementary issue of the company's regular annual catalogue, describes and illustrates all of the firm's latest antennas and accessories. The second publication, 55-H, details the company's complete line of hardware.

Both catalogues are conveniently punched for insertion in catalogue stands. Either or both may be obtained by writing Clifford Shearer, the firm's director of advertising.

CENTRALAB DATA

Centralab, 900 E. Keefe Street, Milwaukee 1, Wis. has issued two new data sheets, one covering feedthrough bushings and the other JAN ceramic standoffs.

The information is provided in abbreviated, tabular form for quick reference. Details of the mechanical construction are also included. Either or both of these publications is available on request.

HIGH-VOLTAGE RESISTORS

International Resistance Company, 401 N. Broad St., Philadelphia 8, Pa. is now offering copies of its Bulletin G-1.

The new publication provides comprehensive data on 45 different types of high-voltage resistors, including characteristics, construction, individual specifications, applications, installation information, etc.

This 8-page publication on the Type MV resistors is available on request.

AUTO ANTENNAS

Snyder Manufacturing Company, Philadelphia 40, Pa. has just published a redesigned catalogue illustrating its new line of auto radio antennas.

The new publication is printed in full color and includes descriptive information on the company's series of cowl and fender mount auto radio antennas plus rear and deck mount antennas. Featured is the new *"Snyder*-Matic" auto antenna which raises or lowers three sections by means of finger-tip dash control.

Requests for copies of this new catalogue should be addressed to Dick Morris, sales manager of the firm.

NEDA BATTERY INDEX

The 1954 edition of the "NEDA Battery Index," published by National Electronic Distributors Association, is being offered by the association to all distributors, service technicians, dealers, etc.

Single copies of the publication are free and larger qauntities are available at $5.75 per hundred by writing the Association at 228 N. LaSalle St., Chicago 1, Illinois.

SOUND EQUIPMENT

The David Bogen Co., Inc., 29 Ninth Ave., New York 14, N. Y. is now distributing a new catalogue covering p.a. amplifiers, sound systems, and sound accessories.

A section entitled "Hints for Selecting the Proper Sound System" has been included for the benefit of the layman. The new catalogue, PA554, gives complete specifications on the *Bogen* line.

The catalogue is currently available from the company's distributors or from the company direct.

CONDENSER SPECIFICATIONS

Astron Corporation, 255 Grand Avenue, East Newark, N. J. has prepared a new folder which gives technical information on its "Blue Point" line of molded plastic paper condensers.

The folder, AB-20B, outlines operating characteristics, voltage ratings and deratings, capacitance stability as well as the test conditions required of the units. Tolerances, wire lead sizes, and other pertinent data are also included.

Copies are available without charge from the company.

WARD ANTENNAS

Ward Products Corporation, 1148 Euclid Avenue, Cleveland, Ohio is currently offering copies of its new illustrated brochure to distributors and dealers.

The new publication features individual flexible catalogue sheets. Instead of the traditional type of booklet, the sheets are housed in a multi-colored folio type cover. By using the individual sheets the catalogues can be kept up-to-date when new models are made available.

Full details on each of the antennas in the company's line are provided.

CABINART CATALOGUE

G & H Wood Products Company, 75 North 11th Street, Brooklyn 11, New York has issued a new catalogue covering the *Cabinart* line of hi-fi equipment cabinets, speaker enclosures, and kits.

The pocket-size catalogue illustrates all of the company's models and includes individual specifications and spot illustrations which highlight each

RAD-TEL Full Year Guaranteed TUBES

70 TO 90% OFF . . . RAD-TEL TUBES FOR QUALITY, PERFORMANCE, AND DEPENDABILITY

COMPARE! Save More At RAD-TEL On All Parts!

VARIABLE CONDENSERS

Manufactured by Philco, Radio Condenser, etc. 2 Gang AM and FM: No. 9 Each 89c. Lots of 3 79c.

Contains 2 separate sections for AM and 2 for FM with padder condensers. With attached slug tuned high frequency coil whose plunger is geared to condenser shaft. Pulley type drive wheel.

2 Gang AM, 3 Gang FM No. 10, equipped with drum pulley and padders. Each 89c. Lots of 3 79c.

3 Gang AM Superhet No. 12, complete with padders and pulley type drive wheel. Each 89c. Lots of 3 79c.

No. 132 CATHODE RAY TUBE REJUVENATOR

Fits all makes of picture tubes. Completely automatic. Easy to install, no tools needed. For A.C. parallel circuits. Your Old Picture Tubes are Still Useful. List price..$5.95

Lots of 10 $1.09 Each $1.29

No. 75—ARMY-NAVY HEADSETS

Individually boxed. Very sensitive. Meets both Army and Navy specifications. List price $16.00.

Each per set 2.95 Lots of 3 Each....2.83

WAFER ROTARY SWITCH KITS

A choice combination of single, double, etc. from 2 to 8 positions. Special Kit of 10..... 1.39

Lots of 3 Kits..... 1.29

No. 107—DOUBLE FLYBACK

TTR-172

Up to 13.5KV output. RCA Type Horizontal deflection transformer, with two filament windings for voltage doubler operation. First time at this low price, 1.89 ea. Lots of 3 1.79

RCA Type Flyback Transformer $1.45 Lots of 3 $1.35

No. 125—PHILCO TV BOOSTER

Completely self-contained, including 2 6J6 tubes . . . 1 for high channels and 1 for low channels and selenium rectifier. Plastic cabinet. In factory-sealed cartons, complete with instructions. $9.95

Model TB-3

No. 46—HI-VOLTAGE R. F. COIL

4500 VOLTS RF TRANSFORMER

Ideal for TV and Oscilloscope power supplies, using 5" to 7" tubes. This buy is too BIG to be beaten!

List price $7.50

Each 79¢ Lots of 3 each 69¢

No. 97—WEN SOLDERING GUN

3 seconds on 120 Volt AC readies it for any soldering requirement. 250 Watt size. Also cuts plastic tile (with special tip). Multi-useful! UL approved. Built in spot light.

Each 9.71

List price—$12.95

Lots of 3, $8.64 each

TIPS

Feraloy Long Life..35c each

Standard Tip .....11c each

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$9.00 each Lots of 3 $8.75 ea.

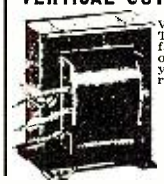
All New Parts At Old Fashioned SAVINGS!

SPEAKERS

All Standard Brands Dynamic + PM

Size	Ohms	Price	Lots of 5
3" x 7"	1000	$0.99	$0.89
5" x 7"	1800	.99	.89
5" x 7"	2700	.99	.89
6"	90	1.49	1.29
	(with 6K6 output transformer)		
8"	680	1.95	1.70
	(with 6V6 push-pull transformer)		
3.5"	38	1.49	1.29
5"	1.47 oz.	1.95	1.70
	(with 50L6 output transformer)		
4"	.68 oz.	1.89	1.64
	(with 50L6 output transformer)		
8"	2.15 oz.	2.95	2.65
10"	2.15 oz.	3.95	3.60

No. 3— VERTICAL OUTPUT TRANSFORMER



Very popular, used in most TV sets. Well-known manufacturer. Matches vertical output tube to the deflection yoke. 10 to 1 ratio. A terrific buy on a top performer.

List Price—$4.50

95c each.

Lots of 5 90¢ each

No. 133 Electrolytic Condensers

Assorted condensers, consists of single, double, triple and quadruple. All popular voltages and capacities. All standard popular brands.

Kit of 10 $2.39

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Fits all TV sets. Phosphor bronze metal plug with rubber insulator and high voltage lead. Seize this buy NOW! List price 75c.

each 19¢ Lots of 10 18¢ each

No. 53 BIAS CONDENSERS

500 MFD 12 V.—Mfgd. by Sangamo, Aerovox & Cornell-Dubilier

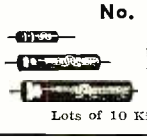
List price—$2.00

Maximum value in minimum space. A buy you've been looking for!

35c each; Kit of 10, $2.95

No. 15—RESISTORS

(ASSORTMENT OF 200)



Standard RTMA Coded or Value printed. Uninsulated, ½ Watt, 1 Watt, 2 Watt, and some 10 Watt. List price—$10.00.

Lots of 10 Kits 99c each $1.39

No. 106—DOUBLE SHELL TYPE POWER TRANSFORMER

No. J184 PRI. 117V. Sec. 266V. 300 ma; 5v, 6 AMP; 6.3V, 1.5 AMPS; 6.4V, 4.4 AMPS; 6.4V, 4.4 AMPS.

$3.50 each

JAN TUBES

Nos. 1619, 1626, 1629, 615, 7193, 954 and 45 special.

Asst. Pkg. of 10

$2.70

Some tubes easily worth $2 each

Additional Tube Values!

1E7	.29	12B4	.60
1LB4	.69	12C8M	.34
1P5GT	.57	12SC7M	.63
2W3	.38	35	.58
3B7	.27	36	.39
3D6	.27	46	.69
6AS6	1.49	55	.49
6AU4GT	.68	58	.60
6U5	.57	1274	.30

Type	Price	Type	Price	Type	Price	Type	Price
OA2	.74	**6AU6**	**.46**	**6Y6G**	**.48**	**12V6GT**	**.46**
OA4	.68	6AV5GT	.83	7A4	.47	**12X4**	**.38**
OB2	.81	**6AV6**	**.40**	7A5	.59	14A4	.69
OC3	.72	**6AX4GT**	**.65**	7A6	.69	14A5	.59
OD3	.70	6B4	.54	**7A7**	**.69**	**14A7**	**.63**
OZ4M	**.65**	**6BA6**	**.49**	**7A8**	**.68**	14AF7	.59
1A5	.49	**6BA7**	**.57**	7AD7	.79	**14B6**	**.63**
1A7GT	**.47**	**6BC5**	**.54**	7AF7	.53	14B8	.63
1AX2	**.62**	6BD5	.59	7AG7	.69	14C5	.79
1B3GT	**.73**	**6BD6**	**.45**	7AH7	.79	14C7	.79
1C5	.43	**6BE6**	**.51**	7B4	.44	14E6	.75
1G6	.24	6BF5	.41	7B5	.45	14E7	.88
1H4	.30	6BF6	.37	7B6	.69	14F7	.65
1H5GT	**.49**	**6BG6G**	**1.25**	**7B7**	**.49**	14F8	.69
1L4	**.46**	**6BH6**	**.53**	7C4	.59	14H7	.59
1LA4	.59	**6BJ6**	**.49**	**7C5**	**.69**	14J7	.30
1LA6	**.69**	**6BK5**	**.80**	**7C6**	**.59**	14N7	.84
1LC5	.59	**6BK7**	**.80**	7E5	.59	**14R7**	**.79**
1LC6	.79	**6BL7GT**	**.83**	7E6	.30	14S7	.89
1LD5	.59	**6BN6**	**.59**	7E7	.59	14W7	.30
1LE3	.59	**6BQ6GT**	**.98**	**7F7**	**.79**	14X7	.69
1LG5	.69	**6BQ7**	**.90**	7F8	.79	14Y7	.62
1LH4	**.69**	**6BZ7**	**.90**	7G7	.89	19BG6	1.39
1LN5	**.59**	**6C4**	**.40**	**7H7**	**.59**	**19T8**	**.69**
1N5GT	**.67**	**6C5**	**.39**	7J7	.79	19V8	.79
1Q5GT	.58	6C6	.58	7K7	.69	24A	.39
1R5	**.62**	**6CB6**	**.54**	7L7	.59	**25AV5GT**	**.83**
1S4	.59	**6CD6**	**1.11**	**7N7**	**.69**	**25BQ6GT**	**.98**
1S5	**.51**	**6CF6**	**.64**	**7Q7**	**.66**	**25L6GT**	**.51**
1T4	**.58**	**6CS6**	**.51**	7R7	.89	25W4GT	.59
1T5	**.59**	6D6	.59	7S7	.79	**25Z5**	**.66**
1U4	**.57**	**6E5**	**.48**	7V7	.89	25Z6	.49
1U5	**.50**	6F5GT	.39	7X6	.54	26	.45
IV	.43	**6F6**	**.59**	7X7	.70	27	.39
1X2A	**.63**	6G6	.42	**7Y4**	**.69**	32L7	.89
2A3	.30	**6H6GT**	**.41**	7Z4	.59	35A5	.58
2X2	.49	**6J5GT**	**.43**	12A6	.54	**35B5**	**.52**
3A4	.45	**6J6**	**.52**	12A8GT	.61	**35C5**	**.51**
3E5	.46	**6J7**	**.43**	**12AL5**	**.37**	**35L6GT**	**.51**
3LF4	.69	6K5	.47	12AQ5	.52	**35W4**	**.47**
3Q4	**.48**	**6K6GT**	**.45**	**12AT6**	**.41**	**35Y4**	**.54**
3Q5GT	**.69**	**6K7**	**.44**	**12AT7**	**.72**	**35Z3**	**.59**
3S4	**.58**	**6L6**	**.64**	**12AU6**	**.46**	35Z4	.47
3V4	**.58**	6L7M	.68	**12AU7**	**.60**	**35Z5GT**	**.47**
5AZ4	.59	6N7M	.63	**12AV6**	**.39**	45	.55
5T4	.79	**6Q7**	**.45**	**12AV7**	**.73**	45Z5	.49
5U4G	**.55**	6R7	.69	12AX4	.67	**50A5**	**.55**
5W4GT	.50	**6S4**	**.48**	**12AX7**	**.63**	**50B5**	**.52**
5Y3GT	**.37**	6S7M	.79	12AY7	.69	**50C5**	**.51**
5Y4	**.51**	**6S78**	**1.69**	12AZ7	.59	**50L6GT**	**.61**
5Z3	**.45**	6S8GT	.53	**12BA6**	**.49**	50X6	.49
6A6	.51	**6SA7GT**	**.55**	**12BA7**	**.60**	50Y6	.49
6A7	.69	6SD7GT	.41	12BD6	.45	50Y7	.50
6AB4	**.44**	6SF5GT	.46	**12BE6**	**.51**	56	.49
6AC5	.69	6SG7GT	.41	12BF6	.39	57	.58
6AC7M	**.86**	6SH7GT	.49	**12BH7**	**.63**	70L7	.97
6AF4	**.90**	6SJ7GT	.41	**12BY7**	**.65**	75	.49
6AG5	**.56**	**6SK7GT**	**.53**	12BZ7	.65	76	.44
6AG7M	**.99**	**6SL7GT**	**.48**	12H6	.56	77	.57
6AH4	**.57**	**6SN7GT**	**.59**	12J5	.42	78	.47
6AH6	**.73**	**6SQ7GT**	**.46**	12J7	.49	80	.43
6AJ5	.65	6SR7GT	.45	12K8	.59	83V	.68
6AK5	**.55**	6SS7GT	.42	12Q7	.59	84/6Z4	.46
6AK6	**.59**	6T4	.99	12S8GT	.62	85	.59
6AL5	**.42**	**6T8**	**.80**	**12SA7GT**	**.65**	117L7	.99
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EICO BROCHURE

Electronic Instrument Co., Inc. of 84 Withers Street, Brooklyn 11, N. Y. has published a new brochure to aid distributors in doing a better selling job at low cost.

Printed in two colors and comprising 6 pages, this new publication describes the highlight specifications of the complete *Eico* line of 38 kits and 42 factory-wired instruments. The brochure folds to 6¼" x 4" for mailing. Space is provided for jobber imprint and addressing. The brochure can be self-mailed for 2 cents postage or enclosed in a business envelope.

JAVEX CATALOGUE

Javex, P.O. Box 646, Redlands, California is now offering copies of its new catalogue No. 254.

The publication covers television installation practices, types of accessories available for a multiplicity of installations, etc. The catalogue gives sizes, prices, colors, and ratings and also lists advertising and promotional materials currently available.

Those interested in v.h.f.-u.h.f. television, experimental p.a. work, amateur radio, and audio fields are invited to write for a copy of this catalogue.

TV ALIGNMENT TOOLS

General Cement Mfg. Co., 919 Taylor Ave., Rockford, Illinois, is currently offering a new illustrated brochure which features 36 television tools plus five tool kits containing matched sets of alignment tools.

Known as No. 3545, the new publication carries brief descriptive paragraphs and illustrations of the equipment. A copy of this brochure and additional information on the company's line of alignment tools is available on request.

SIMPLIFIED HI-FI DATA

Newcomb Audio Products Company, 6824 Lexington Ave., Hollywood 38, Cal., is now offering copies of a new booklet entitled "Hi-Fi is for Everybody!"

Designed to offer a new understanding and simplified approach to high fidelity, this 32-page publication is packed with valuable suggestions for potential hi-fi equipment customers.

The booklet sells for 25 cents a copy and is available from the company direct.

PLANNING FOR COLOR

The Television Transmitter Division of *Allen B. Du Mont Laboratories, Inc.,* 1500 Main Ave., Clifton, N. J., has issued an elaborate booklet "Station Planning for Color Television" which is designed to assist management in setting up its color facilities.

TV Station owners and operators may obtain a copy of this publication by writing the company direct. —30—

tiousness. The engineering on this disc is in keeping with the standard *London* has set for this series, which is to say the sound is indistinguishable from the best found in their regular output. Nice, live sound here, exceptionally well balanced. Quiet surfaces.

BEETHOVEN
SONATA #5 IN F MAJOR FOR VIOLIN AND PIANO
BRAHMS
SONATA #3 IN D MINOR FOR VIOLIN AND PIANO
Christian Ferras, violinist, and Pierre Barbizet, pianist. Telefunken LGX66014. RIAA curve. Price $5.95.

More of the music in the first *Telefunken* release, this time two charming sonatas by two of the "three B's." It has often been argued that you can't bring a symphony orchestra into a living room. But every living room *can* have a piano and violin within its confines. This recording is a literal recreation of a violin and piano sonata as it might sound in *your* parlor. Not too much reverb has been used—you don't have to stretch your imagination or your room to make it fit. Yet the essential "liveness" is present. The violin is smooth and edgeless, the piano clean and liquid-toned, with none of the harsh, too bright-too close "mike sound" which is the bane of so much piano recording. The Brahms gets an altogether exemplary performance from the participants, the Beethoven is less successful. The Beethoven is at fault principally from lack of warmth, from playing too precise, too disciplined. Ferras has a big rich tone, and when he relaxes (as in the Brahms) his fluency of expression is splendidly evident. Ferras is to visit this country in the fall and this recording augurs for a successful debut. Barbizet, while the subsidiary talent, is a convincing and capable pianist, and the whole of the recording is in superb balance. The RIAA curve was adequate without recourse to bass and treble controls.

