CONVERT TO STEREO FOR LESS THAN $100.00

RADIO & TV NEWS

Leading Technical Magazine in the ELECTRONICS WORLD

TRANSISTORIZED TACHOMETER

SERVICE AWARD WINNERS

SINGLE CHANNEL DESIGN FOR STEREO

LATEST ON FM MULTIPLEXING

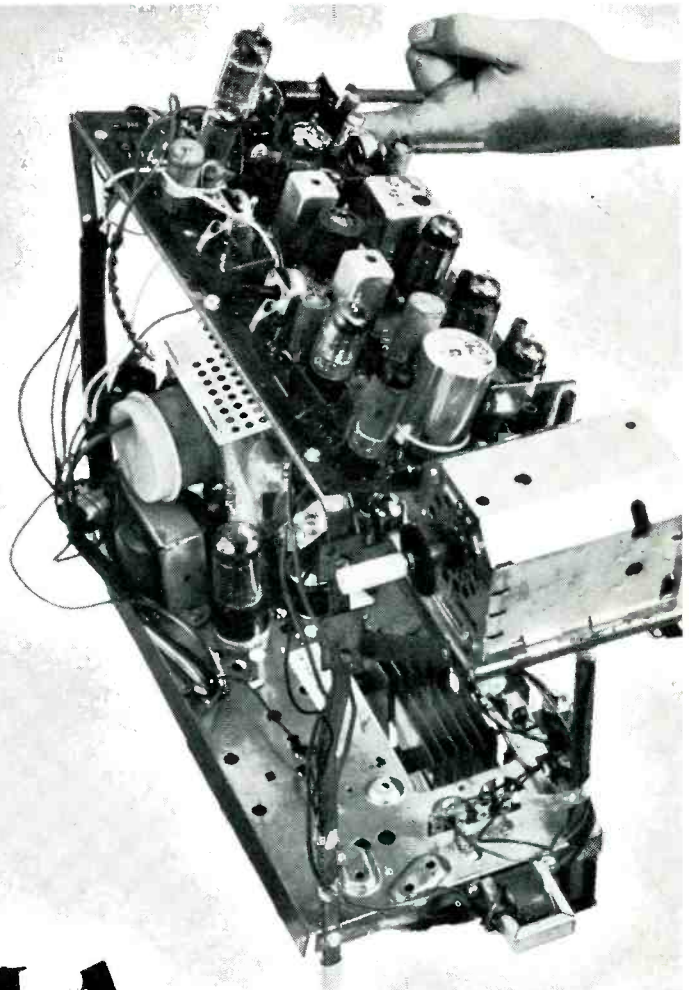
JANUARY 1959

35 CENTS

INDUSTRIAL TUBES & THEIR USES

(See Pages 37 & 39)

Its two year record speaks for itself!



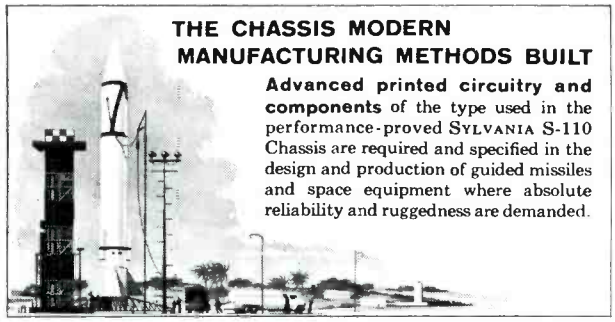
SYLVANIA S-110 CHASSIS

Only 10½ lbs. without yoke

performance proved

- **Better performance under the extremes of line voltage variation.** The advanced high voltage design of the SYLVANIA S-110 Chassis adjusts automatically for maximum performance at both high- and low-voltage extremes.
- **Better performance under heat, humidity and freezing conditions.** The rigid specifications of reliability of components in the SYLVANIA S-110 Chassis assures better performance and longer trouble-free life under extremes of humidity and temperature conditions.

  Alkyd Resin used in the high voltage socket of the S-110 Chassis withstands moisture, dirt and even frost accumulations without any permanent damage, even if these conditions are severe enough to cause arcing. Top performance is assured regardless of warehouse locations.
- **Cuts repair time by 60%.** The orderly arrangement of components in the SYLVANIA S-110 Chassis means that most defects can be located in seconds. Circuit can be traced easily from either side by shadow graph method over your bench light.
- **Designed for maximum strength and minimum weight.** The SYLVANIA S-110 Chassis has all-around girder frame construction which gives it the most favorable strength to weight ratio in the industry. This means easier handling and faster servicing because of its light weight. Yet the S-110 is sturdy and rigid when mounted in the cabinet.



THE CHASSIS MODERN MANUFACTURING METHODS BUILT

Advanced printed circuitry and components of the type used in the performance-proved SYLVANIA S-110 Chassis are required and specified in the design and production of guided missiles and space equipment where absolute reliability and ruggedness are demanded.

SYLVANIA

Pioneer in modern manufacturing methods

Designed to meet the requirements of every specific space, budget, or decor problem—and every listening preference...

University

FAMOUS MEN OF MUSIC CHOOSE UNIVERSITY

University® offers four ways to stereo

1 *Leading Metropolitan Opera Star Leonard Warren converted to stereo quickly, easily and inexpensively... using a compact Stereoflex-2* "add-on" speaker with his University "Troubadour"*

This approach solves many problems for those already possessing a full-range monophonic system, as well as those planning to buy one now with an eye to stereo later. Thanks to the *exclusive dual voice coil* woofer used in all University stereo-adapted systems, only one such woofer is needed to reproduce the *combined* bass below 150 cycles† of both stereo channels. Thus all three models of University "add-on" speakers provide a perfect match by *direct* connection to the original speaker system. Stereoflex-1* is well suited for bookshelf installations. Stereoflex-2, with its narrow silhouette, makes a fine end table. Model SLC* can be affixed to a wall or "lite-pole," its decorative fibreglas housing blending smartly with modern furnishings. Each can also be used with any brand monophonic system *not* having a dual voice coil woofer, by using a University Stereo Adapter Network Model A-1.

2 *Discriminating music lovers may also enjoy magnificent stereo by simply connecting two University "add-on" stereo speakers to a single dual voice coil woofer* in a suitable enclosure*

This approach offers great versatility. Since the woofer's position in the room is uncritical for stereo†, it may be installed wherever most convenient . . . in a small suitable enclosure, or in a wall, closet, etc. The two "add-on" speakers can then be placed to provide optimum stereo reproduction, without upsetting existing room decor.

3 *Noted maestro Fred Waring chose a pair of University RRL* Ultra Linear Response speakers for his stereo system*

When planning his recent cross country concert tour, *Hi Fi Holiday*, Fred Waring turned to University engineers for a compact, quality high fidelity speaker system that could overcome the acoustical deficiencies of the theatres and auditoriums in which The Pennsylvanians would be playing. The performance of the S-11 Ultra Linear Response speakers, mainstays for the system, proved so outstanding that Mr. Waring chose two of them for his own home. Two such identical speakers are an excellent stereo solution in rooms where they can be placed in reasonably symmetrical positions. All University systems are ideally suited for this purpose, because they are stereo-matched in production to within 1 db.

4 *Internationally famed violinist Mischa Elman prefers his stereo all-in-one . . . he selected the fabulous TMS-2*, 'Trimensional' stereo speaker that in his words . . ."approaches the authenticity of concert hall performance."*

A totally integrated single-cabinet system, the TMS-2 literally adds a third dimension to stereophonic sound... the perception of *depth*. Designed to utilize the acoustical properties of the surrounding walls of the room, the TMS-2 performs far beyond the scope of other single-cabinet stereo speakers. Its ingenious combination of electrical and acoustical principles permits placement in a corner or *anywhere* along a wall... lets you and any number of friends enjoy exciting stereophonic sound from almost any position in the room.

WHICH WAY TO STEREO IS IDEAL FOR YOU?

You'll find all the answers in University's FREE *Informative guide to high fidelity stereo and monophonic speaker systems and components.* Here, you'll find complete information on: how to select and place the four major types of stereo speaker systems... how to adapt your present monophonic system to stereo... how to choose a monophonic system *now* for most efficient conversion to stereo *later*... how to plan economical "do-it-yourself" monophonic/stereo speaker systems. See your dealer today or write Desk S-9, University Loudspeakers, Inc., 80 So. Kensico Ave., White Plains, N. Y.

**Trademark and Patent Pending.*

†Bass frequencies below 150 cycles do not contribute to the stereo effect.

RADIO & TV NEWS is published monthly by Ziff-Davis Publishing Company, William B. Ziff, Chairman of the Board (1946-1953), at 434 S. Wabash Ave., Chicago 5, Ill. Second-class postage at Chicago, Illinois. Authorized by Post Office Department, Ottawa, Canada, as second-class matter. **SUBSCRIPTION RATES:** one year U. S. and possessions, and Canada $4.00; Pan American Union Countries $4.50; all other foreign countries $5.00.

RADIO & TV NEWS

Reg. U. S. Pat. Off.

First in radio-television-audio-electronics

Average Net Paid Circulation 236,101

Radio & Television News • Radio News • Television News Trademarks Reg. U. S. Pat. Off.

Editorial and Executive Offices
One Park Avenue
New York 16, N. Y. OR. 9-7200

Member
Audit Bureau of Circulations

MEMBER INSTITUTE OF HIGH FIDELITY MANUFACTURERS INC.

BRANCH OFFICES: Midwestern Office, 434 S. Wabash Ave., Chicago 5, Ill.; Western Office, Room 412, 215 W. 7th St., Los Angeles 14, Calif., John E. Payne, manager.

FOREIGN ADVERTISING REPRESENTATIVES: D. A. Goodall Ltd., London; Albert Milhado & Co., Antwerp and Dusseldorf.

CONTENTS

JANUARY, 1959 **VOL. 61 ■ NO. 1**

ELECTRONICS—GENERAL

HIGH FIDELITY AND AUDIO

TELEVISION-RADIO

TEST EQUIPMENT

AMATEUR AND COMMUNICATIONS

ELECTRONIC CONSTRUCTION

DEPARTMENTS

SUBSCRIPTION SERVICE: Forms 3579 and all subscription correspondence should be addressed to Circulation Department, 434 South Wabash Avenue, Chicago 5, Illinois. Please allow at least four weeks for change of address. Include your old address as well as new—enclosing if possible an address label from a recent issue.

CONTRIBUTIONS: Contributors are advised to retain a copy of their manuscripts and illustrations. Contributions should be mailed to the New York Editorial Office and must be accompanied by return postage. Contributions will be handled with reasonable care, but this magazine assumes no responsibility for their safety. Any copy accepted is subject to whatever adaptations and revisions are necessary to meet the requirements of this publication. Payment covers all author's, contributor's, and contestant's rights, title, and interest in and to the material accepted and will be made at our current rates upon acceptance. All photos and drawings will be considered as part of the material purchased.

MEN 17-55

PREPARE NOW FOR AN INTERESTING AND PROFITABLE FUTURE IN THE GREAT FIELDS OF

Electronics AS USED IN GUIDED MISSILES, ETC.

There are big opportunities for men 17 to 55 in the exciting, profitable fields of Electronics. For more than 27 years we have been preparing men in their spare time at home without interfering with their jobs. During these years, to name a few, we have trained laborers, farmers, clerks, factory workers and salesmen . . . following the same basic method used in our Chicago and Toronto training laboratories. So regardless of your experience, why don't you write for FREE facts today? There is no obligation.

Live-Wire Employment Service

DeVry Tech's Placement Department is in contact with some of the best-known employers in the Electronics field. The service is free to all graduates—and DeVry Tech's record in helping to place men has been outstanding.

Marvels of Electronics

Satellites, guided missiles, and other marvels made possible by Electronics bring us into a new era of wonderment and opportunity!

A GUIDE TO A BETTER JOB, A BRIGHTER FUTURE

Communications • Radar
Computers • Automation Electronics
Radio • Industrial Electronics
Television • Micro-Waves

NO ADVANCED EDUCATION OR PREVIOUS TECHNICAL EXPERIENCE NEEDED!

Fill In COUPON Below It may be your PASSPORT To a more SECURE FUTURE!

Draft Age?

We have valuable information for every man of draft age; so if you are subject to military service, be sure to check the coupon.

Accredited Member of National Home Study Council

FREE Booklet!

We'll give you a free copy of an interesting booklet, "Electronics and YOU." See for yourself how you may take advantage of the opportunities in this fast-growing field.

"One of North America's Foremost Electronics Training Centers"

DeVRY TECHNICAL INSTITUTE

Formerly DeFOREST'S TRAINING, INC.

4141 BELMONT AVE. • CHICAGO 41, ILLINOIS

MAIL COUPON TODAY!

DeVry Technical Institute
4141 Belmont Ave., Chicago 41, Ill., Dept. RN-1-P

Please give me your FREE booklet, "Electronics and YOU," and tell me how I may prepare to enter one or more branches of Electronics as listed below.

Name _____ Age _____
PLEASE PRINT

Street _____ Apt. _____

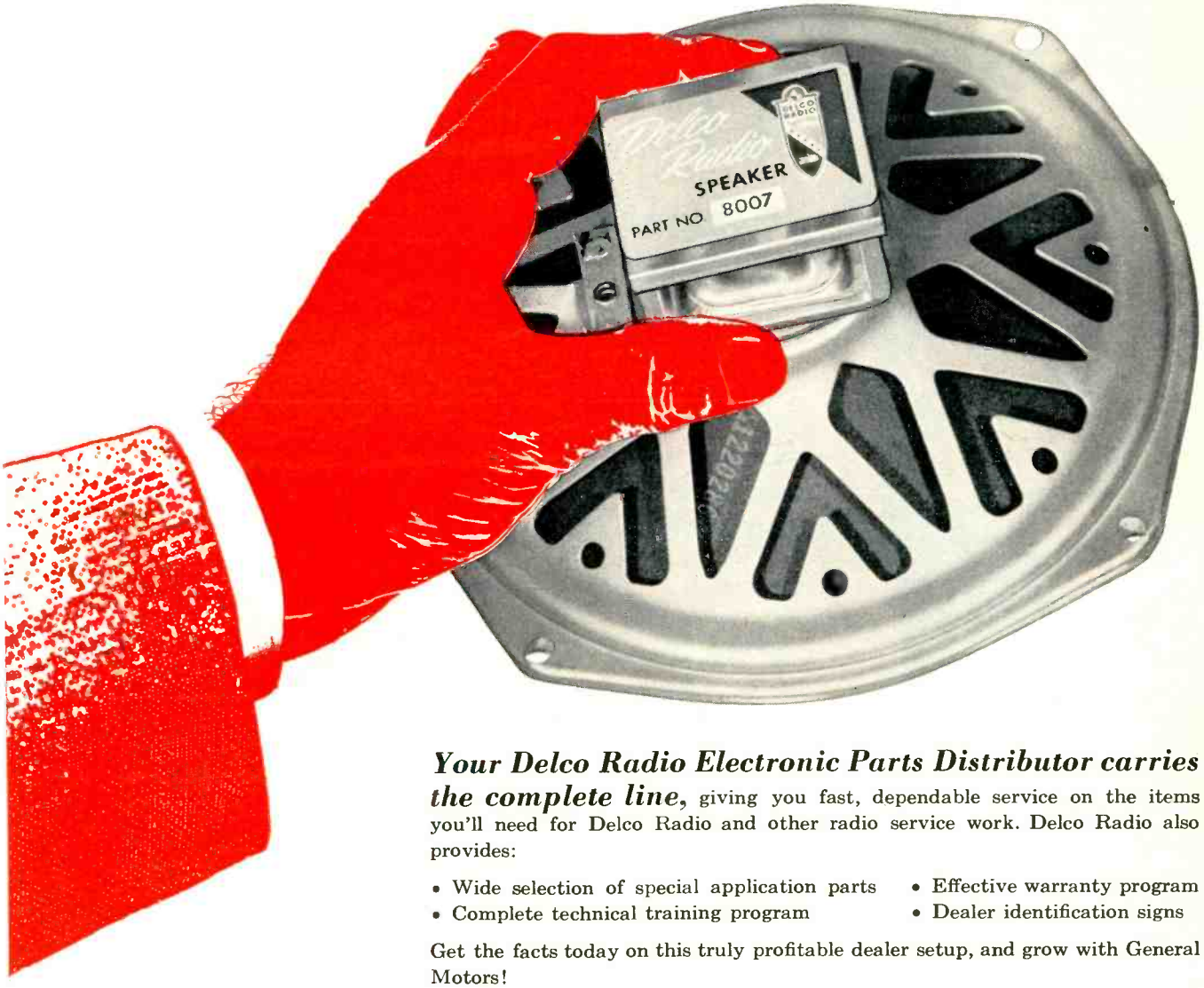
City _____ Zone _____ State _____

☐ Check here if subject to military training.

2047 DeVry Tech's Canadian Training Center is located at 626 Roselawn Avenue, Toronto 12, Ontario

Use Delco Radio Service Parts!

8-inch "Hi-Fi" speaker, No. 8007 offers the most highs, the most lows, the most watts in a medium-price speaker. Designed for replacement use and high fidelity audio systems.



Your Delco Radio Electronic Parts Distributor carries the complete line, giving you fast, dependable service on the items you'll need for Delco Radio and other radio service work. Delco Radio also provides:

- Wide selection of special application parts
- Complete technical training program
- Effective warranty program
- Dealer identification signs

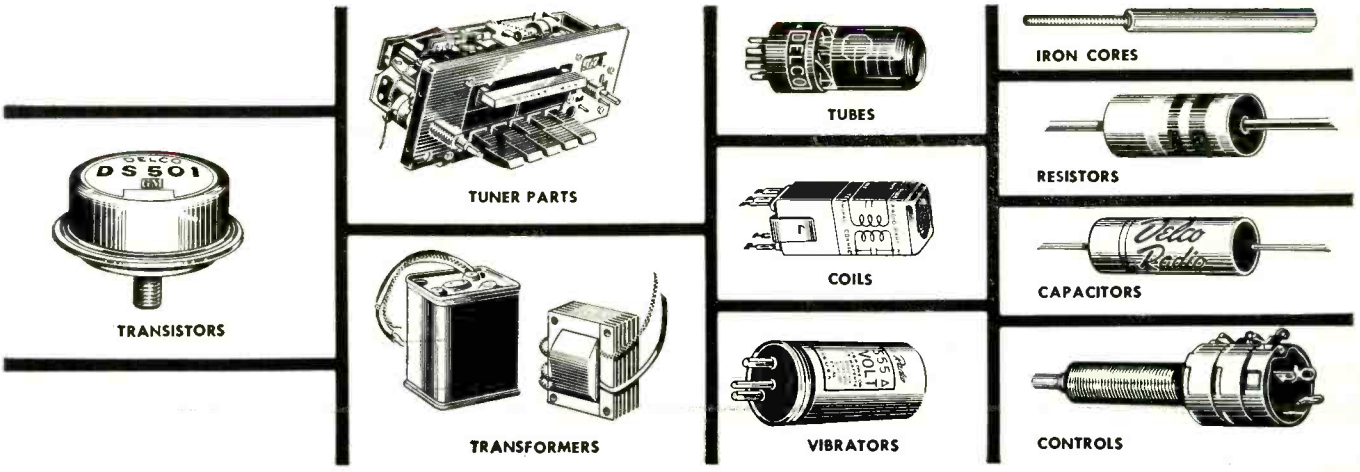
Get the facts today on this truly profitable dealer setup, and grow with General Motors!

Available everywhere through Electronic Distributors associated with . . .

GM U-M-S PARTS SALES UNITED MOTORS SYSTEM

DELCO RADIO

DIVISION OF GENERAL MOTORS, KOKOMO, INDIANA



Every Essential Term in Physics and Electronics – 12,000 of Them

– now in one giant dictionary!

Send today for a free-examination copy of this 1000-page reference work. Used in homes, offices, schools and laboratories.

THE INTERNATIONAL DICTIONARY OF PHYSICS AND ELECTRONICS is the only book available today that gives you – right at your fingertips – definitions, equations, principles and thorough explanations of *every* important term in physics and electronics.

More than 12,000 laws, relationships, equations, basic principles, instruments, apparatus and techniques are described in half a million words. You'll find everything from alphatopic, band and cybotaxis to Wronksian, ylem and Zwitterion.

16 Reference Books in One

You've never seen *so much* useful information in one volume. It takes the place of *a whole library* of reference books on:

Electronics	**Units and Dimensions**
Meteorology	**General Principles**
Mechanics	**Heat and Thermodynamics**
Gases	**Atomic and Nuclear Physics**
Liquids	**Mathematical Physics**
Solids	**Quantum Mechanics**
Acoustics	**Electricity**
Optics	**Relativity**

No more hunting around from book to book for the information you need. No more wading through long texts to get a simple definition. Everything you need can be found simply and quickly in this one handy volume.

Answers Your Questions in Seconds

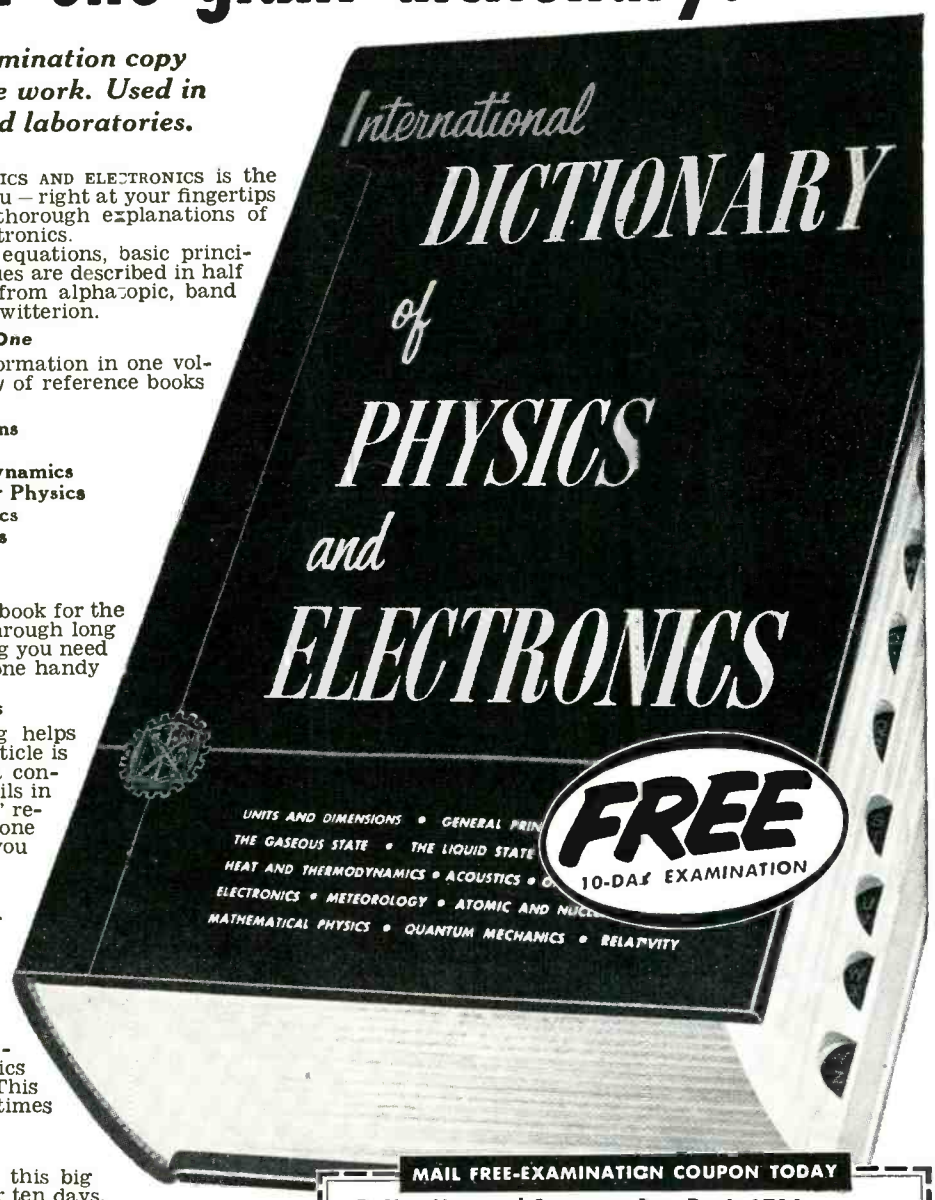
A unique system of cross-referencing helps you locate information instantly. Each article is arranged progressively, beginning with a concise definition and adding additional details in later paragraphs. Boldface "word signals" refer you to other articles relating to the one you are reading. You get the answers you want *in a hurry!*

Save Time — Avoid Costly Errors

You'll turn to this giant, 1000-page reference work dozens of times a day – to recheck your work, to clarify technical articles or engineering data, to increase your own understanding of the complex world of physics and electronics. Where you might otherwise trust your memory, you'll now turn to the International Dictionary of Physics and Electronics to get an answer *you can be sure of.* This helpful volume can pay for itself many times over in just one avoided error!

Examine it For 10 Days FREE

To fully appreciate the usefulness of this big 2¼" thick book, we invite you to use it for ten days. If you do not find it to be one of the most valuable books you have ever owned, you may simply return it and owe nothing. Otherwise, remit payment on the easy terms indicated in coupon. You take no risk. Send coupon today to ***D. Van Nostrand Co., Inc., Dept 371A, 120 Alexander St., Princeton, N. J.*** *(Established 1848).*



MAIL FREE-EXAMINATION COUPON TODAY

D. Van Nostrand Company, Inc., Dept. 371A
120 Alexander Street, Princeton, N. J.

Please send me – for 10 days' FREE examination – the "International Dictionary of Physics and Electronics" thumb-indexed edition. If not completely satisfied, I may return it and owe nothing. Otherwise I will remit $7.50 plus small shipping cost, and $5 a month for 3 months.

Name.....

Address.....

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

☐ Save! Enclose full payment ($22.50) and shipping costs will be prepaid. Money back if not delighted.

In Canada: Order from D. Van Nostrand Co., Ltd., 25 Hollinger Road, Toronto 16, Canada (Price slightly higher)

Acclaimed by Major Journals in Every Field of Science

"Unique. Useful. Presents a wide variety of terms" – SCIENTIFIC AMERICAN

"Remarkably complete. Highly useful. Provides definite and concise answers to a myriad of questions." – PHYSICS TODAY

"Will undoubtedly make a well-deserved place for itself." – SCIENCE

"There has been a real need for such a work." – ELECTRONICS

"Recommended for all that do any reference work in physics." – LIBRARY JOURNAL

"Unique in its field and exceptionally clear in its typography. It should prove a most useful reference." – NUCLEONICS

"The best book of definitions available on the market today. Highly recommended." – TELE-TECH

...for the Record

By **W. STOCKLIN**
Editor

Why 50¢ a copy

TRADITIONALLY New Years is a time for assessing past performances and planning changes and improvements. In this respect magazines are like individuals since we, too, indulge in stock-taking and soul-searching and resolve to make each new year the best ever for our readers.

Unlike individuals, however, our "New Year's Resolutions" are the result of innumerable staff meetings and editorial consultations with our readers and our advertisers. From this array of opinion and information we have formulated our editorial policy for the coming year—and we think you will like it.

First of all, we are going to bring you a bigger and better magazine than ever before. Not only will we provide authoritative and timely articles on a wide variety of subjects but we will give you more of them and cover an even wider scope.

In addition, we plan to institute a series of "fold-outs" which will bring you a wealth of pertinent and valuable data in permanent, easy-to-retain form. Each of these "gatefolds," as they are known in the trade, will carry information you can use in your work or your hobby—in a form which facilitates mounting on your shop or hobby room wall or filing for safekeeping along with your service information folders. The first of these "gatefolds" will appear in next month's issue. This "Sound Chart" will include the "Fletcher-Munson curve," the frequency range of all musical instruments as well as that of the male and female voice, thresholds of hearing and feeling, sound levels of music and speech, etc.

The service technician will find more and more material designed to be of dollar-making and money-saving help to him in his day-to-day operations. The audiophile, whether professionally involved or an enlightened hobbyist, can look to this magazine for up-to-the-minute information on every facet of the field. We will keep you abreast of every new development in stereo—tapes and discs—and the equipment being produced to play them; of the progress in multiplexing, in FM networking, simulcasting, TV simulcasting for stereo—in fact every single thing the hi-fi fan wants to know.

The general reader who prides himself on keeping up with the world of electronics will find that his interests are being catered to as never before. Today's educated man is expected to be conversant with a multiplicity of topics not necessarily connected with his everyday bread-and-butter job. To amplify and round out the news coverage of important events—as provided by the daily papers and the weekly news magazines—we will bring you background material and full details on the equipment and techniques making their mark in our exciting world of electronics.

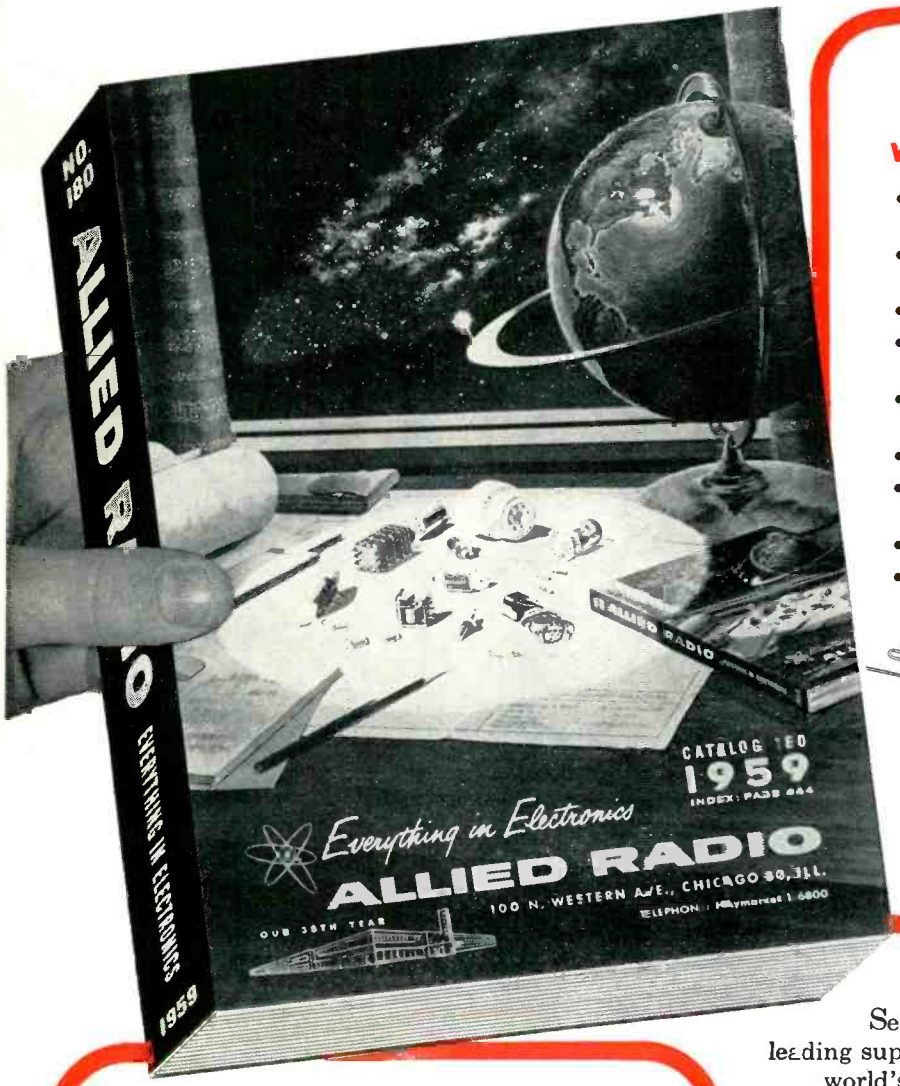
Physically, too, we are planning to increase the over-all attractiveness of the magazine by giving you a sturdier cover, changing some of our type faces for improved readability, and brightening up our layout of the articles. You will find more color in the magazine—used in new and interesting ways. Our "New Year's Resolutions" are designed to make this magazine your *Number One* source for all that is best and most authoritative in the field of electronics. We want you to come to rely on us for *all* the information you should have and want on what is going on in the fascinating and dynamic world of the vacuum tube and transistor—the World of Electronics!

Making such an expansion possible entails a number of unusual expenses which are not now covered by the subscription price of the magazine or the advertising rates. In this period of the 46-cent dollar the cost of physically producing any magazine (typesetting, printing, mailing, paper, and ink) has risen along with your grocery bill and the cost of every service you use. These increased production costs plus the expense of the new projects we have in store for our readers necessitate a modest upward adjustment in the newsstand and subscription prices of this magazine. The decision to raise our price was not taken lightly but the consensus was that our readers would rather have a top quality magazine which brings them ALL the information they want about the world of electronics than settle for less-than-the-best at a pre-inflation price.

Next month when you step up to your newsstand for your copy of the bigger, brighter, and better RADIO & TV NEWS the man will ask you for 50 cents for your favorite publication—but we sincerely believe that the additional pages, additional information, and wider scope of the magazine will have you agreeing that it is the "best half buck I ever spent!"

Limited space prevents our revealing all of our plans now—but next month we will tell you more about the important and exciting changes in store for you. See next month's "For the Record." —30—

free! ALLIED'S 1959 value-packed 452-page ELECTRONIC SUPPLY CATALOG



the only COMPLETE guide to everything in electronics

WORLD'S LARGEST STOCKS

- Latest Stereo Hi-Fi Systems—Everything in Hi-Fi Components
- Money-Saving, Build-Your-Own KNIGHT-KITS—Latest Models
- Values in Recorders and Supplies
- Latest Public Address Systems, Paging and Intercom Equipment
- Amateur Receivers, Transmitters and Station Gear
- Test & Laboratory Instruments
- Specialized Electronic Equipment for Industrial Application
- TV Tubes, Antennas, Accessories
- Huge Listings of Parts, Tubes, Transistors, Tools, Books

featuring:

MONEY-SAVING knight-kits: Finest electronic equipment in money-saving kit form. Complete selection of latest Hi-Fi amplifier, tuner and speaker kits (new Stereo units); Hobbyist kits; Test Instruments and Amateur kits. KNIGHT-KITS are an exclusive ALLIED product.

HI-FI! STEREO! See the world's largest selection of quality Hi-Fi music systems and famous name components. First with the latest in STEREO! Save on ALLIED-recommended complete systems. Own the best in Hi-Fi for less!

Send for ALLIED's 1959 Catalog—it's the leading supply guide—452 pages packed with the world's largest selection of quality electronic equipment at lowest, money-saving prices. Get *every* buying advantage at ALLIED: fastest shipment, expert personal help, lowest prices, guaranteed satisfaction...

send for the leading electronic supply guide FREE!

EASY PAY TERMS: Only 10% down; available on orders of $20 or more. Fast handling—no red tape.

ALLIED RADIO

our 38th year

World's Largest Electronic Supply House

ALLIED RADIO CORP., Dept. 1-A9
100 N. Western Ave., Chicago 80, Ill.