POULENC
SEXTETTE FOR WIND INSTRUMENTS AND PIANO
HINDEMITH
QUINTET FOR WIND INSTRUMENTS
The Fine Arts Wind Players with Leona Lurie, pianist. Capitol FDS, P8258. RIAA curve. Price $5.95.

Chamber works for woodwinds are usually associated more with the 18th century composers than with our contemporaries, yet many a work in this form has been composed by some of our most celebrated moderns. The Hindemith Quintet is an early masterpiece, composed in 1922, and as such predates most of the Hindemith output with which we are familiar. The work seems simple, and yet it is full of invention, and displays the composer's incomparable skill in contrapuntal

scoring. Easy to listen to, but very difficult to perform, this recording is a prime example of virtuoso wind playing. The Fine Arts Wind Players are splendid artists, thoroughly "at home" with the demands of these complex scores. The Poulenc work is the sort of thing we have come to expect from this composer. Sassy, jazzy, it bubbles with light-heartedness and good humor. It's a Parisian boulevardier feeling his oats. The sound of the woodwinds (and the piano in the Poulenc) is outstanding. Sibilant, snarly, guttural, sensuous, whatever the score calls for is delivered with fine, strong intonation, very wide range, with good transients and not a trace of wow or flutter in the longer decay periods. No adjustment was necessary with the RIAA curve. A disc like this is a "must" for wind students.

MACDOWELL
SECOND INDIAN SUITE
Eastman-Rochester Symphony Orchestra, conducted by Howard Hanson. Mercury MG40009. RIAA curve. Price $5.95.

To those of you to whom the name MacDowell conjures up the salon-sweetness of his "To a Wild Rose," this work will come as quite a surprise. Yes, MacDowell has had to bear his musical cross, but this recording should do much to lighten his burden and dispel the notion that he was a composer of naught but trivia. This "Indian Suite" is a full blown symphonic work, and is not in the slightest tainted by the saccharine scoring so typical of "movie-type" tributes to the noble redskin. The five movements of the suite are based on actual thematic fragments of music from such tribes as the Iroquois, Chippewa, the Iowas, and Kiowa. MacDowell has used his material very cleverly and the result is a moving, evocative picture of a dying race. The scoring is brilliant throughout the work, from the powerful expression of the "Legend," the beauty and tenderness of "Love Song," the haunting despair of the "Dirge," to the chilling ululations of "In War-Time" and frenzied gaiety of "Village Festival." Dr. Hanson conducts with a knowing and devoted hand, and his ever-improving orchestra responds with superb playing. Sound is typical *Mercury,* sharp biting brasses, clean silken strings, with some extra sonorous contrabass, and super-accurate percussion of great impact. Wide dynamics and just enough reverb for proper acoustic perspective completes the sonic picture. RIAA curve was adequate and surfaces were quiet.

STRAUSS, RICHARD
AUS ITALIEN
Vienna Philharmonic Orchestra, conducted by Clemens Krauss. London LL969. RIAA curve. Price $5.95.

The recent death of Clemens Krauss will certainly leave an aching void in the ranks of the few conductors who really know how to interpret the difficult music of Richard Strauss. Krauss' mastery of this composer's works is never more evident than in this recording of the early tone poem, "Aus Italien." Written by Strauss on the inspiration of a trip to Italy, it is clearly an immature work, but not without very definite promise of the Strauss that was to come. The most famous part of this work is in the last movement wherein Strauss utilizes the theme material of "Funiculi, funicula." In Krauss' competent hands this is riotous good fun and is a fitting finale to Strauss' pastorale wanderings in the first three movements. The conducting of Krauss is a miracle of precision, coupled with warmth and feeling. His tempi never vary, his obvious good humor is tempered with respect. The Vienna Philharmonic is wonderful and always sounds better in Krauss' loving care. Soundwise, this is an imposing disc. The sonorities generated are truly huge. Clean strings, very weighty brass, fluent woodwinds, and authoritative percussion with some excitingly "live" cymbal clashes in the last movement. Superb balance is a notable feature of this disc. The third version of "Aus Italien" to appear on LP, it is much superior to the other recordings, from both the sonic and conductorial viewpoints. A few db of bass boost helped the RIAA curve in my acoustic setup. Quiet surfaces.

FRANCK
SYMPHONY IN D MINOR
Vienna Philharmonic Orchestra, conducted by Wilhelm Furtwangler. London LL967. RIAA curve. Price $5.95.

A popular sport among music critics for some time has been deriding the conductorial idiosyncrasies of Wilhelm Furtwangler. While it is undoubtedly true that Furtwangler is a man with some ideas peculiarly his own and has more than his share of artistic temperament, he is nevertheless a conductor of great talent. Some of his early performances of Wagnerian music, especially "Tristan und Isolde," were fabulous and have yet to be improved upon by anyone. In this umpteenth version of the Franck warhorse, Furtwangler has chosen the straight and narrow path in matters of tempo and expression and has come up with one of the best performances on records. Throughout the work, Furtwangler accents the lyrical qualities, while exercising restraint in the opening movement, and avoids the temptation of bombast. His is the gradual build-up and the finale usually fraught with redundancy, is a clean-lined and powerful evocation. The Paul Paray-Detroit Symphony version on *Mercury* is amazingly close to this performance, in nearly all respects. The choice here is strictly a matter of taste, or perhaps will be dictated by the sound qualities. Both the *Mercury* and the *London* discs represent all that is the best in modern recorded sound, but from differing viewpoints. The *London* sound is "big-hall," hugely proportioned, with the "over-all bloom" typical of the best European recordings. The *Mercury* sound is super-precise with all elements sharply delineated and extraor-

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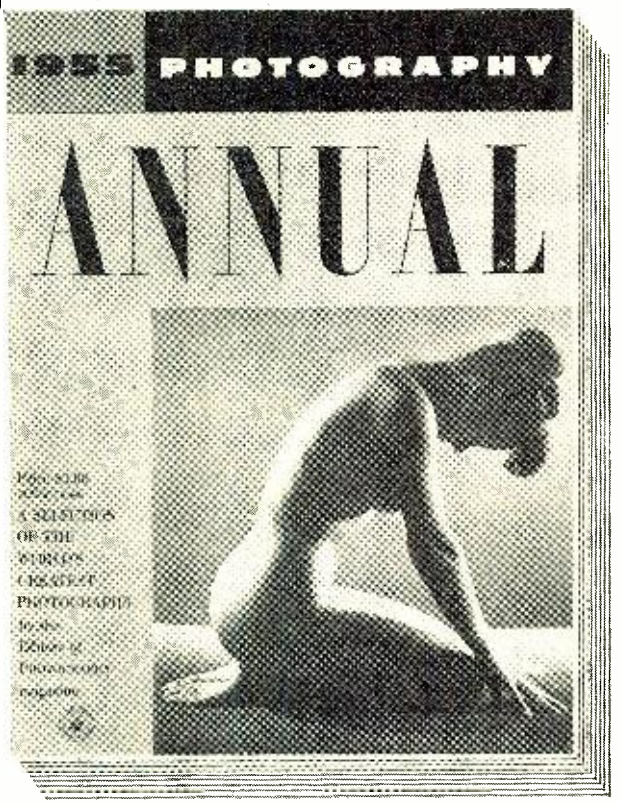

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dinary dynamics. I think anyone contemplating the purchase of the Franck symphony would be wise to concentrate on these two versions. The final choice, if a matter of sound, might be no more than a question of your particular equipment and acoustic surroundings, so listen to both these recordings. The RIAA curve did not need adjustment.

TCHAIKOVSKY
SYMPHONY #2 IN C MINOR
Royal Philharmonic Orchestra, conducted by Sir Thomas Beecham. Columbia ML 4872. NARTB curve. Price $5.95.

Columbia is to be commended for upgrading their catalogue with this recording. The only other LP version was their earlier recording by Mitropoulos and the Minneapolis Symphony which was a 78 rpm transfer. This new disc is superior in every way, performance- and sound-wise. If you are not familiar with this early Tchaikovsky symphony I strongly urge you to listen to this recording. You will find all the elements that have endeared the later symphonies to so many hi-fi fans. Plenty of excitement is generated in this work along with some beautifully lyric sections, as in the second movement. While this work holds none of the power of the 4th, 5th, or 6th symphonies, it is still an interesting and entertaining work, never trite, and really a pleasant change after the countless performances of the last three symphonies. Sir Thomas has always been a master of Tchaikovsky's symphonies and this is not the first time he has recalled the earlier symphonies, (especially this 2nd and the 3rd) from relative obscurity. He knows his material and delivers a nicely paced, well organized reading. The Royal Philharmonic is obviously enjoying itself and plays with verve and vigor. Splendid sound, fine strings, especially in the pizzicato sections, bright brass and heavy, accurate percussion in bass drum and tympani. NARTB curve was better with a couple of db bass boost. Moderately quiet surfaces. A good, but not outstanding, performance of the "Waltz of the Flowers" is included for good measure on the second side.

KETELBEY
IN A MONASTERY GARDEN
IN A PERSIAN MARKET
IN A CHINESE TEMPLE-GARDEN
THE CLOCK AND THE DRESDEN FIGURES
Rochester Pops, conducted by Morton Gould. Columbia AL47. NARTB curve. Price $2.85.

One of the best sounding discs to come from *Columbia* in a long time. In fact, the sound is so good as to lead one to suspect *Columbia* has made some new improvements in mike pickup or cutterhead or somewhere along the line. The music is frankly, if not brutally programmatic, but has found considerable favor with a large segment of the public. It would be unkind to call it corny. It is perhaps best described as "dated." This kind of stuff lends itself very well to up-to-date hi-fi treatment, however, and the result is a low-cost feast of gorgeous hi-fi effects. Rip-snortin' percussion effects here, with Chinese gongs boinging all over the place, clean strings and brilliant brasses. Morton Gould is the right man for this sort of thing and he makes the most of it. The Rochester Pops is composed mainly of personnel from the Eastman-Rochester and Rochester Philharmonic symphonies and is a first class group. NARTB curve was just right. Ticky surfaces in my copy.

FAURE
REQUIEM
Orchestre des Concerts Lamoureux, conducted by Jean Fournet with Pierrette Alarie, soprano; C. Maurane, baritone; Choeur E. Brasseur; M. Durafle, organist. Epic LC3044. NARTB curve. Price $5.95.

The fifth version of this lovely work to appear on LP and in many ways, the best. Fauré was a gentle soul and he was not given to bombast in his music. His "Requiem" reflects his nature perfectly, being a deeply moving, quietly somber and low-key version of the Mass for the Dead. The absence of violins in the scoring is in keeping with the general tenor of the work and Fauré depends on the darker-toned violas and celli, along with contrabass and organ. Pierrette Alarie has a splendid voice and uses it reverently and compellingly. The baritone was too nasal for my taste, but knew his role well enough. The choir is a tightly organized group, with excellent articulation. The *Angel* version of this work has excellent soloists too, but they are not shown off to such good advantage as in this disc because of the sonic deficiencies. This recording has fairly wide range and good dynamics and, above all, good acoustic perspective, so important in choral works. There is a minimum of fusion and "blast" effects between the vocal and orchestral elements. Fournet shows a healthy regard for tempi and expression, but manages to conduct at a pace which sustains interest and does not impose hardships on his forces. The NARTB curve was improved by a little treble cut and bass boost. Moderately quiet surfaces.

SIBELIUS
THE LEGENDS OF LEMMINKAINEN
Symphony Orchestra of Radio Stockholm, conducted by Sixten Ehrling. Capitol P8226. RIAA curve. Price $5.95.

A few years ago this work was relatively unknown in the LP catalogue, except for a couple of recordings of one of the legends, the famous "Swan of Tuonela." Now here we are faced with the third edition of recent months! The Jensen reading on *London* seemed to be near-definitive. This disc offers it considerable competition. Ehrling is one of Scandinavia's better conductors and his familiarity with this music is evident. There is little to choose between them in matter of performance. Ehrling's pace is slower and more deliberate and he emphasizes the

dramatic elements of the work. Jensen essays the more lyric touch and, in general, keeps the work from becoming too heavy-handed. Both readings are uncommonly good and the matter of choice is made still more difficult by the similarity in sound quality. In this version are to be found fine, clean strings, some splendid brass sonorities, very "live" woodwinds and notable percussion. The *London* version is somewhat wider range in frequency and dynamics, and has a definite edge in the matter of acoustic balance. You won't go wrong with either disc. The RIAA curve was better with some bass boost. Good surfaces in my copy.

FALLA
RITUAL FIRE DANCE
ANDALUZA
DANCE OF THE MILLER'S WIFE
GRANADOS
THE MAIDEN AND THE NIGHTINGALE
PLAYERA
ALBENIZ
SEGUIDILLA
SEVILLA
TANGO IN D MAJOR
INFANTE
EL VITO
Leonard Pennario, pianist. Capitol P8190. RIAA curve. Price $5.95.

Some familiar and not-so-familiar music for piano in the Spanish idiom. The pianist is young Leonard Pennario, who is endowed with a dazzling technique and uncommonly fine musicianship. This type of repertoire is right up his alley and the keyboard fairly sizzles with his virtuosity. The most famous work in this collection, "The Ritual Fire Dance," is given an unusual and different performance by Pennario. He goes to considerable pains with pedal technique to sharply accentuate the rhythmic elements. His is the most "Spanish" reading of this piece I have ever heard. The other works are brilliantly played and the little-known "El Vito" is an astonishing tour-de-force for Pennario. Exceptional piano sound in this disc. Piano is properly miked "close-to," with the percussive effect needed for this type of repertoire, perfectly reproduced. Nice wide range and good dynamics and nary a trace of wow or flutter add to an attractive recording. The RIAA curve needed no compensation. Very quiet surfaces.

MASCAGNI
CAVALLERIA RUSTICANA
Milano Symphony Orchestra and Chorus, conducted by Franco Ghione, with Mario del Monaco, Elena Nicolai, Aldo Protti, Laura Didier, Anna Maria Anelli. London LL990/991. RIAA curve. Price $11.90.

Who would ever have thought that a music lover would have *nine* versions of "Cavalleria Rusticana" on discs to choose from! Yet this present recording is indeed the 9th edition in what looks like a never ending stream. You might think that choice here would be really difficult. Not so. The only other album worthy of consideration with this edition is the recent release

of *Angel.* This situation is largely due to two outstanding artists, Mario del Monaco, the "Turiddu" of this set, and Maria Callas, the "Santuzza" of the *Angel* set. What a pity these superb artists are not together in the same recording. That would be a truly definitive "Cavalleria." Instead we have Elena Nicolai (not to be confused with Greek mezzo, Elena Nicolaidi) as "Santuzza" in this album, and di Stefano as "Turiddu" in the *Angel* set. Mess, isn't it! Well, if we can't have them together, which of these "Cavallerias" do we want? I made my decision this way; di Stefano in the *Angel* disc is barely adequate in his performance. Elena Nicolai, while no match for the illustrious Callas, gives a quite satisfactory performance; at least she is convincing! The roles of "Alfio," "Lola," and "Lucia" are sung equally well in both the *London* and the *Angel* sets. Tempo, expression, choral balance, all these factors are equal. Thus we come to the question of sound. The *Angel* is productive of good clean sound, but this *London* is quite a few notches above being merely good. Acoustics and vocal/orchestral balance are the best I've heard in an opera recording for some time. The orchestra has a cleaner, more luminous sound than the *Angel;* where percussion tends to "muddy-up" in the *Angel,* it's sharp and accurate in the *London.* There you have it. Better sound plus the better balance of vocal talent, give the *London* set an edge over the *Angel* in my opinion. The *Angel* does have the advantage of being a couple of dollars cheaper, by virtue of the fact they leave the fourth side blank (just the same as in the old acoustic recording days!) and you pay only for "Cavalleria Rusticana." The fourth side in the *London* has an operatic recital by Mario del Monaco. In some familiar arias and a few off the beaten track, he gives further evidence of his tremendous talent. RIAA curve was adequate. Moderately quiet surfaces. —30—

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By JAMES A. McROBERTS

A WEAVING left-hand side of the raster was experienced on an Admiral model 17DX10 and some others. The right-hand side of the raster was perfectly normal, so the trouble evidently was caused by something upsetting the start of the horizontal sweep. The effect could be caused by vibration of the set cabinet or chassis, or the sound from the loudspeaker.

The defect was localized to the yoke in this instance by tapping various parts with a small rubber mallet of the type used for tapping tubes while testing them. The maximum wave or weave of the left-hand side of the raster (also picture when present) was experienced when the yoke was jarred. The trouble was apparently the upper half winding on the yoke which was varying its capacity to the yoke frame.

The yoke was sprayed with a plastic insulating compound, given an hour to dry, and then tested. The trouble was cured. —30—

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What's New in Radio

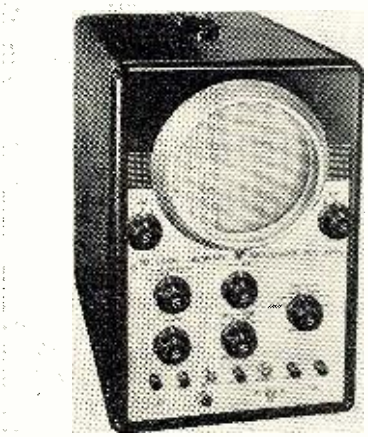
(*Continued from page* 108)

Now available are a "Thru-Window Coupler," two-set couplers, and u.h.f.-v.h.f. antenna crossover networks. The couplers are available as the Model C-2 and C-2B, an economy and bifilar-coil unit, respectively. The crossover networks are designated as the UV-2 for installations with one u.h.f. and one v.h.f. antenna while the UV-3 is for one u.h.f. and two v.h.f. antennas.

Data sheets on all five of these products are available from the manufacturer.

SYLVANIA SCOPE

Sylvania Electric Products Inc.'s Radio and Television Division, 1221 W. Third Street, Williamsport, Pa. is now offering a sensitive, wide-band, all-purpose oscilloscope which was created especially for designing and servicing television receivers.

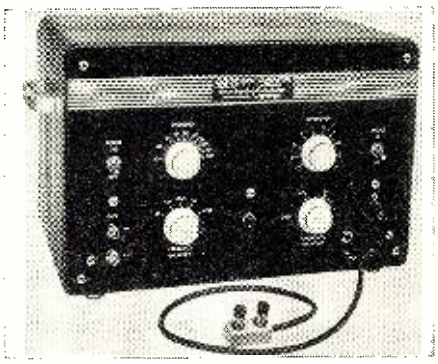


The Type 404 uses a 7" cathode-ray tube for extra-large patterns. Vertical sensitivity is 10 millivolts-per-inch while horizontal sensitivity is 150 millivolts-per-inch. The sweep rate is from 25 cycles to 50 kc.

A data sheet giving complete specifications is available from the company on request.

SQUARE-WAVE GENERATOR

New London Instrument Company, P. O. Box 189, New London, Conn. has recently added a square-wave generator to its line of electronic measuring equipment.



The Model 183 provides square waves suitable for testing the transient and

coming in September...

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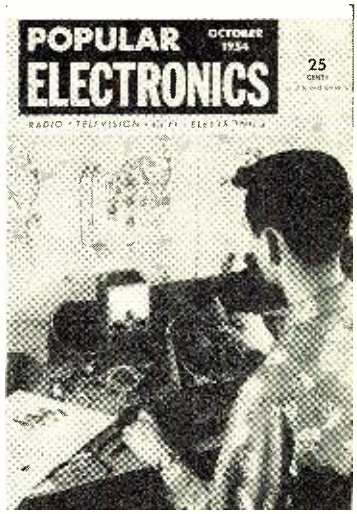

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frequency response of wide-band amplifiers and accurately measures their amplitude. The frequency range is from 10 cps to 1 mc. continuously variable over decade steps. It has a low impedance output which provides 10 volts plate-to-plate. A high impedance 100 volts plate-to-plate is available. A 60 db step attenuator and a 20 db continuous attenuator provide means of using the generator as a voltage calibrator.

FIELD STRENGTH METER

Industrial Television, Inc., 369 Lexington Avenue, Clifton, N. J. is in production on a new version of its field strength meter.

The new model IT-136R features continuous u.h.f. tuning, a *Standard*

Coil v.h.f. tuner, preselection stage for maximum selectivity, and freedom from spurious response.

It is lightweight for portability, a.c. operated for economy, and battery operable for maximum versatility.

CRYSTAL PHOTOCELLS

Standard Piezo Company of Carlisle, Pa. is now offering low cost and extremely small cadmium sulfide crystal photocells which are capable of operating inexpensive sensitive relays directly without an amplifier.

Standard types as small as ¼" diameter by ¼" deep, exclusive of leads, deliver from 2 to 5 ma. when exposed to light of from 50 to 100 footcandles intensity with approximately 100 volts applied across cell and load. Thus, where a light source of good intensity is available, no amplifier is needed.

Bulletin PC-10, giving complete details, is available upon letterhead request.

SERVICE INSTRUMENT

Superior Instruments Co., 2435 White Plains Road, New York 67, N. Y. has announced an improved version of the "Super Meter," the Model 670-A. The new model now includes a built-in isolation transformer which reduces the possibility of meter damage by 50 per-cent.

In addition to its function as a v.o.m., this unit also measures capacity, reactance, inductance, and decibels. It also includes a "good-bad" scale for checking the quality of electrolytics at a test potential of 150 volts.

The Model 670-A is housed in a crackle-finished steel cabinet which measures 6¼" x 9½" x 4½". It comes complete with test leads and operating instructions. —30—

International Short-Wave

(*Continued from page 90*)

at times. (Cox, Dela.; Machajewski, N.Y., others)

Falkland Islands—A *new* and *more powerful* transmitter is being erected at Port Stanley; listed schedule on 6.125, 1500 kc., and 600 kc. as 1815-2000. (Radio Sweden)

Fiji Islands — Radio Suva, 3.980, noted with BBC news relay 0400, bad QRM; listed schedule of 0030-0530, 1400-1600, 1900-2100, 500 watts. (Zahner, Md.)

France—Paris, 11.845, noted around 1400 to Middle East in French. (Zahner, Md.) Heard with *English* for the United Kingdom 1500-1600 on 11.700. (Morgan, Calif., others) Uses 6.045 in parallel now. (Pearce, England)

French Equatorial Africa — Radio Brazzaville, 11.970, is strong around 1700. (Sicks, Ore.)

French Guiana — Radio Cayenne, 6.232A, noted in French 1742 but at weak level. (Hardwick, N. Z.)

French West Africa—Radio Dakar, 9.560A, heard 0247 with man in French, fair level in Calif. (Morgan)

Germany—Radio Liberation, Munich, now operates over 3.990, 6.055, 6.175, 6.185, 7.130, 7.225, 7.275, 9.585, 9.680, 9.765, 11.720, 11.765, 11.780; 3.990 and 6.175 are 20 kw., others are 10 kw. (*WRH*) *Deutsche Welle,* 11.795, Cologne, noted closing 1035. (Morgan, Calif.) Heard on this frequency 2000 with news in Spanish to Latin America. (Ferguson, N.C.) Noted to North America 2030-2330 over 7.290, 6.075. (Alley, Mass., others)

Gold Coast—Gold Coast news is radiated from Accra, 6.049, at 0745; on 4.915 at 1245. (NNRC)

Greece — Chania, 6.678, noted in Greek 1300, weak and with CWQRM. (Hardwick, N.Z.) Overseas sources say *Radio Athens,* 11.718, now has *English* 1200-1300, 1330-1430. (Radio Australia, others) Larissa, 9.745, noted 1450 with operatic selections; with music also around 0115. (Pearce, England)

Guatemala—TGNB, 9.668, noted at good level 2230 in *English.* (Brooks, Kans.; Braunstein, Conn.) TGCQ, 9.700A, *Radio Central,* heard around 1800-1900 in Spanish. (Saylor, Va.) TGWB, 6.180, good level around 2000. (Morgan, N.Y.)

Haiti—On a recent Wed., *Radio Commerce,* 6.088A, was noted with French-*English* lesson 1745. (Bellington, N.Y.) Heard on 9.485 at strong level 1730 in French. (Grennell, Ohio) 4VEH was recently *measured* on 9.656 at 0930, good level in N.C. (Ferguson)

Holland — Hilversum, 1173, good with *English* 1645-1725A. (Brooks, Kans., others)

Hong-Kong — ZBW3, 9.525, noted 0515 at good level with music. (Sanderson, Australia)

Hungary — Radio Budapest noted 2300-2300 to North America on 9.833. (Rugel, Kans.) Is again noted using 11.910 at 1700 for *English* session.

Iceland—TFJ, 12.174, Rekyjavik, is still coming through in its *Sunday only* session 1115-1130. (Cox, Dela.) Has poor modulation. Sent *new* QSL card which shows view of transmitter. (Pearce, England)

India—AIR broadcasts in *English* to Europe daily 0230, news 0235, over 15.380, 17.740. (Radio Sweden) Glendemann, Calif., reports AIR on 9.685A around 0735-0915.

Indo-China—*"Voice of Vietnam,"* Saigon, has news now 0900 on 9.625 *only,* and is then parallel with *Radio France-Asie,* 11.83; the 7.27 outlet has news in French 0815 and is *not* in parallel with 9.625 at that time. (Balbi, Calif.) *Radio France-Asie,* 9.755, still has *English* for Europe 1100. (Pearce, England, others) Heard on 15.420 at 0345 with French-*English* lesson and music. *Radio Hirondelle,* 7.405, Hanoi, noted 0500 with news in French. (Sanderson, Australia) *Radiodiffusion Nationale Khmere,* Cambodia, now radiates on this schedule—Phnom-Penh, 6.090, 1 kw.; *testing new* 10 kw. transmitter also; Battambang (*new*), 6.035, 50 watts; Siemreap (*new*), 4.970, 200 watts, in French and Cambodian 2300-0100, 0500-0815, 1800-1900. (Scheiner, N.J.)

Iran—Radio Teheran, EPB, 15.100, can be heard some days as early as 1330. (Ferguson, N.C.) Has news 1515, closes 1530. (Crowell, Pa., others)

Iraq—Radio Baghdad, HNQ, 11.702A, noted *after* 2344 when Stockholm closes on 11.705; has Arabic vocal music; when Stockholm puts carrier back on the air for Western North America 2351A, Baghdad is blocked out. (Morgan, Calif.) Has brought into use *new* channel of 3.295A for broadcast in *English* for Europe 1415-1500 closedown; news 1430. (Cushen, N.Z., others)

Israel—Tel Aviv now is using the *new* 50 kw. transmitter for French (*"Voice of Zion"*) session 1515-1600, and for *English* 1600-1645 closedown; by now may have inaugurated special beams for America, Europe, Africa; lists current frequency as 9.008. (Levy, N.Y.; Silverman, N.Y., others)

Italy—Rome, 9.57, excellent in *English* 2130-2150. (Kirby, Mo.) And parallel on 9.780. (Ballou, Calif.) Noted with Italian session (starting with news) from 2000 to North America on 9.78. (Ferguson, N.C.) With *English* 1915 on 11.905A parallel 9.57. (Parsons, Pa., others) Heard opening to Britain with news 1330 on 7.290, 11.810, 15.400. (Pearce, England)

Japan—During recent *tests,* the *new* commercial outlet, JJ2KY (now JOZ), 3.925, was heard at fair level 0600. (Balbi, Calif.) QRA for this one is Nippon Short Wave Broadcasting Co., 13 Akasaka-shinsaka, Tokyo, Japan. (ISWC, London) Should be operating now regularly around 1700-0900 as JOZ, 3.925, and JOZ2, 6.095. (*N. Z. DX Times*)

Kenya Colony—Nairobi has *moved* from 4.855 to 4.885 to avoid interference to another station which had prior claim to 4.855; transmissions are

primarily intended for listeners in Kenya and antennas are designed accordingly, station officials point out. (Radio Sweden, others)

Kuwait — Radio Kuwait, 5000, is heard in N.Z. in Arabic 1500, signs off 1600; good level. (Hardwick)

Malaya—BFEBS, Singapore, noted 0815 on 11.955. (Cox, Dela.) Heard on 11.820 at 0800-0815. (Rugel, Kans.) Noted on 9.690 at 0430 with news. (Sanderson, Australia)

Radio Malaya, 7.200, Singapore, has news 0900. (Paris, Australia *via Malmo DX-aren,* Sweden)

Mexico—XEXE, 11.900, Mexico City, is good level around 1930 in Spanish. (Roesener, Ill.)

Mozambique — Lourenco Marques, 7.240A, is heard in Japan in *English* 0955, and with "Lucky Disc" program. (Japanese Short Wave Club)

New Caledonia — Radio Noumea, 3.375, noted at weak level 0253 with music, French announcements, news in French 0300 by man; also heard 0300 on 6.035A, weak but clear. (Cox, Dela.) Strong in Calif. on 6.035A at 0310. (Morgan) Cushen, N. Z., says the 3.375 outlet has been noted with a *new* transmission from 1400 for "early morning listeners" in New Caledonia.

New Zealand—ZL2, 9.540, noted 0200-0300; ZL3, 11.780, heard closing 2300. (Milnes, Ore.)

Nigeria—Lagos, 4.800, logged 1700 with news, closed 1710. (Cox, Dela.) Kaduna, North Regional Station, 3.327, is noted at fair strength in England around 1445 with African music. (Fairs, *via* URDXC)

Norway—Radio Norway, 7.210, Oslo, good level to North America 2000-2100 (Sun. to 2020 when has closing feature *"Norway This Week"* in *English*). (Braunstein, Conn., others)

Pakistan—Radio Pakistan noted on 11.885 parallel 15.225A in Southeast Asia beam now 1945-2030A, news 2000; *best* on 11.885. (Bellington, N.Y.) Heard on 15.255 in *English* 0745-0830; in *English* 1500-1545 on 7.010, 9.545. (Crowell, Pa., others) Has news 0945 on 9.484 now. (Pearce, England) Heard on 11.914 at 1915 with news. (Sanderson, Australia)

Panama—HP5J, 9607, Panama City, fair 2135 with classical music. (Cox, Dela.) HORT, *Radio Balboa,* 6.065, has been heard in N. Z. *before* 0630.

Paraguay—ZPA1, 5.955A, Asuncion closes down 2200. (*N. Z. DX Times*) ZPA4, 9.735, *Radio Stentor,* noted in Spanish 2100, fair level in N. Z. (Hardwick)

Peru—OAX4T, 9.562, and OAX4Z, 5.955, Lima, are both used for *English* 2300. (Radio Australia, others)

Philippines—DZH9, 11.855, Manila, is strong 0900 when has world news. (Grimm, Texas) Heard over DZH7, 9.730, at 0500-1130 with news, native music. (Milnes, Ore.) Good on this frequency 1000 with religious session. (Brown, Wyo.)

Poland—Radio Warsaw noted on 9:615 with interval signal 1700, then with French session. (Bellington, N. Y.)

Portugal—Lisbon's 9.746A outlet is good level in Portuguese to North America 1900-2100. (Parsons, Pa., others) Noted using 15.030 again 0600-0800; heard closing 1530 on 11.996; noted 1535 on 4.000, and near 11.910 at 1650. (Pearce, England)

Roumania—Bucharest, 9.57, good in *English* 2200-2230A in North American beam, closes *English* with interval signal, then goes into Roumanian transmission. (Hyson, Md.; Kirby, Mo., others) Heard as early as 1800 relaying *Radio Moscow.* (Balbi, Calif., others) Noted on this channel for further *English* to North America 2330-2400. (Rugel, Kans., others) Heard parallel over 6.144A. (Machajewski, N. Y.) Noted with *English* session 1430 on 12.032, 9.570, 6.210, 9.254. (Pearce, England)

South Korea—A *new* station on 6.895 is the American Forces Korean Network, calling "This is Vagabond," noted around 0600 or earlier to *after* 0730; at 0700 relays AFRS news from the Far East Network, Tokyo, Japan. (Morgan, Calif.) Has bad CWQRM, announces is on 1150 kc., 1 kw., and 6.895, 400 watts, 24 hours daily. QRA is announced as Vagabond, c/o Postmaster, Box 72, San Francisco, Calif., USA. (Radio Australia)

HLKB, 7.935, Seoul, noted 0505 with Western music and news in Korean. (Sanderson, Australia) Under good conditions, HLKA, 2.510, Seoul, can be heard in Japan 0430 with time signal, 0500-0515 in *English;* announces as *"The Voice of Free Korea."* (Japanese Short Wave Club)

Spain—Madrid, 9.363A, noted at excellent strength ending *English* to North America 2350. (Kroll, N. Y.) *Measured* recently on 9.348. (Ferguson, N. C.) Valladolid, 7.006A, noted 1535 with popular songs; *Radio Mediterraneo,* 6.995A, Valencia, tuned 1625 with music. (Pearce, England)

Spanish Morocco—Radio Dersa. Tetuan, now uses 6.067, 0.25 kw., 0700-1900. (*WRH*)

Sweden—Radio Sweden, 15.155, is good 0600 with news to South America. (Levy, N. Y.) Fine level 0000 on 11.705 to Western North America in *English.* (Grimm, Texas; Brown, Wyo.) Strong on this channel 2300. (Winch, Calif.)

Switzerland—Berne, 11.715, noted closing 1730. (Niblack, Ind.) Berne's 9.535 outlet is good level to North America 2030 - 2300. (Braunstein, Conn.) Excellent in parallel over 7.210. (Stanley, Conn.) Noted on 11.865 at 1350 with news. (Crowell, Pa.)

Syria—Damascus is now heard on 9.555 with its *English* session 1630-1730 closedown. (Levy, N. Y., others) Heard on 11.913A to Latin America 1900-2100. (*Malmo DX-aren,* Sweden) And parallel on 9.555. (Niblack, Ind., Saylor, Va.)

Tahiti—Radio Tahiti, 6.135A, Papeete, noted 2325 with music, announcements in French; closed 0008, weak to fair level in Dela. (Cox) Heard on 7.120 closing 0218 with "La

Marseillaise," poor quality due to noise and CWQRM.

Taiwan (Formosa)—BED4, 11.92, Taipeh, is heard weak to fair in the North American transmission 2200-0100 sign-off. (Balbi, Morgan, Calif.) Has strong signal on *new* beam to the Near East opening 0230 with anthem, then with news on 11.735 parallel 11.920. (Morgan, Calif.; Sanderson, Australia) BED36, 7.300, noted 0600 with news in Chinese, then Western music, good level. (Sanderson, Australia)

Tangier—Pan-American Radio uses 1178 kc. and 7.290 around 0400-1145, 1300-2000, in *English*, French, Spanish, Italian, Arabic, Hindi. (*Malmo DX-aren*, Sweden) Lists relay of news from VOA, New York, for 1400. (Pearce, England)

Turkey—Radio Ankara now uses TAU, 15.16A, parallel TAP, 9.465, with *English* for Western Europe 1600-1645. (Morgan, Calif., others) TAT, 9.515, has good signal in Kans. during the daily *English* beam to North America, at 1815-1900. (Rugel) TAV noted on 17.825 opening 0830 with news to Southeast Asia. *Technical University of Istanbul*, 7.030A, noted 1440 with music, closed with orchestral music 1500; does *not* seem to be in use Sundays.

Uganda—The Uganda Broadcasting Service now radiates on 971 kc., 1 kw., and 5.026, 7.5 kw. in Luganda dialect 0945-1115; in *English* 1115-1215 (news 1115). (Radio Sweden)

USI (Indonesia)—Paris, Australia, notes Medan's YDP, 4.930, at 0930 with clock chimes. Surakarta's YDG3, 7.250A, with native session 0830. (*Malmo DX-aren*, Sweden) Djakarta, 9.710, heard 0622-0700 with news, music. (Rugel, Kans.) Heard with *English* for Europe 1400-1500 over YDF8, 9.865. (Pearce, England) The *Indonesian Air Force Station*, 11.940, operates daily 0430-0730 with 7.5 kw. (*WRH*) YDO, 3.250, Bandjermasin, opens 0430 with *English* recordings. (Collett, N. Z.)