☐ Send FREE 452-Page 1959 ALLIED Catalog

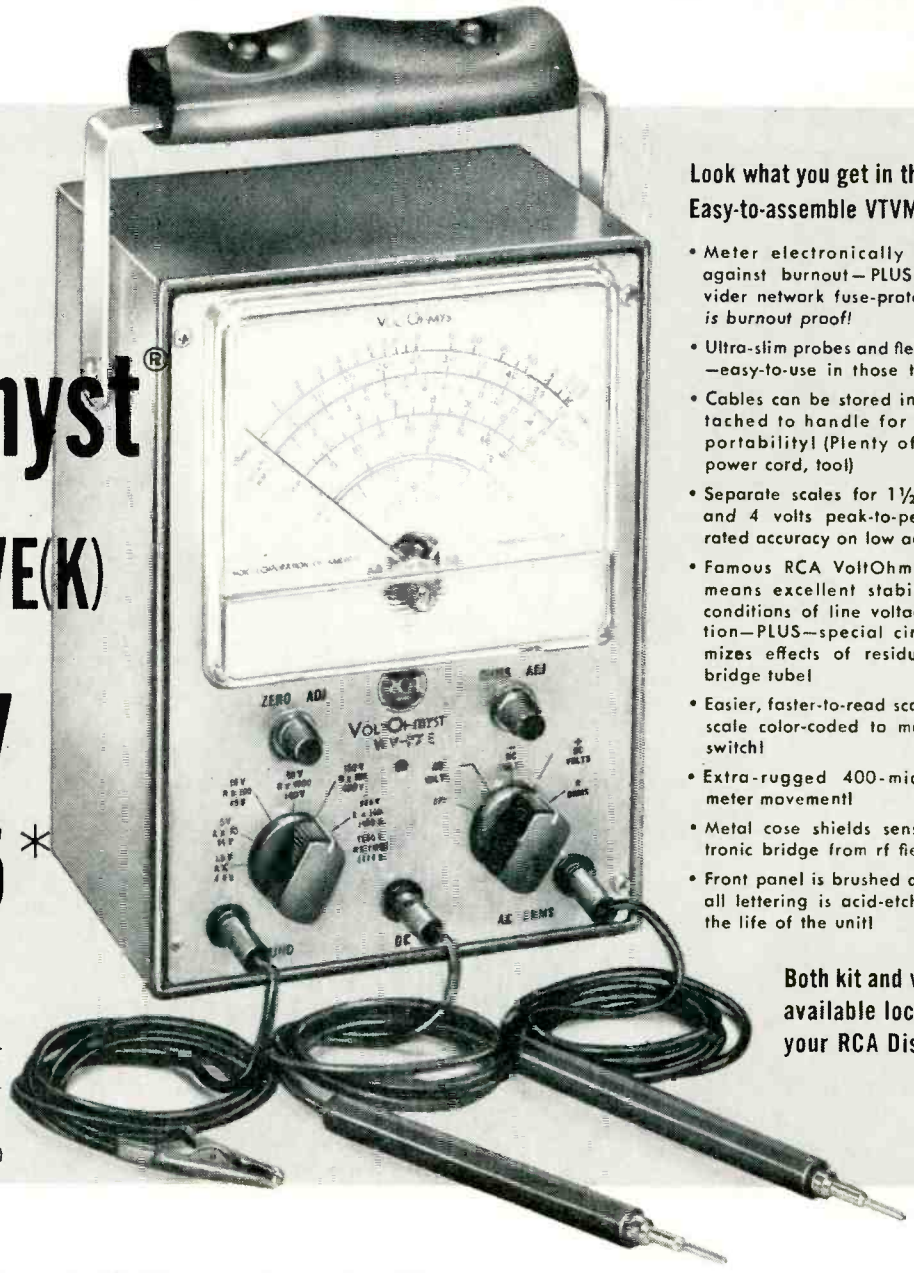
*Name*_____

*Address*_____

*City*_____ *Zone*_____ *State*_____

Now—Kit or Wired

A new VoltOhmyst® Kit—WV-77E(K) for only $29.95*



RCA WV-77E VOLTOHMYST (completely wired and calibrated for only $49.95*)

*User Price (Optional)

Look what you get in this Easy-to-assemble VTVM Kit!

- Meter electronically protected against burnout—PLUS—ohms-divider network fuse-protected. *Unit is burnout proof!*
- Ultra-slim probes and flexible leads—easy-to-use in those tight spots!
- Cables can be stored in sleeve attached to handle for increased portability! (Plenty of room for power cord, too!)
- Separate scales for 1½ volts rms and 4 volts peak-to-peak assure rated accuracy on low ac readings!
- Famous RCA VoltOhmyst circuit means excellent stability under conditions of line voltage fluctuation—PLUS—special circuit minimizes effects of residual gas in bridge tube!
- Easier, faster-to-read scales—meter scale color-coded to match range switch!
- Extra-rugged 400-microampere meter movement!
- Metal case shields sensitive electronic bridge from rf fields!
- Front panel is brushed aluminum—all lettering is acid-etched to last the life of the unit!

Both kit and wired unit available locally from your RCA Distributor!

TV service technicians, hams, hobbyists—now you can buy this easy-to-assemble RCA VTVM kit! Step up and meet the new RCA VoltOhmyst which incorporates famous VoltOhmyst quality, accuracy, and performance—an instrument you'll be proud to display "on the job!"

You get simplified step-by-step instructions, laminated circuit board construction, oversized drawings—all the help needed to accomplish mechanical and electrical assembly faster than you've ever believed possible!

You can buy this instrument, kit or wired "off the shelf" at your local RCA Distributor. Either way, you are assured of an instrument which can give you long, dependable performance. See the RCA WV-77E VoltOhmyst—Kit or Wired—today!

SPECIFICATIONS

Ranges:

DC—0.02 volt to 1500 volts in 7 overlapping ranges

RMS—0.1 volt to 1500 volts in 7 overlapping ranges

Peak-to-peak—0.2 volt to 4000 volts in 7 overlapping ranges

Resistance—from 0.2 ohm to 1000 megohms in 7 overlapping ranges. Zero-center indicator for discriminator alignment

Accuracy—±3% of full scale on dc ranges ±5% of full scale on ac ranges

Frequency Response—flat within ±5%, from 40 cycles to 5 Mc on the 1.5, 5, and 15-volt rms ranges and the 4, 14 and 40-volt peak-to-peak ranges

DC Input Resistance—standard 11 megohms (1 megohm resistor in probe)

RADIO CORPORATION OF AMERICA
Electron Tube Division *Harrison, N. J.*

NOW! at a price you can afford!

MAKE MORE MONEY in TELEVISION RADIO-ELECTRONICS

BETTER...MORE COMPLETE...LOWER COST... WITH NATIONAL SCHOOLS SHOP-METHOD HOME TRAINING!

BETTER... Training that is proved and tested in Resident School shops and laboratories, by a School that is the OLDEST and LARGEST of its kind in the world.

MORE COMPLETE... You learn ALL PHASES of *Television-Radio-Electronics.*

LOWER COST... Other schools make several courses out of the material in our ONE MASTER COURSE . . . and you pay more for less training than you get *in our course* at ONE LOW TUITION!

These two FREE books will show you how!

You get all information by mail . . . You make your own decision . . . at home! NO SALESMAN WILL CALL

TOP PAY...UNLIMITED OPPORTUNITIES LIFETIME SECURITY CAN BE YOURS!

You are needed in the Television, Radio, and Electronics industry! Trained technicians are in growing demand at excellent pay— in ALL PHASES, including Servicing, Manufacturing, Broadcasting and Communications, Automation, Radar, Government Missile Projects.

NATIONAL SCHOOLS SHOP-METHOD HOME TRAINING, with newly added lessons and equipment, trains you in your spare time at home, for these unlimited opportunities, including many technical jobs leading to supervisory positions.

YOU LEARN BY BUILDING EQUIPMENT WITH KITS AND PARTS WE SEND YOU. Your National Schools course includes thorough *Practical* training—YOU LEARN BY DOING! We send you complete standard equipment of professional quality for building various experimental and test units. You advance step by step, perform more than 100 experiments, and you build a complete TV set from the ground up, that is yours to keep! A big, new TV picture tube is included at no extra charge.

EARN AS YOU LEARN. We'll show you how to earn extra money right from the start. Many of our students pay for their course—and more—while studying. So can you!

LESSONS AND INSTRUCTION MATERIAL ARE UP-TO-DATE, PRACTICAL, INTERESTING. Every National Schools Shop-Method lesson is made easy to understand by numerous illustrations and diagrams. All instruction material has been developed and tested in our own Resident School Shops, Laboratories and Studios.

SEND FOR INFORMATION TODAY . . . it can mean the difference between SUCCESS and failure for you! Send for your FREE BOOK "Your Future in Television-Radio-Electronics" and FREE Sample Lesson. Do it TODAY, while you are thinking about your future. It doesn't cost you anything to investigate!

YOU GET...

- 19 Big Kits—YOURS TO KEEP!
- Friendly Instruction and Guidance
- Job Placement Service
- Unlimited Consultation
- Diploma—Recognized by Industry
- EVERYTHING YOU NEED FOR SUCCESS!

SHOP-METHOD HOME TRAINING COVERS ALL PHASES OF INDUSTRY

1. Television, including Color TV
2. Radio AM & FM
3. Electronics for Guided Missiles
4. Sound Recording and Hi-Fidelity
5. FCC License
6. Automation and Computers
7. Radar & Micro-Waves
8. Broadcasting and Communications

GET THE BENEFITS OF OUR OVER 50 YEARS EXPERIENCE

Approved for GI Training

MEMBER

NATIONAL SCHOOLS
Los Angeles 37, Calif.

RESIDENT TRAINING AT LOS ANGELES

If you wish to take your training in our Resident School at Los Angeles, the world's TV capital, start NOW in our big, modern Shops, Labs and Radio-TV Studios. Here you work with latest Electronic equipment - - professionally installed - - finest, most complete facilities offered by any school. Expert, friendly instructors. Personal attention. Graduate Employment Service. Help in finding home near school - - and part time job while you learn. Check box in coupon for full information.

NATIONAL TECHNICAL SCHOOLS
WORLD-WIDE TRAINING SINCE 1905

MAIL NOW TO
NATIONAL SCHOOLS, Dept RH-19
4000 S. FIGUEROA ST. LOS ANGELES 37, CALIF.

Rush free TV-Radio "Opportunity" Book and sample lesson. No salesman will call.

NAME _____ AGE _____

ADDRESS _____

CITY _____ ZONE _____ STATE _____

☐ Check if interested ONLY in Resident School training at Los Angeles.

VETERANS: Give date of Discharge _____

WHAT IS IT?

To the Editors:

Here is a photograph of a piece of equipment which we have picked up in an old house. Can any of your readers tell us what the unit is? All we know is that it was made by *RCA*, and the

4-position switch in the center of the unit is labeled "frequency changer."

A. Gallo
Vision Radio & Television Service
Ford City, Pennsylvania

If any of our readers can identify this piece of equipment, we would certainly like to hear from them.—Editors.

* * *

FRENCH HI-FI AMPLIFIER

To the Editors:

I have just finished reading the article on the French 3-D hi-fi amplifier described in your July issue. Where can I get more information on this amplifier? I am very much interested in the circuit and would like to purchase a unit, if possible.

John J. Nalepa
RCA Mayaguez A. F. B.
Patrick A.F.B., Florida

To the Editors:

Your July issue was one of the best I have seen. How about more information on the French amplifier described?

B. K.
Baltimore, Maryland

For our many readers who have requested the name and address of the manufacturer of the French hi-fi amplifier, it is as follows: B.T.H. Cie Francaise, Tomson-Houston, *Group Petite Materiel, 173, Boulevard Haussman, Paris 8, France. We suggest you contact them directly for further information.—Editors.*

* * *

ASSOCIATION OF THE MONTH

To the Editors:

The Electronic Service Association is very grateful to Radio & TV News for extending to us the honor of being the "Association of the Month" in your September, 1958 issue.

We, who are so often forgotten by the TV manufacturers whose sets we repair and for whom we retain so much good will, wish to thank the editors and the publisher for the time and trouble it must have taken to write and edit such a very fine article.

I, as corresponding secretary, have been receiving compliments from everyone who reads the article as well as from members of ESA for sending the information on to you.

Howard C. Larsen
Corresponding Secretary
Electronic Service Association
Detroit, Michigan

We are pleased to know that you and your Association liked the coverage received in "Service Association of the Month." We certainly would like to invite all service associations to give us the opportunity of telling their story as well. Simply fill in the coupon which usually appears along with our coverage of the "Service Association of the Month."—Editors.

* * *

IGNITION ANALYZER

To the Editors:

I have received several letters concerning the lack of synchronization in the ignition analyzer described in the July issue. Actually, I should have foreseen the difficulty and warned of it in the article.

For example, assume a 6-cylinder automobile engine is idling at 300 rpm. Since each cylinder fires only once every two revolutions, we get 150 displays per cylinder a minute. This means that for a 6-cylinder engine, a scope's sweep must operate at 900 sweeps-per-minute or 15 sweeps-per-second. Many commercial scopes will not sweep at this slow rate.

There are two solutions to this problem. The first is to slow the sweep of the scope by adding an external capacitor. Many scopes have external jacks for such an addition. The second solution is to use the analyzer only at

BIG REWARDS

for the most-wanted men in Radio-TV-Electronics

General Electronics Technician | Radio-TV Engineer | Radio-TV Service Manager | Industrial Electronics Technician | Electrical Engineering Technician | Electrical Draftsman

That's right! There *are* big rewards for the most-wanted men in Radio-TV-Electronics.

You can be one of these men. With the right training you can qualify for a big-pay job in a vital industry. You can start yourself on an exciting, rewarding career in a field that offers unlimited opportunities.

But you must be thoroughly trained. You must know more than wires and tubes. You must *think* in electronic terms.

There's no short-cut to success in Radio-TV-Electronics. But there is a simple, sure way . . . the I.C.S. way.

I.C.S. is the world's oldest and largest technical training school. Sixty-seven years of experience in training 6½ million students have made the I.C.S. system a success-proven method of home study. Today, there are more trained men from I.C.S. in supervisory and management jobs than from any other school.

Up-to-the-minute I.C.S. Courses make electronic fundamentals clear, easy-to-follow. *Personalized* guidance helps you through each step.

You study at home – in your spare time – at your own pace. Everything you learn is practical, usable. Courses are prepared by experts who know what *you* need to know to go places.

Join the ranks of the most-wanted men in Radio-TV-Electronics. Your first step is to send for your free I.C.S. Career Kit. You have nothing to lose. You can gain an exciting career in the fastest-growing industry of all time.

HOW WILL YOUR I.C.S. SUCCESS STORY SOUND?

"I took my diploma from your school in Radio Operating in 1947. In 3 years I became chief engineer of WKOK in Sunbury, Pa. Then I came to California as Audio Engineer for ABC in Hollywood. I still hold this position. I will always be grateful for your help in getting me in the type of profession that has so much to look forward to." *William R. Dreese*

"I had been in the radio-repair business for 30 years, when I enrolled in the I.C.S. Television Servicing Course.

"Now I am able to approach a television job in a systematic manner, while others are still operating on the hit-or-miss level." *Kelsey G. Cobb*

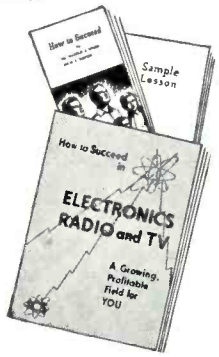
"Up to the time I enrolled, my interest in electronics was purely a hobby, but before completing my course I was able to do a considerable amount of radio work. Now I have a good part-time business." *George A. Chase*

Send the coupon below for your *free* I.C.S. Career Kit!

1 "How to Succeed," 36-page guide to advancement.

2 Opportunity handbook for the field of your choice.

3 Sample lesson (Math) to demonstrate I.C.S. method.



For Real Job Security—Get an I.C.S. Diploma! **I.C.S., Scranton 15, Penna.**

Accredited Member, National Home Study Council

INTERNATIONAL CORRESPONDENCE SCHOOLS

ICS

BOX 02226M. SCRANTON 15, PENNA. (Partial list of 259 courses)

Without cost or obligation, send me "How to Succeed" and the opportunity booklet about the field BEFORE which I have marked X (plus sample lesson):

RADIO TELEVISION ELECTRONICS
- ☐ General Electronics Tech.
- ☐ Industrial Electronics
- ☐ Practical Radio-TV Eng'r'g
- ☐ Practical Telephony
- ☐ Radio-TV Servicing

BUSINESS
- ☐ Cost Accounting
- ☐ Managing a Small Business
- ☐ Purchasing Agent

DRAFTING
- ☐ Electrical Drafting

HIGH SCHOOL
- ☐ High School Diploma
- ☐ Good English
- ☐ High School Mathematics

ELECTRICAL
- ☐ Electrical Engineering
- ☐ Elec. Engr. Technician
- ☐ Elec. Light and Power
- ☐ Practical Electrician
- ☐ Professional Engineer (Elec.)

LEADERSHIP
- ☐ Industrial Foremanship
- ☐ Industrial Supervision
- ☐ Personnel-Labor Relations
- ☐ Supervision

Name_____ Age____ Home Address_____

City_____ Zone____ State_____ Working Hours____ A.M. to____ P.M.____

Occupation_____

Canadian residents send coupon to International Correspondence Schools, Canadian, Ltd., Montreal, Canada. . . . Special tuition rates to members of the U. S. Armed Forces.

the engine speeds where the scope will sync properly. Since it is at the higher speeds where most ignition difficulties appear, this does not represent a handicap of the equipment.

DANIEL P. PETERS
Boonton, New Jersey

We have had quite a few letters concerning sync problems with this unit so that the above suggestions from the author of the article should certainly be useful.—Editors.

* * *

MULTIPLEX ADAPTER

To the Editors:

In the October issue of your magazine, there is an article on stereo broadcasting by M. Snitzer in which the topic of FM multiplexing is covered. I wonder if you could possibly send me a circuit of a multiplex adapter that would be suitable for use with this system.

D. McGOWAN
Willow Grove, Pennsylvania

To the Editors:

One of the good Washington FM stations, WASH-FM, is now broadcasting stereo on a daily schedule by the multiplex system, using a 67 kc. subcarrier. I would like to "get in on this," and would be very interested in seeing a construction article on a multiplex adapter.

EDWARD O. BASSETT
Silver Spring, Maryland

We are sure that all of our readers who are interested in FM multiplex will find some excellent and definitive information in the two-part series on the subject by Paul Hille, which begins in this month's issue. The second part of the series, which will run next month, gives complete constructional details on an FM multiplex adapter designed and built by the author. Because of the lack of standards for FM multiplex, it might not be too good an idea to proceed full speed with the project. However, for those who are interested, we will have complete information available.—Editors.

* * *

BACK ISSUES

To the Editors:

I am writing in an effort to obtain information which you may have covered in some of your back issues dealing with electrostatic loudspeakers. Can you help me?

VARNER L. PADDACK
Grand Forks, North Dakota

The above is typical of a good many requests we get for information contained in back issues of this magazine. For example, two such articles on the subject are "Electrostatic Loudspeakers—Questions and Answers" (June, 1958 issue) and "All About Audio and Hi-Fi — Electrostatic Speakers and Transient Response—Part 6" (October, 1957 issue).

Back issues of RADIO & TV NEWS *are available, commencing with the Febru-*

What Does F.C.C. Mean To You?

What is the F. C. C.?

F. C. C. stands for Federal Communications Commission. This is an agency of the Federal Government, created by Congress in 1934 to regulate all radio communication and radio and television broadcasting in the United States.

What is an F. C. C. Operator License?

The F. C. C. requires that only qualified persons be allowed to install, maintain, and operate electronic communications equipment, including radio and television broadcast transmitters. To determine who is qualified to take on such responsibility, the F. C. C. gives technical examinations. Operator licenses are awarded to those who pass these examinations. There are different types and classes of operator licenses, based on the type and difficulty of the examination passed.

What are the Different Types of Operator Licenses?

The F. C. C. grants three different types (or groups) of operator licenses – commercial radiotelePHONE, commercial radioteleGRAPH, and amateur.

COMMERCIAL RADIOTELE*PHONE* operator licenses are those required of technicians and engineers responsible for the proper operation of electronic equipment involved in the transmission of voice, music, or pictures. For example, a person who installs or maintains two-way mobile radio systems or radio and television broadcast equipment must hold a radiotelePHONE license. (A knowledge of Morse code is NOT required to obtain such a license.)

COMMERCIAL RADIOTELE*GRAPH* operator licenses are those required of the operators and maintenance men working with communications equipment which involves the use of Morse code. For example, a radio operator on board a merchant ship must hold a radioteleGRAPH license. (The ability to send and receive Morse is required to obtain such a license.)

AMATEUR operator licenses are those required of radio "hams"– people who are radio hobbyists and experimenters. (A knowledge of Morse code is necessary to be a "ham".)

What are the Different Classes of RadiotelePHONE licenses?

Each type (or group) of license is divided into different *classes*. There are *three* classes of radiotelephone licenses, as follows:

(1) Third Class Radiotelephone License. No previous license or on-the-job experience is required to qualify for the examination for this license. The examination consists of F.C.C. Elements I and II covering radio laws, F.C.C. regulations, and basic operating practices.

(2) Second Class Radiotelephone License. No on-the-job experience is required for this examination. However, the applicant must have already passed examination Elements I and II. The *second class* radiotelephone examination consists of F. C. C. Element III. It is mostly technical and covers basic radiotelephone theory (including electrical calculations), vacuum tubes, transistors, amplifiers, oscillators, power supplies, amplitude modulation, frequency modulation, measuring instruments, transmitters, receivers, antennas and transmission lines, etc.

(3) First Class Radiotelephone License. No on-the-job experience is required to qualify for this examination. However, the applicant must have already passed examination Elements I, II, and III. (If the applicant wishes, he may take all four elements at the same sitting, but this is not the general practice.) The *first class* radiotelephone examination consists of F. C. C. Element IV. It is mostly technical covering advanced radiotelephone theory and basic television theory. This examination covers generally the same subject matter as the second class examination, but the questions are more difficult and involve more mathematics.

Which License Qualifies for Which Jobs?

The THIRD CLASS radiotelephone license is of value primarily in that it qualifies you to take the second class examination. The scope of authority covered by a third class license is extremely limited.

The SECOND CLASS radiotelephone license qualifies you to install, maintain, and operate most all radiotelephone equipment except commercial broadcast station equipment.

The FIRST CLASS radiotelephone license qualifies you to install, maintain, and operate every type of radiotelephone equipment (except amateur, of course) including all radio and television stations in the United States, and in its Territories and Possessions. This is the highest class of radiotelephone license available.

How Long Does it Take to Prepare for F. C. C. Exams?

The time required to prepare for FCC examinations naturally varies with the individual, depending on his background and aptitude. Grantham training prepares the student to pass FCC exams in a minimum of time.

In the *Grantham Correspondence Course*, the average beginner with NO previous experience or training in radioelectronics should obtain his *second class* radiotelephone license after from 200 to 300 hours of study. This same student should then prepare for his *first class* FCC license in approximately 100 additional hours of study.

In the *Grantham Resident Course*, the time required to complete the course and get your license (under normal circumstances) is as follows:

In the DAY course (5 days a week) you should get your *second class* license at the end of the first 9 weeks of classes, and your *first class* license at the end of 3 additional weeks of classes. This makes a total of 12 weeks (just a little less than 3 months) required to cover the whole course, from "scratch" through *first class*.

In the EVENING course (2 nights a week) you should get your *second class* license at the end of the 22nd week of classes and your *first class* license at the end of 8 additional weeks of classes. This makes a total of approximately 7 months required to cover the whole course, from "scratch" through *first class*, in the evening course.

The Grantham course is designed specifically to prepare you to pass FCC examinations. All the instruction is presented with the FCC examinations in mind. In every lesson test and preexamination you are given constant practice in answering FCC-type questions, presented in the same manner as the questions you will have to answer on your FCC examinations.

Why Choose Grantham Training?

The Grantham Communications Electronics Course is planned primarily to lead to an F.C.C. license, but it does this by TEACHING electronics. This course can prepare you *quickly* to pass F. C. C. examinations because it presents the necessary principles of electronics in a simple "easy to grasp" manner. Each new idea is tied in with familiar ideas. Each new principle is presented first in simple, everyday language. Then after you understand the "what and why" of a certain principle, you are taught the technical language associated with that principle. You learn more electronics in less time, because we make the subject easy and interesting.

Is the Grantham Course a "Memory Course"?

No doubt you've heard rumors about "memory courses" or "cram courses" offering "all the exact FCC questions". Ask anyone who has an FCC license if the necessary material can be memorized. Even if you had the exact exam questions and answers, it would be much more difficult to memorize this "meaningless" material than to learn to understand the subject. Choose the school that teaches you to thoroughly understand – choose Grantham School of Electronics.

Is the Grantham Course Merely a "Coaching Service"?

Some schools and individuals offer a "coaching service" in FCC license preparation. The weakness of the "coaching service" method is that it presumes the student already has a knowledge of technical radio and approaches the subject on a "question and answer" basis. On the other hand, the Grantham course "begins at the beginning" and progresses in logical order from one point to another. Every subject is covered simply and in detail. The emphasis is on making the subject easy to understand. With each lesson, you receive an FCC-type test so you can discover daily just which points you do not understand and clear them up as you go along.

HERE'S PROOF that Grantham Students prepare for F.C.C. examinations in a minimum of time. Here is a list of a few of our recent graduates, the class of license they got, and how long it took them:

	License	Wks.
Robert H. Moore, 807 Grace St., Baldwin, L.I., N.Y.	1st	12
Otis A. Towns, 3638 Bates St., St. Louis, Mo.	1st	12
Robert A. Herrman, 608 Walker Ave., Baltimore, Md.	1st	14
Walter Mengel, Jr., 423 James St., Crystal Lake, Ill.	1st	8
Serge G. Miller, 1315 W. 15th St., San Pedro, Calif.	1st	12
John A. Hayes, 1519 Madison Ave., Memphis, Tenn.	1st	14
Franklin A. VanLeuven, 6061 Woodlawn Ave., Maywood, Calif.	1st	12
Robert A. Morgan, 25 Barrow St., New York, N.Y.	1st	9

OUR GUARANTEE: If you should fail the F.C.C. exam after finishing our course, we guarantee to give you additional training at NO ADDITIONAL COST. Read details in our free booklet.

THREE COMPLETE SCHOOLS

To better serve our many students throughout the entire country, Grantham School of Electronics maintains three complete schools – in Washington, D.C., Hollywood, Calif., and Seattle, Wash. All schools offer the same rapid courses in F.C.C. license preparation, either home study or resident classes.

For further details concerning F.C.C. licenses and our training, send for our FREE booklet, "Careers in Electronics". Clip the coupon below and mail it to the School nearest you.

Get your First Class Commercial F.C.C. License Quickly by training at

GRANTHAM SCHOOL OF ELECTRONICS

821-19th Street, N.W.	1505 N. Western Ave.	408 Marion Street
Washington 6, D.C.	Hollywood 27, Calif.	Seattle 4, Wash.
(Phone: ST 3-3614)	*(Phone: HO 7-7727)*	*(Phone: MA 2-7227)*

Mail This Coupon Now—No Salesman Will Call

MAIL TO SCHOOL NEAREST YOU

To: **GRANTHAM SCHOOL OF ELECTRONICS**

821-19th, NW **Washington** • 1505 N. Western **Hollywood** • 408 Marion **Seattle**

Gentlemen:

Please send me your free booklet telling how I can get my commercial F.C.C. license quickly. I understand there is no obligation and no salesman will call.

Name _____ Age _____

Address _____

City _____ State _____

Interested in: ☐ Home Study, ☐ Resident Classes 96-A

ary, 1954 issue, from our Circulation Department, 434 South Wabash Avenue, Chicago 5, Illinois at a cost of $.40 each.—Editors.

* * *

AUDIO "MIX-IT" BOX

To the Editors:

I have had some correspondence with readers who are anxious to duplicate my audio "mix-it" box (September, 1958 issue).

One question that has come up is the identification of the various knobs that are on the front panel of the box. The four large knobs are, left to right, R_8, R_{11}, R_{37}, and R_{29}. A small screwdriver adjustment next to the meter is R_{23}. The two small knobs below are the "on-off" switch and R_{14}, the master volume control.

Another question has to do with whether a tape head could be used with the mix-it box. It might be possible to connect some tape heads to J_3. However, most heads require special equalization, which is not provided by my mixer. Therefore, a tape preamp would be needed.

Finally, some readers have wanted to know whether a microammeter could be used for M_1. It would be possible to use a 50-microampere meter, for example, with a series diode rectifier or a bridge rectifier ahead of it for this purpose.

LEON A. WORTMAN
New York, New York

We are glad to pass along Author Wortman's suggestions for those who are interested in constructing the mixer he described.—Editors.

* * *

COUNTING COIL TURNS

To the Editors:

Referring to the brief item "Counting Coil Turns" on page 134 of your October issue, I believe it would be easier to count the turns of the handle of the drill rather than its chuck. All you need to do is predetermine the gear ratio. For instance, the chuck on my drill turns 3¾ times for each turn of the handle, so when I want a coil of 300 turns, it is much easier to simply count 80 turns of the handle.

LAWRENCE DAVIS
Columbus, Ohio

Reader Davis' suggestion is a good one, provided the relation between the handle turns and the chuck turns is fairly simple. Just as soon as some fractions start to enter the picture, the additional calculations involved and the resultant lack of accuracy may make it easier just to turn the drill more slowly and count the turns made by the chuck.—Editors.

* * *

7½ IPS 4-TRACK STEREO TAPE

To the Editors:

I was very interested in the articles "Stereo Tape or Disc?" and "Behind the Stereo Scene," which appeared in your October issue.

I have had quite a bit of experience with tape recordings made at 3¾ ips,

and I have found that many tape recorders develop quite a bit of wow at this speed after prolonged use. On the other hand, 7½ ips stereo tapes with just two tracks are too expensive today. Therefore, I think the solution to the tape dilemma is to use the higher speed but go to four tracks. So, how about some manufacturers thinking over the idea and coming out with recorded stereo tape that runs at 7½ ips, but which has four tracks on it. In this way, we will get tape economy and high quality too.

EGON E. ECKERT
Danbury, Connecticut

The arguments expressed by Reader Eckert certainly have merit. On the other hand, there is enough confusion in the tape market today so that the proposal of still another standard might not make too much sense. The fact remains, however, that the new, smaller heads that are suitable for four-track stereo ought to result in still better performance at 7½ ips than the lower-speed machines for which they were designed.—Editors.

* * *

TRANSISTOR SUPERREGEN FM TUNER

To the Editors:

When I came across the article on the transistor superregen FM tuner in the November issue, I was all enthused and ready to build it, that is, until I saw the price of the 3N25 tetrode transistor. My catalogues list this little item at $16.00. This price, in conjunction with the cost of the zener diode, transformer, and other components, probably make the cost of this project well over $25.00.

KENNETH GREENBERG
Chicago, Illinois

Our article carefully mentioned the prices of all special items, and indicated that the total cost would not exceed $25.00. However, according to the information available to the author at the time the manuscript was written, the 3N25 sold for $12.50. According to the latest catalogues, the price is now $16.00 so that Mr. Greenberg certainly appears to be right. The tuner would still be of interest to anyone who wants to experiment with the new tetrode transistor and who wants a simple circuit that works well. However, we certainly must warn our readers of the cost.—Editors.

* * *

SUPREME ROLL CHARTS

To the Editors:

Can you supply me with a roll chart or reprints of articles for use with a Supreme Model 504A tube tester for newer type tubes?

WILLIAM WEBB
Bellevue, Washington

The Supreme line of tube testers is no longer in production, and we know of no source from which up-to-date roll charts are available. However, we are planning a 2-part article telling owners of older tube testers how they may be able to set up these instruments for testing newer tube types. —30—

Learn TELEVISION-RADIO

Servicing or Communications

by Practicing at Home in Spare Time

NRI gives you kits to build these and other equipment

Electronic Technicians Have High Pay, Prestige Jobs

People look up to and depend on the Technician, more than ever before. His opportunities are great, and are increasing. Become a Radio-Television-Electronic Technician. At home, and in your spare time, you can learn to do this interesting, satisfying work—qualify for important pay. A stream of new Electronics products is increasing the job and promotion opportunities for Television-Radio-Electronic Technicians. Right now, a solid, proven field of opportunity for good pay is servicing the millions of Television and Radio sets now in use. The hundreds of Television and Radio stations on the air offer interesting jobs for Operators and Technicians. The military services reward qualified Technicians with higher rank and pay. Police, Aviation, Mobile Two-Way Radio are expanding. To ambitious men everywhere: here is rich promise of fascinating jobs, satisfaction and prestige, increasing personal prosperity.

Make Extra Money Soon, $10 to $15 a Week in Your Spare Time

NRI students find it practical and profitable to start fixing sets for friends and neighbors a few months after enrolling. Picking up $10, $15 and more a week gives substantial extra spending money. Use the Tester built with parts NRI furnishes, to locate and correct Radio-TV receiver troubles. Many who start in spare time, soon build full time Television-Radio sales and service businesses; others enjoy profitable spare time businesses and the security of a source of income to fall back on in case of layoffs, hard times or other changes in regular job. Postage free card will bring you complete facts about the NRI tested way to better pay.

ACT NOW FIND OUT WHAT NRI OFFERS YOU

NRI Has Trained Thousands for Successful Careers in TV-Radio

Studio Engr., Station KATV
"I am now Studio Engineer at Television Station KATV. Before enrolling for the NRI Course, I was held back by limitation of a sixth grade education." BILLY SANCHEZ, Pine Bluff, Ark.

Has All the Work He Can Do
"Since finishing NRI Course I have repaired more than 2,000 TV and Radio sets a year. NRI training certainly proved to be a good foundation." H. R. GORDON, Milledgeville, Ga.

Has Good Part Time Business
"Quite early in my training I started servicing sets. Now have completely equipped shop. My NRI training is the backbone of my progress." E. A. BREDA, Tacoma, Wash.

Cut Out and Mail Postage-Free Card NOW

Sample Lesson and Catalog Both FREE

SEE OTHER SIDE

OLDEST & LARGEST HOME STUDY RADIO-TV SCHOOL

National Radio Institute

Dept. C D , Washington 16, D.C.

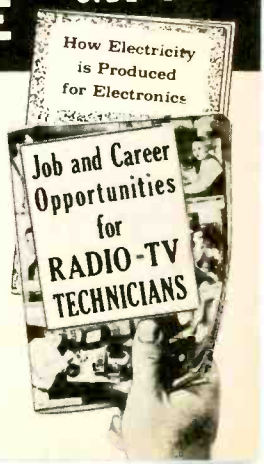
Please send me sample lesson of your Radio-Television Training and Catalog FREE. (No salesman will call.)

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

Address.....

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

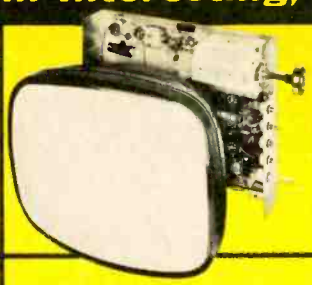
ACCREDITED MEMBER NATIONAL HOME STUDY COUNCIL



NRI SUPPLIES LEARN-BY-DOING KITS WITHOUT EXTRA CHARGE
Technical Know-How Pays Off in Interesting, Important Work

YOU BUILD AC-DC Superhet Receiver

NRI Servicing Course includes all needed parts. By introducing defects you get actual servicing experience practicing with this modern receiver. Learn-by-doing.



YOU BUILD This 17 Inch Television Receiver

As part of your NRI course you can get all components, tubes, including 17" picture tube, to build this latest style Television receiver; get actual practice on TV circuits.

YOU BUILD Broadcasting Transmitter

As part of NRI Communications Course you build this low power Transmitter, learn commercial broadcasting operators' methods, procedures. Train for your FCC Commercial Operator's License.

YOU BUILD Vacuum Tube Voltmeter

Use it to earn extra cash fixing neighbors' sets; bring to life theory you learn from NRI's easy-to-understand texts.

For Higher Pay, Better Jobs Be a TV-Radio-Electronic Technician

Servicing Needs More Trained Men

Portable TV, Hi-Fi, Transistor Radios, Color TV are making new demands for trained Technicians. Good opportunities for spare time earnings or a business of your own.

Broadcasting Offers Satisfying Careers

4000 TV and Radio stations offer interesting positions. Govt. Radio, Aviation, Police, Two-Way Communications are growing fields. Trained Radio-TV Operators have a bright future.

J. E. Smith, Founder

Train at Home the NRI Way Famous for Over 40 Years

NRI is America's oldest and largest home study Television-Radio school. The more than 40 years' experience training men for success, the outstanding record and reputation of this school—benefits you in many ways. NRI methods are tested, proven. Successful graduates are everywhere, from coast to coast, in small towns and big cities. You train in your own home, keep your present job while learning. Many successful NRI men did not finish high school. Let us send you an actual lesson, judge for yourself how easy it is to learn.