USSR—Baku, Azerbaidjan, 4.358, noted announcing "Govori Moskva" at 1430, indicating a relay of *Radio Moscow* then. (Fairs, England, *via* URDXC)

(*Continued on page* 154)

Venezuela — YVKM, 5.030, *Radio Continente,* heard in Spanish 2200 to sign-off which varies 2255-2257.

* * *

Press Time Flashes

Sunspot predictions as broadcast by Berne, Switzerland, include Sept.—3; Oct.—3; Nov.—3. (Ferguson, N. C.) According to ISWC, London, *Radio St. Vincent,* VP2SA, 3.336, operates *Sundays* 1600-1700 with 400 watts. (Morgan, Calif.) *Radio Peking* has *replaced* 11.96 with 15.385 for *English* 2200. (*N. Z. DX Times*) A Communist Chinese outlet is noted on 6.78 at 0815 with news in Chinese parallel several *Radio Peking* outlets. (Balbi, Morgan, Calif.)

According to press dispatches, *Deutsche Welle,* Cologne, German Overseas Service, this year will begin construction of the most powerful short-wave transmitters ever used for German overseas broadcasting—200 kw. compared with the two 20 kw. transmitters now in use (at Hamburg with relay from Cologne studios). When the new stations are completed, broadcasts, in addition to German, will include *English,* French, Spanish, Portuguese. (McPhadden, Calif.) *Radio Pakistan's* regional services are scheduled for Lahore, 1 kw., 2045-2300 Arabic, 3.915, 0200-0400 *English* (except Fri.), 6.075; 0700-1230 (Urdu-Punjab, 3.335. Dacca, 7.5 kw., 2000-2200 Arabic, 4.807; 0100-0230 Bengali (except Fri.), 7.150; 0600-0645, Udru, 4.807; 0700-1130 *English* (except Fri.), 3.325. (*WRH*)

BED7, 7.130, Taipeh, Taiwan (Formosa) closes 0815 in Chinese, and apparently then moves to BED4, 11.920, where has been noted 1015 in Chinese parallel with BED6, 11.735. (Morgan, Calif.) This year's annual gathering of members of the Newark News Radio Club was held Aug. 21 at Green Lane, Pa. A *new* club is Heureka DX-Club, c/o Harald Torgard, Nilserukleiva 15, U. M., Oslo, Norway. "On the Air" reports a *new* club, the New England Listeners Club, c/o Norm Rivers, 18 Saari Parkway, Fitchburg, Mass.

Leon Levy, N. Y., reports a broadcast on 9.833 (channel of Budapest, Hungary), called *"Ce Soir en France"* (*"This Evening in France"*) is heard in French 0300-0330; seems to be a session for or by French Communists; asks for reports to Radio Liberte, 6 Boulevard Poissonier, Paris 9, France.

A *newcomer* is *Radio Sarawak,* Kuching, 4.870 and 850 kc., British Borneo, heard with *English* 0530-0630, Iban (native dialect) 0630-0700, Chinese to 0745, Malay 0745-0830, and then *English* 0830-0845 closedown; is low-powered. (Radio Australia, others) Heard identifying 0830, then with news relay from BBC; closed 0841 with "God Save the Queen." (Balbi, Calif.) During the recent trouble in Guatemala, TGNA, Guatemala City, was damaged severely by machine-gun fire, according to press dispatches. (Morgan, Calif.) *WRH* and other overseas sources say *Radio Addis Ababa,*

Ethiopia, has *moved* from 15.054A to 15.345 (same channel as used by VOA, Tangier). *Not confirmed.* ISWC, London, says that by now the *English* sessions of *Radio Luxembourg* should be relayed *via* short-wave on 6.090.

AFN, Frankfurt, Germany, now uses 3.188 (*new*) at 0000 (Sun. from 0100) to 1900; 10 kw.; replaces 5.470. (*WRH*, others) Noted with call, news, weather 0100. (Pearce, England) According to station announcements, the *English* session from *Radio Pakistan* to Indonesia 0745-0830 now is on 15.360. (*WRH*) The Southeast Asia beam from AIR, Delhi, 0830-0945 (news 0835) is now on 11.710, 15.325. (*WRH*)

According to the *N. Z. DX Times*, the *Voice of America* will move from New York to Washington as of Nov. 1, with *new* QRA of 330 Independence Ave., S.W., Washington, D. C.

The Far East Network, Tokyo, Japan, noted *testing* on 6.160, very strong level, parallel with JKL, 4.86, latter only fair signal, at 0815. (Balbi, Calif.)

The *clandestine* anti-Communist "underground" station, *"Radio Free Russia,"* has been logged on 6.530V at 1315 to close at 1335 when signed off with march; identifies as *"Govori Radyo Stanzia Svobodnaya Rossiya."* (Fairs, England, *via* URDXC)

* * *

Acknowledgment

Thanks for the fine reports. Keep them coming during the autumn DX season ahead—to Kenneth R. Boord, 948 Stewartstown Road, Morgantown, West Virginia, USA. Good listening, fellows! . . . . . K. R. B.

The names of the seven radio pioneers who were the first to achieve trans-Atlantic communications on short waves have been engraved on the monument marking the historic site of Station 1BCG in Greenwich, Conn. The monument, unveiled by the Radio Club of America over three years ago, was altered to include the names of the participants in memory of Major Edwin H. Armstrong. The pioneers whose names now appear on the monument are: Ernest V. Amy, Edwin H. Armstrong, George E. Burghard, Milton Cronkhite, Paul F. Godley, John F. Grinan, and Walker Inman.

Feedback Equalizers

(*Continued from page 57*)

Universal Equalizer

In the interest of greatest flexibility, a means for an ordered control of the various factors that contribute to a playback curve has been devised. Such an arrangement can be termed a "universal equalizer." With this device, one is able to effect any desired playback characteristic and an infinite number of variations about that characteristic.

Although originally meant as a means for confirming the preceding design data, the "universal equalizer" has proven invaluable in the investigation of the effects of factors such as acoustics at the recording location and losses in the recording process. These factors are instrumental in changing the effective recording characteristic.[3] It has been found that many different recordings made by the same manufacturer require different compensation to sound right. Often the required compensation is a slight deviation from the generally accepted one. Sometimes it varies greatly. This type of correction cannot be accomplished by the usual preamplifier tone controls.

After careful consideration of the many factors that enter into high-gain preamplifier design, the configuration shown in Fig. 8 has been chosen. 6AU6's are exceptionally quiet and dependable tubes. The equalizer stage has a gain of 240, reduced to 3 at midband by feedback. Preceding this stage, a triode connected 6AU6 with a gain of 30 brings the over-all midband gain to 90. Thus the unit can directly drive a final power amplifier if need be. Normally, a switching and tone compensating amplifier is used between the two.

Other combinations of triodes and pentodes can be successfully used, but most combinations will not give as high a gain.[1]

Equalizer switching is negotiated by either the "universal" or "alternative" methods of Fig. 8. Both schemes use the same bass turnover selector switches. The first method gives de-emphasis from 0 to 150 microseconds in 10 microsecond steps, whereas the alternative goes from 0 to 105 microseconds in steps of 15 microseconds.

Selection of α and r differs in that the "universal equalizer" offers continuously variable control of these factors over the entire wide range while the alternative gives the extreme ends and popular middle settings. The "universal" α and r dials can be panel calibrated, if desired, with an ohmmeter. In both cases, the calibration marking represents the fraction or multiple that is placed into the circuit by R_{24} and R_{16}. Some constructors may wish to calibrate their dials in terms of $\frac{1}{r}$ and $\frac{1+\alpha}{\alpha}$ in order to more

readily aid mental calculation of f_c and f_r.

$$f_c = \frac{1}{r} f_t$$

$$f_r = \frac{1+\alpha}{\alpha} f_s$$

Potentiometers for these controls should be wired so that a clockwise rotation gives maximum response.

Operation of either equalizer is conducive to rapid and easy selection of any desired curve. Bass turnover frequencies are selected by switches *A* and *B*. Treble de-emphasis is selected by throwing the switches marked directly in microseconds. The total de-emphasis is the sum of the individually chosen ones. α and r are directly selected.

It may occur to the reader that these schemes rely upon the user's detailed knowledge of playback curves. For this reason, these means of selection are unsuitable for the uninitiated. Charts such as the one that accompanies the schematic can be prepared for their use until the user becomes familiar with the scheme of things.

Component tolerances must be carefully watched if results are to be as expected. Commercially available condensers will deviate as much as 100% from their marked value and should be bridged beforehand. Resistors should also be bridged for very best results.

Soldering of these components must be done with care lest they change value with excessive heat. Do not overlook either of these suggestions as most complaints of poor operation can be traced directly to carelessness on these counts.

Since the output impedance of the equalizer stage is fairly low at the higher frequencies, the cathode follower output is not necessary where short output cable lengths will be used or where the unit forms part of a complete equalizer-preamplifier. However, for general use, the cathode follower is desirable.

Liberal use has been made of high resistance "click suppressors" across all switching points. R_5 forms part of a rumble filter.[1] It is recommended that the reference 1 be consulted by those wishing to construct the "universal equalizer." Suggestions for building the equalizer-preamplifier described there are applicable here as well. Some may prefer to use the equalizer schemes of this article in place of the one in reference 1.

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RADIO-TV Service Industry News

AS REPORTED BY THE TELEVISION TECHNICIANS LECTURE BUREAU

A GOOD indication of the growing use of electronic assemblies in a wide variety of new applications is the requests to the Bureau from equipment manufacturers for the names of competent, independent service companies in areas where their products have been sold.

The Bureau has been making this service available to electronic manufacturers. The "National Electronic Service Directory" forms are filed by states and cities. When a manufacturer needs the help of an independent service company in any section where he has sold equipment, the Bureau provides a list of the service companies in that section that have indicated they have the personnel and facilities to handle the type of equipment involved in the installation.

There are hundreds of small manufacturers who have been making specialized electronic equipment for the defense program, that have developed equipment for commercial use to be marketed when their defense commitments taper off. The availability of competent independent service facilities on a national scale is a boon to these small companies and they, in turn, will create installation and maintenance business that will add to the stable, bread-and-butter volume of the service companies that have the personnel, equipment, and management "know how" to handle it.

A Job or a Business

The rapidly expanding opportunities that are opening up for independent electronic service businesses bring into sharp focus the differences between service companies that are operated as *businesses* and those that merely provide a *job* for the owner.

The volume of business that was once available from television servicing led many men into the business on their own on the false premise that this type of service work would, in itself, provide enough business to give the operator a better-than-average income. In this, the reference is to new businesses that entered the field just to handle television service and not to those businesses that, as successful radio service businesses, were able to expand their facilities to handle television service work.

There are highly versatile men who possess the rare combination of a flare for business management and exceptional personal electronic skill. They are tireless workers who have a good natural sense about handling customers, so they build a following of service customers; they maintain liaison with non-servicing dealers from whom they get service referrals; and they are able to handle a large volume of service work by themselves. This sort of a service business provides the owner with a good income as long as he is in good health and can stand the pace of the work. But when he stops the business stops.

The more versatile service companies that have grown up with TV servicing as their base, are flexible as to personnel and capable of expanding in any direction in which profitable service business may be added. Some of these businesses have expanded outside of the electronics field to add service volume that can be handled by their regular personnel. A major field opening up for television service companies is that of installing and servicing room air conditioner units. This field has a short season but it falls during the period that television service is at a low ebb. It is of no interest to the refrigerator service companies since their businesses have to handle peak work loads during the same period that room air conditioners are in greatest demand.

A serious problem that faces the individual technician when he starts a service shop and depends on C.O.D. business developed through advertising to sustain him, is that of getting an adequate, consistent volume of business. Usually, the cream of the service customers are held by the dealers who sold the sets or by the companies that handled initial maintenance and service. A natural tendency is to advertise TV service for less money than established service businesses charge for it. The error in this reasoning is that price shoppers for service are largely fringe customers—usually the most

troublesome type to handle. Many of them are drops, for various reasons, from the mailing lists of the companies that originally handled their service. They are a headache to any technician who solicits their work.

Neglected Service Business

The mirage of profitable business in servicing TV sets has blinded most small service shop operators to the income-opportunities that are available in servicing other types of home electronic devices. Radio service, for example, has been badly neglected. Yet it is a business that the small shop operator could have for the asking since it has been of little interest to the larger service companies.

A little ingenious merchandising would bring in service volume in radio sets when the business is needed. A 2-week "community special" offer to repair any 5-tube model radio for $2.50 plus the cost of parts would pull a lot of inoperative radios into a shop. This could be promoted inexpensively in a striking handbill delivered door-to-door.

Record-changer maintenance is another type of service that has been completely overlooked by most small service shops. Since there are at least two radio sets and one record player of some kind in practically every home, the service shop that goes after this type of business is working in a one hundred per-cent market for its services.

Properly promoted, record-changer service will bring added income in the sale of replacement needles, cartridges and, in many homes where a substantial investment in records has been made, sales of albums, needle pressure gauges, record cleaners, etc.

Recorders

The bars are down on the use of magnetic tape recorders in practically every home now that popular recordings are being sold on one-hour spools. The lack of dependable service—or any kind of service in some localities—for wire and tape recorders has been a sore spot with many users of these devices. With the widening interest in and utility of tape recorders to provide packaged entertainment in the home, the small shop operator, and particularly those located in community or residential areas, can put a sounder base under their businesses by offering home recorder service.

Color Television

It is doubtful whether color television receiver servicing, in volume, will ever fall into the hands of the small shops. The deterring factor will be the cost of the test equipment necessary to do the service economically and efficiently.

The failure of the average service shop operator to take into account *all* of his costs of operation in establishing his service labor rates, precludes his keeping abreast of the times with the new instruments.

In home radio service, an experienced technician could get by with inexpensive test equipment if he wasn't concerned with the quality of the sound that came from the set and if he was content to charge off the extra time he had to give to the tough ones he serviced by hit or miss methods.

A certain amount of servicing of monochrome TV sets can be done by simple tube substitutions, although it is a bad practice since a tube failure is often an indication of impending circuit failure. However, only an inept technician attempts even minor service on a TV set without having some test instruments within reach. So the test instrument investment for monochrome receiver servicing has been considerably higher than was necessary for radio servicing.

Color television will require a substantial investment in test instruments even for use in the simplest replacements and adjustments that can be made in the home. Sound business reasoning will lead to the conclusion that this equipment should be amortized in service charges as rapidly as is legally possible. It is questionable whether one man working alone, with all of the other responsibilities of running a business, could handle a large enough work load to amortize his equipment, pay his business expenses, and provide him with an income commensurate with his training and experience.

Bad Advertising

Recently an advertising man, commenting on the various things that small business operators do that are negative promotions, pointed out the TV service signs on old battered cars and trucks as an example of inept advertising.

People like to deal with prosperous-looking, successful businesses, he said, and the appearance of a service car or truck with a company or an individual's name on it tells its own story to the prospective purchaser of service. If the service car or truck looks good it lends prestige and dignity to the service company that has its name on it. If it is dog-eared, battered up, it carries a connotation that the service company is on the fringe of failure.

Where old, battered automotive equipment is used on service calls, he said, it is far better to leave all advertising off it.

This also applies to the appearance of the service shop. The caliber of people who are willing to pay for first-class service won't deal with businesses that have dirty, unkempt store fronts and show windows. A set owner in Grand Rapids, Michigan recently told your editor that he and several friends there had called a service company to service their TV sets because they had been impressed with the appearance of the building and show windows when they drove by the shop. "An orderly, neat appearing business like that," they reasoned, "must know how to give good service."

The appearance, deportment, and

working habits of the man who calls to service the set in the home provide either good or bad advertising for the business. Recently a set owner, pointing to the illustration of a v.t.v.m. on your editor's desk, said "The man who takes care of our TV set always uses a complicated gadget like that. Once we called another man who advertised cheaper service. He came out and just changed two tubes and didn't check anything. Two weeks later we had trouble again. So we called this reliable service company. He used this kind of a set to test our TV and found that one of the parts had shorted out. That's what caused the tubes to burn out. Believe me, we'll never call a service man again because he advertises cheap service charges."

This clearly demonstrates how the set owning public pays for its own education about service. When a set owner buys service on price and gets stung—as they usually do—they never try to buy service again on the basis of price.

Building a Business

Servicing electronic equipment will continue to open up new business opportunities for men who crave the freedom of individual initiative through operating their own businesses. Very few industries provide this kind of an opportunity. Complex mechanisms make it necessary to use expensive equipment to service them. Service organizations are necessary to support these substantial investments in servicing and maintenance equipment so the amortization load can be carried by a group of men.

This will also happen in some phases of electronic service. Television, for instance, will gradually shift to color sets and the more complex servicing problems color reception will present. And remember, too, that television will find a place in many important applications in the home in other than broadcast TV. For instance, the same method that would make subscription TV possible could also be used for visual as well as aural communications between set owners provided TV cameras were installed at both points. Although this would be impractical at this time because of the cost of the cameras, the industry that spanned the gap from radio to television in less than twenty-five years will someday produce television cameras within the price range of the average home owner.

Because of the many complex factors involved, the shift of television from monochrome to color will probably bring about a decided shift of television maintenance and servicing into the hands of well-managed service organizations that are able to carry the substantial stock and equipment that will be required. This service industry will employ many thousands of technicians, supervisors, and managers of service; some estimates forecast a total service force of more than 300,000 people engaged in the business of installing and servicing TV by 1960.

But television is just one facet of the

giant industry electronics is destined to be. We previously mentioned the vast service market in radios and record changers that has been almost completely neglected by the independent service industry for the past several years. Another electronic device that has been rapidly coming to the fore is the radio-controlled mechanism for remote operation of garage doors. Many small radio shops hit a business bonanza when they started promoting these units in their communities.

In the field of mobile two-way communications, the Citizens band will eventually bring into existence a variety of instruments which will operate on this assigned band of frequencies. Many model airplane and model boat enthusiasts control their powered craft by radio using miniature transmitters and receivers sold by hobby shops.

Despite its amazing potential, the electronics industry will always keep the door of opportunity open for the technician who wants to engage in business of his own. But to make a success of his business, the ambitious technician-businessman must understand his industry well enough so that he can make a place for himself by selling service on the type of equipment he can handle profitably in the area where he operates. —30—

"CBS-COLORTRON 205"

CBS-Hytron has demonstrated its "CBS-Colortron 205" large-screen, direct-viewing, all-glass, tri-color television picture tube to the press. It employs a curved shadow mask and tri-color screen in combination with the three-beam electronic gun. The tube provides a choice of full color or black-and-white pictures on a screen having an area of 205 square inches. In the matter of size it most closely approximates the standard 21 inch black-and-white tube.

The increased screen area has been obtained by printing the screen directly on the inside of the face and by constructing its curved shadow mask so as to achieve maximum utilization of the area on the face. This additional screen area has been gained by positioning the three supports for the shadow mask above and below the desired screen area to obtain the desired 4 x 3 aspect ratio. The sides of the mask and screen are thus left free of interference.

Development of a photographic technique, similar to photoengraving, makes it possible to deposit the screen (composed of approximately 300,000 triangularly arranged groups of phosphor dots) directly on the inside of the tube's curved face—the same location used in black and white picture tubes. A light, easily assembled curved shadow mask is uniquely positioned behind this screen. This mask is perforated with approximately 300,000 tiny matching holes through which the electron beams from the three guns are aimed at their related phosphor dots on the screen. Because each shadow mask is used as a negative to print its individual screen, the screen and mask are brought into perfect registry.

As we go to press RCA has just announced a 21" color tube, which gives a 250-square-inch picture. —30—

"Concert Hall on Wheels"

(*Continued from page 67*)

flesh and blood orchestra, as the composite Fig. 2 illustrates. While the trebles are on one side of him and the basses on the other, the middles coming from both sides become directionally diffused and serve to form a physical (or acoustical) bridge between the treble and the bass ends of the car.

Now to get down to brass tacks. How is all this effect achieved? How shall we take the single channel (monaural) program that we receive on the car radio and convert it into a *synthetic* stereo system? Having already justified this conversion on the basis of "geometric-frequency" band separation, let us examine what this entails from a technical angle.

Such frequency-band separation of the ordinary type is, by itself, not new nor difficult to obtain. It is accomplished by means of a "crossover" network, of which the general form is illustrated in the dotted section of the accompanying schematic diagram, Fig. 3. It will be noted from this schematic, however, that this crossover network is only one small part of the present system, and although we shall presently see that in this application the crossover network is somewhat unconventional, it will nonetheless be advantageous to briefly point out the major advantages that accrue to the usual multi-speaker system employing crossover networks. First, by the use of such frequency-band discriminating networks intermodulation distortion is greatly reduced by the separation of the signal energy into a low-frequency band and into a high-frequency band, and subsequent channeling of the electrically separated bands of energy into physically independent reproducers. This permits the low-frequency and high-frequency reproducers to function independently, each with maximum efficiency.

What differentiates the present system from a simple dual-channel speaker system? We are not dealing here with a simple woofer and tweeter, but with two speakers "A" and "B," which today may be called upon to perform as woofer (A) and tweeter (B) or tomorrow as woofer (B) and tweeter (A). The "A-B" or "B-A" arrangement will be dependent upon factors such as who is sitting in what section of the car, the musical preference of the car occupants, the musical content of the program, and the noise conditions encountered on the road. This necessary alternate woofer-tweeter or tweeter-woofer arrangement places a very special prerequisite upon the system. In contrast to the usual *frequency-band specialized* woofer and tweeter, both speakers in this system must be of equal *wide range and high fidelity* capabilities.

The crossover frequency for this ap-

plication was selected on the basis of dividing the ten octaves of the usable musical spectrum from 16.351 cps to 16,744 cps into two equal parts of five octaves each. This places the actual crossover frequency at 493.88 cps (approximately 500 cps). By this choice the lower five octaves become the "bass and lower middle choirs" of the orchestra, and the upper five octaves become the "upper middles and treble choirs" of the orchestra.

To permit selecting the manner in which this binaural or stereo system will operate, that is, whether it will be "woofer-tweeter" or "tweeter-woofer," a simple selector system is provided as shown in Fig. 1, and as indicated in the schematic diagram. In the one position, "Bi-A," the lows are channeled to the forward speaker, while the highs are sent to the rear. In the alternate position, "Bi-B," this channeling is reversed. Thus there is afforded a choice of orchestral set-up best suited to the operator's musical tastes. You may have the bass in front of you and the treble in back, or you may chase the bass into the rear of the car and bring the violins forward at the turn of the switch from "Bi-A" to "Bi-B."

The third position of this switch, "Mon.," eliminates the frequency separation function completely, thus making the two speakers perform exactly the same over the full fidelity range. With the master selector switch in this "monaural" position, there are provided auxiliary "on and off" toggle switches which permit the use of one or both speakers, either front or rear. Dummy loads are provided in these auxiliary circuits so that switching these speakers on or off will not upset the level of either speaker individually.

Individual volume controls for each speaker are also provided so that the proper volume balance between the speakers may be obtained for any one of the three alternate switch positions, and to compensate the individual output levels for the unequal distances of the two speakers from either the front or rear seat (whichever one happens to be the favored one). Since most of the volume manipulation will be performed at this control panel, it may prove desirable, but by no means necessary, to remove or jump the built-in volume control of the receiver itself. If this is done, then a fixed volume control should be inserted in the receiver, and this volume control should be set at the point where the audio output stage will not be pushed into areas of distortion.

The constants shown on the schematic (Fig. 3) for the 500 cps crossover section are selected for a 3.2 ohm output circuit which is the normal output impedance of an automobile radio. For economy sake, the 15 μfd. condenser may be a low voltage back-to-back type of electrolytic. This is small in size and may be mounted by means of a fuse clip soldered to the rear of one of the "L" pads as shown in the rear view of the device (Fig. 4).

The second "L" pad may serve as a support for the choke by soldering to its back a brass screw which will, in turn, support the lightweight air core choke. The winding data for this choke, *L*, is given in the schematic diagram.

There is no hard and fast rule as to how to operate this binaural system, therefore the alternate switch position is made available. In cases where the existing speaker is located down low and perhaps pointed downward as in some not-too-old installations, it will be found advantageous to operate the system with this downward-beamed speaker reproducing the lows. The rear speaker which will, in this case, reproduce the highs, may then be mounted in a separate enclosure placed on the rear shelf of the car in such a manner that it will beam the high frequencies forward.

However, if the existing speaker is well up on the dashboard and directed fairly well at the listener, as in the more modern car installations, then the installation may be modified in the following manner. Admirable low-frequency results may be obtained if a good high-fidelity speaker is mounted flush on the rear shelf so that the back of the speaker looks into the trunk of the car. This trunk volume will provide adequate rear baffling of the speaker which is so essential for the reproduction of good low-frequency sound. As far as the treble tones from this speaker are concerned, the rear window, usually at an inclination of close to 45° will, by reflection, throw the treble tones forward into the passenger area of the car, when this speaker is called upon to carry the treble.

However, it will be found in practice that the operation of this installation will afford the most pleasure when the forward speaker becomes the treble reproducer and the rear speaker performs the bass function. The trebles coming toward the face of the listener will add greatly to the acoustic "presence." Since most of the intelligibility of sound is in the treble region, the listener will get a better perspective acoustic picture if the highs "face" him, and the lows float around to him from some other direction. The user will of course have to follow his own preferences in this matter and these performances will, to a considerable degree, be affected by the car's interior acoustic properties, by the quality of the speakers used, by the program material being received, and by the favored listening position within the car.

The placement of this stereo control panel is determined by the car in which it is installed. It may be mounted in the glove compartment to keep it out of prying hands. However, if you like to exhibit your accessories, some convenient spot may usually be found below the dashboard panel. Or it may even be built into some blank section of the dashboard such as the glove compartment door. —30—

NEW EQUIPMENT FOR THE AUDIO TECHNICIAN

TAPE REPEATER REEL

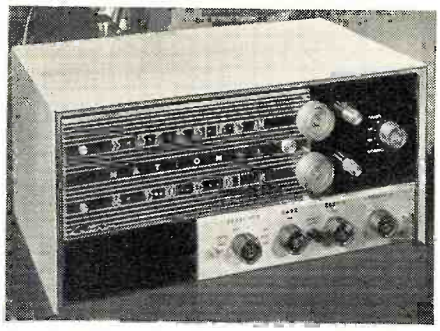
Industrial Electronics, Inc., 127 Light Street, Baltimore 2, Md. is now offering a tape repeater reel which may be placed on the take-up spindle of any tape recorder.

The reel is designed to be loaded with up to 20 minutes of tape. The tape can be wound in either direction. The reel itself is ruggedly constructed of heavy plastic with precision ball-bearing tape rollers. The removable retainer band is chrome-plated spring brass. The over-all diameter is 6.75 inches and the 5/16" center hole fits standard tape recorder spindles, thus converting any tape recorder into a message repeater.

NATIONAL AM-FM TUNER

National Company of Malden, Mass. has introduced a line of audio components which has been styled for contemporary living and provides good performance and appearance.

One of the new units in the company's "Horizon" line is the "Criterion" AM-FM-binaural tuner which incorporates several interesting features.



Among the new features are the company's "Mutamatic" tuning for rejection of inter-station noise, printed circuitry, and 8 to 10 capture ratio, plus good stability, selectivity, and sensitivity plus freedom from drift.

The new tuner permits simultaneous AM and FM reception with separate volume and tuning controls to permit simultaneous outputs. Provision is also made for receiving FM multiplex broadcast as soon as the system is authorized by the FCC.

UTC AMPLIFIER KIT

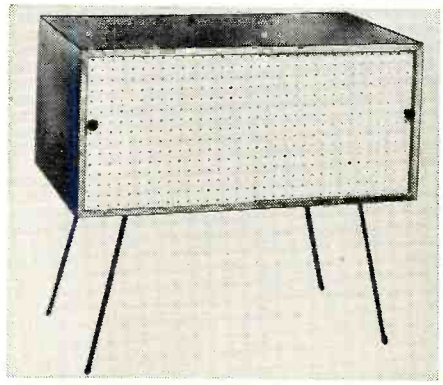
United Transformer Company, 150 Varick Street, New York 13, N. Y. is now offering an amplifier kit which employs new engineering principles to provide an instrument with 36 db of feedback on a multiple loop basis.

The amplifier has a rated power output of 20 watts with .07 per-cent intermodulation distortion at 1 watt and 1 per-cent at 20 watts. Frequency response is controlled for 1 db from 20 to 20,000 cps.

Because of its printed circuit construction, completion of the kit involves only the additional connection of 17 leads to screw terminals. For full details on the MLF amplifier kit, write the manufacturer direct.

CABINART ENCLOSURE

G & H Wood Products Company, 75 North 11th Street, Brooklyn 11, N. Y. has introduced a new equipment cabi-



net, the Model 50, which has been especially designed for the modern interior.

The new *"Cabinart"* unit houses high-fidelity equipment in a contemporary setting. Sliding front panels of perforated white Masonite keynote its functional design. The cabinet may be used on wrought iron legs, wall mounted, or atop a bench. It measures 35½" wide, 16" high, and 16" deep. The wrought iron legs are 16" long.

RCA SPEAKERS

Two new loudspeakers have been added to the replacement line offered by the Tube Division of *Radio Corporation of America,* Harrison, N. J.

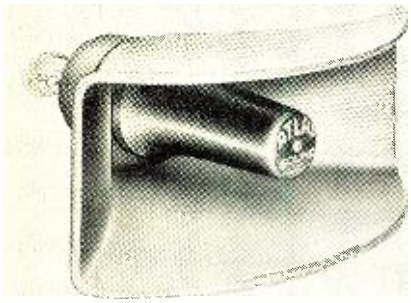
The speakers are a 6½" PM type (*RCA*-220S1) for replacement service in table model radio and TV receivers and in centralized sound systems; and a 6 by 9 inch PM type (*RCA*-218S1) for use in auto radios and in home music systems. Both speakers utilize standard RETMA mounting dimensions. The Type 220S1 incorporates a 2.15 ounce *Alnico V* magnet, a 3.2 ohm voice coil, and a special "universal" flange for mounting a wide range of transformer sizes. The Type 218S1 has a 3.2 ohm voice coil, an *Alnico V* magnet weighing only 2.9 ounces yet having the performance capabilities of a speaker designed with a 3.16 ounce magnet.

THE "COBRA-JECTOR"

Atlas Sound Corp., 1449 39th Street, Brooklyn 18, N. Y. has added a new wide-angle, all purpose projector to its line of horns.

The "Cobra-Jector" is designed to

provide penetrating coverage of wide areas and under adverse sound conditions. The new Model CJ-30 features an indestructible polyester fiber-glass



projector, an *Alnico V* Plus magnetic assembly, 100 per-cent phenolic diaphragm and voice-coil assembly, all-weather double-sealed non-resonant construction, all-weather tropicalized and polarized finish on all metal parts, and universal mounting bracket.

Input power is 15 watts, input impedance is 8 ohms. Response is 250 to 9000 cps. The front opening measures 14" x 6". The over-all length with bracket is 14".

RECORD PLAYER

Olympic Radio & Television Inc., 34-01 38th Ave., Long Island City, N. Y. is now marketing a portable record player, the "Contata."

The instrument features a *Garrard* professional-type record player, a *G-E* reluctance pickup, a preamplifier, and an a.c. circuit with power transformer. The frequency range of the unit is 30 to 15,000 cps. Separate bass and treble controls are provided.

TAPE RECORDER INVERTERS

American Television & Radio Co., 300 E. 4th Street, St. Paul, Minn. is now offering an inverter which permits the operation of any standard tape recorder in an automobile.

The recorder inverter operates from the 6- or 12-volt d.c. automotive stor-

age battery system and provides 110 volts a.c. to the recorder. It is available with mounting brackets for under-the-dashboard or trunk mounting. A remote control unit is available for use with the inverter when it is mounted in the trunk compartment.

Complete literature on these units is available from the company on request.

PACKAGED PHONO-RADIO

Terminal Radio Corporation's Sound Studios at 85 Cortlandt St., New York 7, N. Y. is now offering a complete

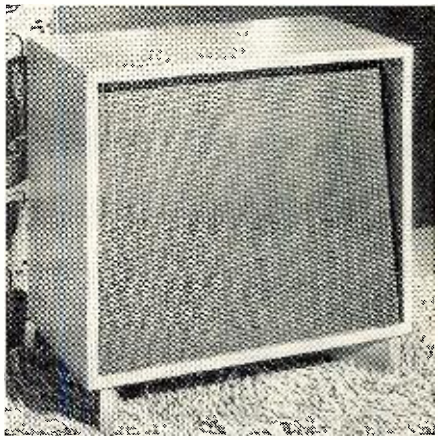
packaged radio-phono system consisting of a *Craftsmen* C800A AM-FM tuner, a *Craftsmen* C500A amplifier, a *Garrard* RC-80 changer, an *Electro-Voice* 12 TRXB triaxial speaker, and a *G-E* RPX-050 triple-play variable reluctance magnetic cartridge.

The company is also offering two cabinets to house this "5-Star System," an *Electro-Voice* "Peerage" unit to house the equipment and the "Aristocrat" with folded horn for the speaker.

"LARGO" SPEAKER SYSTEM

Permoflux Corporation, 4900 W. Grand Ave., Chicago 39, Ill. is merchandising a new wide-range speaker system, the "Largo."

The system utilizes the new *Permoflux* Model 8V81 "Super Royal" speaker and the 32KTR "Super Tweeter" model in an acoustically correct enclosure designed to match the speaker characteristics. The enclosure is a unique horn-loaded, non-resonant baffle with the horn loading of the speaker back wave taking place in the cabinet base. This principle results in an extremely compact unit with every inch of the cabinet serving a useful acoustic purpose.



Frequency response is 35 to 16,000 cps. It will handle 15 watts, has an impedance of 8 ohms, and measures 24" wide, 14" deep, and 21" high.

FREED-EISEMANN TUNER

The Model 750 AM-FM tuner has been added to the *Freed-Eisemann* line of audio components.

AM and FM circuits are designed for maximum gain at minimum noise, with a.f.c.-controlled FM terminating in a Foster-Seely limiter-discriminator. The new tuner is self-contained with all controls within a fully-enclosed front panel assembly. The unit is housed in a baked ebony finish on the front panel with bronze escutcheon and two-tone knobs. The chassis and other metal parts are copper plated.

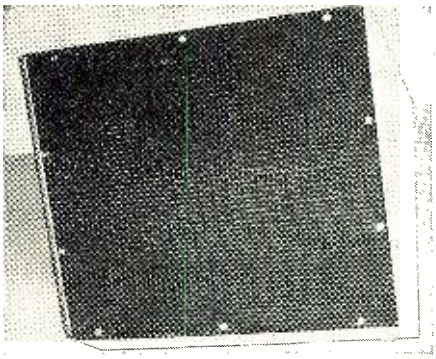
STEPHENS ENCLOSURES

Stephens Manufacturing Corporation of Culver City, California has introduced a "patio-garden" speaker enclosure, the Model 602.

Designed for installation under the eaves, the new enclosure is 29½" wide, 20½" high, and 17½" deep at the top and 6½" at the bottom. The unit is

also adaptable for indoor use in those areas where outdoor listening is seasonal.

The Model 602 is a rear horn-loaded enclosure for use with the "Tru-Sonic"



122AX coaxial or 112FR 12" speakers. Two other models, the 600 and 603, are also available in this same line. Write the company for complete specifications.

RECORDER-RADIO

Two new tape recorder-radio combinations have been announced by *Ampro Corporation,* 2835 N. Western Ave., Chicago, Illinois.

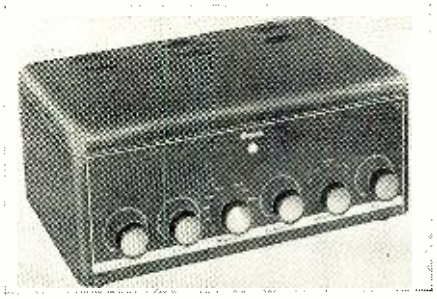
In both models the built-in radio utilizes the tape recorder's amplification system consisting of a six-tube, four-rectifier circuit playing through a 6 by 9 inch *Alnico* PM speaker. The "Hi-Fi" (Model 756-T) at 7½ ips, has a frequency response of 40 to 12,500 cps while the "Celebrity" (Model 755-T) at 3¾ ips has a frequency response of 40 to 8000 cps.