No Experience Necessary—NRI Sends Many Kits for Practical Experience

You don't have to know anything about electricity or Radio to understand and succeed with N R I Course. Clearly written, well-illustrated NRI lessons teach TV-Radio-Electronic principles. You get NRI kits for actual experience. All equipment is yours to keep. You learn-by-doing. Mailing the postage-free card may be one of the most important acts of your life. Do it now. Reasonable tuition. Low monthly payments available. Address: **NATIONAL RADIO INSTITUTE, Washington 16, D. C.**

NRI Graduates Do Important Work

Now Quality Control Chief
"Had no other training in Radio before enrolling, obtained job working on TV amplifiers before finishing course. Now Quality Control Chief." T. R. FAVALORO, Norwich, N. Y.

NRI Course Easy to Understand
"I opened my own shop before receiving my diploma. I have had to hire extra help. I am independent in my own business." D. P. CRESSEY, Stockton, Cal.

Works on Color-TV
"NRI changed my whole life. If I had not taken the course, probably would still be a fireman, struggling along. Now Control Supervisor at WRCA - TV." J. F. MELINE, NewYork, N.Y.

FIRST CLASS
Permit No. 20-R
(Sec. 34.9, P. L. & R.)
Washington, D.C.

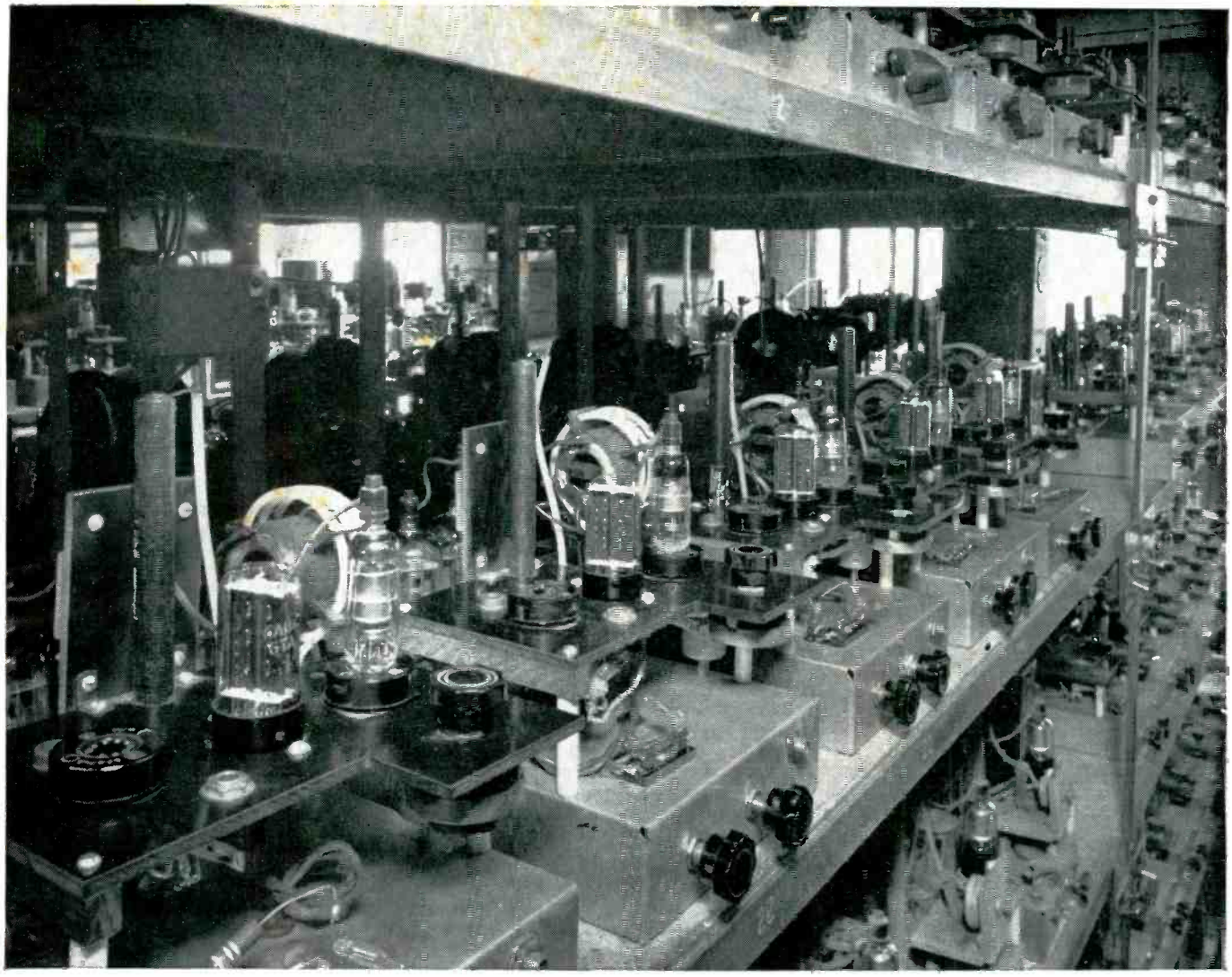
BUSINESS REPLY CARD
No Postage Stamp Necessary if Mailed in the United States

POSTAGE WILL BE PAID BY

NATIONAL RADIO INSTITUTE
3939 Wisconsin Avenue
Washington 16, D.C.

SAMPLE LESSON
64-page CATALOG
both FREE

SEE OTHER SIDE



NEW CONTROLLED

Dynamic Life Tests...

...ASSURE UNIVERSAL TUBE REPLACEMENTS Testing tubes in sets is good . . . but not the best way. We life-check tubes dynamically in TV sets . . . in addition to many other extensive tests for materials, production, design and static life. But there are interaction problems in set testing which obscure the causes of tube failure. And some models of TV sets operate tubes conservatively. CBS-Hytron has, therefore, developed controlled dynamic life tests to examine all important characteristics under the most stringent TV set conditions.

...HELP PINPOINT AND CORRECT FAULTS Day in, day out, tubes are cycled and checked under accelerated conditions at low (105 v) and high (140 v) line voltages. Components and dynamic operating conditions are controlled to point the finger unrelentingly at the exact nature of tube failures. They may be opens, shorts, gas, gradual deterioration of electrical characteristics, etc. Once the tests locate the fault, the correction is invariably the same: improvement of tube design or manufacturing techniques.

...CUT YOUR CALL-BACKS. This new controlled dynamic life testing is your answer for dependable, universal replacement tubes for all TV sets. It is a big reason why CBS-Hytron tubes can cut your call-backs. Be sure to ask for CBS-Hytron tubes.

More reliable products through Advanced-Engineering

CBS-HYTRON, Danvers, Massachusetts
A Division of Columbia Broadcasting System, Inc.

Within the Industry

DR. PHILIP N. HAMBLETON has been appointed supervisor of research and development, tubes, for *CBS-Hytron,* a division of *Columbia Broadcasting System, Inc.*

Dr. Hambleton was previously senior physicist in the tube research and development laboratory. Prior to joining the firm he was associated with *Sylvania Electric Products* and *Philco Corporation.* In addition, he served as supervisor of *Superior Tube Company's* electronic laboratory.

He received his Doctorate in Physics from The Johns Hopkins University, and is a member of the Institute of Radio Engineers, the American Institute of Physics, and the American Physics Society, among others.

* * *

HARRY L. BRYANT, vice-president and chief engineer at *Radio Recorders,* Hollywood, Calif., has been elected executive vice-president of the Audio Engineering Society.

Mr. Bryant is the first westerner ever to hold post in the association, the only national engineering society devoted exclusively to audio technology. He is a fellow of the organization and served previously as western vice-president.

* * *

HAROLD J. ADLER has been named vice-president in charge of operations at *Shure Brothers, Inc.* In this capacity he will be responsible for all engineering and manufacturing activity at the company.

A licensed engineer and a senior member of the Institute of Radio Engineers, Mr. Adler was graduated in 1930 from Armour Institute, now part of the Illinois Institute of Technology, Chicago.

He was chief electrical engineer of the *Sentinel Radio Co.* for 17 years and was director of engineering of the *Hallicrafters Co.* for five years. Mr. Adler also was vice-president of *Edwin I. Guthman Co.* and for the past three years has been a private consultant to industry on engineering, manufacturing, and sales.

* * *

COMPONENTS CORPORATION announces the formation of its Nuclear Instrument Division. Jerry B. Minter will be in charge of this new division . . . The entire master television antenna business of **AMY, ACEVES AND KING** has been acquired by **AMPLITEL INCORPORATED.** The purchase includes patents and all existing contracts for service and future installations . . . **DI-AN CONTROLS, INC.** has been formed in Boston, Mass. Products planned include magnetic logical elements, shift registers, special purpose computers, industrial control systems, digital storage systems, and servo amplifiers.

* * *

SID N. COTTIN has been appointed show director for the Institute of High Fidelity Manufacturers.

He was formerly sales and advertising manager for *Crest Records* and *Shelley Products Ltd.* Previously he had been an advertising and printing consultant.

Mr. Cottin will be responsible for the handling of all Institute-sponsored shows throughout the country.

* * *

WALTER L. BROUGH has been named manager, manufacturing division, of *ORRadio Industries, Inc.,* a new position with the company.

Prior to joining the firm Mr. Brough was associated with *Hercules Motors Corp.* as executive vice-president. He was also chief engineer, *Union Drawn Steel Div., Republic Steel Corp.,* and spent many years with *Timken Roller Bearing Company.*

Mr. Brough is a graduate of Fenn College, Cleveland, Ohio and saw service in the Navy during the Second World War. He is a member of the American Society of Mechanical Engineers.

* * *

E. LEON CHAFFEE is among those named to receive a 1959 award from the Institute of Radio Engineers. He is to receive the "Medal of Honor," the highest technical award in the radio-electronics field, for "his outstanding research contributions and his dedication to training for leadership in radio engineering." Dr. Chaffee is the former director of the Cruft Laboratory, Harvard University and is Rumford Professor of Physics, Emeritus, and Gordon McKay Professor of Applied Physics, Emeritus.

In addition, the Morris Liebmann Memorial Prize will go jointly to Charles H. Townes, Professor of Physics, Columbia University, and Nicolaas Bloembergen, Gordon McKay Professor of Applied Physics, Harvard University.

Jack W. Herbstreit will receive the

ownership of a complete and currently maintained

PHOTOFACT SERVICE DATA LIBRARY SPELLS SUCCESS FOR SERVICE TECHNICIANS

here's actual proof from the men who know!

"We believe it is almost impossible to give fast and efficient service without PHOTOFACT. Sams PHOTOFACTS are a great help in trouble-shooting and replacement parts. They save time and money for us."

—Gerald L. Jellis, Watertown, So. Dak.
(Operator of "Radio TV Center")

HERE'S MORE PROOF... FROM COAST-TO-COAST

OHIO
"I find SAMS PHOTOFACT an absolute necessity in doing a job quickly and accurately...extremely helpful..."
—Dan M. Heinrich, *Westlake, Ohio*

PENNSYLVANIA
"PHOTOFACT is an invaluable 'piece of equipment' in our repair shop and it speeds our shop repairs 100%."
—Luther W. Wilkes, *Houtzdale, Pa.*

NEW JERSEY
"PHOTOFACT is used here every day, like an extra brain."
—Joseph M. Decker Jr.
Newton, N. J.

MASSACHUSETTS
"I would be lost without PHOTOFACT."
—Emilio Conzo, *Newton, Mass.*

MAINE
"Having data on sets plus parts listings, etc., means the difference between getting sets fixed and out in a reasonable length of time or having them tied up while securing such information, as I am located in a small town and have to depend on mail service for parts and information."
—Samuel S. Sawyer,
Kezar Falls, Maine

VIRGINIA
"I don't know how we would get along without PHOTOFACT, as we work on all makes and models."
—Kenneth E. Jenkins,
Big Stone Gap, Va.

CALIFORNIA
"With PHOTOFACT, the information I need is always at hand. I don't have to worry about a repair job because I know I will have a schematic that gives me correct information in the simplest possible form."
—J. R. Stukes, *Norwalk, Calif.*

WISCONSIN
"In my business, I service all makes of TV sets. Without good service literature such as PHOTOFACT, this would be an impossible task—especially to do a quick, intelligent job. In my estimation, Sams PHOTOFACTS is unequalled. I would hate to conduct a business without them. Keep up the good work!"
—Willard F. Dumke,
Menasha, Wis.

ILLINOIS
"PHOTOFACT makes it possible to identify any part in any model TV...It is possible to locate trouble in almost any set through the use of Sams."
—Sam Rogondino, *Lake Forest, Ill.*

(These are just a few of the hundreds of "Success with PHOTOFACT" letters in our files)

SEE YOUR SAMS DISTRIBUTOR TODAY,
OR WRITE TO HOWARD W. SAMS FOR FULL DETAILS

NEW! EASY-BUY PLAN

—the money-saving way to build your complete profit-making PHOTOFACT Library!

NO INTEREST—NO CARRYING CHARGE—AS LITTLE AS $10 DOWN

FREE! VALUABLE STEEL FILE CABINETS FOR REGULAR PHOTOFACT SUBSCRIBERS AND PHOTOFACT LIBRARY PURCHASERS

GET THE FULL DETAILS

HOWARD W. SAMS & CO., INC.
2203 E. 46th St., Indianapolis 6, Ind.

☐ Send me Free booklet "Your Guide To Maximum Profits"

☐ I'm a Service Technician: ☐ full-time; ☐ part time

My Distributor is: _____

Shop name _____

Attn. _____

Address _____

City _____ Zone____ State_____

Harry Diamond Memorial Award and the Vladimir K. Zworykin Television Prize goes to Paul Weimer of *RCA Laboratories*.

These awards will be presented at the 1959 IRE National Convention to be held in New York City next March.

* * *

DR. ALFRED N. GOLDSMITH has been elected to the board of directors of *RCA Communications, Inc.*

Dr. Goldsmith joined the parent company in 1919 and for 12 years served as director of research and then vice-president and general engineer. Since 1931 he has served as a technical consultant to the company.

He has been president of the Institute of Radio Engineers and the Society of Motion Picture and Television Engineers. In addition, he is a Fellow of the American Institute of Electrical Engineers, the Institute of Radio Engineers, the Acoustical Society of America, and the American Association for the Advancement of Science, to mention just a few.

Among Dr. Goldsmith's citations are the Medal of Honor and Founders Awards of the IRE, the Progress Medal Award of the SMPTE, and the Modern Pioneers Award.

* * *

ELECTRONIC INDUSTRIES ASSOCIATION's tube and semiconductor division is now operating the EIA Standards Laboratory, 32 Green St., Newark, N. J.

The new agency performs test measurements for tube and semiconductor manufacturers of the Association in connection with the recommendations of the appropriate Joint Electron Tube Engineering Council committees, and operates under the direction of the Association's engineering department with supervision by the executive committee of the tube and semiconductor division.

G. F. Hohn will head the Laboratory's operations.

* * *

KENNETH C. MORITZ has been named sales manager of the semiconductor division for *Raytheon Manufacturing Company* . . . **C. R. (RUSS) ROBERTSON** has been elected vice-president, sales, at *Weller Electric Corp.* . . . The appointment of **G. W. TUNNELL** to the post of manager, broadcast, systems, and shop repair service sales, has been announced by *RCA Service Company* . . . **AARON NEWMAN** has been appointed chief engineer of *Lafayette Radio's* kit division . . . **JAMES A. HANNAN** is now manager of the international division of *Centralab*, a division of *Globe-Union, Inc.* . . . *Conrac, Inc.* has named **CHARLES V. DICKMAN** national sales manager for the firm's "Fleetwood" products . . . The appointment of **F. J. VAN POPPELEN** as sales manager of *Motorola's* semiconductor

(*Continued on page* 103)

(Commercial)

FCC License Exams

your Guarantee of Success in Electronics

in a Minimum of Time

mail coupon NOW!

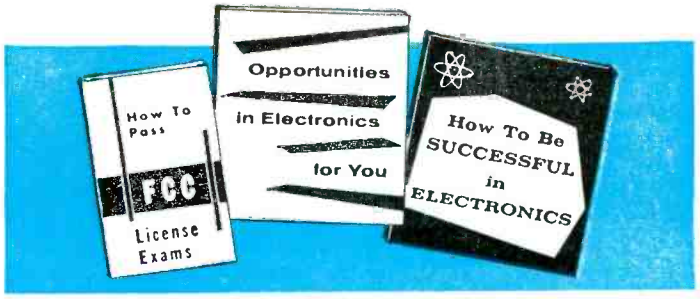
here's proof of good jobs

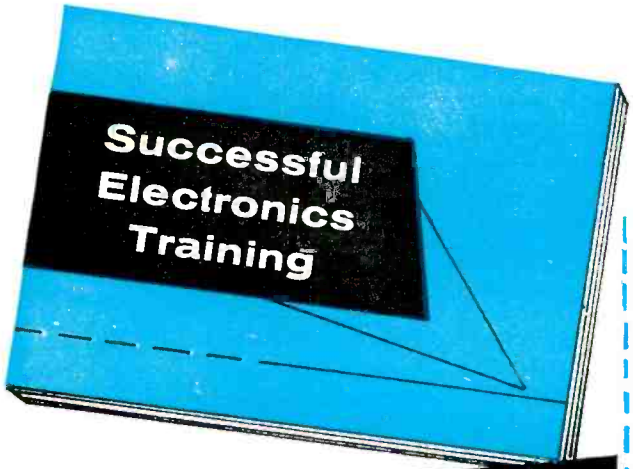
Irving Laing:

"Your lessons are helping me a lot in my Navy work. You cover topics that were not presented by the Navy at the E.T. School. . . . Your course has helped greatly to get my 2nd class FCC ticket. I am now a radio and T.V. engineer at WTVS and WDTR in Detroit, Michigan."

Irving L. Laing,
15887 Robson,
Detroit 27, Michigan

Get all 3 FREE





Receive All These Booklets FREE!

Accredited by The National Home Study Council

Cleveland Institute of Radio Electronics

Desk RN-25, 4900 Euclid Ave., Cleveland 3, Ohio

Please send FREE Booklets prepared to help me get ahead in Electronics. I have had training or experience in Electronics as indicated below:

- ☐ Military
- ☐ Radio-TV Servicing
- ☐ Manufacturing
- ☐ Amateur Radio
- ☐ Broadcasting
- ☐ Home Experimenting
- ☐ Telephone Company
- ☐ Other.....

In what kind of work are you now engaged?.....

.....

In what branch of Electronics are you interested?.....

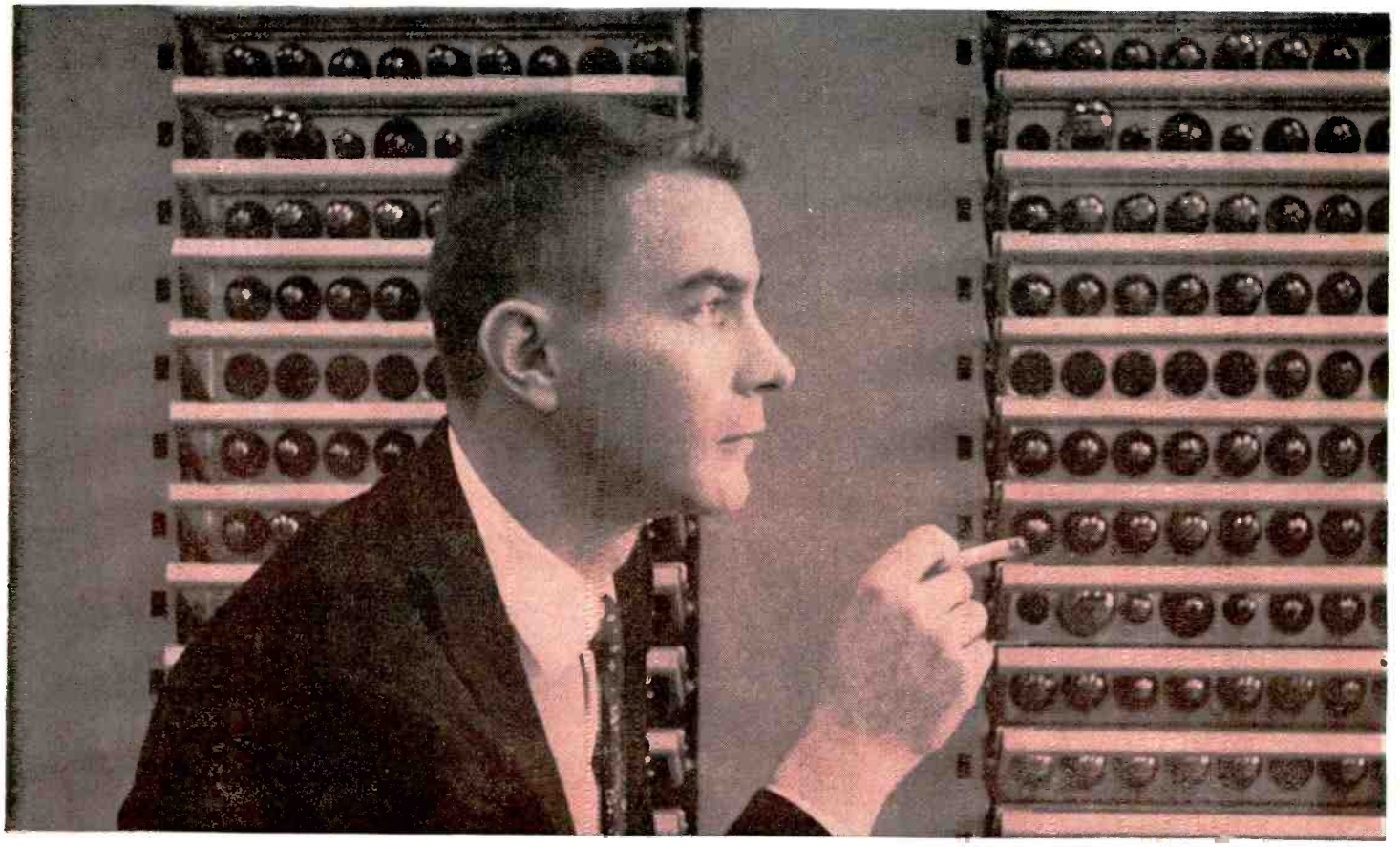
.....

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

Address.....

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

Special Tuition Rates to Members of Armed Forces Desk RN-25



How far can you go in electronics . .

"Just being called a Field Engineer—an impressive title for a man without a degree—that really gives me a lift."

This is Jim Pieratt talking. With a high school education and Navy Technical training behind him, Jim holds a key job in one of America's most important electronic projects. He's an IBM Computer Units Field Engineer on Project SAGE.

Jim is 25, lean, crew-cut and soft-spoken. He smiles modestly when you ask him about his accomplishments. We were curious to know whether he had been technically inclined when he was a youngster.

"The truth is that I didn't become interested in electronics until I joined the Navy," says Jim. "Before that, the only technical thing I might have done was to take a couple of alarm clocks apart. I chose electronics in the Navy because I thought there was a future in it."

Change of attitude

"A lot of fellows may think, as I did, that a computer is too complicated for anybody but an Einstein to understand. It's not so. Even the largest computers like SAGE, which occupies space equivalent to a city block, can be comprehended by the ordinary man. But I didn't know this when I went for my employment interview—and I wondered if the algebra and trig I'd taken at Kalamazoo Central High would qualify me. Then my interviewer told me a little about computers . . . how they work and what my job would be after I finished IBM school. I made up my mind right then; I wanted this job."

Training school

Soon, Jim and 21 other fellows like himself started training in Kingston, New York, getting on real intimate terms with IBM's electronic giant. Marvel of complexity though it is, when it sits on the floor and you study it part by part, the computer loses its mystery. Little by little, you begin to understand the whole from the sum of the components.

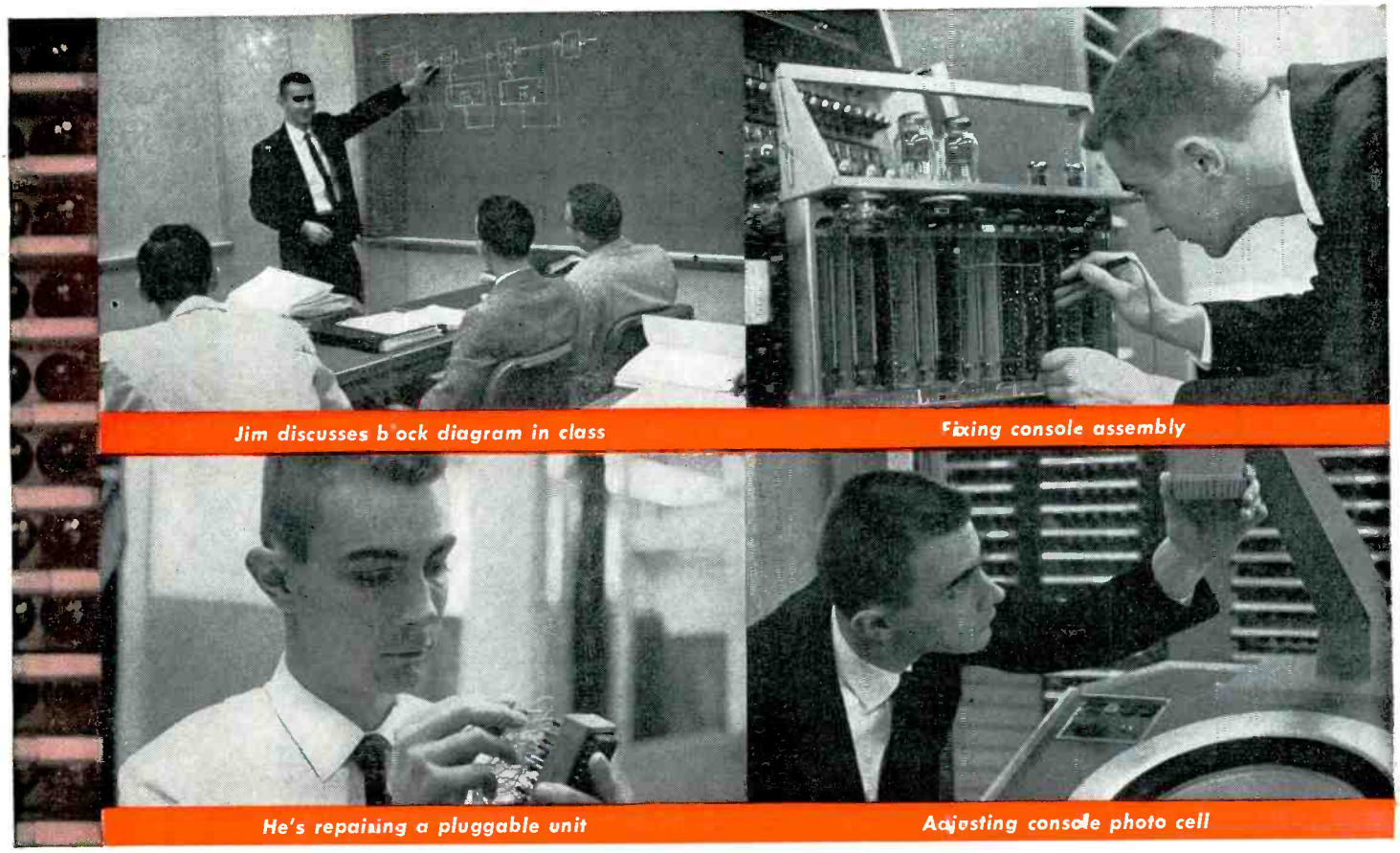
"The 25 weeks I spent in training were very happy," says Jim. "It's interesting all the way. They encourage you to think for yourself and you're rewarded for your effort. Field Engineers can merit salary increases based on school performance."

Strategic job on Project SAGE

Jim is stationed in Virginia, near Richmond. His duties include installing, checking and testing out computer units. The giant electronic computers are the very heart and mind of Project SAGE (Semi-Automatic Ground Environment). To the in-put section of the computer comes data from radar sites, ships, reconnaissance planes and ground observer posts throughout the country. The display consoles give a visual representation of the complete air defense situation. Jim's prime responsibility is to keep the display consoles running.

8 pleasant hours a day

"I'm essentially my own boss and I'm encouraged to think for myself. For me, this is an ideal environment.



Jim discusses block diagram in class

Fixing console assembly

He's repairing a pluggable unit

Adjusting console photo cell

. . without a degree?

What do I like best about my job? Trouble-shooting, I think. I enjoy being able to repair anything that isn't working properly. As a Field Engineer, I have opportunities to assume other engineering functions. For instance, while I have nothing to do with design engineering, I do suggest changes for review by the Design Engineers. I also rewrite engineering procedures."

Where do you go from here, Jim?

"There's plenty of room for me to grow at IBM. My next step up should be to Systems Engineer. This calls for more headwork. After that, if I display enough initiative, I may become a Group Supervisor."

Family, friends, recreation

Jim, his wife and three-year-old daughter live in a pleasant ranch home, just a few miles from the site. Social life? "We've made quite a few friends here," says Jim. "Mostly among the IBM fellows and their wives. We play golf together."

Where do you go from here?

Can you look ahead, as Jim Pieratt does, and see yourself as a man on the way up? Maybe you should give some thought to IBM Military Products and the Project SAGE program. Opportunities are greater than ever. IBM's long-range program will continue to grow in importance and vast sums will be invested in hiring the right men to accomplish its vital objectives.

If you have a minimum of 3 years' technical schooling—or equivalent experience—you may be eligible for advanced training for 5 months as a Computer Units Field Engineer. While training, you receive full pay plus living allowance before assignment to a permanent location. You are paid a salary, not hourly wages, plus overtime.

From then on, you can go as far as your abilities and ambition will take you. IBM is the leader in a field that offers you unlimited horizons. And, as you may already know, at IBM you receive company-paid benefits that set standards for industry today.

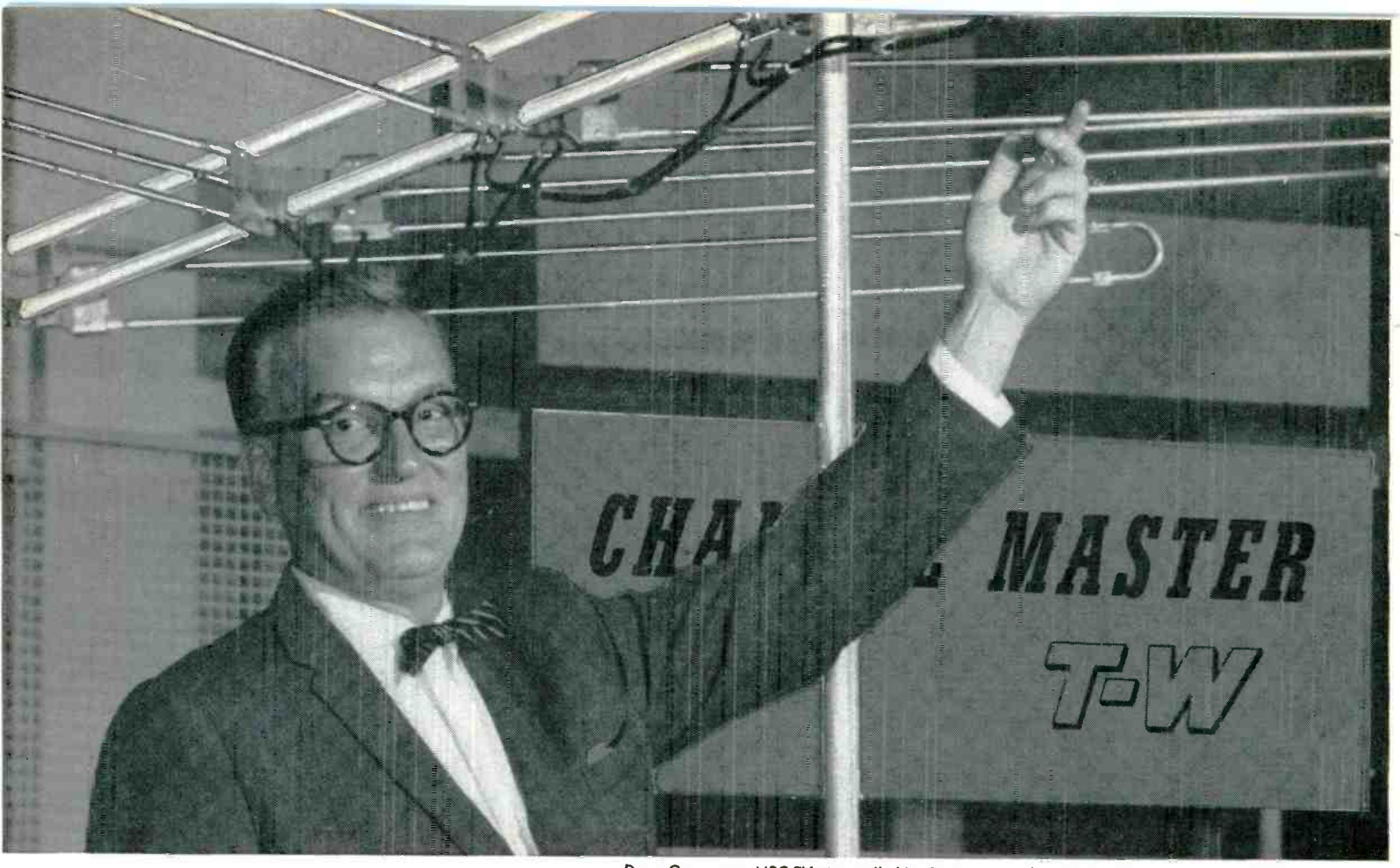
WRITE TODAY TO:

Mr. N. H. Heyer
Dept. No. 650A
Military Products Division
IBM Corp., Kingston, N. Y.

You'll get a prompt reply. Personal interviews arranged in all areas of the United States.

IBM®

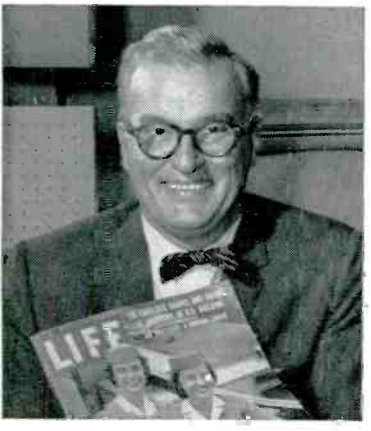
MILITARY PRODUCTS

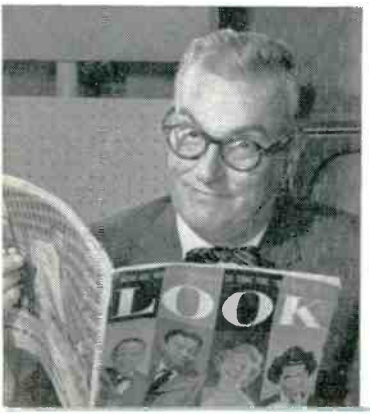


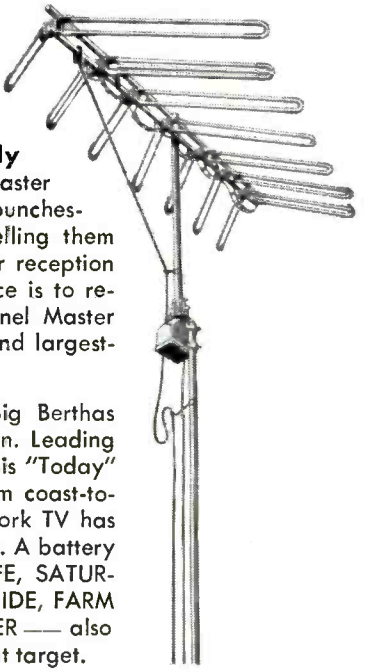
Dave Garroway, NBC-TV star, tells his viewers to replace their old antennas with T-W's.

Let Garroway show you

...how CHANNEL MASTER promotes antenna replacements on network TV, in national ads





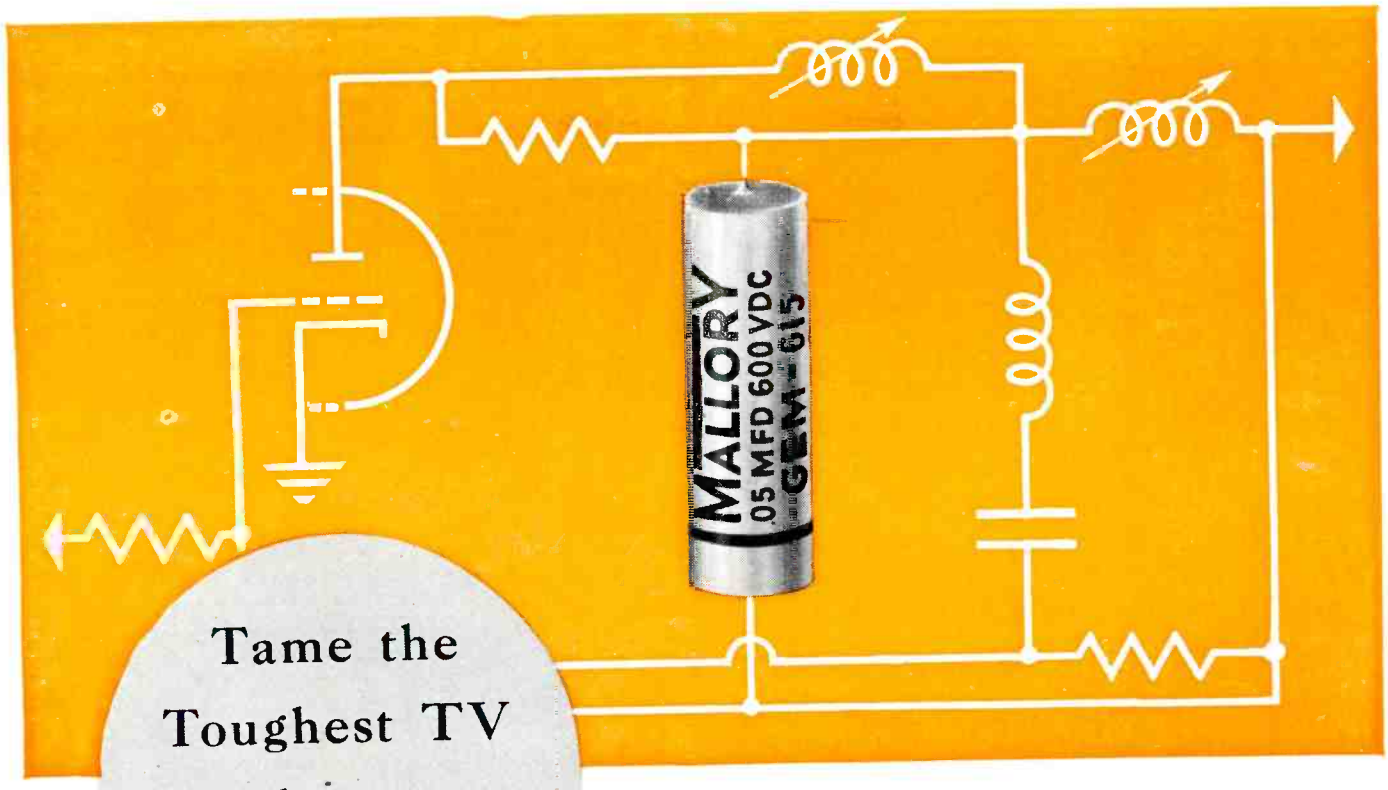


There are millions upon millions of over-aged, obsolete antennas in use today—providing weak TV reception for their owners. **These antennas must be replaced immediately**—and that's just what Channel Master has been telling the public in a no-punches-pulled ad campaign. We're also telling them that the best way to get good, clear reception and more years of peak performance is to replace their old antennas with Channel Master T-W's—the word's most powerful and largest-selling fringe area antennas.

We've wheeled advertising's Big Berthas onto the firing line for this campaign. Leading the barrage is Dave Garroway on his "Today" show, with 134 NBC-TV stations from coast-to-coast. This is the first time that network TV has ever been used to advertise antennas. A battery of 6 top consumer magazines—LIFE, SATURDAY EVENING POST, LOOK, TV GUIDE, FARM JOURNAL and PROGRESSIVE FARMER—also takes aim on the antenna replacement target.

CHANNEL MASTER CORP.

ELLENVILLE, NEW YORK

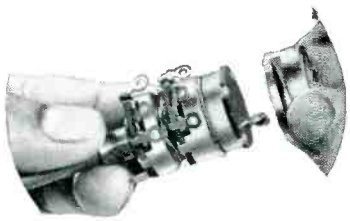


Tame the Toughest TV Replacement Spot with a . . . . Mallory Gem Capacitor

This circuit should be familiar—half of a 6SN7 serving as the horizontal oscillator in a typical TV receiver circuit. The marked spot in the diagram is a tough assignment for a capacitor. If it opens, you lose raster. If it changes capacity, or if the replacement is beyond tolerances, the horizontal sweep will not sync in.

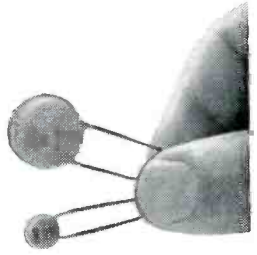
When replacing this capacitor, always use a Mallory Gem. It's moisture-proof—won't drift in capacity or internal resistance. Conservative voltage ratings guarantee reliability—in this, or any circuit. Get Gems today from your Mallory Distributor in the handy 5-pack.

FP Capacitors—the original 85°C filter



Sta-Lor Dual Controls—tailor-made in 30 seconds

Gold Label Vibrators—unequalled performance and life

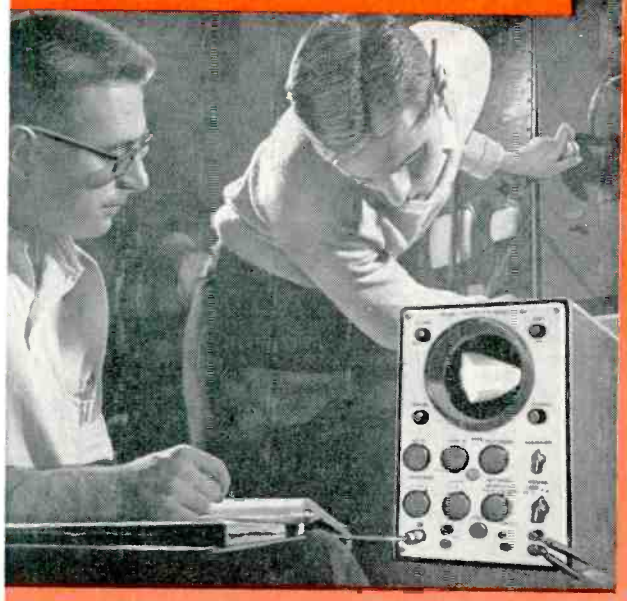


RMC Discaps—world's leading ceramic capacitors

Depend on Mallory components for service

P. R. MALLORY & CO. Inc.
MALLORY
P. R. MALLORY & CO. Inc., INDIANAPOLIS 6, INDIANA

RESIDENT SCHOOL COURSES



Industry needs Electronic Technicians!

Let RCA train you in Advanced Electronics

This is the college-level training you need to work with professional engineers on research, development or production projects in such fields as: automation, guided missiles, radar, television, computers and other advanced electronic applications

RCA Institutes Resident School in New York City offers this comprehensive course that prepares you for any field of electronics you may choose. Other courses in TV & General Electronics, Radio & TV Servicing, and Radio Telegraph Operating.

Classes start four times each year. Applications now being accepted. Approved for Veterans.

RCA INSTITUTES, INC.
SCHOOL OF TELEVISION
AND ELECTRONIC TECHNOLOGY
A Service of Radio Corporation of America

RCA INSTITUTES DEPT. RNR-19
350 W. Fourth St., N. Y. 14, N. Y.

Please send me your FREE catalog of Resident School courses in New York.

NAME .....
please print

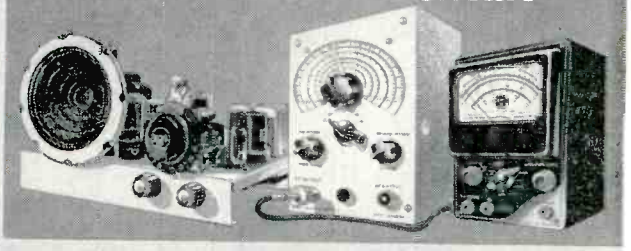
ADDRESS .....

CITY ..... ZONE .....

HOME STUDY COURSES

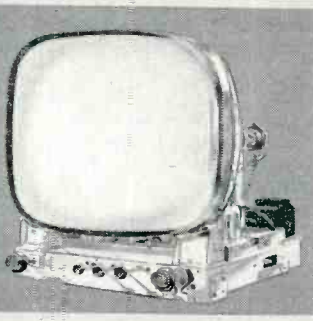
course I

Electronic Fundamentals



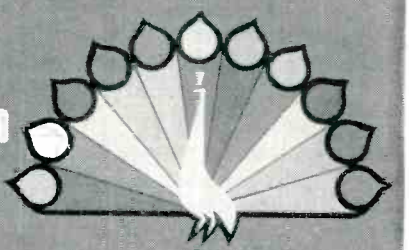
course II

Television Servicing



course III

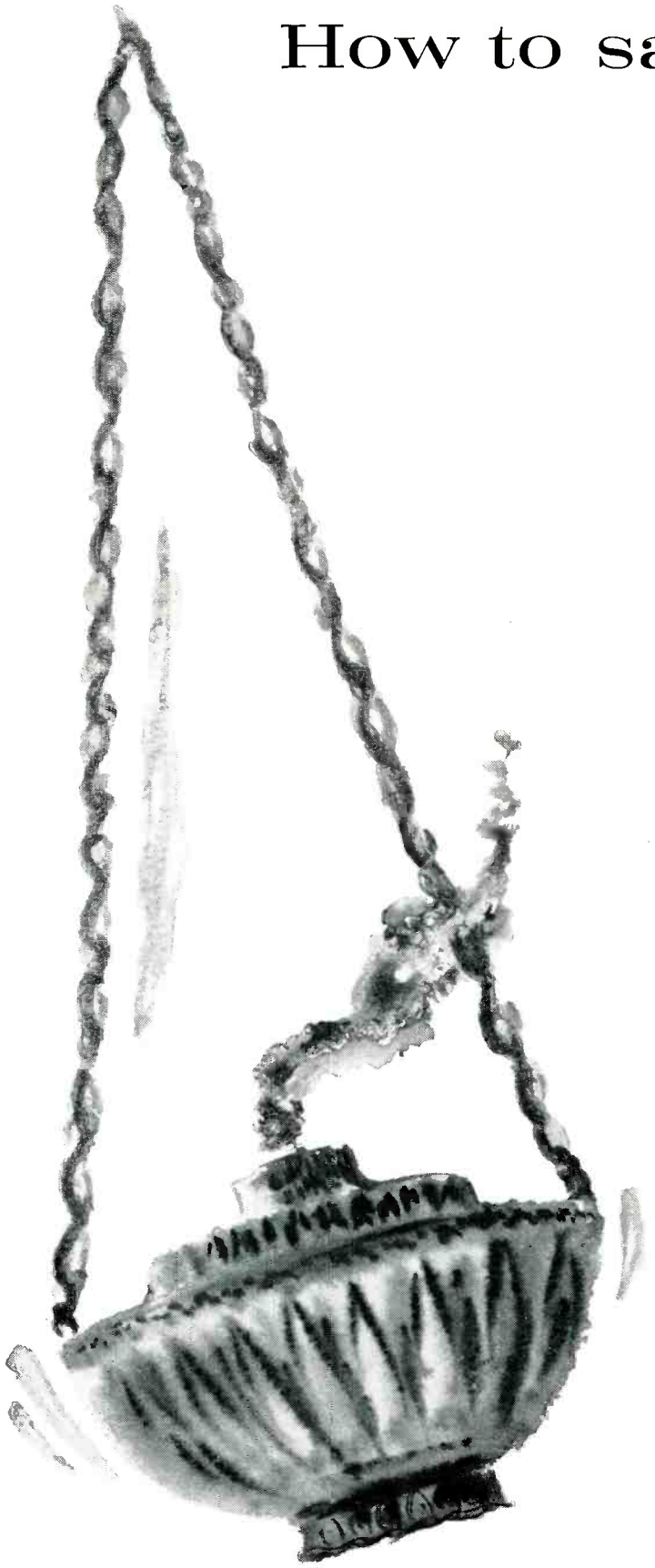
Color Television



RCA Institutes offers you the finest of Home Study training. The equipment illustrated and text material you get with each course is yours to keep. Practical work with very first lesson. Courses for the beginner and the advanced student. Pay-as-you-learn. You need pay for only one study group at a time.

Send for Our Complete Catalog FREE

How to save 77 years



The boy Galileo sat in the sanctuary of Pisa's great cathedral, observing the movement of a lamp which had been set swinging by a sudden gusty draft. The chain by which it was suspended from the high ceiling was of such a length that the arcs decreased but slowly. Strange thing, though. No matter how far the pendulum swung, its movement consumed the same time. Galileo made a note of that. The year was 1581.

The old man sat at his writing desk, sixty years and a thousand disputes later, writing down a new theory. The regularity of a swinging pendulum might be combined with a spring mechanism to improve the unreliable clocks of that day. So Galileo scribbled on, and did nothing more about it. A number of years after his death Huygens took the notes and invented the pendulum clock. *Seventy-seven years had elapsed since the boy made the observation upon which it was based!*

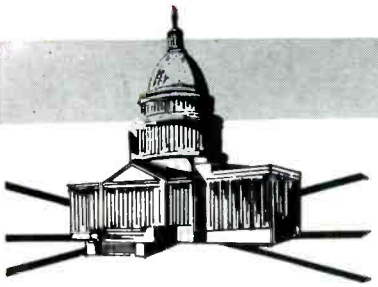
The creative thinker today still need not have a specific use in mind when, by equation or formula, he branches off from the accepted to the hitherto unknown. The classic invention of this decade, the transistor, evolved in the Bell Telephone Laboratories as scientists sought a deeper understanding of semiconductors. On the other hand, another great invention, the feedback amplifier, came from the acutely creative mind of one Bell engineer faced with a specific problem.

Current Bell Laboratories activities—in such areas as data transmission, radar and submarine cable development—call for the coordinated efforts of all types of thinkers and all types of approaches. One type complements another.

Today, seventy-seven years would not have elapsed between the swinging lamp and the swinging clock pendulum—certainly not at Bell Labs, where ideas, though not rushed, are carefully advanced toward fruitful application in national defense, industry and communications. An important part of this harvest is the efficiency of America's telephone service, unequalled anywhere else in the world.

BELL TELEPHONE LABORATORIES

WORLD CENTER OF COMMUNICATIONS RESEARCH AND DEVELOPMENT



Spot News

Latest Information on the Electronic Industry

By RADIO & TV NEWS' WASHINGTON EDITOR

TV TO JOIN TELESCOPES IN STRATOSPHERE BALLOON FLIGHTS--A new role for television in high-altitude astronomy is now being blueprinted by the National Science Foundation and the Office of Naval Research. The program calls for linking of a TV system to remote-controlled balloon-mounted 12 and 36-inch telescopes which will probe celestial objects 80,000 feet above the earth.

THREE-DIMENSION RADAR DEVELOPED FOR ARMY--A three-dimensional transistorized radar which detects airborne targets at extreme range and for the first time simultaneously computes distance, bearing, and altitude, has been announced by the Department of the Army. Called "Frescanar", the new technique, developed by the Hughes Aircraft Company, Fullerton, California, is the eye of a "missile monitor", an Army air defense guided-missile fire distribution system for mobile use with a field army. Citing five basic advantages of the system over conventional radars, Army spokesmen said that "Frescanar" concentrates all available power in sharp pencil beams of energy flashing on and off in fan-shaped array to pinpoint targets at great distance with extreme accuracy; uses a single antenna and operator--conventional systems need two or more radars, operators, and master consoles to achieve similar results; computes range, bearing, and altitude at the same time; provides greater speed--all three types of data (range, bearing, and altitude) are transmitted to missile batteries, helping them to direct missiles on targets more rapidly; and sees targets more clearly. For more information and pictures, refer to page 69.

NO PAY-TV APPLICATIONS FILED THUS FAR WITH COMMISSION--According to FCC Commissioner Robert T. Bartley no request for subscription TV service has as yet been received in Washington, and it appears as if the whole problem will have to be resolved by the Congressional committees now investigating the situation.

N. Y. INDUSTRIAL ELECTRONIC FIRMS CITED FOR LICENSE-INTERFERENCE VIOLATIONS--Two New York industrial electronic companies specializing in r. f. heating equipment have been ordered by the FCC to cease and desist from violating Part 18 of the rules by operating equipment which is neither licensed nor certified by a qualified engineer or the manufacturer and which is causing interference to TV and radio service in the New York City area.

CLOSED-CIRCUIT TV PROVIDES INSTRUCTION ON GUIDED MISSILES--Telecasting of a two-hour course on guided missiles over a 280-mile closed-circuit has been inaugurated from the U. S. Army Ordnance Guided Missile School at the Redstone Arsenal, Huntsville, Alabama, to the U. S. Army Armor School at Fort Knox, Kentucky. The courses deal with the maintenance of six Army missiles: Nike-Ajax, Nike-Hercules, Corporal, Lacross, Hawk, and the Redstone. Cameras have been set up to make pickups from five locations and provide images to screens that measure 6' by 8'.

STEREOPHONIC BROADCASTING UNDER STUDY BY FCC--The Commission has invited comments on the use of stereophonic techniques by TV, AM, and FM broadcasters. In the past, most test broadcasts have been by jointly operated AM and FM stations in the same locality reproducing the same program on their respective channels. Combination TV-AM or TV-FM broadcasts are now being demonstrated. Also a limited number of FM stations are experimenting, under a developmental authority granted by the Commission, with dual FM channel transmission--one on the regularly assigned channel and the other on a multiplex subchannel. In this system only one receiver is required but a special adapter is necessary to extract the sound from the multiplex subchannel.

-30-

You know, yourself, how comforting it is to see a familiar face among strangers. Well, to the majority of your customers, TV *is* strange, too. They don't understand it. They count on you to "keep 'em going". And, the "familiar face" is the famous RCA monogram. When they see it on that famous red/black carton, *they* know *you* know your business...and use the best replacement tubes and parts money can buy.

You can cash in on the built-in prestige of RCA. Make this best-known name your stock-in-trade. Your Authorized RCA Tube Distributor handles a complete line of RCA Tubes to meet your service needs.

RADIO CORPORATION OF AMERICA
Electron Tube Division *Harrison, N. J.*

STEREO AND MONAURAL

the experts say... in HI-FI the best buys are

EICO®

World-famous EICO advantages guarantee your complete satisfaction:

- Advanced engineering • Finest quality components
- "Beginner-Tested," easy step-by-step instructions
- LIFETIME service & calibration guarantee
- IN STOCK — Compare, then take home any EICO equipment—right "off the shelf"—from 1900 neighborhood EICO dealers.

Over 1 MILLION EICO instruments in use throughout the world.

NEW STEREOPHONIC EQUIPMENT

HF85: Stereo Dual Preamplifer is a complete stereo control system in "low silhouette" design adaptable to any type of installation. Selects, preamplifies, controls any stereo source—tape, discs, broadcasts. Superb variable crossover, feedback tone controls driven by feedback amplifier pairs in each channel. Distortion borders on unmeasurable even at high output levels. Separate lo-level input in each channel for mag. phono, tape head, mike. Separate hi-level inputs for AM & FM tuners & FM Multiplex. One each auxiliary A & B input in each channel. Independent level, bass & treble controls in each channel may be operated together with built-in clutch. Switched-in loudness compensator. Function Selector permits hearing each stereo channel individually, and reversing them; also use of unit for stereo or monophonic play. Full-wave rectifier tube power supply. 5-12AX7/ECC83, 1-6X4. Works with any 2 high-quality power amplifiers such as EICO, HF14, HF22, HF30, HF35, HF50, HF60. Kit **$39.95**. Wired **$64.95**. Includes cover.

HF81: Stereo Dual Amplifier-Preamplifier selects, amplifies & controls any stereo source – tape, discs, broadcasts—& feeds it thru self-contained dual 14W amplifiers to a pair of speakers. Monophonically: 28 watts for your speakers; complete stereo preamp. Ganged level controls, separate focus (balance) control, independent full-range bass & treble controls for each channel. Identical Williamson-type, push-pull EL84 power amplifiers, excellent output transformers. "Service Selector" switch permits one preamp-control section to drive the internal power amplifiers while other preamp-control section is left free to drive your existing external amplifier. Kit **$69.95**. Wired **$109.95**. Incl. cover.

MONAURAL PREAMPLIFIERS (stack 2 for Stereo)

NEW HF65: superb new design, Inputs for tape head, microphone, mag-phono cartridge & hi-level sources. IM distortion 0.04% @ 2V out. Attractive "low silhouette" design. **HF65A** Kit **$29.95**, Wired **$44.95**. **HF65** (with power supply) Kit **$33.95**. Wired **$49.95**.

HF61: "Rivals the most expensive preamps" — Marshall, AUDIOCRAFT. **HF61A** Kit **$24.95**, Wired **$37.95**, **HF61** (with power supply) Kit **$29.95**. Wired **$44.95**.

MONAURAL POWER AMPLIFIERS (use 2 for STEREO)

HF60: 60-Watt Ultra Linear Power Amplifier with Acro TO-330 Output Xfmr.; **"One of the best-performing amplifiers extant; an excellent buy."** AUDIOCRAFT Kit Report. Kit **$72.95**. Wired **$99.95**. Cover E-2 $4.50.

HF50: 50-Watt Ultra Linear Power Amplifier with extremely high quality Chicago Standard Output Transformer. Identical in every other respect to HF60, same specs at 50W. Kit **$57.95**. Wired **$87.95**. Cover E-2 $4.50.

NEW HF35: 35-Watt Ultra-Linear Power Amplifier. Kit **$47.95**. Wired **$72.95**. Cover E-2 $4.50.

HF30: 30-Watt Power Amplifier. Kit **$39.95**. Wired **$62.95**. Cover E-3 $3.95.

NEW HF22: 22-Watt Power Amplifier. Kit **$38.95**. Wired **$61.95**. Cover E-2 $4.50.

NEW HF14: 14-Watt Power Amplifier. Kit **$23.50**. Wired **$41.50**. Cover E-6 $4.50.

MONAURAL INTEGRATED AMPLIFIERS (use 2 for STEREO)

HF52: 50-Watt Integrated Amplifier with complete "front end" facilities & Chicago Standard Output Transformer. **"Excellent value"**—Hirsch-Houck Labs. Kit **$69.95**. Wired **$109.95**. Cover E-1 $4.50.

HF32: 30-Watt Integrated Amplifier. Kit **$57.95**. Wired **$89.95**. Both include cover.

HF20: 20-Watt Integrated Amplifier. "Well-engineered" — Stocklin, RADIO TV NEWS. Kit **$49.95**. Wired **$79.95**. Cover E-1 $4.50.

HF12: 12-Watt Integrated Amplifier. **"Packs a wallop"**—POP. ELECTRONICS. Kit **$34.95**. Wired **$57.95**.

SPEAKER SYSTEMS (use 2 for STEREO)

HFS2: Natural bass 30-200 cps via slot-loaded 12-ft. split conical bass horn. Middles & lower highs: front radiation from 8½" edge-damped cone. Distortionless spike-shaped super-tweeter radiates omni-directionally. Flat 45-20,000 cps, useful 30-40,000 cps. 16 ohms. HWD 36", 15¼", 11½". **"Eminently musical; would suggest unusual suitability for stereo."**—Holt, HIGH FIDELITY. Completely factory-built: Walnut or Mahogany. **$139.95**; Blonde, **$144.95**.

HFS1: Bookshelf Speaker System, complete with factory-built cabinet. Jensen 8" woofer, matching Jensen compression-driver exponential horn tweeter. Smooth clean bass; crisp extended highs. 70-12,000 cps range. Capacity 25 w. 8 ohms. HWD: 11" x 23" x 9". Wiring time 15 min. Price **$39.95**.

FM TUNER

HFT90: surpasses wired tuners up to 3X its cost. Prewired, pre-aligned, temperature-compensated "front end" — drift-free. Precision "eye-tronic" tuning. Sensitivity 1.5 uv for 20 db quieting — 6X that of other kit tuners. Response 20-20,000 cps ±1 db. K-follower & multiplex outputs. **"One of the best buys you can get in high fidelity kits."** — AUDIOCRAFT KIT REPORT. Kit **$39.95***. Wired **$65.95***. Cover $3.95.

BEFORE YOU BUY, COMPARE:

You may examine the complete EICO line at any of 1900 neighborhood EICO distributors coast to coast. Compare critically with equipment several times the EICO cost—then you judge. You'll see why the experts recommend EICO, kit or wired, as your best buy.

EICO, 33-00 NORTHERN BLVD., L. I. C. 1, N. Y.
Fill out coupon on other side for FREE CATALOG

Add 5% in the West.

* LESS COVER, F. E. T. INCL.

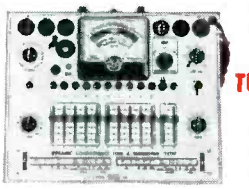
the specs prove it . . your BEST BUY is EICO®

for COLOR & Monochrome TV servicing

FREE CATALOG

shows you HOW TO SAVE 50% on 50 models of top quality professional test equipment.

MAIL COUPON NOW!

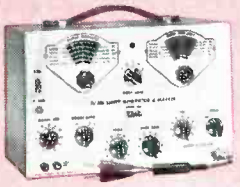


NEW! DYNAMIC CONDUCTANCE TUBE & TRANSISTOR TESTER #666

KIT $69.95 WIRED $109.95

COMPLETE with steel cover and handle.

SPEED, ease, unexcelled accuracy & thoroughness. **Tests all receiving tubes** (and picture tubes with adapter). **Composite indication of Gm, Gp & peak emission. Simultaneous sel of any 1 of 4 combinations** of 3 plate voltages, 3 screen voltages, 3 ranges of continuously variable grid voltage (with 5% accurate pot). **New series-string voltages:** for 600, 450, 300 ma types. **Sensitive** 200 ua meter. **5 ranges meter sensitivity** (1% shunts & 5% pot). **10 SIX-position lever switches:** freepoint connection of each tube pin. **10 pushbuttons: rapid** insert of any tube element in leakage test circuit & speedy sel. of individual sections of multi-section tubes in merit tests. **Direct-reading** of inter-element leakage **in ohms. New gear-driven rollchart. Checks n-p-n & p-n-p transistors:** separate meter readings of **collector leakage current & Beta** using internal dc power supply. Deep-etched satin aluminum panel; rugged grey wrinkle steel cabinet. **CRA Adapter $4.50**



NEW! TV-FM SWEEP GENERATOR & MARKER #368

KIT $69.95 WIRED $119.95

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

COLOR and Monochrome DC to 5 MC LAB & TV 5" OSCILLOSCOPE #460

KIT $79.95 WIRED $129.50

• Features DC Amplifiers!

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

5" PUSH-PULL Oscilloscope #425: Kit $44.95, Wired $79.95.
7" PUSH-PULL Oscilloscope #470: Kit $79.95, Wired $129.50.

NEW! RF SIGNAL GENERATOR #324

KIT $26.95 WIRED $39.95

150 kc to 435 mc with ONE generator! Better value than generators selling at 2 or 3 times its cost! Ideal for IF-RF alignment, signal tracing & trouble-shooting of TV, FM, AM sets; marker gen.; 400 cps audio testing; lab. work. **6 fund. ranges: 150-400 kc, 400-1200 kc, 1.2-3.5 mc, 3.5-11 mc, 11-37 mc, 37-145 mc; 1 harmonic band 111-435 mc. Freq. accurate to ±1.5%;** 6:1 vernier tuning & excellent spread at most important alignment freqs. **Etched tuning dial,** plexiglass windows, **edge-lit hairlines.** Colpitts RF osc. **directly plate-modulated by K-follower** for improved mod. **Variable depth of int. mod. 0-50%** by 400 cps Colpitts osc. **Variable gain ext. amplifier:** only 3.0 v needed for 30% mod. **Turret-mounted coils slug-tuned** for max. accuracy. Fine & Coarse (3-step) RF attenuators. RF output 100,000 uv; AF sine wave output to 10 v. 50-ohm output Z. 5-way jack-top binding posts for AF in/out; coaxial connector & shielded cable for RF out. 12AU7, 12AV7, selenium rectifier; xmfr-operated. Deep-etched satin aluminum panel; rugged grey wrinkle steel cabinet.

NEW! PEAK-to-PEAK VTVM #232 & UNI-PROBE (pat. pend.)

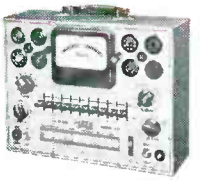
KIT $29.95 WIRED $49.95

Half-turn of probe tip selects DC or AC-Ohms.

Uni-Probe — exclusive with EICO — only 1 probe performs all functions!

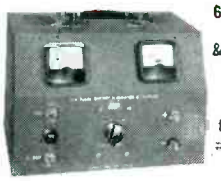
Latest circuitry, high sensitivity & precision, wide ranges & versatility. **Calibration without removing from cabinet.** New balanced bridge circuit. High Z input for negligible loading. 4½" meter, can't burn-out circuit. **7 non-skip ranges on every function.** 4 functions: +DC Volts, −DC Volts, AC Volts, Ohms. Uniform 3 to 1 scale ratio for extreme wide-range accuracy. **Zero center.** One zero-adj. for all functions & ranges. **1% precision** ceramic multiplier resistors. Measure **directly** peak-to-peak voltage of complex & sine waves: 0-4, 14, 42, 140, 420, 1400, 4200. DC/RMS sine volts: 0-1.5, 5, 15, 50, 150, 500, 1500 (up to 30,000 v with HVP probe & 250 mc with PRF probe). Ohms: 0.2 ohms to 1000 megs. 12AU7, 6AL5, selenium rectifier; xfmr-operated. Deep-etched satin aluminum panel, rugged grey wrinkle steel cabinet.

New!
Series/Parallel
R-C COMBINATION BOX #1140
KIT $13.95
WIRED $19.95



TUBE TESTER #625
KIT $34.95
Wired $49.95
- tests 600 mil series string type tubes
- illuminated roll-chart

Pix Tube Test Adapter $4.50



6V & 12V BATTERY ELIMINATOR & CHARGER #1050
KIT $29.95
WIRED $38.95
Extra-filtered for transistor equipt.
#1060 KIT $38.95
WIRED $47.95

New!
Miniaturized
MULTI-SIGNAL TRACER #145A
KIT $19.95
WIRED $28.95

20,000 Ohms/Volt V-O-M #565
KIT 24.95
Wired $29.95

1000 Ohms/Volt V-O-M #536
KIT $12.90
Wired $14.90

Reads 0.5 ohms −500 megs, 10 mmfd−5000 mfd, power factor.
KIT $19.95
Wired $29.95

R-C BRIDGE & R-C-L COMPARATOR #950B

VTVM PROBES	KIT	Wired
Peak-to-Peak	$4.95	$6.95
RF	$3.75	$4.95
High Voltage Probe-1		$6.95
High Voltage Probe-2		$4.95
SCOPE PROBES		
Demodulator	$3.75	$5.75
Direct	$2.75	$3.95
Low Capacity	$3.75	$5.75

TURN PAGE FOR MORE EICO VALUES

Prices 5% higher on West Coast.

EICO® L.I.C. 1, N.Y.

Send for FREE CATALOG now

EICO, 33-00 Northern Blvd., L.I.C. 1, N. Y. R-1

Show me HOW TO SAVE 50% on ☐ Test Instruments ☐ Hi-Fi ☐ Ham Gear. Send me FREE Catalog, name of neighborhood dealer.

Name.....

Address.....

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

By **DAVID SASLAW**
Amperex Electronic Co.

INDUSTRIAL TUBES & THEIR USES

The growing industrial electronics field relies on special electron tubes designed to do special jobs.

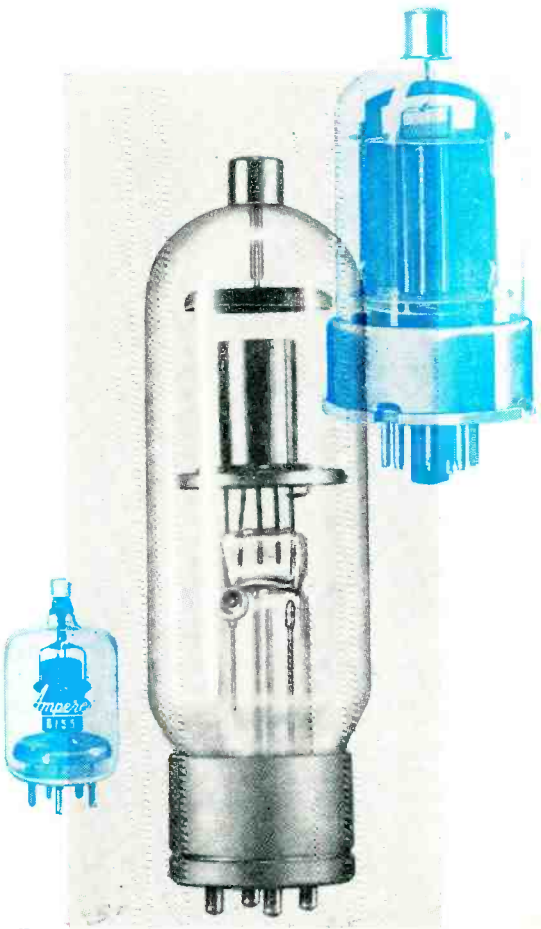
NOWADAYS the magic words in the electronics industry are "transistor" and "micro-miniaturization." Mere mention of these words induces visions of miniature components going into miniature equipment having miniature power requirements. However, this is only part of the picture; a more detailed examination of the industry reveals a strong upsurge in the use of large electron tubes which go into massive industrial equipment having correspondingly high power requirements.

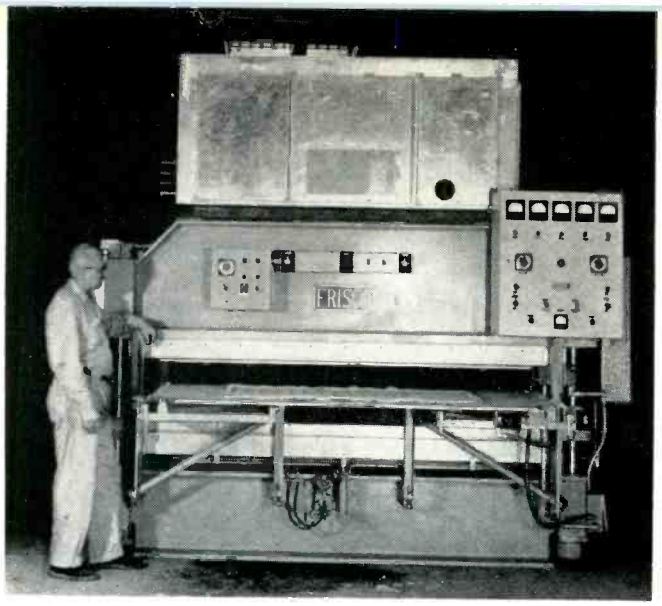
At first glance it is hard to understand how these apparently contradictory trends could be part of the same picture. The connection becomes clear only when we realize that the large tubes are an essential part of the production machinery used to produce transistors. In truth the transistor could not have been developed to its present state if it had not been for the prior development of large industrial tubes.

For instance, one of the obstacles which faced the would-be transistor manufacturer was to produce, in quantity, germanium crystals pure to within a few parts in a billion. It was not until specialized induction heating equipment was developed that large scale crystal growing became a reality. In turn, the induction heating equipment could not be developed until suitable industrial tubes were available.