Both instruments feature an electromagnetic piano-key control system. Solenoids operate all functions, eliminating breakdowns and wear often found in mechanical linkage systems, and provide fast, simplified recording and playback.

BOGEN AMPLIFIER

David Bogen Co., Inc., 29 Ninth Ave., New York 14, N. Y. is in production on the DB15G amplifier which uses the partial cathode-loading techniques and features a built-in record equalizer having separate controls for low-frequency turnover and high-frequency equalization.

The new amplifier, which is designed as a companion unit to the company's R640G AM-FM tuner, is compact and sturdy. It incorporates the company's



"loudness contour selector" which permits the selection of five distinct frequency response characteristics.

Information on both the amplifier

and tuner will be supplied by the manufacturer on request.

COMBINATION STYLUS

Pickering & Company, Inc., Oceanside, Long Island, N. Y. is now offering the Model 260 turnover pickup cartridge with a diamond stylus for long-playing recordings and a sapphire stylus for standard 78 recordings. The diamond stylus is of .001" radius for LP's while the sapphire unit has a radius of .0027" for standard grooves.

Except for the sapphire stylus, this new unit is identical in all respects to the company's Model 260 double-diamond turnover pickup. —30—

Within the Industry

(*Continued from page* 18)

entry blanks on any of the exhibit floors and there is no limitation to the number of entries that may be submitted by any person.

Personnel affiliated with distributors, dealers, and manufacturers may compete, along with the general public. Prizes will consist of merchandise certificates for sound equipment of the winner's selection.

* * *

HARRY L. CHANEY has been appointed chief engineer for *Kay-Townes Antenna Company,* of Rome, Georgia.

He was formerly an electronics engineer at the Signal Corps Engineering Lab. at Belmar, N.J. where he developed and designed a receiving tube characteristics test set which has been adopted as a standard at the Lab.

Since the war he has been a field engineer with *Tele-King* and chief engineer for *Electronic Devices Company* of New York.

In his new post he will be in charge of all engineering and development programs at the antenna firm's electronic laboratory.

* * *

G. LEONARD WERNER has been named general sales manager of *The Astatic Corporation* of Conneaut, Ohio.

Mr. Werner resigned as sales manager of *Mark Simpson Manufacturing Co., Inc.* to accept his new position. He also served as chief engineer and director of sales engineering with the *Masco* organization.

He entered the radio business in 1930 and for a number of years manufactured sound and intercom equipment and other electronic devices. He has been a ham since the mid-20's. He is associated with the IRE, SME, Sales Manager's Club, and the SE-8 technical group of RETMA. —30—

Two-in-the-Hand

(*Continued from page* 65)

As it stands right now, I can still live with the birdies, and have been copying pretty good DX in the car without too much trouble due to other strong local stations.

Tuning and Adjustment

Assuming that you've built up the preceding stages, have an adequate plate supply, and are hearing something besides 60-cycle hum in the speaker, initial adjustments of each stage are in order.

The R.F. Amplifier: You'll be glad you built those neutralizing condensers, as there's a lot of doodling required to arrive at a well-adjusted and properly neutralized push-pull amplifier. I like to neutralize the stage with antenna and power connected; after all, that's the condition under which it must operate. Try this:

After resonating L_1, L_2, and L_3 with a grid dipper, screw both neutralizing trimmers in to maximum capacity and rotate C_2 over its range. Chances are you'll hear the gosh-awfullest noises as the stage "takes off" at resonance! Back off the adjustment of each neutralizing condenser *very slightly* and rotate C_2 again. More racket!

Continuing the process—a tiny adjustment at a time—you should eventually find settings of C_{N1} and C_{N2} where the stage approaches neutralization, and the background noise "peaks" at resonance. After each adjustment of the neutralizing condensers, C_4 should be retuned with C_2 to keep input and output tanks resonated together, as changing neutralizing capacity slightly detunes each tank circuit.

When you find the point where the background noise peaks, the stage is not necessarily neutralized; it may be regenerative, although not oscillatory. Here's where more fine adjustment enters. There will be a neutralizing condenser setting where noise peaks the *least amount*, which should represent the approximate center of the "neutralizing plateau." At that point, the amplifier should show the best signal-to-noise ratio, but not its maximum gain. If the stage is regenerative, its gain will be somewhat higher, but so will its ability to amplify noise! Remember, signal-to-noise ratio is determined by the r.f. stage, and you can crank in plenty of gain later in the i.f. stages, where the lower frequency noise figure is of less importance.

Fig. 1 shows manual adjustment of C_2 to obtain best relative signal-to-noise ratio at a given signal frequency. Because the resonance peak is usually not the place where best signal-to-noise ratio occurs, I've brought the input control out where it may be manipulated and, if necessary, slightly detuned from the signal frequency. You'd

be surprised to note the difference made with control over this function. In many cases, adjusting the input has made the difference between copying a bit of plain noise level or bringing an "S" one-half signal into QSA range.

The Oscillator: With the converter operating, turn on your transmitter crystal oscillator or choose a time when you know signals are on the band. Using an insulated tuning tool, slowly rotate C_{20} until a rush of noise can be heard; at that point, you're nearing the correct oscillator frequency setting. Careful adjustment of C_{20} should bring in a harmonic of your crystal oscillator and other local signals.

Start this procedure with a trial setting of the slug about half-way into L_5. Find a signal near the low end of the band, then screw the tuning knob out until you locate another signal near the top end of the band. Count the number of turns required between band edges; if bandspread is too limited, then start over, but with the slug starting a half-turn farther out, etc. A little practice allows fine adjustment of the slug position to the point where the band is just tuned by a given number of dial rotations. This takes some patient work, but is really worth it when the last adjustment has been made.

It's difficult to obtain absolute dial-scale linearity; the band has a tendency to crowd when the slug is closest to the coil. Proper tapering of the slug will help the situation, and requires time and patience.

After you're satisfied with bandspread tuning and linearity, tune to several known signal frequencies, marking each lightly on a blank dial. After adjusting the mixer grid circuit (see next section) the dial may be inked permanently. After once setting up the system, a properly-constructed slug-tuned device of this nature will hold calibration until two meters freezes over, and you'll probably be glad you took the trouble.

If you'd rather not fool with a slide-rule indicator, a bit of gear-ratio figuring can result in a neat pulley-and-vernier dial arrangement, wherein a commercially available unit such as the *National* MCN dial string-geared to the slug pulley, accomplishes the same purpose. It's much easier, and not quite so pretty, but perhaps you'd prefer to be more of an operator and less of an artiste!

The Mixer: Use the grid-dipper to ascertain that L_3 resonates to 145 mc., and L_1 to about 10.6 mc. Temporarily wind a few turns of link around L_4 and couple it to your communications receiver, tuned to 10.6 mc. With the r.f. and oscillator stages operating, peak both coils on background noise.

Now here's where some tricky business enters. L_6, coupling r.f. voltage from oscillator to mixer, is shown to be two complete turns of linkage. That much coupling was found to be necessary for a satisfactory amount of

injection voltage to be delivered to the mixer grids. Injection voltage is extremely important with respect to optimum conversion efficiency, signal-to-noise ratio, and good over-all noise figure. Axiom: 'Tis better to over-inject than under-inject.

Because of the amount of coupling, the oscillator is heavily loaded, thus tuning the mixer grid circuit changes the oscillator frequency. So OK, it pulls—it's a fixed-tuned stage, isn't it? When you resonate the mixer grid, you'll alter the dial calibration a bit, thus final calibration should not be made until the mixer is tuned to its proper frequency.

Using your communications receiver as a temporary i.f. strip, go back to the r.f. stage and start all over again until you're satisfied the three stages are beginning to operate properly. By the time you're ready to try the converter in your car, the remaining circuits present practically no problem.

The I.F. Amplifier and Second Converter: Sticking closely to the values given for these two stages should result in immediate operation. The 6BA6 stage will amplify to beat the band when L_7 and L_8 are peaked at the intermediate frequency; using background noise as a source reference, resonate both coils, lock their slugs in place, and forget 'em.

If wired according to the diagram, the 6BE6 mixer should also function right away. With the converter connected to the car radio's antenna input, you'll hear satisfactory amounts of background hiss if all's well, and very little otherwise. There being no tuned stages in the second mixer, ascertain that the 9 mc. crystal is oscillating. This is determined by listening for its 16th harmonic at 144 mc., weak but distinguishable. With the harmonic tuned in, place a finger against the crystal holder, which should shift the frequency very slightly, thereby identifying the harmonic as such.

Potential at pin #6 of the 6BE6 socket should be approximately 7 volts when the over-all plate supply delivers about 150 volts. Over-all current drain of the 5 tubes should not exceed 30 ma.—22 ma. for the tubes, and 8 ma. necessary to "fire" the voltage regulator tube. Power supply may be made from the car radio's vibrator pack, providing it's not one designed to go dead with an extra milliampere drain. Most modern car radios should be capable of fulfilling the function with little trouble.

A Final Word

The converter was designed not as a general mobile front end, but rather as an extremely selective receiving system to be used in the pursuit of DX from a fixed-mobile location. Standing still, in other words. The tuning is quite sharp, and was meant to be that way; this is a DX amateur's receiver.

At this writing, some DX has been heard (and worked) from the car,

using just the 19" quarter-wave whisker, which DX apparently was inaccesible to a few home-station installations having the advantage of high-gain beam antennas. Just to prove the point, said DX was first contacted with a mobile 4-element 7.6 db beam from a high, clear hilltop location, then the same stations were re-worked from the driveway of the house in a flat residential section, using only the quarter-wave whisker.

The main reason for writing this article (other than for money!) was to present the advantages of the slug-tuned oscillator. Hoping you'll give it a try, and sure that you'll enjoy using it as much as we have, here's 73 and good luck from W6WGD. —30—

Basic Color TV

(*Continued from page 44*)

itive pulses are made available to a vertical blocking oscillator. At the same time, both positive and negative pulses are made available to the phase detector in the horizontal sweep system. Appropriate filters are inserted between the pulse take-off points and their respective sweep systems to remove the undesired pulses and permit only the desired pulses to get through.

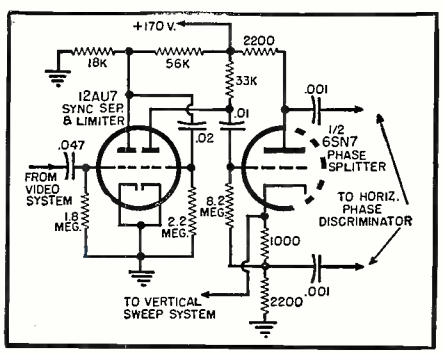
The a.g.c. stage used in nearly all color television receivers is of the keyed or triggered variety, that is, positive pulses reach the plate of the tube at the same instant that positive horizontal sync pulses in the video signal arrive at the control grid of the a.g.c. tube. The tube current that flows when these two pulses are active establishes the negative bias voltage that is fed back to the control grids of several video i.f. stages and the grid of the r.f. amplifier.

Many of the a.g.c. systems now employed in monochrome sets may be used in color sets with similar results. The introduction of the color signal has not basically altered the need for or purpose of automatic gain control.

The deflection systems of most present-day color TV receivers, like the a.g.c. systems, strongly resemble their monochrome counterparts. These, together with the high-voltage and convergence circuits, will be discussed next month.

(*To be continued*)

Fig. 8. Sync separator section of a color TV set. Note similarity to the circuits used for this function in monochrome sets.



Technical BOOKS

"HOW TO INSTALL & SERVICE AUTO RADIOS" by Jack Darr. Published by *John F. Rider Publisher, Inc.*, New York. 111 pages. Price $1.80. Paper bound.

A practical, no-nonsense approach characterizes this volume by one of the "old timers" in the auto radio servicing field.

From his wealth of experience the author has provided specific "how-to-do-it" instructions for the technician who wishes to take advantage of the lush market for installing and servicе these "mobile music boxes."

The author has limited his discussion to the circuitry and techniques that are unique with auto radios so the user of this text must have a thorough working knowledge of AM receiver circuitry.

The text is divided into three main sections covering installation, servicing, and the service shop. The section on the service shop is especially valuable since the business end of servicing is often neglected because of the emphasis on the servicing angles. Coming from a practicing and successful shop owner, this material is a veritable gold mine for the newcomer in the field as well as the experienced hand.

* * *

"LOUDSPEAKERS" by G. A. Briggs. Published by *Wharfedale Wireless Works*, England. Available from *British Industries Corporation*, 164 Duane St., New York 13, N.Y. 86 pages. Price $1.60. Third Edition.

This handy, pocket-sized manual has been written for the layman and the audiophile lacking formal training in audio engineering.

Since the author is one of those all-too-rare individuals who can make complex subject matter intelligible to the tyro, we believe that most readers will find this book enlightening and informative.

Almost all of the material presented in this slim volume is basic and thus immune to obsolescence. The chapters cover the development of speakers, magnets, chassis or cone housing, cones, centering devices, impedance, phons and decibels, frequency response, response curves, volume and watts, resonance and vibration, cabinets and baffles, extension speakers and volume controls, room acoustics, transients, crossover networks, negative feedback, transformers and matching, comparing performance, speaker life, Doppler effect, and speaker efficiency.

* * *

"SPECIALIZED AUTO RADIO MANUAL" by Rider Staff. Published by *John F. Rider Publisher, Inc.*, New York. 123 pages. Price $1.80. Paper bound. Volume 3-A.

This is the third volume in this new series from *Rider* and covers receivers

installed in *Chevrolets, Pontiacs, GMC* trucks, and *Chevrolet* trucks during the years 1950-1954.

Like the previous volumes in the series each receiver is pictured, diagrammed, and completely described. A schematic and parts list is included for each receiver along with the necessary alignment data and hints covering any tricky features or special "bugs."

The service organization or technician who specializes in auto radio service work can step up servicing volume with factory-authorized information of this type.

* * *

"TECHNICIAN'S GUIDE TO TV PICTURE TUBES" by Ira Remer. Published by *John F. Rider Publisher, Inc.*, New York. 152 pages. Price $2.40. Paper bound.

This is a specialized work covering the fundamentals of television only as they apply to the operation, maintenance, and repair of the picture tube and its accessory parts.

The bulk of the book is devoted to direct-view picture tubes as befits their pre-eminent position in present-day television but projection tubes and the new color picture tubes are also covered but in a less thorough manner.

The author covers the basic parts of the picture tube, picture tube accessories and adjustments, physical and electrical characteristics, repair and replacement, as well as including a table of picture tube specifications.

The text material is well illustrated, clearly and simply written, and is prepared in such a way that the maximum amount of information has been disseminated in the fewest possible pages. —30—

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66, 67	University Loudspeakers, Inc.
82	Radio Craftsmen, Inc.
117	Channel Master Corp.
155	Radio Club of America

ERRATUM & ADDENDUM

A typographical error was responsible for the mis-print in connection with the offer of the "Rectifier Handbook" (page 126, July issue) by Sarkes Tarzian, Inc. The company is located in Bloomington, Indiana not Bloomington, Illinois as indicated in the item.

* * *

Many of our readers have inquired about the availability of binders for their back issues of RADIO & TELEVISION NEWS. We have recently heard of a source for such binders and are passing the information along to our readers. Goldsmith Brothers, 77 Nassau Street, New York 8, N. Y. are in a position to supply such binders. Write direct to the firm for prices.

Classified

Rate 50c per word. Minimum 10 words

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COMPLETE radio, electronics theory & practice: television; broadcasting; servicing; aviation, marine, police radio. 12 or 18 months. Catalog. Valparaiso Technical Institute, Dept. N, Valparaiso, Ind

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TAPE Recorders, Tapes, Accessories. Unusual Values. Dressner, Box 66R, Peter Stuyvesant Station, N. Y. 9.

FREE: Get our monthly electronic lists. Dick Rose, Everett, Wash.

TUBES and equipment bought, sold, and exchanged. For action and a fair deal, write B. N. Gensler, W2LNI, 136F Liberty, N. Y. 6, N. Y.

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ALUMINUM TUBING, Angle and Channel Plain and Perforated Sheet. Willard Radcliff, Fostoria, Ohio.

SALE! New $24.95 Videon Junior TV Booster $9.95 each, New $19.95 VDX antenna rotator $19.95 each Cash only. Hargis, Box 716, Austin, Texas.

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HIFI Records at savings. Example: $12.90 Mercury Olympian Nutcracker Suite, just released $9.00. Reviewed July Radio News. Free catalog: High Fidelity Records, Box 701, Kansas City, Mo.

CODE—practice oscillator kit, complete with transistor and battery $14.95 postpaid. Caldwell, Box 685X, 1421 Arch St., Phila. 2, Pa.

BLONDER-TONGUE channel 3 CS-1 strips. Slightly used. 1 for $40.00. J. K. Colehour, 274 Chestnut St., Pensacola, Fla.

G.E. Cartridges—$3.95, VM Triomatic—$23.50, Collaro 3/532 Intermix-spindle-xtal—$34.50. Tuners, Amplifiers, Low Prices. Fidelity Unlimited, 63-03 39th Ave., Woodside, N. Y.

TV-FM antennas. All types including UHF. Mounts, Accessories. Lowest prices. Wholesale Supply Co., Dept. H, Lunenburg, Mass.

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14 YEARS Aviation Experience. 6 yrs. coll., age 34, administrative, communications. Prefer Govt liaison or sales work. LCDR Dave Bowman, N.A.S. Minneapolis, Minn.