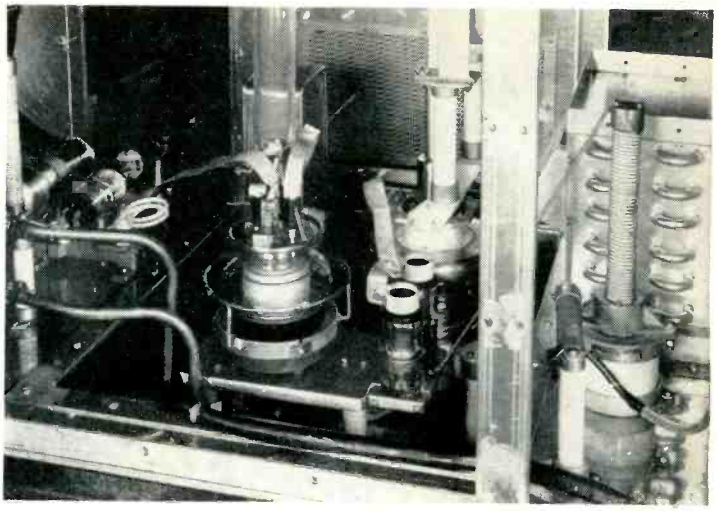
Let us not forget, however, that these advances in industrial electronics are relatively recent. Despite this the electronics industry has done a tremendous amount to further automation technology by developing tubes and circuits to control production machinery and also by developing tubes and circuits to increase the efficiency of the industrial processes. In fact, it is through processes such as induction and dielectric heating and ultrasonics that the extent of the upsurge in the use of large tubes can be measured. For example, in the case of the ultrasonics industry, commercial volume in 1957 exceeded about $25,000,000, up from practically nothing several years earlier. It is predicted that within a few years sales may top $100,000,000. As for induction and dielectric heating, the volume of industrial equipment sales has increased from about $185,000,000 in 1954 to over $300,000,000 in 1957.

This rapid growth, in conjunction with its relative newness, makes the field of electronics of special interest to the technician. Although most of the present equipment is serviced by the manufacturer, the trend is away from this type of arrangement and towards servicing by individual companies within the neighboring area. This is one place where the independent TV and radio technician, if he is alert, could find additional business income. To succeed he must understand the general scope of the field, the types of tubes and where they are used, and





Laminating press ready to bond inside panel of automobile door.



Oscillator for large dielectric-heating plastic laminating press.

be able to identify the different types of equipment.

What Is an Industrial Tube?

Before going into the specific uses of high-frequency energy, we should get some idea of what an industrial tube is. After all, the tube is really the heart of industrial high-frequency equipment. In reality there are two operating conditions which clearly separate the industrial tube from other similarly rated tubes. These are: 1. The industrial tube works into loads which vary widely in impedance. 2. The industrial environment includes constant vibration plus large intermittent shocks.

In the early development stages of high-frequency equipment, communications tubes were used because they were immediately available and nominally satisfied the frequency and power requirements. However, it soon became obvious that many of these tubes wouldn't hold up in industrial service. The first approach to solving the problem involved decreasing the length of the tube elements to improve mechanical strength. This still didn't do it. The problem wasn't fully solved until the tubes were designed to withstand overloads on the anode and grid caused by the varying load impedances. It was at this point that industrial tubes became really different from communications tubes. Massive graphite anodes were incorporated in the radiation-cooled tubes and very heavy copper anodes in water—or forced-air-cooled tubes. Naturally the grids were made proportionately heavier too. The result is that for an equivalent power and frequency rating, the industrial tube is larger and more rugged than the communications tube. Table 1 lists some r.f. oscillator triodes and mercury vapor rectifiers used in various industrial applications.

Of all the applications of industrial electronics, induction and dielectric heating, and ultrasonics represent the greatest potential to the technician—they are new enough for him to get in on the "ground floor." In addition, circumstance is working in his favor since all three fields use similar high-frequency generators to power their working elements. By becoming familiar with the type of generator used in one field, a good insight is gained about the generators used in the other two.

Electronic generators are built with outputs ranging from a fraction of a kilowatt to several hundred kilowatts. However, no matter what the power output, the generator always contains both a rectifier and an oscillator section. Mercury vapor tubes are usually used in the rectifier section to provide the high-voltage d.c. used by the oscillator. The oscillator tube, in a suitable circuit, produces the required high-frequency energy.

Most industrial oscillator circuits are adaptations of the Colpitts and Hartley

Table 1. R.f. oscillator and mercury vapor rectifier tubes are listed here along with some of their applications.

TUBE TYPE	PLATE POWER OUTPUT (watts)	FREQUENCY* (mcs)	APPLICATION			
			Induction Heating	Dielectric Heating	Ultrasonics	Power Rectifier
833A	1600	30	X			
866AX	—	—				X
872A	—	—				X
5771	40000	25	X	X		
5868/AX9902	1690	100	X	X	X	
6146	70	60			X	
6155/4-125A	375	120			X	
6156/4-250A	1000	75			X	
6693	—	—				X
6800	33000	22.5	X	X		
6961	6000	50	X	X		
7092	2720	50	X		X	
7237	6000	50	X	X		

*Higher frequency operation possible at reduced power output.

circuits shown in Fig. 2. These circuits are essentially class C amplifiers in which part of the output power is fed back to the input to create the drive. The output power is coupled to the load by either inductive or capacitive action. The inductive coupling is achieved by making the work coil part of the output tank circuit. Capacitive coupling is accomplished by using a portion of the voltage across the tank circuit to develop an electrostatic field in the load.

In general, industrial oscillator circuits are extremely simple to service although the high energy used does create special problems. The main difficulty for the technician will be his lack of familiarity with the effects of varying load impedances. This is of special significance because the variations are very large; as much as 50% from the beginning of an operating cycle to the end.

Induction Heating

As early as 1900, attempts were made to heat metals by inducing currents in them through the medium of a magnetic field. Many of these attempts were successful, but because of technical difficulties, the process remained essentially a laboratory phenomenon. In the period from 1930-1940, advances in radio engineering laid the groundwork which made it possible for induction heating to come out of the laboratory. The high-frequency, high-energy radio tubes developed during this period were not actually successful for industrial applications, but the differences involved ruggedness rather than basic design. It didn't take long for the tube designers to make the required changes and for industry to find still more applications for the new tubes.

Before going into the applications, we should get some idea of how induction heating works. The process basically consists of inducing current in the work piece by placing it in a varying magnetic field. The induced current acts the same as any other current to produce heat as a simple I^2R function. In non-magnetic materials eddy current losses do the heating while in magnetic materials it is a combination of eddy current and magnetic hysteresis losses. Both these quantities are affected by frequency, but hysteresis losses vary directly with frequency while eddy losses increase as the square of frequency. Since induction heating generators usually operate at fairly high frequencies, the hysteresis losses become insignificant in relation to the eddy current losses. Also, because eddy current losses increase as the square of frequency, it might be assumed that the heating action would increase by the same ratio. Unfortunately, this is only true at the lower frequencies. Table 2 indicates the power and frequency range usually used in induction and dielectric heating and ultrasonics.

An additional effect of frequency is that the depth of current penetration

COVER STORY

AUTOMATION, and the role played by the electronics industry in achieving it, has been in the news so much of recent years that another story about it hardly creates much interest. On the other hand, a story about the continuing need for hand craftsmanship by an electron tube manufacturer, presumably a prime mover in the trend towards automation, is both interesting and newsworthy. The cover picture illustrates just such a situation at the plant of Amperex Electronics Co., Hicksville, Long Island.

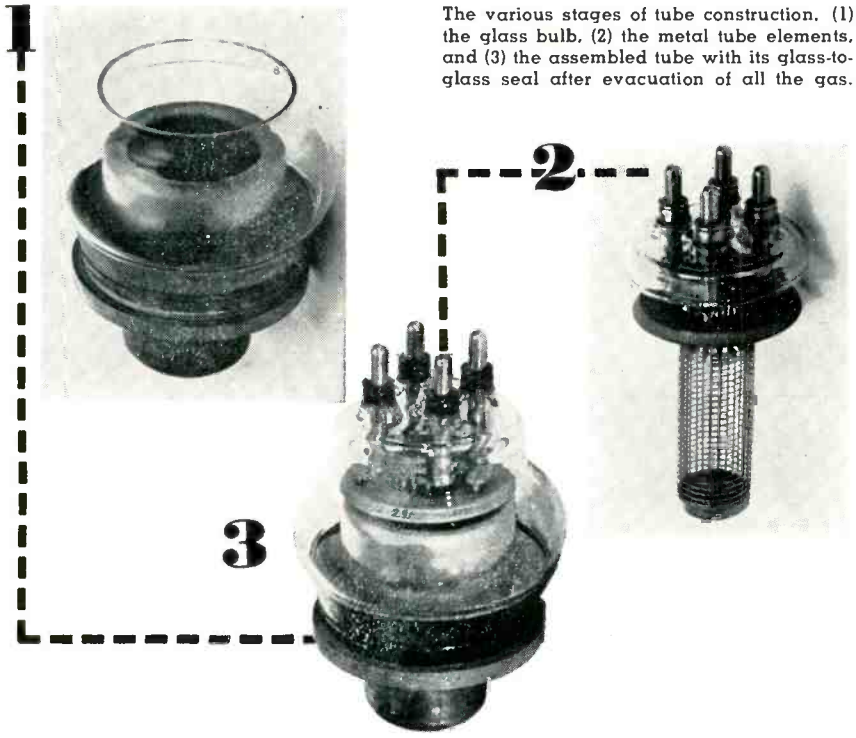
The intricately contoured glass bulbs of many large electron tubes are still shaped by essentially the same methods used in the early days of tube production; that is, by means of hand-held tools manipulated by a skilled operator. The cover photo shows a craftsman shaping the bulb of a modern industrial triode, Amperex Type 5771, using only the paddle in his left hand. He presses the paddle against the flame-softened glass, slowly changing the contours until the desired shape is reached. Working as fast as the process will allow, it takes him fully 20 minutes to shape each 5771. Rotating at the same speed as the envelope are the tube's elements at the right. Our photographer's photoflash and fast shutter speed "froze" the rotation.

Examination of the finished tube leaves no doubt that a great deal of skill is required to produce its complex shape with precision and speed. But skill is not enough; there are so many differently shaped tubes made today that wide experience is also necessary. For example, Tom Fagan, the operator shown in the cover photo, has been shaping glass at Amperex for more than 20 years. In addition, his crew (Tom is the foreman) averages 10 years' experience per man. This heavy concentration of experience is no accident however, it clearly indicates the high calibre of craftsman needed for this job.

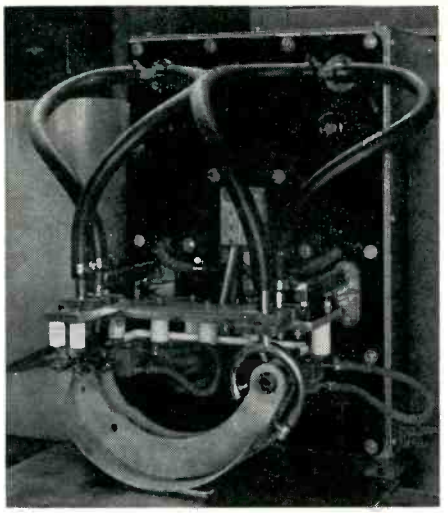
Turning the process back a few steps, we discover that the bulb started out as an ordinary cylinder of glass. In order to shape the glass it must be heated until it is plastic; soft enough to model with a paddle and yet firm enough to retain its imparted shape. The glass is a special composition (Corning Type 705) designed to facilitate metal-to-glass seals.

After being shaped, the bulb is joined to the mount assembly by a glass-to-glass seal, the operator again exercising his skill to make the joint "electrically invisible" (at radio frequencies heated glass becomes a conductor thus raising the possibility of bulb failure in areas of varying thickness due to localized heating). The next step is to evacuate all gas from the tube. A multiple-stage vacuum pump removes gas from the bulb while an induction heater frees any gas trapped in the metal tube elements. When the vacuum reaches 10^{-7} mm. of mercury, the tube is sealed. Finally the completed tube is tested and inspected thoroughly to insure high quality. The completed tube is a high-power triode and is used as an r.f. oscillator in induction and dielectric heating equipment and in radio transmitters. It operates in the frequency range from 2-25 mc. at a plate power output of 40 kilowatts. It sells for $600.00.

(Cover photo by Dave Henderson)



The various stages of tube construction. (1) the glass bulb, (2) the metal tube elements, and (3) the assembled tube with its glass-to-glass seal after evacuation of all the gas.



Automotive brake shoes being induction welded in unit shown directly above.

Fully assembled parking meter is being cleaned in the ultrasonic bath at the left.

decreases as the frequency increases. Another way of looking at this is that the heating can be confined to the surface by choosing the appropriate frequency.

Now let us examine the applications. These can be divided into three categories; processing, joining, and melting of metals. (Non-metals can be heated too, but the amount actually processed this way is so small that it can be ignored.) Metal processing includes surface hardening, annealing, drawing and normalizing; metal joining includes welding, brazing, and soldering; and metal melting includes growing extremely pure crystals (like the germanium crystals mentioned before) and refining the special ores required.

By examining these applications we can draw some conclusions about the type of generator needed for each category. In metal processing only the surface is heated. This requires relatively high frequencies, the exact frequency depending upon the penetration required. See Fig. 1. On the other hand, the amount of power required depends on both the depth of penetration and the material. For instance to case harden steel shafts 1⅛ inch in diameter, to a depth of 0.030 inch requires a 25 kilowatt generator.

The power required for metal joining is roughly the same as for processing (see Table 3), but the operating frequency may be higher. For instance, frequencies up to 3 megacycles are used to seam-weld copper tubing. The power needed for metal melting varies widely from much greater than to about the same as the other areas. The much greater power is explained by the large mass of metal normally melted in an induction furnace. However, a recent application such as the zone refining (crystal growing) of silicon for transistors requires only a 10 kilowatt generator operating at 4 megacycles.

In general, then, it can be said that most induction heating generators operate in the frequency range from 10 to 500 kilocycles with some new applications going up to 4 megacycles. Also the most commonly used size is 25 kilowatts, although there are applications which require up to 1200 kilowatts.

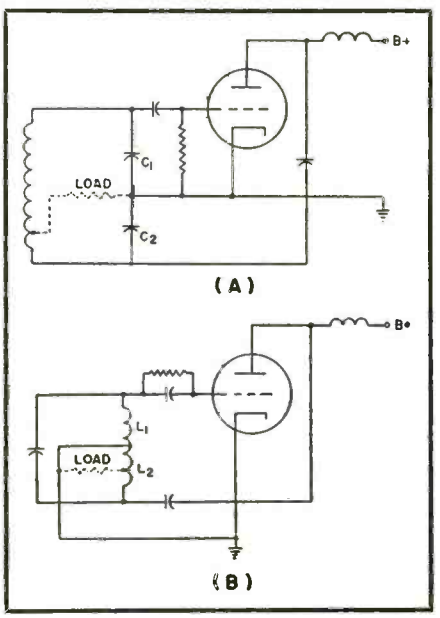
Dielectric Heating

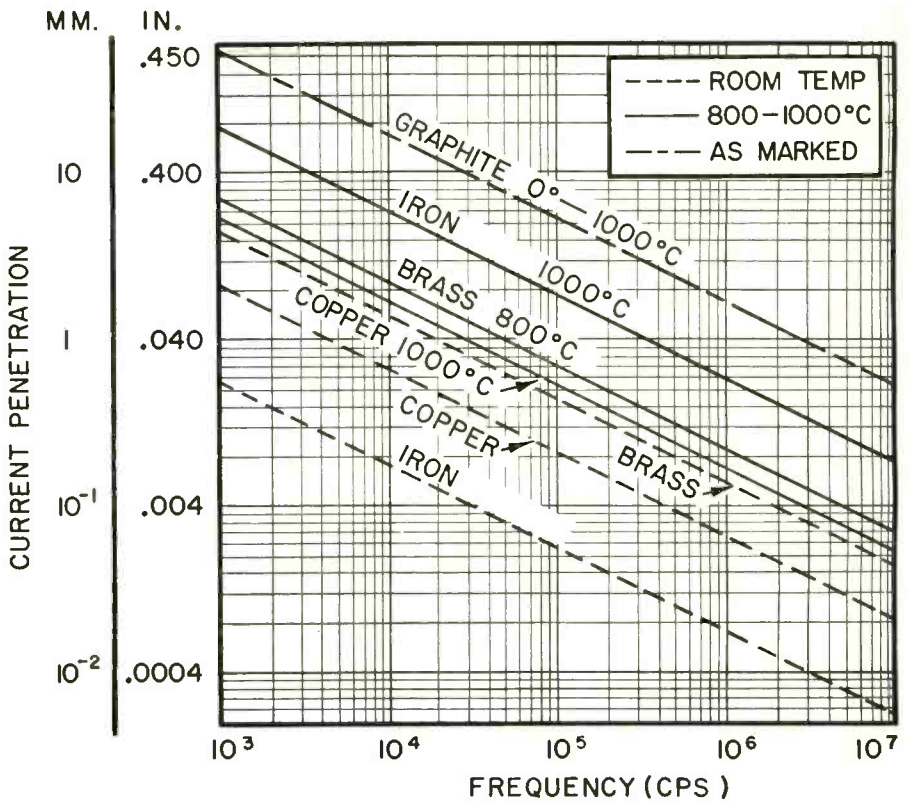
Dielectric heating, like induction heating, is also a by-product of the

(*Continued on page* 98)

Fig. 1. Current penetration for common → materials at various applied frequencies.

↓ Fig. 2. Basic Colpitts (A) and Hartley (B) oscillator circuits. Refer to text.





A Compact, Low-Ripple Radio Battery Eliminator

Simple power supply replaces "A" and "B" batteries without introducing hum.

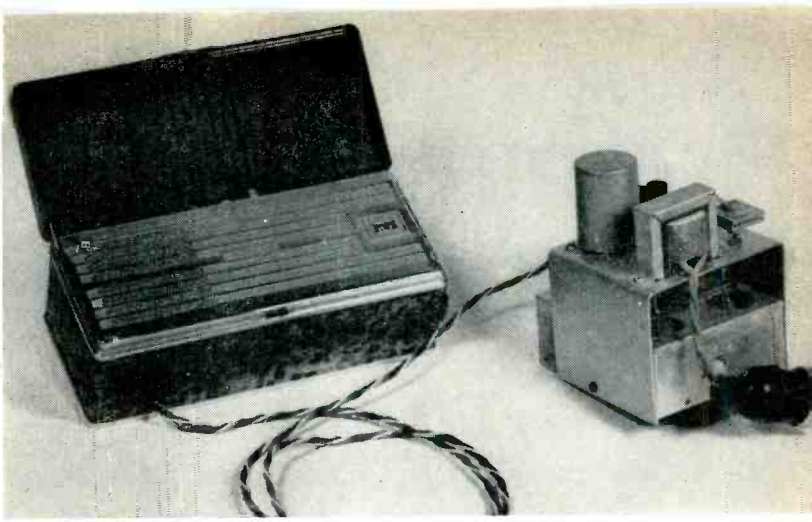


Fig. 1. The portable connected to its a.c.-powered pack.

By **WILLIAM V. LOEBENSTEIN**

AS LONG as there are battery-operated radios there will always be a certain species of individual who will not rest until he has successfully eliminated the batteries. The reason the job isn't easy is because of the high degree of filtering that must be attained in order to eliminate hum caused by line frequency. Doing away with the "B" battery is relatively easy. The current drain is small and normal *RC* filtering is adequate with a conventional power supply. The real problem arises in trying to eliminate the "A" battery because the current is relatively high and the filaments through which it flows serve also as the cathodes, which are extremely sensitive to hum. A filter of the conventional *LC* or *RC* design, with sufficiently low ripple voltage to be acceptable, would be prohibitively expensive and quite bulky, to say the least. An extremely versatile network and one which is all too often overlooked is the parallel-T filter. It fits the bill perfectly in this application.

Electrifying the battery radio could have been accomplished by rewiring the tube sockets and replacing the tubes with others of similar characteristics but with indirectly heated cathodes. One excellent example which the author has seen described utilizes a very satisfactory arrangement in that there is no need for a separate a.c.-operated power-supply chassis. In the present instance an auxiliary chassis is required for the composite power supply, as shown in Fig. 1. A distinct advantage, however, is the fact that the radio itself has not been modified in any way. In other words, while its versatility has been increased through complete electrification, the power pack can be disconnected and the batteries re-installed in less than two minutes!

The set for which the power supply was designed is an *RCA* Model BP-10 "Personal Radio" powered by one 67½ volt *Minimax* "B" battery and one 1½ volt flashlight-type "A" battery. Its tube complement consists of a 1R5, a 1T4, a 1S5, and a 1S4. By placing a milliammeter in series with each battery, in turn, the current requirement was found to be 9 to 10 ma. for the "B" battery and about ¼ ampere for the "A" battery. (These quantities could have been estimated from the average characteristics of the tubes. This is less reliable than the actual measurement, however, as any experimenter will agree.) Ohm's Law can now be used to replace the radio by two dummy loads until the power supply has been constructed. The example for the case at hand is: 67.5 / 0.0095 = 7000 ohms dummy load for the "B" supply and 1.5 / 0.25 = 6.0 ohms for the "A" load.

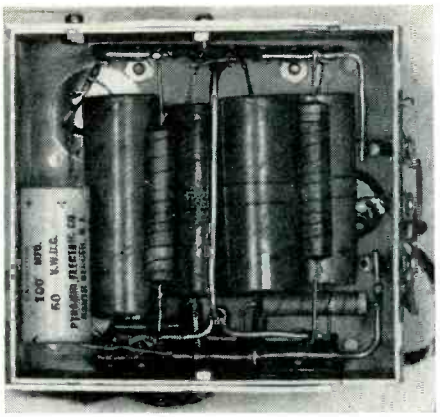
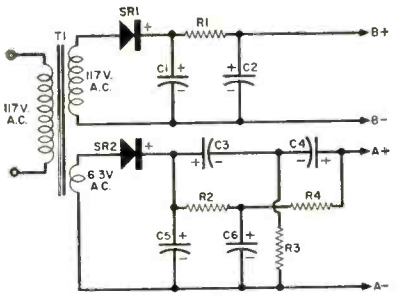


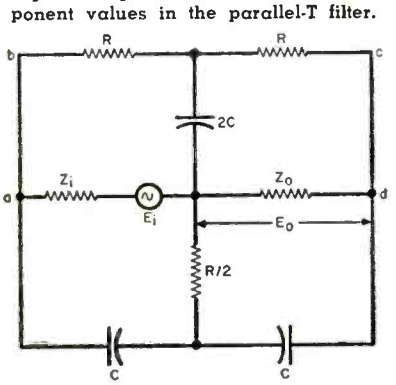
Fig. 2. Bottom view of power supply.



R_1—9000 ohm, 10 w. wirewound res.
R_2, R_3—4½ ohm, 10 w. wirewound res. (see text)
R_4—2¼ ohm, 10 w. wirewound res. (see text)
C_1-C_2—40/40 μfd., 150 v. elec. capacitor
C_3, C_4—500 μfd., 15 v. elec. capacitor
C_5—100 μfd., 50 v. elec. capacitor
C_6—1000 μfd., 15 v. elec. capacitor
T_1—Power trans. 117 v. @ 30 ma.; 6.3 v. @ .6 amp.
SR_1—65 ma. selenium rectifier
SR_2—250 ma. selenium rectifier (modified, see text)

Fig. 3. Schematic of the eliminator.

Fig. 4. Diagram for determining component values in the parallel-T filter.



Construction of "B" Supply

The "B" supply is shown mounted on the top deck of the chassis in Fig. 1. It is a conventional half-wave rectifier consisting of an isolating transformer, selenium diode, and a single pi-section *RC* filter. The final step in completing the "B" supply is the choice of a suitable dropping resistor to place in the filter circuit. Again Ohm's Law came to the rescue. The capacitor-input filter would charge to peak if it weren't for the internal impedance of the rectifier. Peak voltage is equal to the transformer high-voltage secondary multiplied by $\sqrt{2}$ or about 165 volts. The internal impedance of the 65 ma. selenium rectifier is about 500 ohms (assumed to be all resistive). The total resistance of the circuit is equal to the sum of the load resistance, the internal impedance, and the unknown filter resistance R. Remembering that the current is about 10 ma., we have:

$$7000 + 500 + R = 165 / 0.01$$

or:

$$R = 9000 \text{ ohms}$$

Therefore, a resistance of this value was used and found to be about right.

Parallel-T Filter

Before continuing with the "A" supply, it would be well to consider the basic circuit of the parallel-T filter. A comprehensive solution for the general

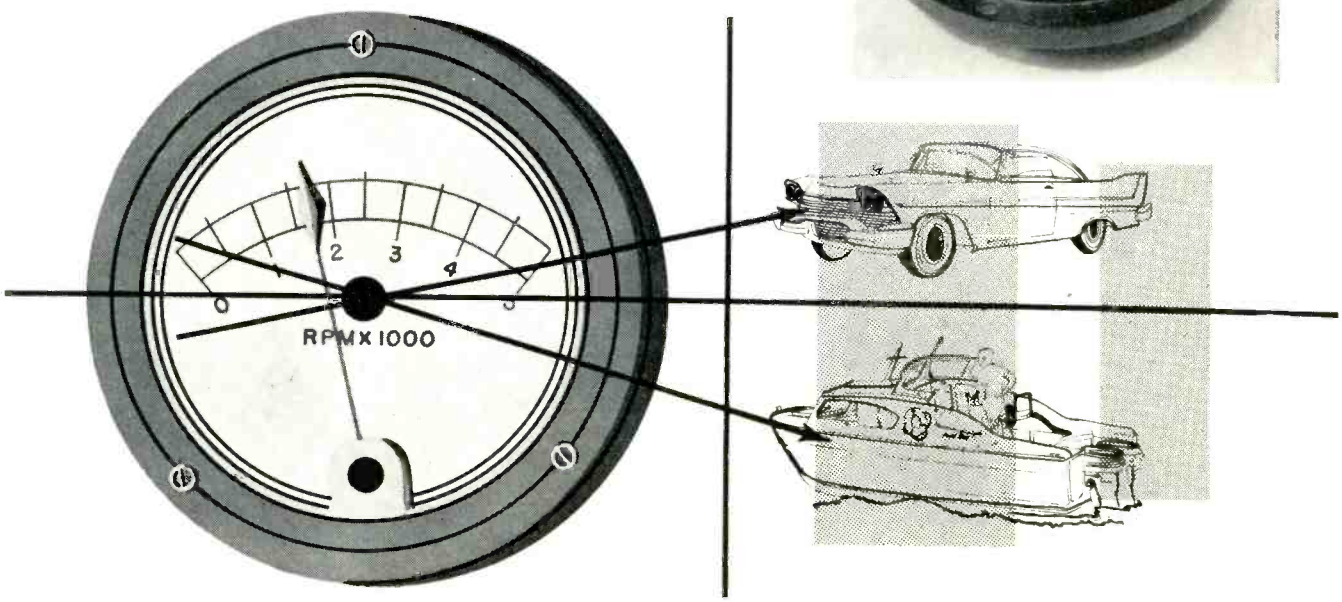
(*Continued on page* 148)

A TRANSISTORIZED TACHOMETER

By **RICHARD H. SMALL**
and
M. MICHAEL BRADY

A simple, electronic engine speed indicator, powered by 6- or 12-volt battery, for car driver or boat owner.

All components are mounted on a phenolic board disc fastened to meter terminals.

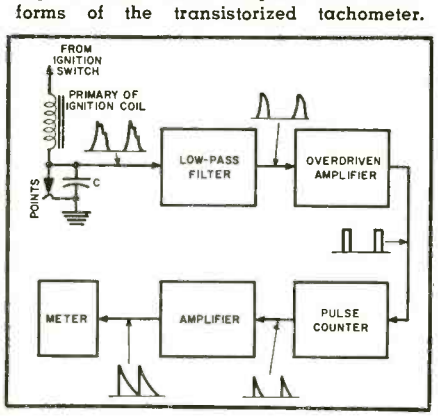


MANY car drivers or boat owners have a need to measure the speed of their engines and many, out of curiosity, find tachometers interesting. Almost all sports cars and a good many power boats are equipped with tachometers which read engine speed in rpm.

Automotive tachometers are usually identical to an ordinary speedometer in construction, except that they obtain their mechanical drive from the engine instead of a portion of the transmission geared directly to the drive shaft. Marine tachometers, on the other hand, are often of the generator-indicator type, because the distance between the engine and the instrument panel is usually too great to use a mechanical drive shaft. Both the speedometer-type and the generator-indicator type tachometers require a mechanical drive from the engine. To add such a mechanical drive to an engine is often a cumbersome task requiring at least an extra pulley on the fan belt or an attachment to the distributor.

Another approach to indicating engine speed is to measure the frequency of voltage pulses from the ignition system. Tube circuitry could be used to build such a pulse-frequency measuring device, but the problem of providing filament and plate potentials to tubes almost offsets the advantage of not having a mechanical drive. Transistors, however, can function at low supply voltages and are thus logical devices to use in an electronic tachometer circuit.

Fig. 1. Basic block diagram and waveforms of the transistorized tachometer.



The Basic Circuit

The basic block diagram of an electronic tachometer is shown in Fig. 1. The input to the circuit is in the form of low-voltage pulses from the primary side of the ignition coil. In a four-stroke cycle engine, each spark plug fires once every two revolutions of the crankshaft. If the engine has six cylinders, there is a total of three plug firings per revolution; if the engine has eight cylinders, there is a total of four plug firings per revolution. Each plug firing is produced by the opening of the breaker points in the primary circuit of the ignition coil. The direct relation between pulses-per-second from the primary of the ignition coil and engine rpm is: $f = CN/120$ where f is the pulse frequency, C is the number of cylinders, and N is the speed of the engine in rpm. For a two-stroke-cycle engine, each plug fires once every revolution of the engine, so this relationship becomes $f = CN/60$. The input to the tachometer circuit can then be regarded as pulses of frequency f.

Because the low-voltage pulses from the breaker points are not perfectly square and may contain a good deal of noise and extraneous signal due to point contact bounce, a low-pass filter is needed at input to the tachometer to remove signals above the highest frequency expected. The pulses from the output of the filter are then amplified and clipped in an overdriven voltage amplifier and fed to a pulse counter circuit. The output of the pulse counter is a pulse train of total volt-time area

directly proportional to the pulse frequency of its input. The output of the counter is then amplified and fed to some integrating indicator device.

Circuit and Its Operation

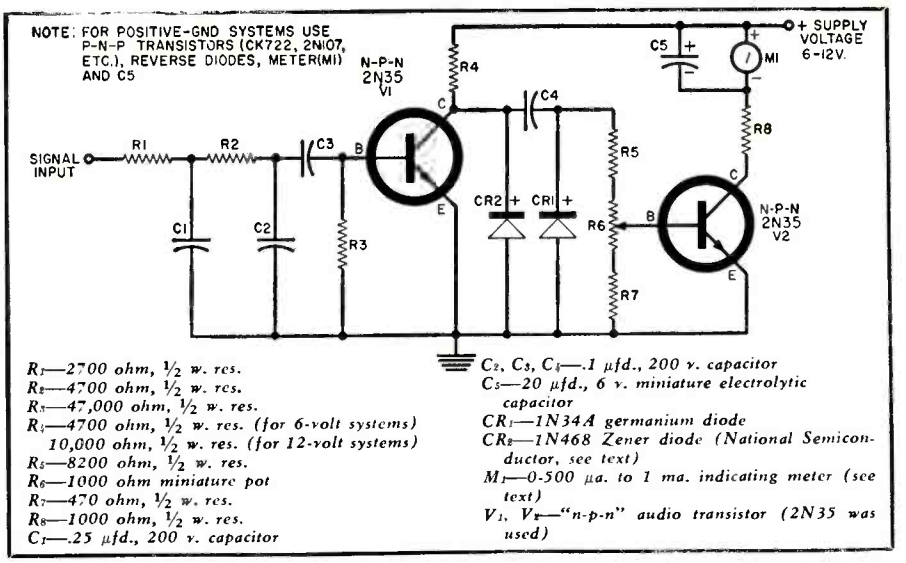
The schematic diagram of the transistorized tachometer for negative-ground electrical systems is shown in Fig. 2. This circuit is designed for operation on six or twelve volts, as indicated on the schematic. The circuit functions in exactly the same fashion as does the general block-diagram circuit of Fig. 1. The input low-pass filter is formed by resistors R_1 and R_2 and capacitors C_1 and C_2. The values of these components are chosen so that the filter attenuates above 350 cycles, which corresponds to an eight-cylinder engine speed of 5250 rpm. If a maximum tachometer indication of greater than 5000 rpm is desired, then appropriate values should be chosen to provide a higher filter cut-off frequency. Capacitor C_3 couples the output of the filter to the common-emitter-connected clipper-amplifier transistor, V_1, while resistor R_3 provides the necessary input bias resistance. R_4 is the load resistance for the first stage.

Capacitor C_4, diode CR_1, and resistors R_5, R_6, and R_7 form the "pulse counter" circuit. The function of the counter is to convert constant-amplitude square pulses into constant volt-time area exponential-fall pulses. The effective counter circuit is shown in Fig. 3. The transistor driver-clipper, V_1, is represented by an equivalent square-pulse generator in series with an internal resistance R_i, the diode CR_1 being represented by a switch. With each rising edge of an input square pulse, the diode CR_1 conducts and capacitor C_4 charges almost to the peak value of the input pulse in a time determined by the relatively short time-constant R_i-C_4. When the input drops to zero with the fall of an input pulse, the diode CR_1 blocks and capacitor C_4 discharges through the output resistance R_o (R_5-R_6-R_7 in Fig. 2), with a rate of fall determined by the time constant R_o-C_4. In this manner the output of the circuit is an exponential fall pulse for each square pulse in.

The second transistor V_2, serves as a current amplifier to amplify the input pulses which are then integrated by the meter M_1. Capacitor C_5 aids the integrating properties of the meter at low pulse frequencies.

Meter M_1 can be any standard 500 microampere to 1 milliampere meter. The meter used in the unit shown in the photo was removed from war-surplus aircraft electronic equipment. Because the meter must be re-calibrated in rpm, almost any meter scale is acceptable. A convenient scale conversion would be to use a 0-500 microampere meter scale for a 0-5000 rpm tachometer.

The component parts used in the circuit are standard miniature transistor-circuit components. All resistors are ordinary ½-watt carbon units, while the potentiometer, R_6, is a miniature unit. Capacitors C_1, C_2, C_3, and C_4 are miniature 200-volt units intended for printed-circuit transistor work. C_5 is a miniature electrolytic with a 6 working volt rating. Transistors V_1 and V_2 are ordinary *n-p-n* audio-frequency transistors. The operation of the circuit is such that the over-all parameters of transistors are not of prime importance: almost any inexpensive transistor will perform the function well. The counter diode CR_1 is an ordinary germanium diode. The entire circuit can be mounted on a phenolic board and fastened to the meter terminals, as shown in the photo.



R_1—2700 ohm, ½ w. res.
R_2—4700 ohm, ½ w. res.
R_3—47,000 ohm, ½ w. res.
R_4—4700 ohm, ½ w. res. (for 6-volt systems)
10,000 ohm, ½ w. res. (for 12-volt systems)
R_5—8200 ohm, ½ w. res.
R_6—1000 ohm miniature pot
R_7—470 ohm, ½ w. res.
R_8—1000 ohm, ½ w. res.
C_1—.25 μfd., 200 v. capacitor
C_2, C_3, C_4—.1 μfd., 200 v. capacitor
C_5—20 μfd., 6 v. miniature electrolytic capacitor
CR_1—1N34A germanium diode
CR_2—1N468 Zener diode (National Semiconductor, see text)
M_1—0-500 μa. to 1 ma. indicating meter (see text)
V_1, V_2—"n-p-n" audio transistor (2N35 was used)

Fig. 2. Complete diagram for negative-ground system. See note for positive ground.

Calibration and Operation

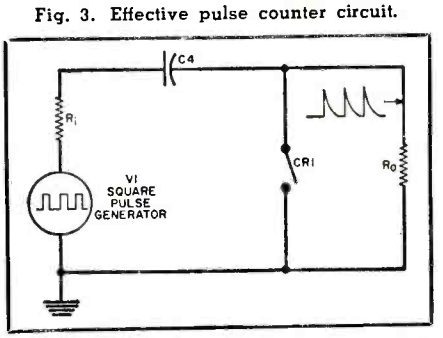
The unit may be calibrated so that the meter reads full-scale for any desired input frequency. As an example, a six-cylinder engine full-scale deflection of 500 microamperes could be set to correspond to an input pulse frequency of 250 pulses-per-second, or an engine speed of 5000 rpm. The unit should, of course, be calibrated using a pulse generator with a known pulse frequency output. However, a very accurate calibration can be obtained using an ordinary sine-wave audio oscillator to supply the input signal. The output amplitude of the oscillator should be set in such a way that further increases in amplitude do not affect the reading of meter M_1. The circuit is then operating on the positive peaks of alternate half-cycles of the oscillator output.

The potentiometer, R_6, should be adjusted to give full-scale deflection of the meter for the computed maximum frequency corresponding to the desired full-scale rpm reading. Two or three other points should then be checked to determine if the meter reads linearly with input frequency.

The basic circuit of Fig. 2 may be modified in many ways to improve performance and increase the accuracy of the rpm indication. The regulation of the electrical-system voltage in most cars and boats is fairly good except when the engine is idling and the battery is discharging heavily. The pulse counter of the tachometer circuit is partially sensitive to changes in input voltage. If the quiescent output voltage of transistor V_1 is not constant, then the tachometer will be in error by an amount proportional to the percentage variation from the normal quiescent voltage at which the unit was calibrated. The input voltage to the counter can be held constant by using a regulator diode (CR_2 in Fig. 2). The diode in the unit shown is a silicon Zener diode (diode operated at its breakdown voltage in the reverse direction) with a Zener voltage of about 4.5 volts. Many semiconductor manufacturers make Zener diodes; the one in the authors' unit is a *National Semiconductor* 1N468.

In operation the entire unit draws less than 2 milliamperes from its power source and, in addition, requires no mechanical connections to the engine. The electrical connections are simple: one ground, one power lead from the ignition switch, and one signal lead from the distributor breaker points. The wide variety of meters and components available makes the unit readily adaptable to almost any dashboard or instrument panel layout. The authors have mounted their units in the space provided in the dashboard for the installation of a clock. The cost of the unit is relatively small compared to shaft-drive or generator-indicator types of tachometers. It should have a life expectancy limited only by the life of the transistors used. 30

Fig. 3. Effective pulse counter circuit.



Low-Cost Stereo System

By **R. J. MEAGHER**
Senior Engineer, CBS-Hytron

For less than $100, including speakers, you can enjoy stereo using this home-built dual 10-watt amplifier.

STEREOPHONIC sound can now be enjoyed without lavish outlays for equipment, as this article will prove. The stereophonic sound system to be described can easily be built by anyone who has ever made a radio or audio amplifier.

The audiophile who considers any speaker costing less than $100 inferior may not appreciate this system since the amplifier and speakers together in this setup cost less than this sum.

The author had been enjoying long-playing records using an old changer and a good fidelity amplifier unit. Then the new stereo records became available and the problem of how to take advantage of this sound "bonus" without spending a small fortune cropped up. After looking at various units and reading many articles on the subject, the author designed this particular system with two thoughts in mind. The first criterion was good stereo sound rather than a system having fancy specifications and the second was to keep costs at a minimum by using parts on hand where possible. Both objectives were met.

The Pickup

The stereo cartridge selected by the author was the *Columbia* CD compatible stereo cartridge, Model SC-1. It was installed in the tone arm of the old changer with a second shielded cable (supplied with the cartridge) added for stereo. The arm was first balanced to have zero weight since the cartridge weight provides the proper tracking pressure. This was done by adjusting the spring load, but may be accomplished with lead weights on the rear of the arm. A pressure gauge can be used to verify the recommended stylus pressure of 5 to 7 grams.

The Amplifiers

The dual-amplifier was then built using the circuit of Fig. 3. One power supply feeds both amplifiers, and uses an old TV power transformer. Such a transformer is easily obtained and pro-

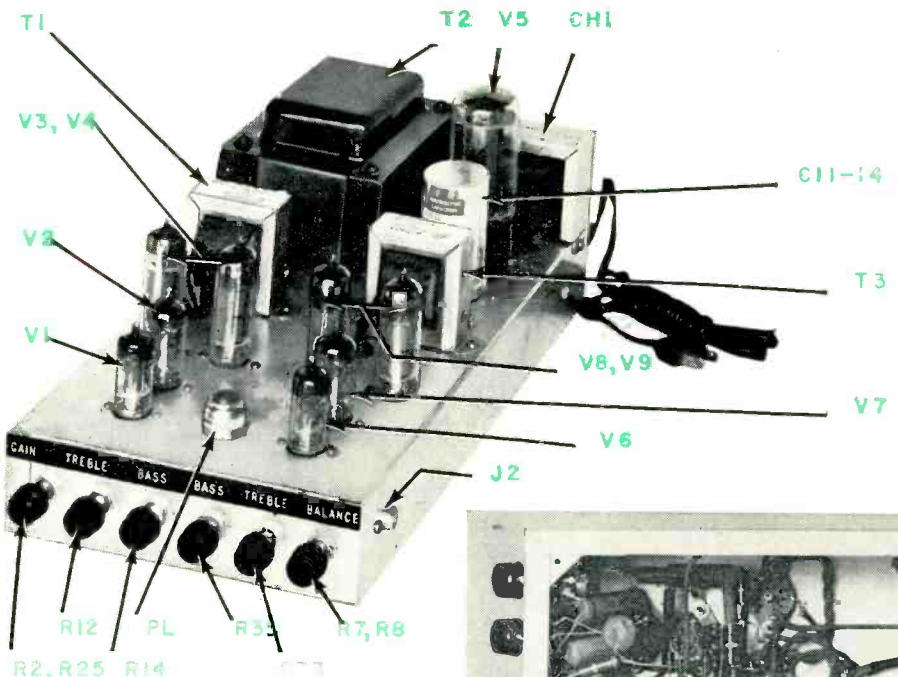


Fig. 1. An over-all view of the dual amplifier is shown in this illustration. Common power supply circuits for both channels of amplification are located at the very back portion of the chassis.

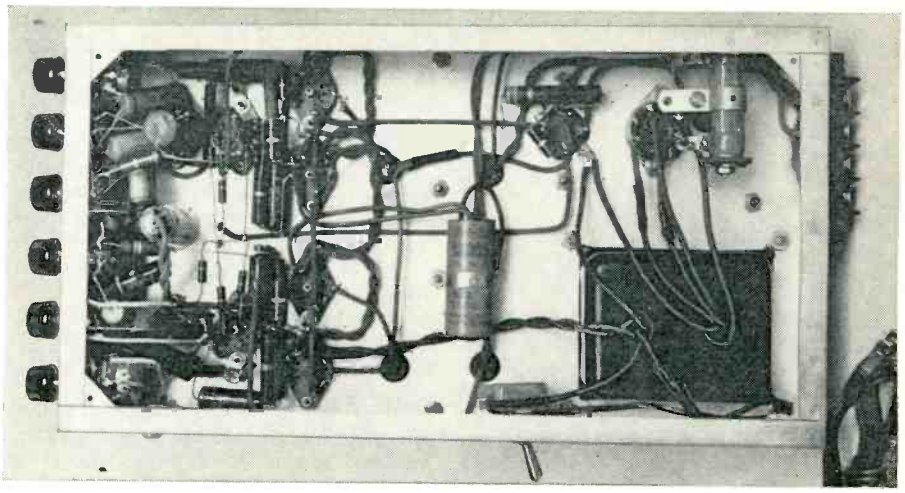


Fig. 2. Under-chassis view of the amplifier is shown here. Input terminals are on both sides of the chassis near the front, while the output terminals are on the rear panel just behind the tapped voltage-adjusting resistor R_{23}.

vides high current with good regulation. The amplifiers are identical. The 7025 (the low-noise version of the 12AX7) was chosen for its low inherent noise and hum level and the 6BQ5 for its high gain. The first stages (6C4's) are included to take care of possible low-level inputs, but since a high-output cartridge was used (the *Columbia* SC-1 is rated at 0.4 volt) sufficient gain is derived in the 7025 stage to drive the 6BQ5's. Thus, with this type of cartridge, a further cost saving can be effected by eliminating the 6C4 stage of each amplifier. No shielding was found necessary due to the short leads from the two-channel, separated layout as shown in Fig. 2. A hum balancing potentiometer was not needed because of the fortuitous choice of tubes and layout. The heater leads to the tubes should be twisted all the way and the heater ground should be made at the 6C4 end. If hum level should prove objectionable, an aluminum mesh cover can be used on the bottom of the chassis. Oscillation or motorboating may occur in either amplifier and, if so, the blue and brown leads of the output transformer involved should be reversed.

All resistors and capacitors should be chosen for small physical size since space is at a premium in the front end. All potentiometers are small ½-watt units. Considerable saving was effected by using *Merit* #2904 output transformers. They are rated at 18 watts and exhibit very satisfactory response in this circuit (run within 10-watt rating).

The purpose of the 200-ohm, 20-watt resistor between the 5U4GB and filter choke is to adjust plate voltage to within 6BQ5 ratings. They operate at about 300 volts. This will vary with different power transformers so that, in some cases, a larger resistor may be needed. R_1, R_{24}, R_2, R_{25} and C_1, C_{15} provide equalization for the SC-1 cartridge. If a different cartridge is used, these values should be changed to conform to the manufacturer's suggestions.

The positions of the line switch, input jacks, and pilot light (the latter is not shown in the schematic) were chosen only for convenience in the author's built-in cabinet and may be relocated for each individual case, taking care to keep the leads from the jacks to the tubes short and the 117-volt a.c. leads away from the high-gain inputs.

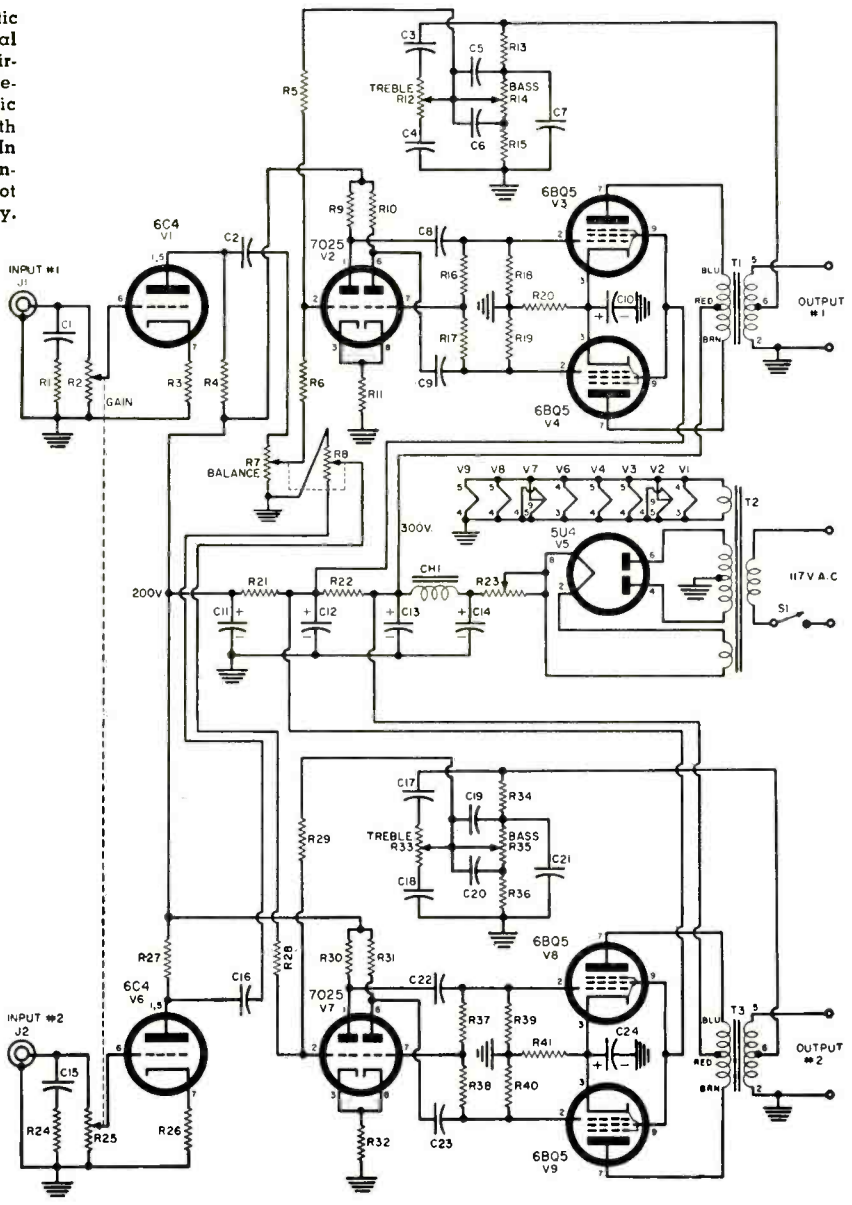
Little further need be said about the amplifier circuits, since they are straightforward. Figs. 1 and 2 show the parts layout. Except for keeping leads short to avoid the necessity for shielding, the parts layout is not critical. Be sure to place the power transformer so that its windings are at right angles to the output transformers to prevent induced 60-cycle hum, since they are close to one another.

The Controls

Referring to the circuit diagram (Fig. 3) and the front-view photograph (Fig. 1), there is a single master gain control for both channels. This control is R_2, R_{25}, a dual potentiometer, shown

(*Continued on page* 104)

Fig. 3. Here is the complete schematic diagram and parts listing for the dual 10-watt stereo power amplifier. The circuit is designed to accommodate a ceramic stereo cartridge. If a magnetic cartridge is to be used, a preamp with proper equalization would be needed. In this case the RC networks across the input jacks must be removed. A 6-volt pilot lamp may be wired across heater supply.



R_1, R_{24}—180,000 ohm, ½ w. res.
R_2, R_{25}—1 megohm, ½ w. dual linear-taper pot
R_3, R_{26}—1500 ohm, ½ w. res.
R_4, R_{27}—150,000 ohm, ½ w. res.
R_5, R_{29}—1 megohm, ½ w. res.
R_6, R_{28}—470,000 ohm, 1 w. res.
R_7, R_8—500,000 ohm, ½ w. dual linear-taper pot
R_9, R_{10}, R_{30}, R_{31}—270,000 ohm, ½ w. res.
R_{11}, R_{32}—1000 ohm, 1 w. res.
R_{12}, R_{14}, R_{33}, R_{35}—50,000 ohm, ½ w. linear-taper pot
R_{13}, R_{34}—10,000 ohm, ½ w. res.
R_{15}, R_{36}—680 ohm, ½ w. res.
R_{16}, R_{17}, R_{18}, R_{19}, R_{37}, R_{38}, R_{39}, R_{40}—1 megohm, ½ w. res.
R_{20}, R_{41}—150 ohm, 2 w. res.
R_{21}—1000 ohm, 2 w. res.
R_{22}—4700 ohm, 2 w. res.
R_{23}—200 ohm, 20 w. adj. res.
C_1, C_{15}—.002 µfd., 600 v. disc ceramic capacitor
C_2, C_3, C_{16}, C_{17}—.01 µfd., 600 v. disc ceramic capacitor
C_4, C_{18}—.05 µfd., 600 v. disc ceramic capacitor
C_5, C_8, C_9, C_{19}, C_{22}, C_{23}—.02 µfd., 600 v. disc ceramic capacitor
C_6, C_{20}—.2 µfd., 200 v. capacitor
C_7, C_{21}—.0003 µfd., 600 v. disc ceramic capacitor
C_{10}, C_{24}—20 µfd., 50 v. elec. capacitor
C_{11}-C_{12}-C_{13}-C_{14}—20/20/10/10 µfd., 450 v. elec. capacitor
S_1—S.p.s.t. switch
J_1, J_2—RCA-type phono jack
CH_1—2 hy., 200 ma. filter choke (Author used old TV choke. Merit C2974 or equiv.)
T_1, T_3—Universal output trans. 4000/7000/8000/10,000/14,000 ohms c.t. to .17 to 32 sec. (Merit A-2904 or equiv.)
T_2—Power trans. 350-0-350 v. @ 200 ma.; 5.0 v. @ 3 amps; 6.3 v. @ 4 amps (Triad R-20-B or old TV transformer can be used)
V_1, V_6—6C4 tube
V_2, V_7—7025 tube
V_3, V_4, V_8, V_9—6BQ5 tube
V_5—5U4GB tube
Spkrs—6" x 9" ovals (Author used Lafayette SK75)

Airborne Relay for Intercontinental TV

The French Air Force radar-testing "Bretagne" bomber was specially outfitted as an intercontinental TV relay station.

By **A. V. J. MARTIN**
Carnegie Institute of Technology

Successful French attempt links North Africa to Europe by means of single plane relay station.

THE first successful attempt at using an airborne relay for intercontinental television trasmission took place last summer with Africa and Europe the continents involved. Planned and developed by *Radio Télévision Française (R.T.F.)*, this airborne relay was used twice. On July 14th, Bastille Day, programs originating in Algiers were relayed across the Mediterranean to France and telecast over the entire French television system, which covers roughly 80 percent of the country.

On September 4th, General de Gaulle's historic speech inaugurating the Fifth Republic was telecast throughout France and relayed across the sea to the North African television transmitters.

A single plane was used for both transmissions, the waves thus crossing the Mediterranean in two jumps. The first attempt will be described in some detail since both operations were practically identical. The feat becomes all the more remarkable when it is realized that the decision to relay the first program was taken on July 8th—just six days before the actual telecast. Only the video signal was transmitted *via* the airborne relay system to be described.

The Links

A special transmitter, radiating towards the plane, was set up in Bouzarea. It received the signal through two microwave links, one coming from the control center in Algiers and the other one from the Cap Matifou TV transmitter. Two links were used to insure continuity of the program in case of a failure in one of the microwave systems. Actually, no failure occurred.

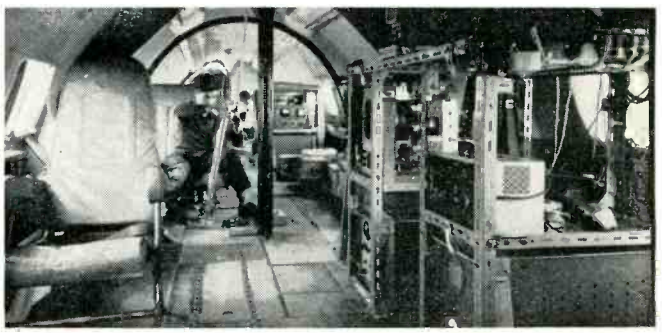
The special transmitter had a peak power of 500 watts and used an antenna with a gain of 18 db. The antenna was oriented 15 degrees east of true north. The frequency was 173.4 mc. and the polarization horizontal.

This transmitted signal was received by the plane flying in circles of 12-mile radius at an altitude of 20,000 feet. The flight was made within a carefully chosen zone, east of the Balearic Islands. In the plane the signal was demodulated, amplified, and used to modulate a 500-watt transmitter which operated on 212.85 mc. and whose antenna was oriented toward France.

No automatic device could be relied upon to correctly orient the two antennas aboard the plane so two engineers, with the help of the gyro compass, continuously monitored and oriented the receiving and transmitting antennas. In France, again for precautionary reasons, two receiving stations had been installed—one near Marseille and the other in the Black Mountain range. This latter installation was the one actually used. Both receiving stations were linked by microwave to one of the TV transmitters of the national chain. The link used covered 120 miles in a single jump to feed the 200 kw. transmitter covering the southwestern portion of France. From there the program was distributed throughout the country over the permanent microwave-coaxial system that links the thirty-odd transmitters comprising the national network.

The Audio Signals

As mentioned previously, only the video portion of the transmission was relayed over the airborne link. To avoid unnecessary risks and to eliminate over-elaboration of the



The engineer is orienting one of the directional antennas installed on the plane. Receiving equipment is at the right.

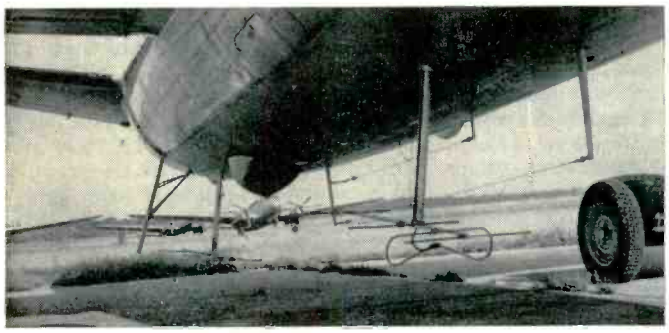
equipment which had to be carried by the plane, the sound was transmitted over an entirely different route. The audio portion was sent through the trans-Mediterranean submarine telephone cable, then through post office telephone links to Paris—from which point it was distributed over the television chain.

It is the custom in France to telecast on a nationwide basis only such programs as would be of national interest. However, there is a permanent system, called "Eurovision," linking together the national chains of practically all Western European countries. This means that programs of

international interest could be telecast from England to Austria and from Norway to Italy at the flick of a switch. For example, the recent coronation of Pope John XXIII was transmitted from the Vatican *via* "Eurovision." Jet planes were used to carry both kinescope and video tape recordings of the ritual to the U. S. for early televiewing.

The French Air Force cooperated in these intercontinental TV transmissions by lending a "Bretagne" bomber, equipped for flight test of radar units, for the project. It had available a 27½-volt, 7 kw. d.c. power supply plus a rotary converter which provided 5 kilowatts of 50-cycle, 117-volt a.c. Because of weight limitations a 500-watt transmitter was considered to be the largest that could be handled.

The receiver was a high quality commercial model, modified to pass only 7 mc. instead of the 10.5 mc. of the 819-line French picture. The small loss of detail was compensated



Two 4-element retractable yagis were used beneath the fuselage.

by an improved signal-to-noise ratio. At 20,000 feet every signal within the frequency range came in loud and clear—radar, beacons, marine traffic, FM and TV stations from Italy and Spain, etc. The reception was considered proof of the advantage of reduced bandwidth in this application.

The video output of the receiver was visually controlled and fed to a sync signal re-generator which reshaped the line and frame sync signals. This completely re-generated signal was then fed to the 500-watt transmitter.

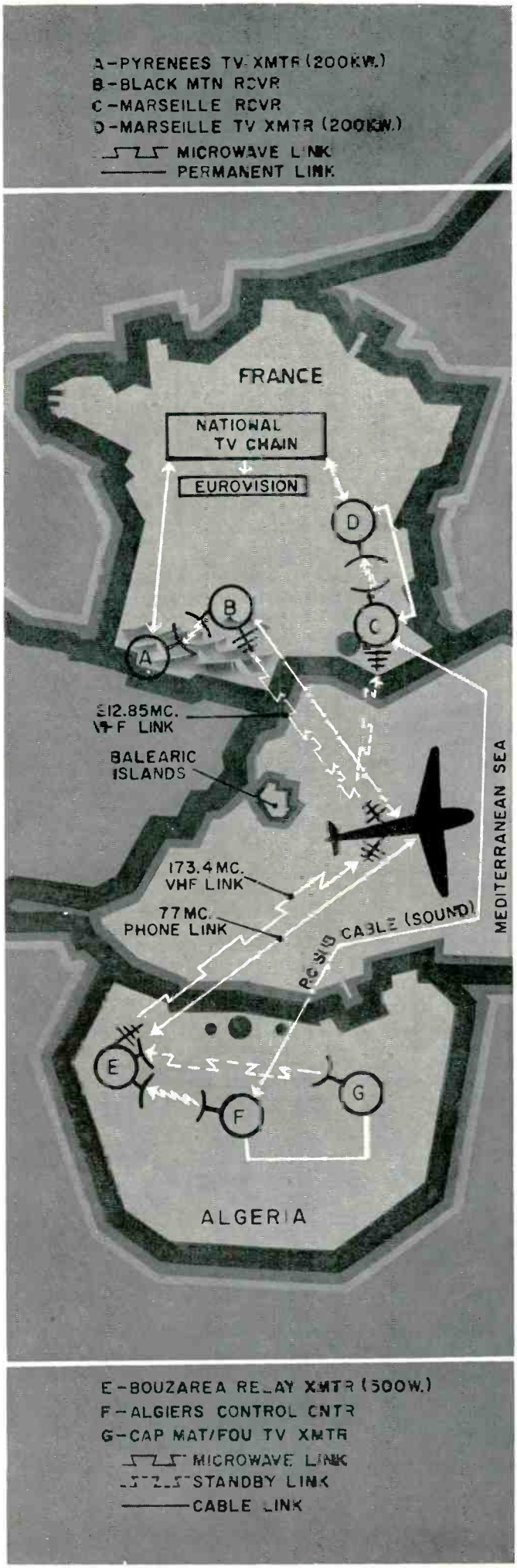
The transmitting and receiving antennas were simple 4-element yagis, connected to coaxial feeders through a bazooka circuit for good impedance matching. They were supported by retractable masts which could be extended to 8 feet below the fuselage after take-off.

The phone link on 77 mc. took care of intercom requirements between engineers on board the plane and in Africa.

The intense field, generated by the transmitter, permeated the entire plane and degraded the accuracy of the navigational equipment aboard. In addition, the engineers found it a full-time job keeping the transmitting antenna in line with the land-based receiving station. For this and other reasons, the signal received in France varied over very wide limits and a sync re-generator had to be brought into operation at the receiving sites. Although the reception was of somewhat varying quality, on the average it was about on a par with "Eurovision" programs originating in countries with 405- or 625-line systems.

These original results were bettered in the September telecast in which the direction of the program transmission was reversed. Previous experience with the airborne relay was of great help and, as a result, the picture quality, as received in North Africa, was decidedly improved ranging from fair to good.

All-in-all it can be said that the experiments were successful—demonstrating to engineers and the public alike the feasibility of such transmissions. These trials now take their place alongside a number of *R.T.F.* "firsts" which include direct transmissions from submarines, from deep sea diving bells, from caves, coal mines, helicopters, jet test planes, racing cars, etc. Perhaps the day of trans-oceanic TV is not as distant as we thought! —30—



Map at the right shows how signals originating in North Africa were relayed by a high-flying plane to France. Link was also used for signals originating in France and destined for Africa.

SINGLE PUSH-PULL STAGE FOR BOTH STEREO CHANNELS

By **NORMAN H. CROWHURST**

Simple simplex-type circuit for stereo does away with two output tubes and one output transformer.

EDITOR'S NOTE: *The circuit discussed in this article aroused considerable interest when it was introduced in a paper presented by CBS engineers before the Audio Engineering Society. Here we evaluate the system, and answer some of the questions that have been asked about it.*

The importance of the circuit lies in the fact that two output tubes and one full-power output transformer are able to handle both stereo channels. There are some limitations to the flexibility of the input and output circuits, but from where we sit, it appears that the circuit will find widespread use.

As we go to press, the Heath Co., under license by CBS Laboratories, is investigating an inexpensive stereo system utilizing an improved and more sophisticated version of the principles described herein.

IF STEREO can be recorded in a single groove, why cannot it be amplified by a single amplifier? As with so many questions, this one has two possible answers: it can't be done; and the people who do it! In this case the latter are *CBS Laboratories,* as reported in a paper before the Audio Engineering Society, jointly authored by B. B. Bauer, W. S. Bachman, J. Hollywood and G. Maerkle.

The question, "How does it work?", which this article aims to answer, can likewise be asked with different attitudes: the man who said it can't be done has objections, and doesn't think it can work *properly;* while the person who is unprejudiced just wants to know, in simple terms, the principles involved, as well as "Does it do a job as good as two separate amplifiers, of the same, or lower cost, or with the same total output?".

In an ordinary push-pull amplifier, all the tubes and other components of the push-pull part are in duplicate, and handle audio exactly the same, except that one "pushes" when the other "pulls". For good push-pull operation, both "halves" of the amplifier carry identical waveforms, except that one swings up when the other swings down. Usually great care is exercised to ensure the two halves are balanced so the waveforms really are identical.

But actually a push-pull amplifier is two separate amplifiers, the only tie together being at the input, or phase inverter, and the output, a push-pull transformer. Failure to maintain the ideal balance would not cause any trouble until the two are recombined at the output. So what is to stop each side of the "push-pull" stage being used for one channel of stereo, instead of going to all that trouble to get exact identity for just one output? And when you look at it, the principle is quite simple (although one can always say that when someone else has already done it!). In fact it's as simple as making each half carry the modulation from one side of the record groove in a 45-45 record (Fig. 1).

By now it is well known that, when the two channels work together, as they do for a center-located sound, the groove moves from side to side without any change in depth (Fig. 1C). When only one channel carries program, due to a sound originating from one extreme side, only one wall of the groove is modulated (Fig. 1A or 1B). And when the two work in opposition, the groove goes directly up and down (Fig. 1D).

This last condition does not normally happen at lower frequencies, because it would represent a sound "off-stage". But it can and does happen at higher frequencies, because the time difference can then amount to several wavelengths.

From Fig. 1 it will be seen that the center-located sound gives the normal push-pull waveform combination, while the out-of-phase condition gives "push-push". Stereo program would be mono if it only contained the push-pull com-

Fig. 1. The relationship between various types of grooves on a 45-45 disc and the outputs from the stereo cartridge discussed in the article. Although coils are shown, ceramic elements would produce the same results. (A) and (B) show sound in one channel only, while both channels have equal signals in (C) and (D). In (C) the cut is completely lateral, in (D) it is vertical.

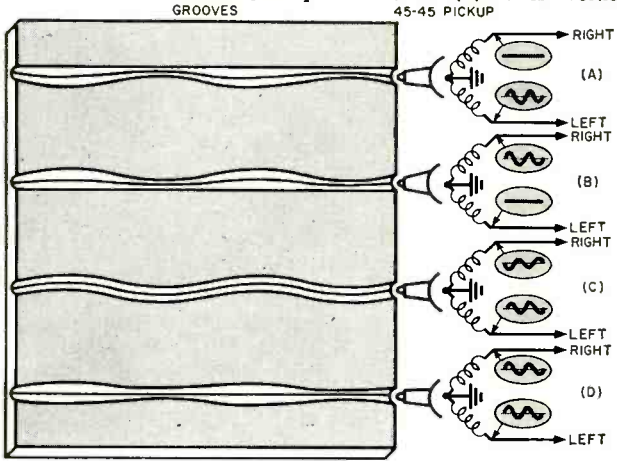


Fig. 2. The double-matrixing transformers operate push-pull and "push-push", or single-ended, to produce these waveforms.

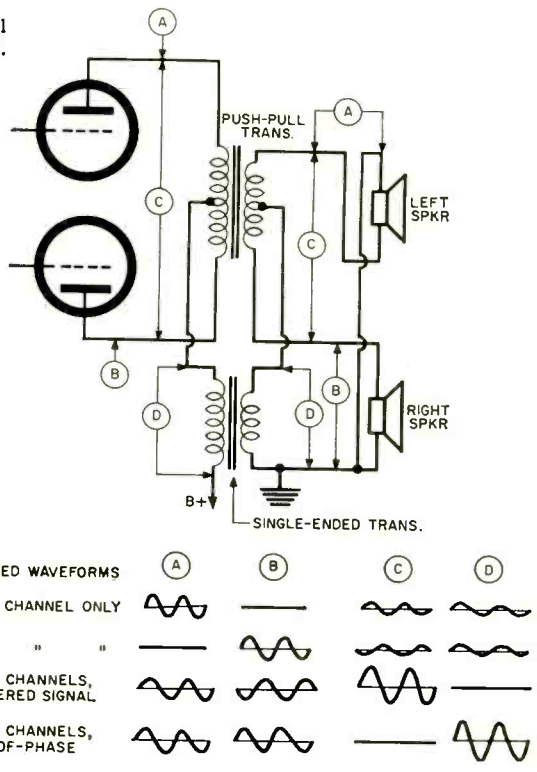


Fig. 3

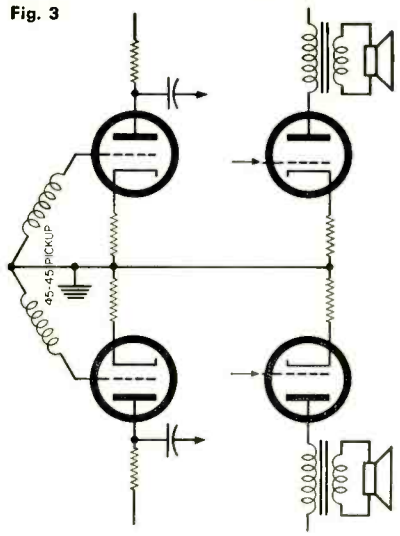


Fig. 3. With single-ended output transformers, a full-length, push-pull amplifier could be used as two separate single-ended amplifiers as described in the text.

Fig. 4

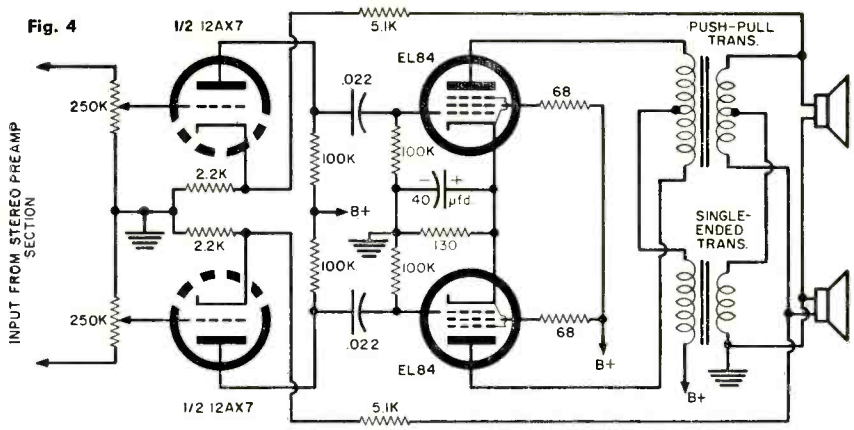


Fig. 4. Schematic diagram of driver and output stages, showing use of feedback.

Fig. 6. Class B operation is a condition not completely realizable in practice: it depends on "curves" with straight lines and sudden corners (A); practical tubes have bends (B).

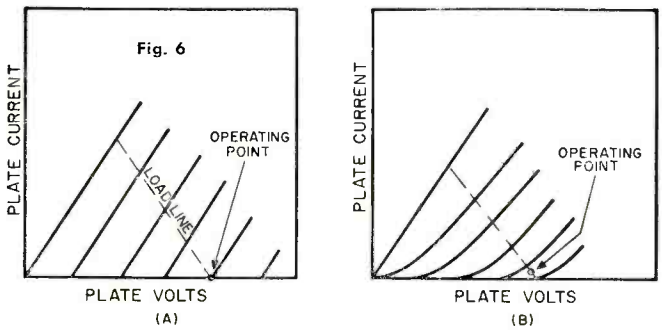


Fig. 5

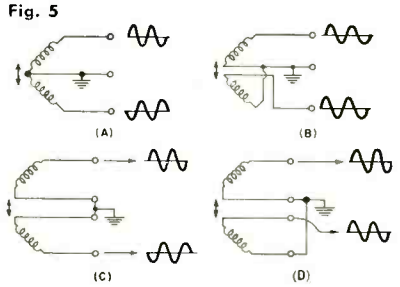


Fig. 5. The two possible ways a 3-terminal cartridge can be connected internally (A) for CBS push-pull system and (B) for "regular" separate system. A 4-terminal cartridge can be connected (C) for CBS system and (D) for "regular" stereo system.

bination, but on the other hand, very little of it reaches the completely push-push condition of simple up-and-down. Most of it lies somewhere between these extremes.