(More classified ads on page 178)

Classified Continued from Page 177

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MISCELLANEOUS

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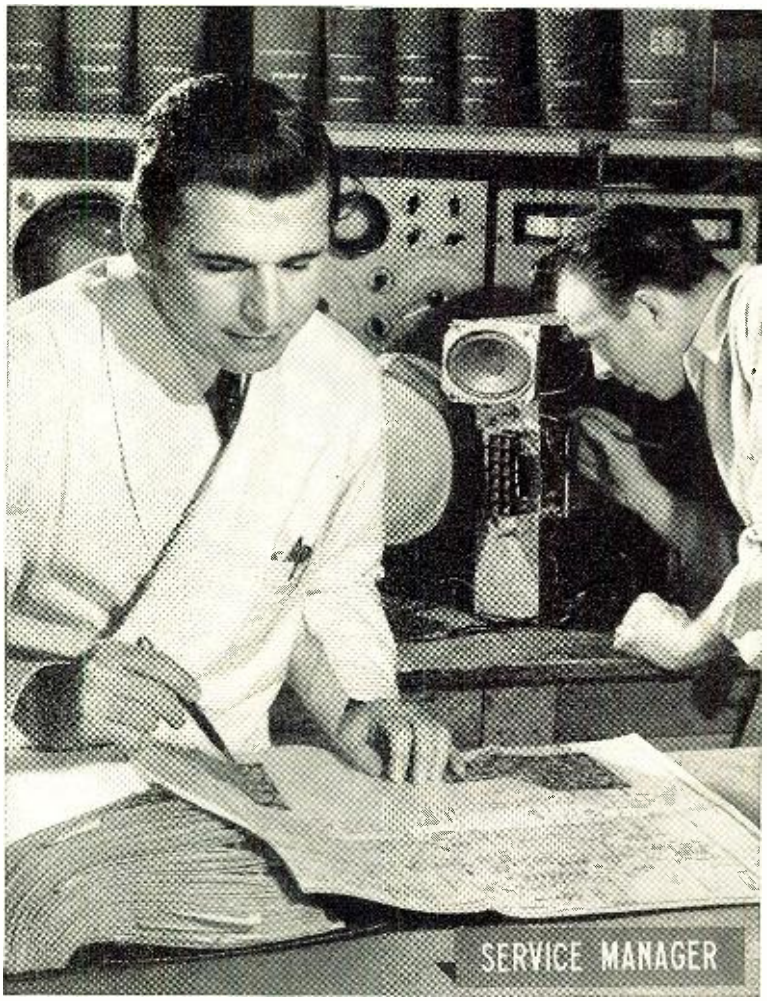
SEPTEMBER 1954

Here's a NEW Way to Reach the Top in TV SERVICING



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Installing front-end channel selector strips in modern UHF-VHF Television receivers and learning UHF servicing problems and their solution is part of the practice you get if you live in a UHF area. To cash in on the coming color TV boom you'll need the kind of knowledge and experience which this training gives.

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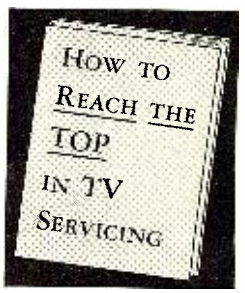

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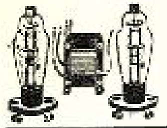

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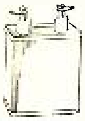

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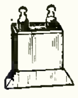

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2X.1MFD/2000V $1.39; 2 for $2
.5MFD/600V ......25c; 6 for $1
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1MFD/600V ....39c; 3 for $1
2MFD 600V ....59c; 5 for $2
4MFD/3000V ....$7.98; 2 for $14
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5MFD/600V ....$1.50; 3 for $4
16MFD/600VAC/1800VDC $5.95; 2 for $10

MICA CONDENSERS

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A	.02	600	69c; 5 for 2.25
A	.015	2500	1.25; 3 for 3.15
B	.01	600	30c; 5 for 1.35
B	.01	1200	50c; 5 for 2.25
A	.005	2500	60c; 5 for 2.75
B	.004	600	40c; 3 for 1.05
B	.002	1200	30c; 4 for 1.00
A	.002	2500	98c; 3 for 2.25
A	.001	1200	25c; 3 for .66
C	.0007	3000	89c; 3 for 2.39
A	.0004	2500	39c; 6 for 1.95
C	.0001	3000	89c; 3 for 2.00
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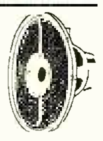
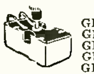
Write for Mica Condenser Catalog

HI-FI SPEAKERS



All 8 ohm, V.C., Alnico V Magnets, Inbuilt Network, 2 wires needed for HF & LF Response. Famous Hi-Fi Speaker Mfrs.
15" Coaxial PM & 5" Tweeter, 25 watt/20-17500 cy. Model P25CO......$23.75
12" Coaxial PM & 3½" Tweeter, 12 watt/45-15KC Spec....$12.75; 3 for $35
8" Coaxial PM & 2½" Tweeter. 8 watt/70-15000 cy. Model PSCO....$7.98; 2/$15
12" HI-FI PM 10 watt/35-14kc......$9.95
8" HI-FI PM 7 watt/45-14kc......$7.25

AUDIO COMPONENTS

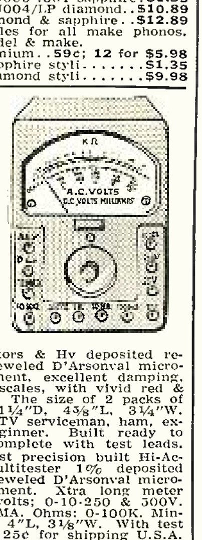


GE RPX050 Orig. GE Box. $6.69
GE RPX040/78 Goldtone $5.25
GE RPX041/MG Goldtone $5.25
GE RPX052/Dual (D&S) $17.75
GE RPX053/.001 & .003 diamonds. Reg $34.05: "TAB" Gtd. $25.98

"TAB" GTD Phono Needle Replacements
RPJ010 Dual .001 & .003 sapphire ..$1.95
RPJ012 Dual .001 & .003 diamonds. $20.89
RPJ001/78 or RPJ003/.001 sapphire $1.35
RPJ003/78 or RPJ004/LP diamond..$10.89
RPJ013 Dual diamond & sapphire..$12.89
Replacement needles for all make phonos. Please specify model & make.
MGor78 single osmium..59c; 12 for $5.98
MGor78 single sapphire styli.......$1.35
MGor78 single diamond styli.......$9.98

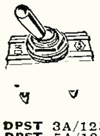
NEW POCKET AC-DC VOM

MODEL 727C MULTITESTER $9.99 (+ 25c Ship. in U.S.A.)



Reads AC & DC volts, 0 to 5, 25 250&1000 volts. DCMA; 0 to 1, 10, 100MA ohms; 0 to 10K & 100K Hi-Accuracy—1% wire wound resistors & Hv deposited resistors. Rugged jeweled D'Arsonval microamp meter movement, excellent damping, extra long meter scales, with vivid red & black calibrations. The size of 2 packs of king cigarettes. 1¼"D, 4⅜"L, 3¼"W. A must for every TV serviceman, ham, experimenter or beginner. Built ready to work (no kit). Complete with test leads.
Model 552 smallest precision built Hi-Accuracy pocket multitester 1% deposited carbon resistors, jeweled D'Arsonval micro-amp meter movement. Xtra long meter scale. AC & DC volts; 0-10-250 & 500V. DCMA: 0-1 & 250MA. Ohms: 0-100K. Miniature size 1½"D, 4"L, 3⅛"W. With test leads $6.99, plus 25c for shipping U.S.A. **MONEY BACK GUARANTEE.** Schools & colleges, write for qty price.

TOGGLE SWITCHES



SPDT 15A/125V Center Off—AN3022-1B ......69c; 5/$2.50
SPST 5A/125V used. LN 4/$1
SPDT 15A/125V Center Off Mom. ..79c; 3/$2.00; 20/$10
SPDT 15A/125V AN3022-3B Ea. 59c; 3/$1.25; 30/$10
DPST 20A/125V AN3027-2B Ea. 69c; 5/$2.50; 25/$10
DPST 3A/125V AH&H ....3/$1.00; 20/$5
DPST 5A/125V BKLT CSD...49c; 3/$1.20
3PDT 22A/125V C'Hammer.$1.49; 2/$1.98
4PDT 10A/125V..$1.98; 3/$5.00; 20/$30

"TAB" THAT'S A BUY

BARGAINS—BARGAINS

Just off the press. "TAB" scoop sheet. Tools, portable radios, audio equip., radio parts & equipment. All items way below usual Bargain Prices. Write for the "TAB" scoop sheet.

106 WATT SEC PHOTOFLASH KIT—115 VOLT AC OPERATION

Includes transf condensers two /525 MFD/450 V/Total 103W/Secds. Resistors, capacitors, rectifier, flash tube in indicating flash gun, guide ±40 on Kodachrome. Special. $39.98

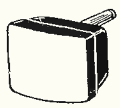
BATTERY 106WATT/SCDS PHOTOFLASH KIT
Same specs, only batteries operates 450 to 500V TOTAL.................$36.98
525MFD/450V/53w'scds condensers, low leakage (2MA) Spec $9; 2/$17; 4/$32.00
61MFD/1.8KV/100WS oil cendsrs 85pcs $3.98
CK5517 mini (no fil) gas rectifier...$2.88
1600VDC miniature ¼"x2" rectifier.$2.98
Electronic Flash Handbook ckt data....50c

"TAB" PHOTOFLASH LAMPS

"Tab" No.	Replaces	W-Sec Max.	Each
TLW	FT118/FA104	150	$5.98
TH1	AMGLO 5804X	100	10.98
23ST	GE FT 210	200	9.98
THVA	SYLV. 4330	200	9.98
V4X4	X400	200	10.98
TLX	FA100/DX	150	9.00
53GT	GE FT 403	500	13.50
353GTQ	GE FT 503	2000	49.98
FT105	FT105	150	4.29

Trigger Coil for GE 86 G41....$1.47
"TAB" FLASH Tube Data..........50c

RCA Licensed ONE YEAR GTD PICTURE TUBES



Tube Type	Dud Return	No Dud
10"	$10.00	$12.00
12"	12.00	14.25
14"	14.00	16.50
16"	16.00	19.00
17"	17.00	20.00
19"	19.00	22.25
20"	20.00	23.50
21"	21.00	24.50

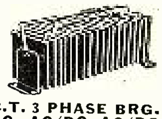
IMPORTANT: Ship your old tube with order prepaid only. If you return your old tube, use Dud return prices. All prices F.O.B., N.Y.C. Add shipping charges.

BATTERY CHARGER RECTIFIER

13-0-130 (CT) 100 Amp., fan cooled, or 34amp air cooled. For 6V booster chgrs. New Selenium type.
$11.98 @, 2 for $22, 6 for $60
Exporters Write for Qty Price

SELENIUM RECTIFIERS

*FULL WAVE BRIDGE**



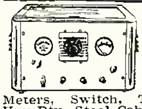
We specialize in power rectifiers to your specifications. Contact "TAB" for fast delivery on any rating, from one amp up to and above 1000 amps, convection or fan cooled. Single or 3 phase to your spec's. Magamp rectifiers also.

Max Amps	18/14* Volts	36/28* Volts	72/56* Volts	130/100* Volts	144/118* Volts	266/217* Volts	AC/DC 30/12	C.T. 3 PHASE BRG. AC/DC 120/150	AC/DC 240/300
1	$ 1.40	$ 2.40	$ 4.60	$ 8.50	$12.75	$22.25	$ 2.10	$14.90	$28.95
2	2.10	3.00	6.00	10.50	15.75	28.85	Q	15.90	30.95
2½	3.00	4.20	8.00	13.00	18.75	31.85	Q	Q	Q
4	3.75	7.50	14.50	25.25	26.75	38.85	2.95	18.90	36.95
6	4.50	9.00	17.50	33.00	34.75	54.85	3.25	20.90	39.95
10	6.60	12.75	25.00	42.50	44.75	84.85	4.75	36.90	71.95
12	8.20	16.25	30.00	46.00	54.75	99.85	5.95	41.90	81.95
20	13.25	25.50	49.00	79.50	82.75	160.85	7.35	50.90	97.95
24	16.25	32.50	58.00	86.50	94.75	190.85	9.95	89.90	159.95
30	20.00	38.00	72.00	121.50	128.75	235.85	Q	117.90	225.95
36	25.00	48.50	88.00	158.50	165.75	295.85	14.95	134.90	269.95
50	32.00	62.50	Q	189.75	195.75	405.85	23.95	179.90	359.95
100	60.00	120.00	Q	380.75	390.75	795.85	39.95	359.90	719.95

Rectifier & Transformer 115V/60 cy

up to 14VDC at 12 amps.........$19.98
up to 28VDC at 4 amps..........14.98
up to 28VDC at 12 amps..........29.98
up to 28VDC at 24 amps..........63.98
up to 28VDC at 50 amps..........127.00

HIGH CURRENT PWR SUPPLIES

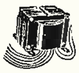


Variable 0-28VDC, Completely Built, Ready to Go. Full Wave Selenium Rectifier, Transformer, Variac, Volt & Amp Meters, Switch, Terminals & Fuse. In Hvy Dty. Steel Cabinet. Standard 115V 60 cy input. 220V or to order. Write.

Stock Number	Continuous Rating	With Meters
T28V5A	0-28VDC at 5 Amp	$47.75
T28V12A	0-28VDC at 12 Amp	89.00
T28V24A	0-28VDC at 24 Amp	129.50
T28V50A	0-28VDC at 50 Amp	239.50

T816 0-8or16VDC Variable up to 10Amps, rated 6or12VDC filtered, cont. duty.$34.00

RECTIFIER XFMRS

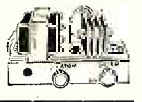


Primary 115V 60 Cyc
Secondary 0-9-12-18-24-36V
4 Amp .....$8.75; 2/$15.75
12 Amp .....$16.75; 2/$29.95
24 Amp .....$35.75; 2/$69.95
18 Volt only 2 Amps....$ 1.98
2X 12Volts/2A or 12V/4A or 24V/2Amp cased. Each......$3.59; 3/$10; 12/$36

RECTIFIER CHOKES

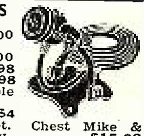
CH07/4 Amp./.07HY/.6RES/10#..$ 7.95
CH01/12 Amp./.01HY/.1RES/12#.. 14.95
CH004/24 Amp/.004HY/.025R/20#. 29.95

DC POWER SUPPLY



Variable DC Power Supply. Full Wave Rectification, 6000Mfd filter Condenser, fused. Rated 6.3V or 12.6V at 2 amp. operates 115V/60 cy. Model 2DCF ...$12.98
As above except 4 amp. Model 4DCF ...$20.98

MIKES & HEADSETS



Crystal Mike Cartridge Ea. $1.25; 5 for $5.00
Crystal Mike & Cable Ea. $2.50; 3 for $6.00
Navy Mike Carbon..$1.98
P-20 Headset Hi-Imp.$2.98
T30V Throat Mike Dble Button 200-5000 Cps #2B1630V..85c; 6/$4
Sound Powered Headset. Chest Mike & Throat Mike, U. S. Navy,........$15.98

230 TO 115V AUTOFORMERS

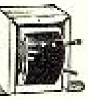
For 220-240V/50-60 cy input. To 110-120V or step-up. With cord, Plug & Receptacle.
TPA050/50W $2.55; TPA075/75W $3.65
TPA100/100W $4.00; TPA200/200W 5.75
TPA250/250W $6.75; TPA300/300W 7.25
TPA500/500W $8.25; TPA750/750W 11.75
Model TPA1000/1000 Watts/1KW.. 16.95
Model TPA1500/1500W/1.5KW ... 22.50
Model TPA2000/2000W/2KW 28.95
Model TPA3000/3000 Watts/3KW.. 49.95

TRANSFORMERS

ALL 115V 60CYC INPUTS
2500V/20MA, 6.3V/.6A. 2.5V/1.75A 4/BC412 Scope.$7.98
1600VCT/5MA,6.3VCT/3A,6.3VCT/10A, 2.5VCT/5A..$7.95
950VCT 100MA, 5V/2.5A, 5V/5A, 45V/1A, 10V/1.5A $4.98; 3 for $13
900V/35MA, 2x2.5V/2A Xclent 1800V Dbler. TWO 2X2 FIL WNDGS........$2.25
778VCT/200MA, 5V/3A, 6.3VCT/5A THORDARSON..$4.98; 2 for $9; 6 for $24
770V/2.5MA, 2.5V/3A, HMSLD FILTER PARTS 4/scope........$3.69; 2 for $6.00
700VCT/70MA,5VCT/3A,6.3VCT/2.5A$3.95
600VCT/50MA, 6V/3A, 6V/1.5A, 5V/1A HALF SHELL.$2.49; 2 for $4.50; 10 for $20
550VCT/250MA, 5V/2A, 6.3VCT/2.5A, 12.6V/3.5A, RCA CSD.......$4.50; 2/$8
500VCT/60MA, 6.3V/4A HMSLD..12.6V/4A $2.98
420VCT/90MA, 6.3V/1.9A, W/INPUTS 6, 12, 24, 115VDC & 115 & 230 VAC @....$1.49
2X330VCT/10MA Each Winding......$3.49

TRANSFORMER SPECIAL

6.3 Volt 3¾ Amp



Continuous, 115VAC input. Size 2 5/16"H/2"L/1⅛"W, mtg cntr 2⅜"; SPECIAL Ea. $1.00; 12 for $10.00.

FILAMENT TRANS.

2.5VCT/10A 12.5KVINS..$5.50; 3 for $14
2.5VCT/10A 5KVINS..................$3.59
7.5VCT/12A 15 KVINS 10.95; 2 for $17.50
24V 1.25A CSD........$1.98; 2 for $3.49
42.5V/2A Sel Rect Xfmr.......$4.98; 2/$8
64V/1 Amp HMSLD.....$3.49; 2 for $5.00
2X12.6V/2A, or 25.2V/2A, or 12.6V/4A CSD........$3.59; 3/$10.00; 12/$36.00

FILTER CHOKES

Check These Reduced Prices
50Hy/125ma/Csd/H'sld $2.89
20Hy/300ma or 15 Hy/400ma 8.95
13.5 Hy 1 Amp./17KVins....35.00
Dual 2Hy/300ma. USN.....95c; 2 for 1.49
10Hy 100 MA Freed....................1.39
3Hy 40ma UTC Hi "Q"......69c; 2 for 98c
6Hy 175MA..............$1.49; 2/$2.49

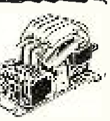
YOU PICK THEM 39c EA WHILE THEY LAST

LOTS OF 10
Your selection of 10 at 39c each or smaller quantity at indicated prices.