(Most common stereo cartridges are phased in such a way that lateral motion produces in-phase signals. By simply reversing the connections to one of the pickup elements, the phase conditions shown in the figure are obtained. With 4-terminal cartridges this is simply a matter of transposing 2 leads; with 3-terminal cartridges the manufacturer must provide the required phasing. See Ques. 2.—Editor)

If one pick-up output were fed into each side of the so-called push-pull stage, and each side had a separate output transformer feeding its own loudspeaker, we should have a couple of separate amplifiers working from a common power supply, of the quality normally expected using single-ended output stages (Fig. 3). The kernel of the new development is the double matrixing (mixing) output circuit that effects an economy in output transformer requirements, and *at the same time* enables the normal advantage of push-pull output to be obtained.

Instead of using one output transformer for each channel—left and right—separate transformers handle virtually the "lateral", or push-pull and "vertical", or push-push components (Fig. 2). Remember, the out-of-phase condition never normally happens in stereo program at low frequencies, and only stands a random chance of happening at higher frequencies.

So the transformer that carries the two plate currents in parallel does not need a good bass response. Thus the normal objection to a single-ended output—loss of bass—is avoided in having the transformer acting single-ended. The *CBS* paper also claims an advantage in downgrading bass response to the "vertical"—a built-in vertical rumble rejection, that certainly can often be helpful.

The other transformer acts strictly push-pull, and thus is able to have all the qualities of a push-pull output transformer. Now we begin to see where the saving comes in. Only *one* high quality push-pull output transformer is needed; the other can be smaller and much cheaper. And we need only one push-pull output stage, as regards all the other components, through which to feed stereo program material.

Feedback is taken from the resultant output to the voice coils, back to the cathodes of the driver stage (Fig. 4). This can reduce distortion in either channel (left or right), correct frequency response, and reduce any error in the double-matrixing action of the output transformers.

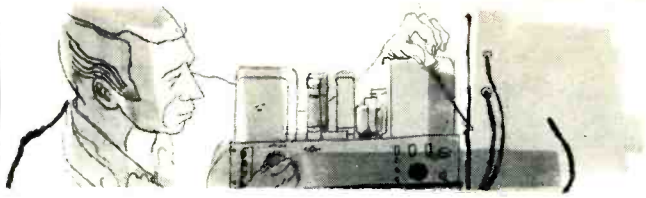
That about tells the story as far as the principle is concerned. But a new idea like this will start (in fact it has started) some questions, with the idea "Does it really buy all this?". So let's take some of these questions, as a way of exploring the potentialities of this kind of amplifier.

1. You said the push-pull transformer has all the advantages of a normal push-pull output transformer. I can see that the static, or quiescent plate currents will balance and thus maintain its inductance and low frequency response; but isn't part of the function of a normal output transformer to cancel even order distortion from the amplifier? How can this happen when the amplifiers are handling different channels?

This objection would be true for separate, single-ended output transformers (Fig. 3). But with this arrangement, the push-pull transformer only handles that part of the composite program content that is strictly push-pull. The "single-ended" component is handled by the smaller transformer. There is, in almost any stereo material, a dominance of high amplitude lower

(*Continued on page* 146)

1 2 3 4 5 6 7 8 9 10



Service-Business Problems

By **WILLIAM LEONARD**

Unsound pricing, manufacturer service, and drug store tubes are three that confuse set owners.

IN DISCUSSIONS about the management problems involved in the operation of an electronic service business, it is interesting to observe the growing interest among dealers in the economics involved. The technical facets of service, which once dominated the thoughts of the majority of the independent service dealers, are being gradually eclipsed by the urgent demands for increased income to meet mounting operating and living expenses.

While the operation of a service business follows the pattern of any independently owned retail store in many ways, there is one significant difference: the service dealer must find ways and means to sell time, experience, and transportation costs at a profit.

A retail merchant operating on an average gross profit of forty per-cent is required only to have the needed merchandise on his shelves when a customer comes in to buy it. The major problem of this retailer is to develop enough volume of business at forty per-cent gross profit to cover operating costs, a better-than-average salary for himself, and a profit on his investment.

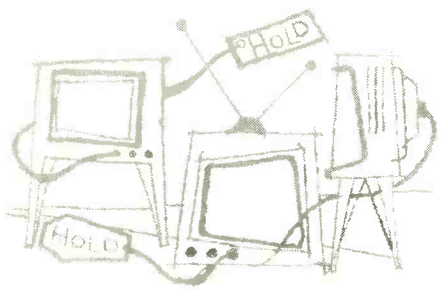
Assuming that three dollars per hour is a nominal price for the time, knowledge, and skill of an experienced technician, the service dealer who charges five dollars for a home service call gets the same gross profit percentage for his technicians' time as the retailer gets on the merchandise he sells. However, the service dealer has an additional operating cost that the conventional retailer does not have: he must deliver this skilled service to the customer's home. Thus, out of his forty per-cent, he must pay transportation costs in addition to the normal operating expenses of his business establishment.

The dual expense burden of maintaining a business location for the shop *and* transportation costs to perform service in the home led many dealers into some type of retail diversification as a means of taking a part of the shop's overhead load off the back of the consumer-service phase of the business. While this diversification has helped many dealers to lighten their overhead burden, they still find it necessary to get adequate charges for service work. An analysis of the ten foremost problems in the management of small service businesses indicates that the governing factor in their success is this very ability to get adequate charges for service time and labor.

The first of these fundamental management problems is that of maintaining an adequate volume of *profitable* business. This means that the gross profit over and above the cost of materials purchased must be sufficient to pay overhead and operating costs, provide the dealer with at least a normal income, and pay a return on the investment in the business. To accomplish all of these objectives, the dealer must make a satisfactory profit on service time as well as the normal profit on the tubes and parts he sells in connection with his service work.

Since a business must be *managed* if it is to prosper and grow, another dealer problem is that of allocating part of his time and attention to planning and promotion. In order to afford the time necessary to manage his business, he must make an adequate profit on the time he is in the field servicing sets.

One of the most serious problems of service management is that of maintaining an adequate stock of tubes to handle any tube-failure service job in one call. Here the dealer is faced with a double-sided problem. First, he has the investment to consider. A representative stock of tube types including an adequate number of those most-used, will require more money than the average small dealer can afford to tie up in that one element of his business. The second part of the problem is that of handling a tube caddy stocked with all of the numerous types that may be required in home servicing. As one dealer expressed it, "When one of the larger caddies is filled with tubes, it's one hell of a load to carry up three flights of stairs."



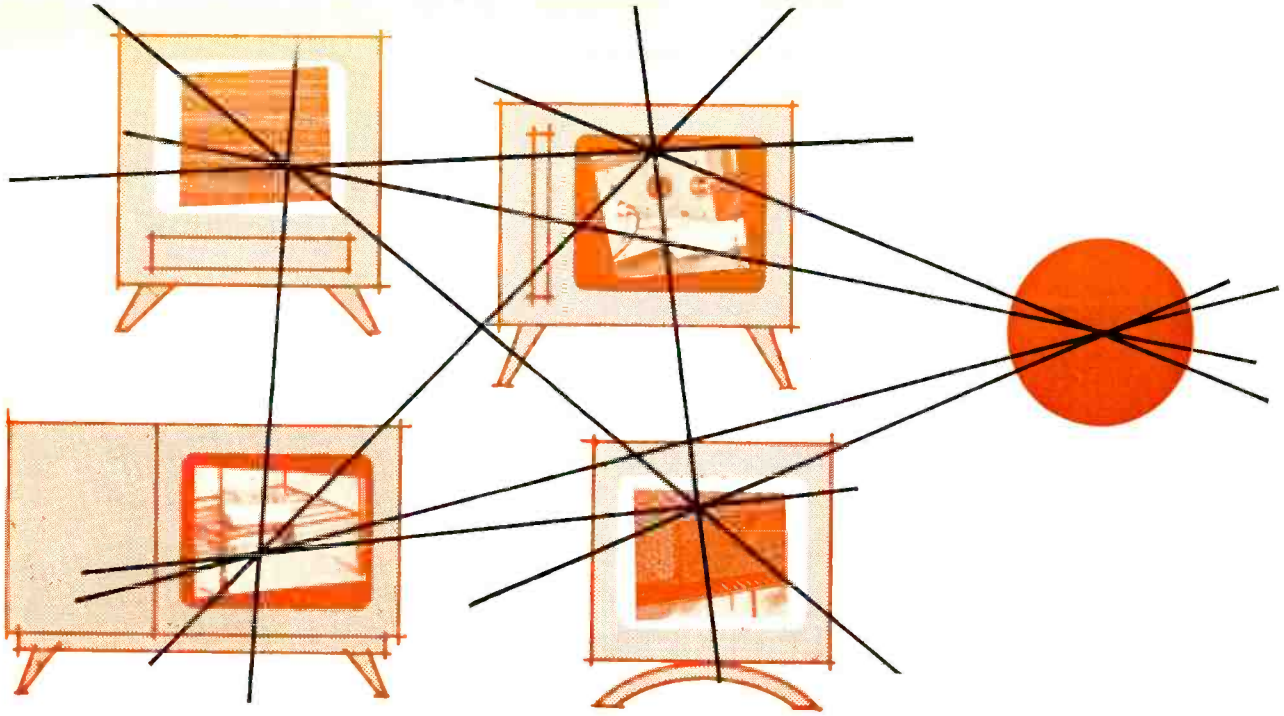
The fourth major management problem is that of determining the type of advertising that will produce the best results with the amount of money available for this phase of business promotion. To determine how best to use his limited advertising budget, the dealer should experiment with direct mail, newspaper, cards, and handbills to determine which produces best in his location and community. It takes time and unfettered thinking to plan and to evaluate results. This time must be paid for out of adequate profits from service calls.

A basic weakness in service management generally has been the failure to pursue consistently a studied promotion program. While word-of-mouth advertising has been the promotional mainstay of most ethically operated shops, it also is business that can be lost quickly to competent part-timers whose service charges are less than those of full-time shops. There is a marked public preference for dealing with stable, successful businesses. The only way the public can know about a dealer's business is what they see in the appearance of his shop and the manner in which customers are handled by phone and in personal contacts.

In the development of any business, there come times when it is wise to expand and other times when it is best to hold the line. The controlling factor in making the right decisions about expanding or maintaining the *status quo* is a sound understanding of the economic forces at work in the particular trading area. A service dealer should be personally acquainted with all of the other businessmen in his community to keep informed about what is going on business-wise.

Call-backs, another problem, are dually expensive. In the first place, it costs the dealer money to make them; in the second place, the average custimer goes through a period of *loss of confidence* when it is necessary to call for service shortly after a set was fixed. Some dealers have drastically reduced

(*Continued on page* 101)



Practical Know-How for Multi-Set TV Installations

By **JACK BEEVER**
Jerrold Electronics Corp.

Building type and structure are important. Motels, hotels, and hospitals call for different techniques.

NO HARD and fast rules for wiring TV distribution systems in buildings with coaxial cable can be laid down—but certain generalities apply to practically all jobs. Familiarity with general technique plus a little ingenuity usually produces a specific, successful installation.

One thing is certain—the particular application may modify the layout of the job. The simplest, cleanest, and generally most satisfying approach to a system installation is to be found in a new building where conduit and outlet boxes have been placed as the building was constructed. As long as the conduit layout was made with a specific wiring plan in mind, the work of installation is simple. The only special tool needed is an electrician's fish wire.

Beware the job however, where the conduit for a TV system has been laid out by an electrician or draftsman who thinks that TV can be wired like a nurse-call system in a hospital. On these you can lose your shirt, since the building owners will insist on concealed wiring and the conduit layout may make it almost impossible. The author recently turned down a 200-room hospital installation because of this. Some runs had cable losses alone over 70 db! This ignorance of TV systems is a good break-in point for the technician who is looking for this type of work. By offering his services on layout of systems to an architect, he can make a friend and write his own specs, thus getting an immediate bidding advantage.

The harder jobs (and also easier ones) will come when existing buildings are being wired. Here is where much money and labor can be saved by a little preliminary cerebration, which is just a high-priced word for "horse sense."

The first thing to look for is the presence of "dead space"—areas which adjoin those to be wired, but in which it does not matter if the wire is not concealed. Such spaces are basements (unfinished), attics, or "crawl" spaces above or below finished rooms. Such spaces can accommodate feeder cables in the horizontal direction. When wiring is done so that feeders run vertically, "drops" (as in multi-floor buildings), air-vent ducts, elevator shafts, "furring" for pipe or conduit runs, and even closets such as broom closets may be used when these elements are placed one above the other.

When none of these vertically aligned spaces are available, interior wiring can be considered; and then, as a final resort, wiring concealed in special molding may be the answer. Of course the use of unconcealed wiring, always possible, needs no real discussion.

Let's consider the case where a dead space is available over the ceiling of a motel. At first glance, it looks as if the cable could be run across the ceiling joists, down inside the wall, to an outlet of the combined isolation and matching type, then back up to the dead space, across to the next room, down, up, and so on. This can be done. However, in modern frame construction, there will be a "fire stop" between the studs, usually about halfway up, as in Fig. 1.

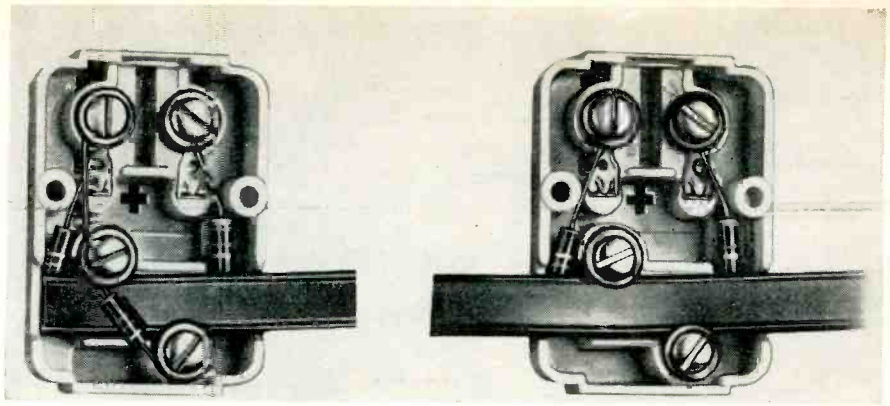
The purpose of these stops is to prevent drafts from developing in the walls, thus slowing the spread of fire if one should occur. For the technician wiring a building, fire stops are a solid deterrent to running vertical wires in partition walls. If the job must be done, plaster must be broken above and below the fire stop and the stop itself notched to allow cable passage.

In the motel, advantage can often be taken of the closet. If the outlet can be placed on a wall that "backs up" on a closet, the cable may be brought through the ceiling of the closet, then through the wall of the closet into the back of the outlet, as in Fig. 1B. Usually there is no objection to the exposure of the cable in a closet as long as none is visible in the room.

When wiring can be done from a basement or crawl space beneath a one-story building, the fire stop is no deterrent. The difficulty here is in locating the points to drill up into the space between the plaster surfaces. The best technique here is to drill a small hole back an inch or two from the edge of the baseboard through the floor—a hole as small as possible, using a bit of about $\frac{1}{16}$". Measure the distance to the face of the wall from the hole, drop a small piece of bright wire through the hole, then locate the wire below the floor. Knowing the distance from this point to the wall surface, add 2" to this measurement and then drill up into the wall. Fishing cable into the opening for the outlet is then no problem.

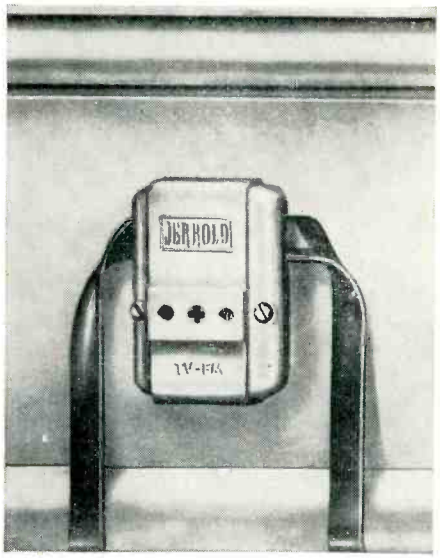
In either of these two wiring techniques note that the actual cable length has been increased over the point-to-point distances indicated on drawings. In wiring below the floor, an additional 4 or 5 feet may be added

Multi-Set TV Installations

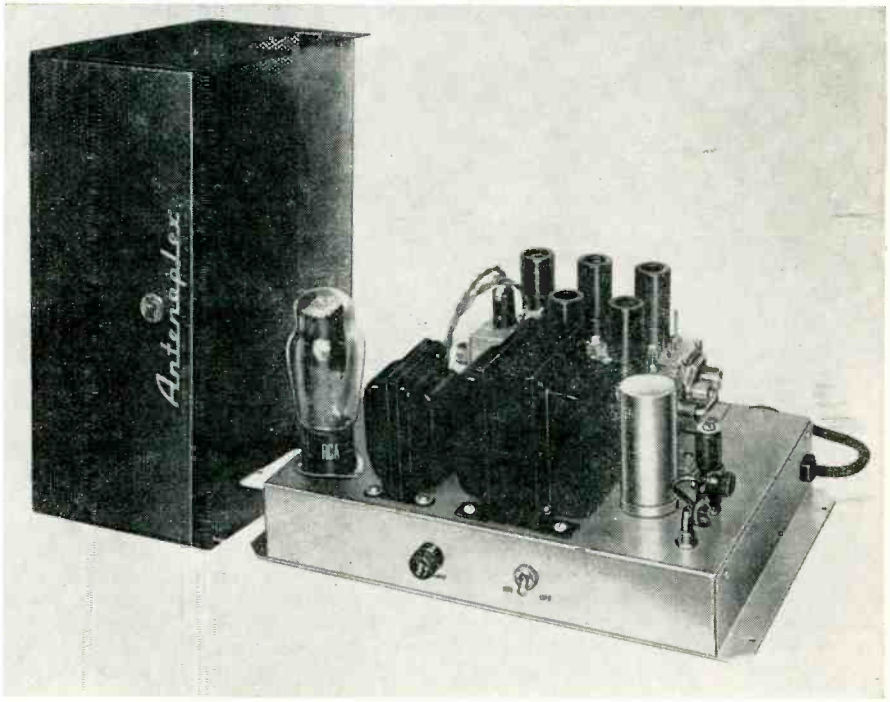


Inside view, from the rear, of two wall-mounting outlets for feeding TV sets. The extra resistor in the unit to the left is shunted directly across the 300-ohm line. It is used where the line is terminated in any given outlet. These units are used chiefly in modest, 300-ohm, home distribution systems.

← Front view of receptacles shown above and to the right, made by Jerrold.



One type of broadband v.h.f. distribution amplifier, the RCA SX-2LH, is designed for medium gain, medium-power output, and optimum v.h.f. response.



per room, which is usually insignificant. In the over-the-ceiling method, from 12 to 16 feet per room may be added—roughly an additional decibel of loss per room. This can be serious.

When confronted with this situation, a change in distribution technique may solve the trouble. We have been discussing the type of tap that combines isolation and matching in one container. By using the type that provides isolation in one unit and match in another, the over-all line length can be reduced.

Fig. 3 illustrates such an application. The isolation unit cuts into the line above the ceiling and a *single* coaxial line descends to the terminating outlet in the room. With this technique, the feeder cable itself remains very close to the length determined by point-to-point measurement. However, the *set* on a "drop" in such a wiring method sees the isolation loss of the tap-off unit *plus the loss in the drop line*. A building drop, usually only a few feet, can be neglected; but if some vagary of construction requires any considerable length this loss must be taken into account when determing set levels of signal at the receiver.

The trick of mounting outlets back-to-back when adjoining rooms are being wired should always be considered. Electrical outlet boxes are available that can be set into a wall in such a fashion that both sides are open, and each side will accept a standard outlet. When you are wiring a series of rooms, these can cut the number of descending and ascending cables in half. Fig. 2 illustrates this.

Care should always be taken that coaxial cable does not rest on uninsulated steam or hot-water pipes. The dielectric of these cables softens with heat and the center conductor can then "migrate" away from its central position. This changes the characteristics of the cable, causing a "lump" or discontinuity in the line, which can be a source of reflections. By the same token, cable fasteners should not be tightened excessively, since "cold flow" —a deformation resulting without heat —also occurs.

Many jobs must be done in buildings using solid walls, usually cement block but sometimes brick or tile. If the ceilings do not allow access or the dead space is too small to be usable, wiring can be run externally, usually under the eaves, but sometimes buried next to the wall. These cases almost invariably require separated isolation and matching units. Part of a typical installation using this technique is shown in Fig. 4. The closet trick can be used here, also: enter the closet high up, under the eave; then drop down to the appropriate level for the tap on the outside wall of the closet (interior of the room).

This method of installation is peculiarly adapted for existing hospitals, the feeder wires running around the sides of the building at a level just below the windows and drops going in through holes in the walls. The method has the advantage of very little interference with the interior of the building. If care is used, little or no plaster patching need be done. Each opening for a drop should be calked after the tap is mounted. Use an ordinary calking gun or the self-applicator types of calking compound available in hardware stores.

Hotels pose a special problem, but are usually very easy to wire nevertheless. Practically all hotels have vertical raceways built in, one raceway rising between each pair of rooms. These raceways may be ventilating ducts,

wireways, or pipeways. They are usually "furred" into a column or a wall corner. (The term "furred," in construction work, refers to a false construction to hide a hollow space.) For example, many of the huge columns seen in large, open buildings are not as large as they look—they have been furred out to provide space for ascending and descending services.

When laying out a hotel installation, the wiring is done so that rooms are wired in "columns" vertically, not in horizontal "ranks," along a floor. The feeder lines are usually called "risers" (even though they may run down instead of up!). In nearly all cases, the outlet may be cut directly into the wall of the raceway. The feeder then drops from outlet to outlet. Where cutting the outlet into the wall is ruled out, the isolation tap can be used and a drop run exposed along a baseboard or under the molding to a terminating outlet. It is quite feasible to mix these tap-off units along a line so that one outlet is a combined type and the next the separated type. A peculiarity to note here is that there will be two rooms to each floor on each riser in most cases—watch this when figuring out line losses.

In any case, try to avoid exact periodicity in cutting taps into a line—try to keep a varying length of cable between each tap. When taps are cut in at exactly equal spacings, the small discontinuities caused tend to pile up an error at one frequency, which may result in a "suckout"—heavy attenuation occurring at one frequency or one small band of frequencies.

In this connection, the author recalls a case where some thousands of feet of RG-11 type cable had been run in the forming rolls during manufacture at a time when the forming rolls had picked up a quantity of some foreign matter. This resulted in a slight thickening of the cable's polyethylene dielectric, occurring regularly spaced at a length equal to the circumference of the rolls. This cable exhibited an attenuation of 56 db per thousand feet as compared to a normal attentuation of 18 db—*but only at 69 mc.* The net result was an impossibly distorted channel-4 picture. This was many years ago—and present-day manufacturers take precautions against such occurrences—but it shows the danger of periodic discontinuities. Practically all manufacturers of coaxial cables today sell, at a slightly higher price, cable that has been "swept," that is, it has been inspected by measuring the results of feeding signals from a sweep generator through it, thus exposing excessive losses at specific frequencies.

The sweeping technique, which is possible for a well-equipped service shop, is illustrated in block-diagram form in Fig. 6. The test is performed by first setting up the equipment as illustrated, but leaving the cable out, and using more attenuation in the variable attenuator than the expected cable loss. Thus a reference pattern can be developed on the scope that is really the combined response curve of the generator and amplifier. This may be recorded or traced.

Now the cable is inserted as shown in Fig. 6 and attenuation is reduced with the variable attenuator until the scope trace returns to the previously recorded height at any given frequency point. The amount of attenuation taken out is the loss of the cable, at the frequency involved. Since the curve will change shape, this check may have to be performed at various frequencies, which can be identified by markers. These curves will invariably show a ripple across the tap. As long as the ripple does not exceed 3 db, it can be ignored. Fig. 5 shows some typical curves across a single channel. The amount or depth of these ripples can be estimated closely by noting the amount of attenuation that must be taken out to bring the dip in the curve up to the average level. Two things need to be watched. The amplifier used must have more gain than the normal losses of the cable and care must be taken that the amplifier is not overloaded.

Speaking of amplifiers, certain precautions need to be observed in installing them, the first of which involves safety. These units develop heat and care must be taken that such heat cannot accumulate to cause a fire or amplifier damage. When equipment cabinets are used, they must be louvred or ventilated in some way to keep amplifier temperatures in the normal range.

The a. c. supply should be taken from lines not subject to sudden heavy loads that may produce excessive line-voltage variations. If installation must be made in areas of heavy vibration, such as occur in some elevator lofts (primarily those for freight elevators), shock-mount the amplifiers, using springs—not rubber. Springs of the type used on screen doors may be cut up and applied as in the old-fashioned microphone mountings.

Don't allow coaxial cables to flap or rub against surfaces. Perforation of the outer jacket allows moisture to creep in next to the braid, with consequent oxidation of this braid. This kind of rot can cause severe headaches for service personnel, since the cable slowly increases its losses. The process may take months, and the trouble is extremely hard to find. For the same reason, don't use coaxial cable that shows obvious signs of abuse.

One final word. Keep your instruments—field-strength meter, sweep generators, and marker generators—in calibration. —30—

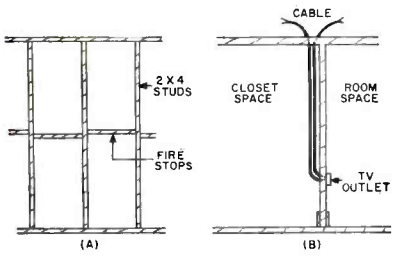


Fig. 1. Firestops (A) hamper vertical running of cables. However, closet space (B) can be used to hide wiring, with outlet on room wall of closet.

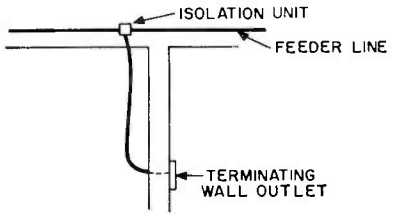


Fig. 3. Separate units for isolation and matching can reduce line lengths.

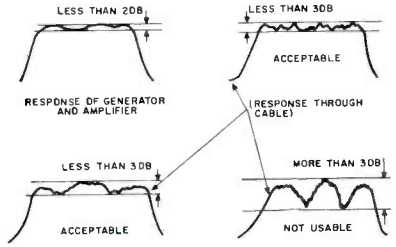


Fig. 5. To check cable by the sweep method, compare response of generator and amplifier (upper left) with that observed when cable is added to set-up.

Fig. 4. If suitable wiring space is not available in the structure, external under-the-eave wiring can be used.

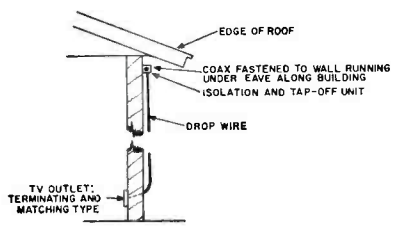


Fig. 2. Wiring outlets for adjacent rooms back-to-back cuts line lengths.

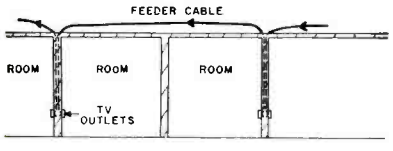
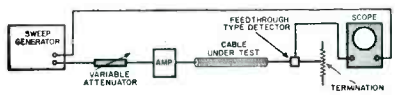
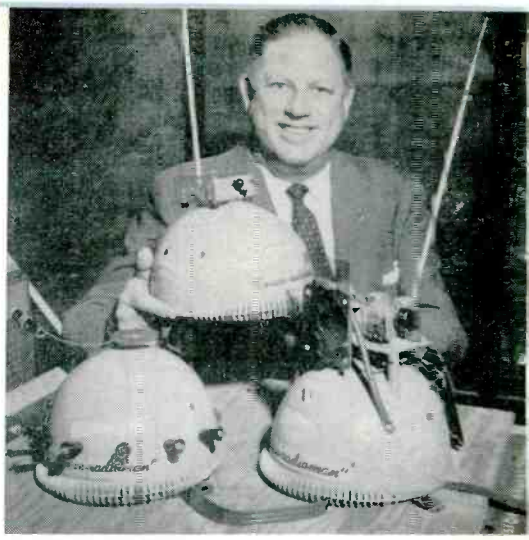


Fig. 6. This set-up for sweep-checking transmission line exposes undesired deviations in cable frequency response.



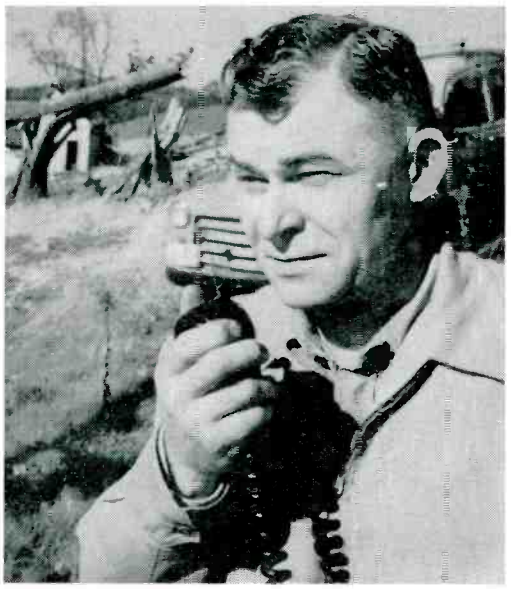
EDWIN B. HAINES

ALBERT P. KAZLKONIS

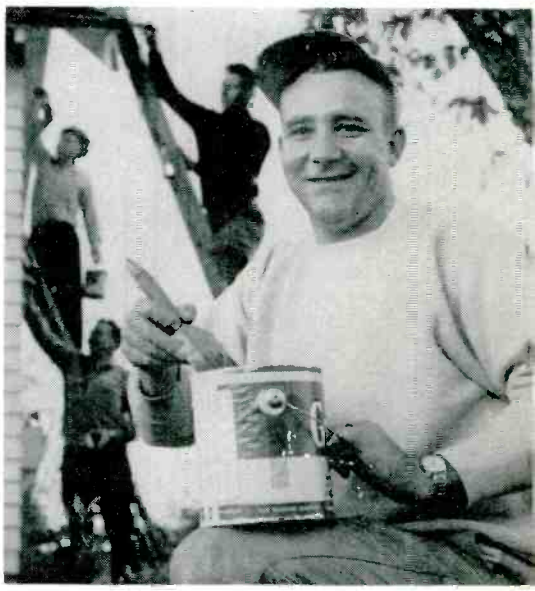


STANLEY EVERETT

All-American Service



VERNON TOWNSEND



BRYCE R. McNEELY

THEODORE W. FICKERT

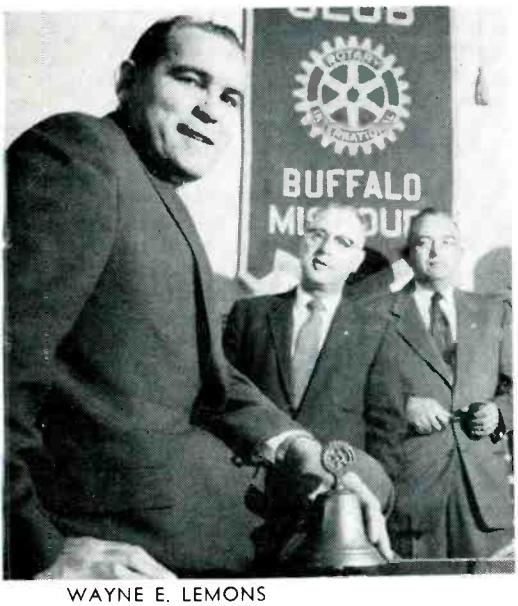
VERNON E. BROOKS

AT A PRESENTATION in Washington, D. C. on November 21, ten men stepped out of the ranks of TV service and into the limelight to accept trophies and $500 checks. They were receiving *General Electric's* 1958 All-American Awards from general manager Irvine D. Daniels of the *G-E* receiving tube department. Senator John Sparkman, of Alabama, one of the judges who helped select them, was speaker at the ceremony. Others on the award committee were Bennett Cerf, publisher and TV panelist, and Charles E. Shearer, 1957-58 president of the National Junior Chamber of Commerce.

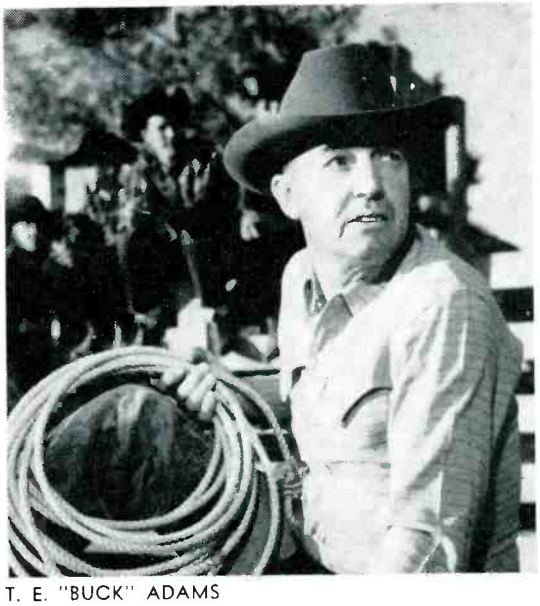
The winners make an interesting comparison with the group chosen for 1957. The first list showed more men honored for single exploits, often involving their roles as hams in floods, plane crashes, and other emergencies. The 1958 group is stronger in men who have made marks in less dramatic, long-range projects reflecting civic and business responsibility. Many are active in service associations:

This year's list of ten television and electronic technicians honored by General Electric for unusual community services in 1958 reflects some interesting changes in emphasis as compared to the award winners who were similarly honored for 1957.

Technician Awards: 1958



WAYNE E. LEMONS



T. E. "BUCK" ADAMS

A. GEORGE CATAVOLO

EDWIN B. HAINES, Bloomington, Minn. (*Oxboro Radio & TV*), was outstanding in a home-town, youth sports program involving over 2000 youngsters in several sports. A Boy Scout leader, he is also active in the Centennial, Lions Club, and Civic League.

ALBERT P. KAZUKONIS, Brockton, Mass. (*Brockton TV*), instructs Boy Scouts and other youth in radio fundamentals, contributing time and materials. He is active in promoting better business ethics.

STANLEY EVERETT, Alhambra, Calif. (*Everett's TV & Radio Sales*), has contributed used TV sets to Parent-Teacher Association drives; developed a radio space hat to publicize fund drives for veterans' hospitals and other institutions; leads in civic work in Kiwanis Club, Masonic Lodge, Valley Businessmen's Association, Valley Boulevard Associates Committee, and the Community Church.

VERNON TOWNSEND, Menomonie, Wisc. (*Townsend's Radio*), provided radio communications during a tornado last June; devotes much time to civil defense emergency radio facilities and networks in Dunn County.

BRYCE R. McNEELY, Kelso, Wash. (*McNeely's Ace TV*), assists in a wide range of work from child safety to soil conservation; led a volunteer group in painting the home of an aging widow; donated a lot as a children's playground; is state v-p of the Junior Chamber of Commerce.

THEODORE W. FICKERT, Hatfield, Pa. (*Hoover's Radio-TV Sales & Service*), is a youth recreation leader; helped organize and held office in the local Junior Chamber of Commerce; served on the Boy Scout Council; is a Heart Fund leader; and promotes good community-business relations.

VERNON E. BROOKS, Norristown, Pa. (*Brooks Electric Co.*), led the American Business Club in sponsoring scholarships for therapists to work with paralytics, and in a fund drive for a school for the handicapped. He is active in the Chamber of Commerce, Red Cross, Community Chest, and other bodies, provides free service to religious and charitable groups.

WAYNE E. LEMONS, Buffalo, Mo. (*A-1 TV & Radio*), conducted after-class electronics courses in Missouri schools and has been active in Little League baseball and Rotary.