ELECTROLYTIC CONDENSER

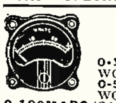
Fresh Stock
2X 20MFD/450VDC..69c; 3 for $1.95
3X 15MFD/450VDC..98c 3 for 2.50
3X 20MFD/400VDC..79c; 2 for 1.29
25MFD/450VDC ....69c; 3 for 1.95
20MF/450V&20MF/25V ....5 for 1.95
50 mf/350vdc FP................5 for 1.00
30-15-10 mf/250vdc ....5 for 1.00
16MFD/450V ....55c; 3 for 1.20
Dual 8MFD/450V......75c; 3 for 1.50
Dual 16MFD/450V.....85c; 3 for 2.00

POWER RELAY



G.E. CR 2811C 22 AQ Heavy duty electric relay 3PST/NO. Contacts rated 50 amp; input 220V/1-Phase/60 cyc. Usable Transmitters, Power Circuits or Motor Starting, for motors up to 25 HP. G.E. Price $72.
"TAB" SPECIAL......$18.00; 6 for $98

METER SALE



50% OFF REG RESALE PRICE
0-1MADC/3½" RND/MR35-W001DCMA/$8.33 Reg..$3.95
0-5MADC/3½" RND/MR35-W005DCMA/$8.33 Reg..$3.95
0-100MADC/3½" RND/MR35W100DCMA/$8.33 Reg.................$3.95
0-30VDC 2½" RND/Aircraft "AN"..$2.98
0-800VDC/Weston 301/3½" SQ/1000R-Per-Volt/$25.00 List $9.95
0-1500VDC/3½" RND/$12.95 Reg...$5.95
0-150VAC/Westinghouse 3" SQ.....$4.95
120-0-120ADC/with-Shunt/"AN"...$4.98

Money Back Guarantee (Cost of Mdse. Only) $5 Min. Order F.O.B. N.Y.C. Add Shpg. Charges or 25% Dep. Tubes Gtd. via R-Exp. only. Prices subject to Change Without Notice.
Rector 2-6245

TUBES

"TAB" TESTED & GUARANTEED
PRICES SUBJECT TO CHANGE
WRITE FOR COMPLETE LISTING

OA2 .... $0.88
OA3/VR75 1.04
OB2 ..... 1.37
OB3/VR90. .96
OC3/VR105 .92
OD3/VR150 .92
1B3/8016. .80
1B22 .... 1.82
1B23 .... 8.87
1B24 .... 8.98
1B26 .... 2.24
1B27 ....11.98
1B32/532A 2.48
1B35 .... 9.15
1B37 ....14.87
1B38 ....29.45
1B41 ....49.95
1B42 ....17.48
1B46 .... 1.98
1B63 ....45.00
1D21/SN4. 3.89
1L4 ..... .48
1L6 ..... 1.35
1LD5 .... .98
1LN5 .... .78
1R4 ..... 1.29
1R5 ..... .59
1U4 ..... .52
1U5 ..... .54
1X2A .... .98
2A4G 1.18
2C36 ....27.00
2C39A ...26.98
2C40 .... 4.98
2C43 ....17.48
2C44 .... 1.15
2C51 .... 3.88
2D21 .... 1.18
2E31 .... 1.49
2E43 .... 1.49
2J31 ....27.00
2J32 ....29.48
2J33 ....27.00
2J34 ....24.98
2J37 ....12.70
2J38 ....69.98
2J39 .... 6.98
2J42 ...148.98
2J48 ....24.45
2J49 ....84.00
2J50 ....99.98
2J51 ...238.98
2J55 ....84.98
2J56 ...149.00
2J62 ....49.45
2K22 ....23.48
2K23 ....11.48
2K25 ....28.49
2K25/723AB..23.88
2K28 ....27.48
2K29 ....22.88
2K33 ...219.48
2K39 ...134.99
2K41 ...126.00
2K48 ....99.48
2X2 ..... .42
3B22 .... 2.48
3B23/RK22 4.95
3B24 .... 4.70
3B25 .... 4.39
3B26 .... 3.70
3B28 .... 7.90
3C22 ....85.00
3C23 .... 8.67
3C31/C1B. 3.45
3C33 .... 9.51
3C45 .... 9.98
3D21A ... 8.15

3D22 ....13.97
3D23 .... 4.90
3E29 ....14.49
4C35 ....21.49
4D21 ....18.99
4E27 ....22.49
4J22 ...129.51
4J31 ....99.51
4J52 ...199.99
EL5BHD ..15.99
5C21/C6J. 9.89
5C22 ....38.95
5D21 ....14.98
5J29 ....11.92
5R4GY ... 1.20
5R4GYW .. 1.75
5U4 ..... .55
5V4G .... .95
5Z3 ..... .99
6AG5 .... .71
6AG7 .... 1.14
6AH6 .... 1.21
6AJ5 .... 1.40
6AK5 .... .87
6AK6 .... .92
6AL5 .... .48
6AL7GT .. .98
6AN5 .... 3.27
6AQ5 .... .52
6AQ6 .... .81
6AQ7GT .. 1.29
6AR6 .... 3.27
6AS7G ... 3.48
6AT6 .... .54
6AU5GT .. 1.10
6AU6 .... .56
6AV5GT .. .98
6AV6 .... .49
6AW6 .... 1.09
6B4G 1.18
6BA6 .... .54
6BA7 .... 1.09
6BC5 .... .63
6BC7 .... 1.23
6BD6 .... .83
6BE6 .... .54
6BF5 .... .98
6BG6G ... 1.58
6BH6 .... .63
6BJ6 .... .69
6BK7 .... 1.58
6BL7GT .. 1.19
6BN7 .... 2.69
6BQ6GT .. 1.20
6BQ7 .... 1.65
6C21 ....24.50
6C4 ..... .52
6C5 ..... .68
6CB6 .... .59
6CD6G ... 1.69
6D4 ..... 2.70
C6J/5C21. 9.89
6J4 ..... 6.66
6J5 ..... .54
6J6 ..... .58
6K4A 3.68
6L6 ..... 1.48
6L6G 1.08
6L6GA ... 1.08
6L6GAY .. 1.98
6SA7GT .. .66
6SC7 .... .90
6SF5 .... .78
6SG7 .... .64
6SH7 .... .61
6SJ7 .... .58
6SK7GT .. .56
6SL7GT .. .64
6SN7GT .. .68

6SQ7GT .. .62
6SR7 .... .62
6SS7 .... .88
6SU7GTY.. 2.69
6T8 ..... .96
6U4 ..... .74
6U8 ..... .99
6V6 ..... 1.39
6V6GT ... .59
6W4GT ... .52
6X5GT ... .54
6Y6G .... .88
7A8 ..... .68
7C7 ..... .76
7F7 ..... .82
7F8 ..... 1.24
7H7 ..... .72
7N7 ..... .92
7V7 ..... 1.06
7Y4 ..... .68
8D21 ...298.00
12A6 .... .48
12AH7GT . 1.45
12AL5 ... .54
12AT6 ... .54
12AT7 ... .89
12AU6 ... .72
12AU7 ... .69
12AV6 ... .52
12AV7 ... .98
12AW6 ... 1.18
12AX7 ... .98
12AY7 ... 1.69
12BA6 ... .59
12BA7 ... .94
12BD6 ... .59
12BE6 ... .59
12BF6 ... .85
12BH7 ... 1.29
12SA7GT.. .68
12SC7 ... 1.08
12SF7GT.. .84
12SG7 ... .80
12SH7 ... .63
12SJ7 ... .54
12SK7 ... .66
12SL7GT.. .62
12SN7GT . .68
12SQ7GT.. .54
12SR7 ... .66
FG17 .... 3.90
24G 3C24. 1.32
25BQ6GT.. .98
25L6GT .. .67
25Z5 .... .78
25Z6GT .. .58
FG27A ... 8.24
28D7 .... 1.94
35B5 .... .52
35L6 .... .67
35T 4.88
35Y4 .... .68
35Z5 .... .54
41 ...... .72
42 ...... .68
45Z3 .... .88
48 ...... 1.98
50A5 .... .76
50B5 .... .54
50C5 .... .54
50L6GT .. .62
RK61/XFG1 .. 2.65
FG67 ...14.68
HY69 .... 4.98
71A ..... .74
75 ...... .64
78 ...... .78
80 ...... .58

81 ...... 1.38
83 ...... 1.12
83V 1.22
84/6Z4 .. .62
100TH ... 9.88
FG105 ...19.48
117L/M7GT . 1.98
117Z6GT.. .96
CV148 ... 9.98
FG166 ...48.49
FG172 ...29.00
250TH ...18.97
250TL ...17.75
304TH ...12.49
304TL ...12.49
388A 1.48
WL417A .. 8.48
417A/5842 ..18.50
GL434A ..12.69
446B 3.48
450TH ...49.97
450TL ...52.00
460/HF200 .15.95
CK502AX . 1.49
CK503AX . 1.49
CK505AX . 1.79
CK512AX . 1.45
CK531DX . 1.89
531 ..... 5.72
CK532DX . 1.89
WL532A .. 3.68
CK533AX . 1.29
CK536AX . .99
CK538DX . .98
CK539DX . 2.19
CK541DX . 1.99
CK543DX . .99
CK544DX . .99
CK546DX . 1.99
CK571AX/5886 .. 2.49
CK573AX/6029 .. 3.49
WL676 ...34.98
703A 4.72
705A 1.88
707A 7.90
707B 14.88
715A 4.96
715B 7.94
715C 17.98
717A .... .88
719A 24.48
721A 3.92
722A/287. 1.94
723A/B ..16.98
724A 3.95
724B 2.74
725A 9.98
726A 14.48
726B 44.88
726C 64.88
801A .... .42
803 ..... 3.48
805 ..... 3.22
807 ..... 1.54
808 ..... 2.62
809 ..... 3.58
810 .....10.88
811 ..... 3.00
812 ..... 2.70
813 .....11.48
814 ..... 4.98
815 ..... 5.98
826 ..... .95
828 ..... 9.25

829 ..... 7.94
829B 12.48
832 ..... 7.72
832A 9.92
833A 39.45
834 ..... 5.95
836 ..... 5.95
837 ..... 1.42
849 .....29.45
860 ..... 4.48
861 .....22.48
865 ..... 1.26
866A 1.50
872A 3.29
CK1005 .. .68
1613 .... .82
1614 .... 1.95
1619 .... .36
1625 .... .32
1632 .... .68
1633 .... .98
1634 .... 1.18
1635 .... 1.69
1636 .... 3.08
1642 .... .62
1644 .... .92
2050 .... 1.48
2050W ... 2.48
5654 .... 1.72
5670 .... 3.44
CK5672 .. 1.20
CK5678 .. 1.28
5687 .... 3.74
CK5702 .. 2.90
CK5703 .. 1.29
5713 ...120.00
5812 .... 2.99
5814 .... 2.08
5840 .... 7.98
8012 .... 2.58
8013A ... 3.92
8025A ... 4.68
9001 .... 1.12
9002 .... .82
9003 .... 1.12

XTAL DIODES
1N21A ... 1.55
1N21B ... 2.10
1N22 .... 1.22
1N23 .... 1.35
1N23A ... 1.89
1N23B ... 2.00
1N25 .... 4.98
1N26 .... 8.75
1N27 .... 1.55
1N34 .... .64
1N34A ... .88
1N35 .... 1.65
1N38A ... 1.29
1N41 .... 8.95
1N42 ....16.95
1N45 .... 1.45
1N46 .... .69
1N47 .... 4.00
1N48 .... .47
1N51 .... .45
1N54 .... .78
1N54A ... 1.00
1N58A ... 1.15
1N60 .... .60
1N63/K63. 2.49
1N64 .... .69
1N69 .... .98

Other Types in Stock. Write.

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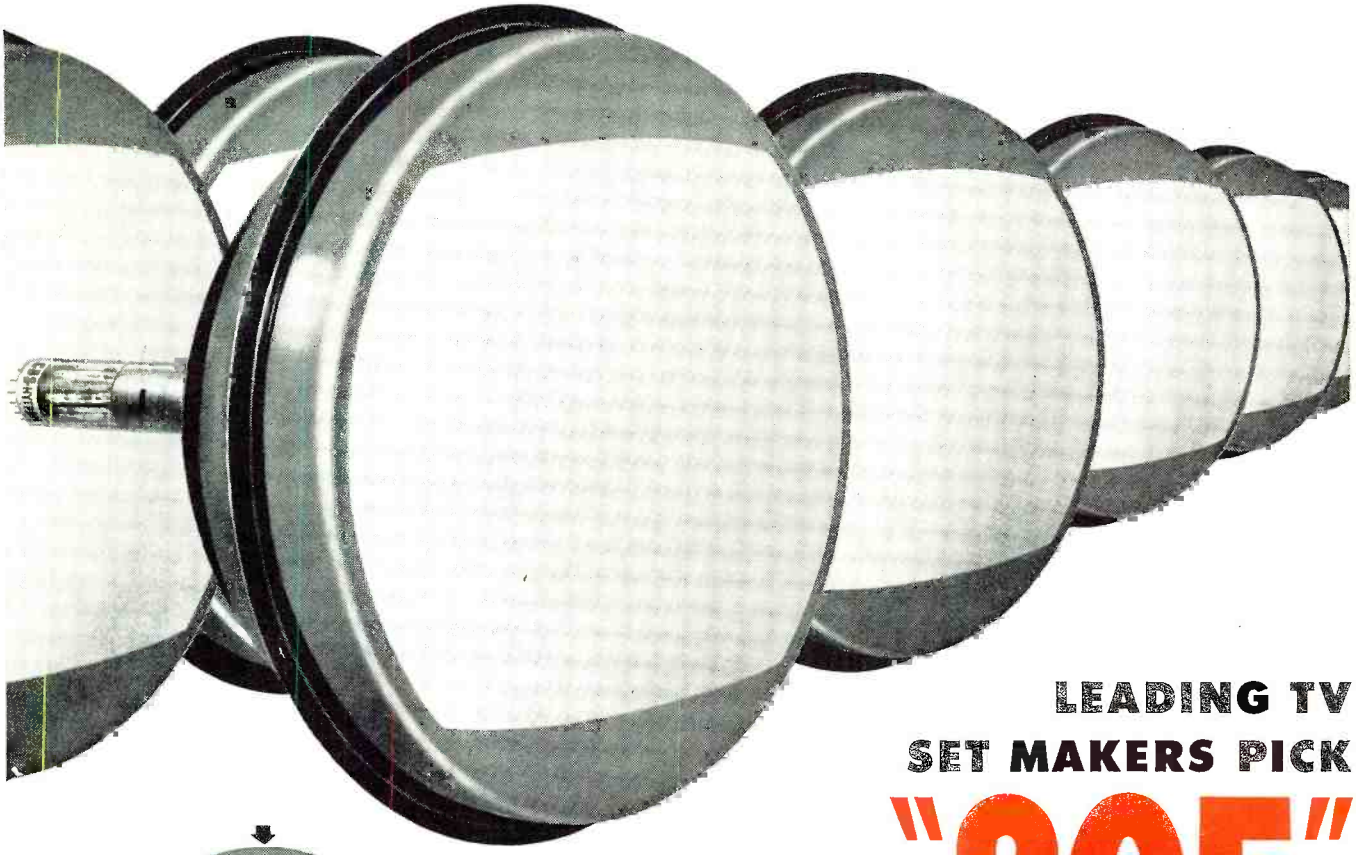

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CBS-COLORTRON "205"

LEADING BIG-SCREEN COLOR TUBE

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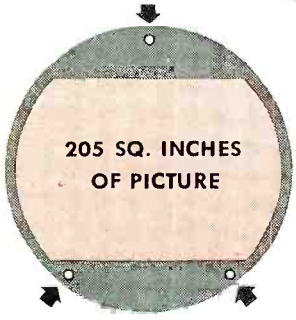
. . . for Delivery NOW!



HOW "205" ACHIEVES BIGGEST PICTURE

As its name implies, picture area of "205" is a big 205 square inches. The "205" achieves this maximum utilization of screen area: 1. By photographic printing of tricolor screen directly on inside of curved face. 2. By using a simple, light-weight shadow mask. 3. By positioning the three mask supports above and below the desired screen area . . . where the screen is masked off anyway by the set maker to obtain the desired 4 x 3 aspect ratio. This permits full lateral use of screen.

The CBS-Colortron "205" is *today* traveling in freight cars and trucks to the nation's leading TV set manufacturers. It was chosen by them, because of: The "205's" larger 205-square-inch screen. The "205's" over-all superior performance. The "205's" easier circuit adjustments. The "205's" absence of "pincushioning" and other distortion. And the "205's" availability in production quantities now!

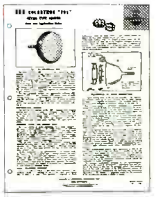
BIG-SCREEN COLOR TV IS HERE . . . today . . . at CBS-Hytron. Original . . . simple . . . functional . . . advanced design of the "205" made this possible: 1. With its curved screen-mask construction. 2. With its maximum use of the screen area. 3. With its electromagnetically converged three-beam electron-gun assembly. And CBS-Hytron's huge, new Kalamazoo plant stands ready to step up the "205's" availability when needed. Yes, you can look to CBS-Hytron as the leader . . . and major producer of big-screen color picture tubes.

IT'S CBS-HYTRON FOR NEW COLOR RECEIVING TUBES TOO

TYPE	DESCRIPTION
CBS-Hytron 3A3	Half-wave, high-voltage rectifier
CBS-Hytron 6AM8	Diode, sharp-cutoff pentode
CBS-Hytron 6AN8	Medium-mu triode, sharp-cutoff pentode
CBS-Hytron 6BD4A	Sharp-cutoff beam triode, high-voltage regulator
CBS-Hytron 6BD6	Sharp-cutoff r-f pentode color demodulator
CBS-Hytron 6BJ7	Triple-diode d-c restorer

NEW . . . FREE "205" DATA

Keep abreast of big-screen color TV. Four-page sheet on CBS-Colortron "205," RETMA type 19VP22, contains complete data on: Construction . . . operation . . . application . . . installation . . . adjustment . . . electrical and mechanical characteristics. Write for Bulletin E-227 today!



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The New Mallory '188' Concealed Converter is mounted inside the TV set . . . out of sight! All that shows is a clear plastic selector dial and switch. Installation is easy. A bracket and four screws are supplied to mount the unit on either side or at the top in wood cabinets. For plastic or metal cabinets, the converter may be mounted on the fiber-board rear enclosure.

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