T. E. (BUCK) ADAMS, Channing, Tex. (*Adams Appliance & Hardware*), donated material and labor for electrical and plumbing work in his church. "He will do anything to help a fellow man," reports a booster, "repair a broken-down jalopy, pen a wild cow—where there is trouble, there you will find Buck at work."

A. GEORGE CATAVOLO, Somerville, Mass. (*Elm Radio & TV Service*), donates equipment, time, and service to schools, churches, and youth groups to promote electronics education and reduce delinquency. He has bought full-page newspaper ads ("Open Letter to President Eisenhower") urging improvement in education.

By JOHN T. FRYE

Cold and Hot

MONDAY was not Barney's best day. Weekend dating usually left the Number Two Man of Mac's Service Shop pretty sleepy; so Mac was not astonished when he returned from lunch to find his assistant precariously perched on a high stool and slumped over the service bench with his tousled red head pillowed on his folded arms, sound asleep.

Mac glanced from the figure at the bench down to the tall round can he carried in his hands; then he noiselessly removed the protecting cap from the spray nozzle on top of the can and tiptoed quietly across the room. Holding the can several inches from the head of the sleeping youth, he depressed the valve. A white, disappearing cloud hissed forth and played around the nape of Barney's neck.

With a yowl of surprise the boy leaped to his feet. "Wow! What a draft! Must be getting lots colder outside," he exclaimed as he rubbed the back of his neck. "Oh, oh!" he continued as he spied the can in Mac's hands; "what are you up to?"

"That's your cold draft," Mac said with a grin as he punched the valve again. "It's *General Cement's* 'Spray-Koat Circuit-Cooler'."

"So what's it good for besides going around annoying innocent people?" Barney asked with a huge yawn.

"It's actually freon gas under high pressure," Mac explained. "You use it on a circuit component you suspect of being temperature-sensitive. When this gas hits a radio part, that part gets very, very cold in a great big hurry."

"Hm-m-m-m, you're filtering through to me. That ought to be just what the doctor ordered for those radio and TV sets that display intermittent symptoms when they are first turned on. After these sets warm up a bit, the annoying condition disappears until the set is turned off and allowed to cool down completely; then it's right back. When you're trying to troubleshoot one of these little dandies, you have to act fast and catch it cutting out when it's first turned on or you're out of luck. They are great time wasters. In the past I've seen you put these sets outside in the winter or in the refrigerator in the summer to make them good and cold. Now we can put the chill on them right on the bench with that bottled north wind."

"And the good part is we can make that north wind blow exactly where we want it. We can cool off a small section of the circuit—or even a single part, such as a dubious capacitor—without affecting the rest of the circuit. And don't overlook the fact that it can also be used on those sets that cut out *after* they get warm. You simply spray a section of the circuit at a time until the set starts to operate again. That tells you where the defective component is. When the set cuts out again, you can cool off a part at a time. When the right one is chilled, it will make the set come back on."

"Man! That's real cool!"

"There are some horse-sense precautions to observe in using the stuff. For one thing, don't play the spray on the skin at close range. It will actually freeze a chunk of the flesh in nothing flat. The salesman was telling me one of their boys was demonstrating the stuff by squirting it on the palm of his hand, and he developed a nasty 'burn' that was really a frostbite. The closer the nozzle is held to an object, the colder that object gets. You will see a sort of rime appearing on an object sometimes, but it disappears immediately. I'm told the gas leaves no residue to interfere with electronic action."

"I suppose another horse-sense precaution is to see the spray doesn't fall on a hot glass tube," Barney observed. "I'll bet you could really crack a rectifier bulb that way."

"You certainly could," Mac said as he placed the can on the shelf with the imposing array of chemicals used in service work. There was contact cleaner, corona dope, cement solvent, alcohol, carbon tetrachloride marked with skull and crossbones, acrylic spray, "Lubriplate" and silicon gel, and recorder head cleaner.

Mac picked up a high-voltage doorknob capacitor from the bench and favored it with a sour look.

"Wish I could work out a quick and accurate way of checking this cuss," he commented. "It really gave me a hard time. The set came in with no picture. Checking revealed the high voltage was only about three or four kilovolts. The first thing I did was put the ohmmeter of the v.t.v.m. that reads up to 1000 megohms across the capacitor. It showed no leakage at all.

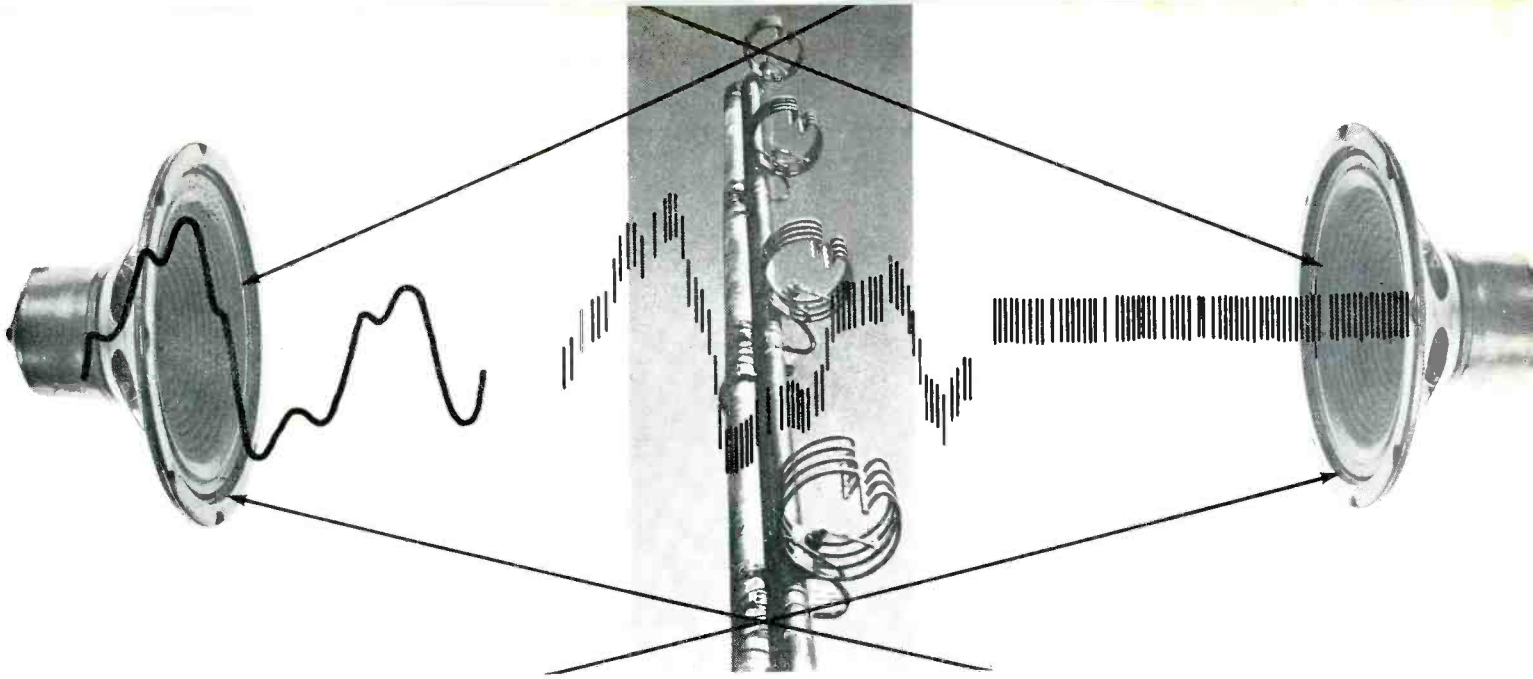
"A drooping high-voltage symptom is often a headache because it can be produced by so many different circuit defects. The accompanying symptoms did not help much, either. The boost voltage was low, but cutting in an outboard boost voltage supply did not restore the high voltage. Neither did changing the horizontal oscillator, horizontal output, damper tube, or high-voltage rectifier. The waveform at the grid of the output tube was somewhat lower in amplitude than rated, but this was not enough to cause the trouble. I checked the output transformer for shorted turns, but nothing was wrong.

"I happened to touch this capacitor while I was making the last test, and it was noticeably warm. I determined to cut it entirely out of the circuit, even though this took a bit of doing. When I did so, the high voltage flipped right up. Replacing the capacitor restored everything to normal; however, it was necessary to replace the high-voltage rectifier that probably had been damaged by the heavy current drain.

"But then I started trying to find a check of this capacitor that I knew to be bad that would show it so. I had absolutely no luck. I used our ohmmeter that places 450 volts across the test leads and reads up to 20 megohms, but this capacitor showed no more leakage than a brand new unit. Next I tried our leakage tester that uses a neon bulb to indicate leakage resistance up to 500 megohms, but this also failed to show anything wrong.

"I've finally concluded the capacitor has no leakage until a certain critical voltage is reached; then it abruptly develops a comparatively low resistance. Any attempt to test the capacitor with voltages below this critical potential must fail to show anything wrong. I was talking this over with my friend, John, who works in an experimental laboratory and also does some TV service work. He was telling me he had run into identically the same thing and had decided to see what happened to the capacitor when it was subjected to an increasing voltage. The lab has a source of d.c. voltage that can be increased from zero up to twenty thousand volts and he put this on the defective capacitor. When the voltage reached about 5000 volts, the capacitor suddenly shorted and exploded and blew bits of itself all over the lab."

(*Continued on page* 112)



FM MULTIPLEX -ITS PRESENT AND FUTURE

By **PAUL F. HILLE, Jr.**
Polarad Electronics Corp.

Part 1. Authoritative article on basic principles of a technique that promises stereo from a single FM station.

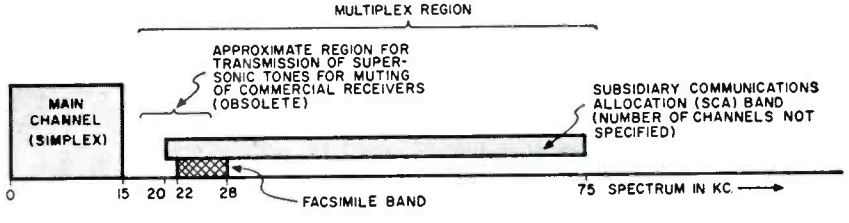
SEVERAL years ago the inception of color television provided the electronic industry with a practical example of r.f. spectrum conservation. To what was generally considered to be an already crowded television frequency band, engineers managed to add a significant amount of information necessary for the effective transmission of TV programs in full color. Concepts involving modulation and demodulation in suppressed-carrier processes, band limiting, and phase considerations were employed in addition to the previously common techniques associated with conventional amplitude-modulation systems. Of special significance is the fact that this color information was incorporated (theoretically, at least) into the standard monochrome transmissions without appreciably affecting the technical quality of the latter.

The matter of spectrum conservation has been of special import to FM broadcasters for some time. Many critics of frequency-modulation transmissions have been able to argue effectively that the spread of a 50 to 15,000 cps audio band over an r.f. frequency realm some 200 kc. wide is, at best, extremely extravagant when the lack of channel space for commercial and military applications is acute. Not at all impressed by the efficacy with which an FM system distributes its modulation energy over a wide spectrum, these critics have pointed out that the relative amount of energy per sideband pair is often very low in high-deviation transmissions. Faced with mounting objections from this quarter, and also taking cognizance of the fact that many FM stations are having difficulty in marketing their programming commercially, the FCC finally allowed a limited type of non-broadcasting operation within the standard frequency-modulation band from 88 to 108 mc. The fact that these point-to-point transmissions have been taking place for the past three years without the average FM listener being aware of them attests to the technical merits of the process. Practically, these allocations have enabled many FM stations to offer long periods of high quality classical music with few commercial interruptions while still allowing the station to sell other facilities to the industry and business at a reasonable profit. Strict engineering standards prevail, however, so that the normal broadcast aspects of FM transmissions are not adversely affected.

Fig. 1 shows the presently allocated *audio* spectrum of stations in the standard commercial FM band. It is important to realize that we are considering the audio-modulation spectrum of the station and not the actual 200 kc. r.f. channel allocation. In effect, it may be said that the multiplex spectrum is only available after the demodulation process at the receiver, although it will be apparent that the r.f. spectrum of the transmission will also reflect the additional information being transmitted by the fact that more sidebands are in existence in areas where none would normally be situated in standard simplex operation.

From Fig. 1 it may be observed that the audio-modulation spectrum has been defined as far as 75 kc., 55 kilocycles of which can be called the multiplex region. The multiplex region itself is divided into two sections, a facsimile band occupying the spectrum from 22 to 28 kc. and a subsidiary communications band from 20 to 75 kc. With respect to facsimile broadcasting,

Fig. 1. Audio modulation spectrum of FM stations. In addition to the 15 kc. band reserved for the standard broadcast transmissions there are available several other services to a commercial consumer. The subcarrier modulation used in the facsimile band can be either FM or AM; in the SCA band, AM is not permitted. Stereo transmissions will probably be made in a part of this band. Refer to text.



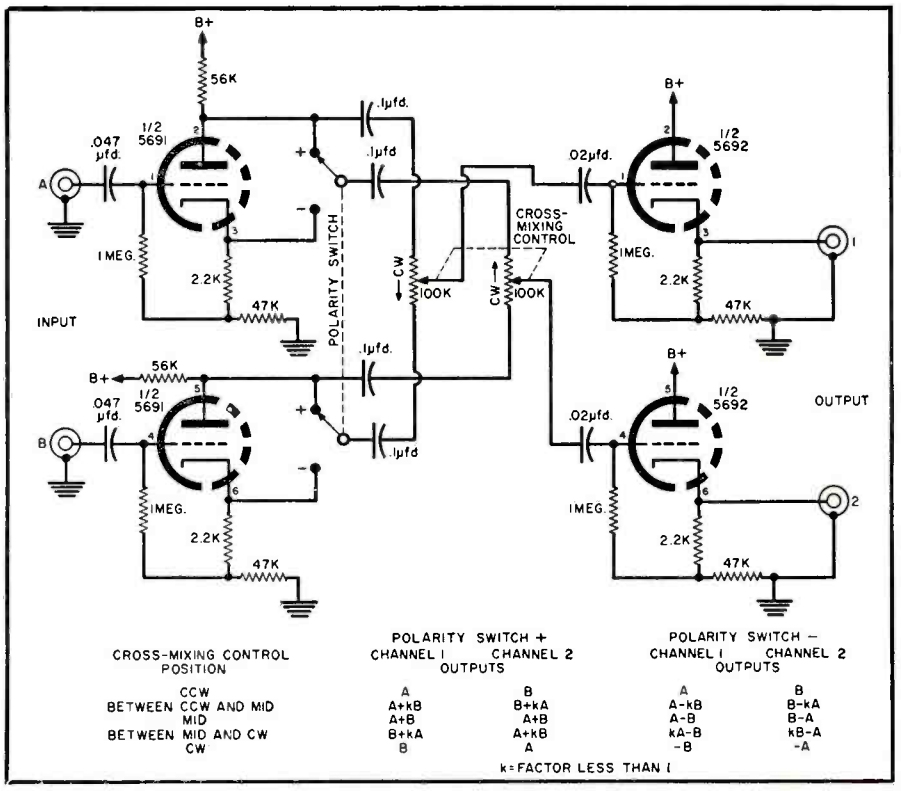


Fig. 2. A cross-mixing amplifier used to balance two stereo channels. This circuit is essentially that which is used for the AM/FM stereo transmission system shown in Fig. 3B. It may also be used to advantage in home music systems.

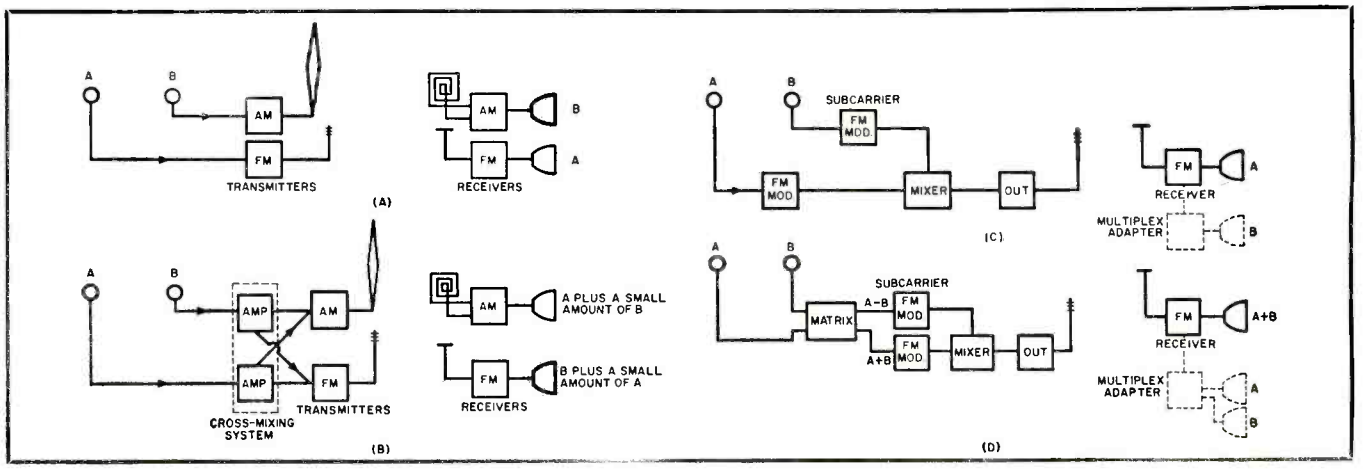
it will suffice to indicate that either amplitude- or frequency-modulation of the subcarrier is permitted; with the AM sidebands or instantaneous subcarrier frequency not extending outside of the 6 kc. band. To protect the main channel from the raucous sounds associated with crosstalk from a facsimile transmission, the main FM carrier cannot be modulated beyond 5% (of ±75 kc.) by the subcarrier and its sidebands. The SCA (Subsidiary Communications Allocation) band is restricted to use as a medium for the transmission of commercial material of a non-broadcast nature, such as background music, news, stock quotations, and the like. It is particularly important to remember that, according to law, these are *private* point-to-point services and it is unlawful for unauthorized persons to derive remuneration from such transmissions. Unlike the obsolete method of muting certain portions of normal simplex FM programs by means of supersonic tones, the multiplex system effectively removes the commercial service from the home listener.

Technically, the SCA band is interesting because very little was specified concerning operation therein except that the system be frequency modulated and restricted to the allocated region. Persons familiar with FM theory will realize that a relatively large number of possible modes of operation are practical within such a spectrum. As an example, consider the operations outlined in Table 1. Assume we have two modes of subcarrier modulation, the first with a peak-to-peak deviation occupying 3.5 kc. and the second with a p-p deviation of 16 kc. Although the sideband distribution of the latter extends to a maximum of 40 kc., as against 30 kc. for the former, both may be operated within the SCA band at the same time since their peak deviations add up algebraically to only about 20 kc. In other words, the spectrum allocation is based on instantaneous frequency of the subcarrier and not on the position of the last sideband in the subcarrier modulation spectrum. Because of crosstalk considerations, however, the average FM station is usually content with one, or at most two, subcarrier channels—with a guard band conveniently placed between. In addition, as Table 1 shows, it must always be remembered that the minimum sideband distribution for an FM signal can, at best, be only equal to that of an AM signal with the same modulating frequency. This is another way of saying that there must be *at least* one pair of sidebands spaced f distance from the carrier, where f is the audio modulating frequency.

Crosstalk

Before moving on to a discussion of actual circuitry in connection with multiplex systems, it is worthwhile to mention briefly some of the aspects connected with the problem of crosstalk. As far as the FCC is concerned, the crosstalk problem connected with multiplex operation is significant only with respect to its effect on the main channel. Establishing limits on this interference assures, as was previously mentioned, the high quality of reception associated with FM broadcasting. The actual specification, as applied to frequency modulation of the main carrier by the multiplex operation(s),

Fig. 3. Several simplified versions of stereo transmission and reception. The method shown in (A) represents the conventional method of AM/FM stereo transmission which has been criticized on several counts. The system of (B) attempts to remedy one obvious fault of (A) in that listeners with only one mode of reception will receive only half the program information. The transmission system in (C) is obviously unsatisfactory for reasons similar to those rejecting (A). The "sum and difference" method proposes a matrix system at the transmitter itself. As a result of this important technique it is possible to obtain almost complete reception of program information by a listener with an ordinary FM receiver (D).



states that such interference must be at least 60 db below 100% modulation (the latter in FM transmission is equivalent to a deviation of ±75 kc.) in the simplex band from 50 to 15,000 cps. This means that if the main channel audio output of an FM receiver discriminator is 1 volt peak-to-peak for a simplex transmission, any residual audio modulation related to the *multiplex* operation(s) can have a maximum superimposed amplitude of only one millivolt. Since most commercially available home receiver systems are not capable of resolving a dynamic range of this magnitude, it can be assumed that the multiplex operation will go unnoticed by the casual listener.

While the transmitted audio-interference component of the multiplex channel impressed onto the main channel should not exceed the −60 db level just indicated, the amount of *modulated subcarrier* superimposed on the main-channel detected audio output in the FM tuner may go as high as 10 db below 100% modulation. This corresponds to 30% modulation of the main carrier by the subcarrier(s) and would result in a .33 volt peak-to-peak signal riding on our previously established 1 volt p-p reference (see Figs. 4 and 5). For SCA operation, this .33 volt p-p component must be a frequency-modulated signal, so that with reasonable precautions following the discriminator in the receiver and in subsequent amplifier systems there should be little difficulty in preventing undesired subcarrier demodulation. This condition would be quite different if an AM subcarrier were used, as is the possibility with facsimile multiplex transmissions. Since there are usually many possible sources of amplitude non-linearity in conventional home receivers and amplifier systems, there would be a good chance that an AM subcarrier would be demodulated somewhere along the path from FM discriminator to loudspeaker. Depending on the amount of demodulation which could result, the existence of such an AM subcarrier might well be objectionable. This is one reason why modulation of the primary FM carrier by the subcarrier in facsimile multiplex transmissions must be held to a maximum of 5% (of ±75 kc.), resulting in a maximum superimposed subcarrier component of 50 mv. in the reference receiver.

In relating the relative amounts of the various components at the output of the receiver discriminator, it must also be mentioned that an FM station cannot legally exceed 100% modulation of the main carrier under any condition, irrespective of the possible presence of one or more subcarrier channels. This explains why stations which engage in multiplex operation produce less volume in a conventional FM tuner than their counterparts without subcarrier transmissions. In other words, the peak-to-peak amplitude of the composite modulating signal shown in Fig. 5B must not exceed the p-p amplitude of the signal in 5A, if the latter represents 100% modulation.

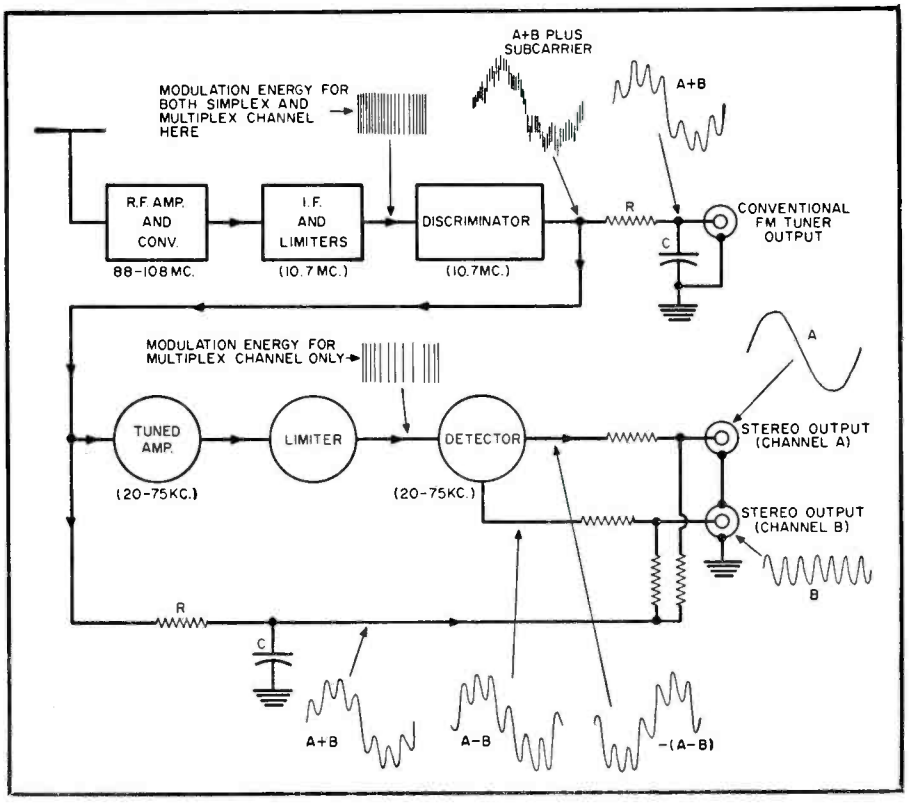
In the matter of crosstalk just discussed, there are two items of importance which were ignored. One is the effect of the de-emphasis network which follows the detector in standard FM receivers. Because of the 6 db/octave slope of this network, the subcarrier component will be attenuated by at least 20 db relative to 1 kc. at the detector output, thereby considerably reducing the problem of crosstalk in following circuits. Of course, it must not be forgotten that any inherent phase distortion in the circuitry *preceding* the discriminator in an FM tuner will also play a part in raising the level of cross modulation and will produce effects which are far more detrimental to the multiplex channel than to the main channel. This may be readily conceived by considering the relative modulation energy contained in the main channel as opposed to the secondary channel. For these reasons most FM stations which operate a multiplex service not related in modulation content to the main channel find it necessary to eliminate the subcarrier during silent periods in the multiplex

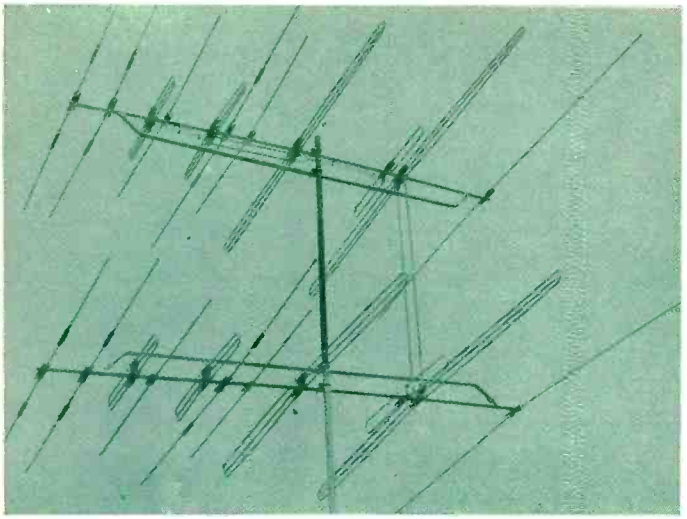
(*Continued on page* 139)

MODULATING FREQUENCY (cps)	MODULATION INDEX β	NO. OF SIDEBAND PAIRS GREATER THAN 5% OF UNMODULATED SUBCARRIER	REQUIRED CIRCUIT BANDWIDTH (kc.)
		(Subcarrier Deviation = ±1.75 kc.)	
75	23.40	21	3.75
300	5.80	8	4.80
1000	1.75	3	6.00
6000	0.29	1	12.00
10,000	0.18	1	20.00
15,000	0.12	1	30.00
		(Subcarrier Deviation = ±8 kc.)	
300	26.7	21	16.00
1000	8.00	10	20.00
6000	1.33	3	36.00
10,000	0.80	2	40.00
15,000	0.53	1	30.00
		(Subcarrier Deviation = ±25 kc.)	
1000	25.00	21	52.00
6000	4.16	5	60.00
10,000	2.50	4	80.00
15,000	1.66	3	90.00

Table 1. Sidebands and bandwidth for transmission with subcarrier having 6.4%, 29%, and 91% modulation. A ± 27.5 kc. deviation (covering the entire subcarrier band from 20 to 75 kc.) would be equivalent to 100% modulation.

Fig. 4. Block diagram of conventional FM receiver and single-channel multiplex adapter showing signal waveforms throughout the receiving system for the "sum and difference method" of stereo transmission. Most of the subcarrier is eliminated by the de-emphasis networks R and C. The waveforms are drawn for two pickup frequencies of 1 kc. and 7 kc. on stereo channels A and B respectively.

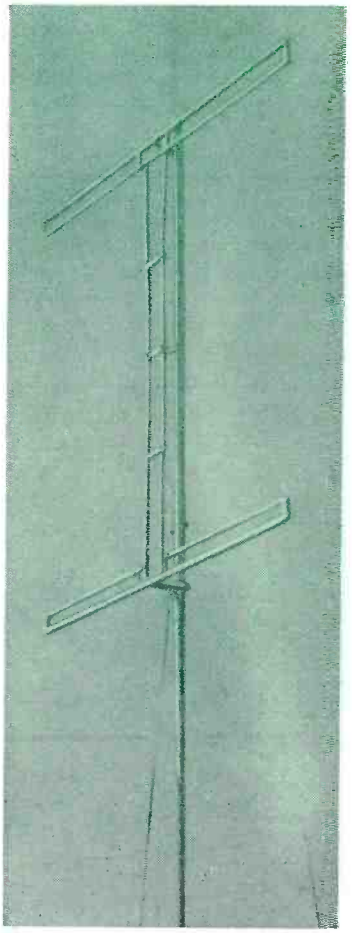


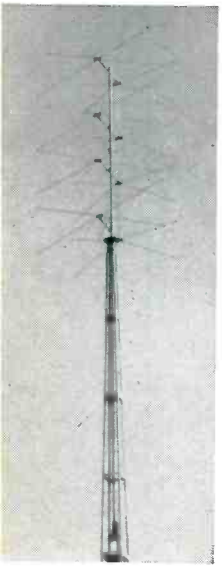


By **WALTER H. BUCHSBAUM**
Television Consultant, RADIO & TV NEWS

If more signal is what you are looking for, haphazard connection of more than one unit won't get it. Here are the things to take into account.

The Right Way to Stack Antennas





Arrays on this page suggest the broad possibilities of stacking. A 2-bay conical appears at the upper right, a 2-bay yagi at upper left. Two stacked dipoles are directly above, and a 4-bay conical is shown at the left.

WHENEVER the signal obtained from one antenna proves insufficient, the possibility of using two antennas immediately suggests itself. It is generally understood that the spacing and connections of two or more antennas must be arranged in a certain way to get stronger signals. Most of our readers also know that two antennas do not give simply twice as much signal. As a matter of fact, the theoretical maximum from two antennas is considered to be 1.56 times the (voltage) signal strength from a single antenna, or 3.86 db.

Whenever two antennas are brought near each other, they will affect each other's impedance and pickup characteristics as well. As they are spaced farther apart, this interaction will be less. However, if they are spaced too far apart, it becomes difficult to connect them together properly, and losses in the connecting lines eventually nullify any advantage of using two antennas.

The simplest case of stacking involves the use of two identical antennas, spaced one above the other and connected by quarter wavelength matching stubs, as shown in Fig. 1A. Although half-wave dipoles are shown here, all of the data applies just as well to the stacking of yagis, conicals, or any other antenna types. Every antenna configuration has a characteristic impedance which is made up of a variety of different factors such as radiation resistance, inter-element mutual impedance, and others. For our purposes, only the sum total—the characteristic impedance at the antenna terminals—is important. In the example of Fig. 1, this characteristic antenna impedance is called R_1 for the upper and R_2 for the lower antenna. In the case of simple dipoles, this would be about 73 ohms for each; but most TV antennas tend toward a 300-ohm characteristic impedance. Before any stacking arrangements are considered, this impedance must be known: manufacturer's data sheets should be consulted if any doubt exists. The second impedance that must be known is the characteristic impedance of the transmission line. For most TV installations, conventional 300-ohm twin-lead is used.

Fig. 1B shows the electrical equivalent of the antenna stacking arrangement of Fig. 1A. Each antenna is represented as a voltage source and a resistance (R_1 and R_2) and each quarter wavelength ($\lambda/4$) matching stub is shown as a transformer. The primary of each transformer is connected to the antenna impedance. The two secondaries are connected in parallel to the terminals (T_1) of the transmission line. We know that the impedance looking into the transmission line at T_1 should be 300 ohms. Therefore, the impedance looking out of each matching-stub transformer must be 600 ohms, so that the parallel combination is correct.

Fig. 2 shows the configuration of a matching stub that is one-quarter wavelength long. The same operation is obtained with 3/4, 5/4, etc. wavelengths —any *odd* multiple of a quarter wave. At one end is the antenna impedance R_1 and at the other the desired impedance R_T, which should be connected across the transmission line. If we assume that we wish to match two 300-ohm TV antennas to a 300-ohm transmission line—a usual case—then each matching stub must transform the 300-ohm antenna impedance R_1 into a 600-ohm impedance R_T. This is accomplished by making the characteristic impedance of the matching stub itself a value between the 300- and the 600-ohm end impedances. To be precise, the matching-stub impedance R_0 must be the square root of the product of

the two end impedances, as shown by the first formula in Fig. 2. For our example, this turns out to be 424 ohms.

Just as the characteristic impedance of a parallel-wire transmission line is determined by the diameter of the conductors and their spacing, so is the matching-stub impedance. This relationship is given by the second formula for R_o shown in Fig. 2. For this example, R_o is 424 ohms. This must therefore equal 276 *log* $2D/d$ where D is the center-to-center separation and d is the diameter of each conductor. The larger the diameter of conductors used, the greater will be the required separation D to obtain a given impedance for R_o. Conversely, the lower the impedance R_o, the closer the two conductors would be for a given tubing diameter. Since available wire or tubing would be used to make up the stub, R_o and d would be known at the start, and the formula would be solved for D, the separation between conductors.

The wavelength *in free air* is the same for matching stubs and for antenna separations. However, if the matching stubs are made up of insulated twin-lead, wavelength measurements become shorter. Any insulating material, such as polyethylene, slows radio waves down; therefore, the wavelength will be shorter than in free space. For simplicity, then, stacking bars should be made up of bare rods or tubing.

In Fig. 1A it appears as if the spacing S between antennas is less than a half wavelength. Actually, appreciable spacings *up to* a half wavelength will increase the signal strength. The maximum gain possible with good impedance matching is shown in Fig. 1C for various spacing values. Note that half-wave spacing gives the best gain.

To illustrate how two typical 300-ohm antennas can be stacked to give up to an additional 3.86 db of gain, consider the case where it is desired to improve reception on channel 4. (Since matching elements are resonant affairs, good broadband operation becomes less feasible as antennas are stacked. More will be said about this later.) We must first determine what a quarter wavelength is for channel 4. A wavelength in free air is determined by the formula $984/f$, where f is the frequency in megacycles and wavelength is in feet.

Since the metal bars of which the matching transformers will be constructed reduce wavelength to some extent, a better formula to use, which will take the reduction into account with sufficient accuracy for most cases, is $936/f$. The formula for a quarter wavelength, then, is $234/f$. The mid-frequency of the channel-4 bandwidth (66-72 mc.) is 69 mc. Thus 234/69 is 3.4 feet.

Having thus determined the length of the two parallel metal rods or wires, we must decide how far apart they must be spaced to obtain the desired impedance match. Let us assume that metal rods with a cross-sectional diameter (d) of half an inch are being used. R_1 and R_2 are each 300 ohms. The impedance of the line is also 300 ohms. Therefore R_T must be 600 ohms, since 600 in parallel with 600 is 300 ohms, which is the line impedance we wish to match. Thus, from the first formula in Fig. 2, the impedance of the stub (R_o) must be the square root of 600 x 300. This is 424 ohms.

With R_o and d known (½-inch diameter tubing is assumed), we can solve the second formula for the spacing (D) between the centers of the two conductors. This comes out to 8.58 inches. Log tables or the log scales of a slide-rule can be used. For those who wish to avoid encounters with logarithms, the spacing just worked out will cover that multitude of cases where 300-ohm antennas are being matched to 300-ohm lines; *i.e.*, where the matching impedance R_o is equal to 424 ohms.

Where R_1 and R_2 are 72 ohms and R_T is 600 ohms, as is the case with other antennas, R_o is 208 ohms. To obtain this impedance, spacing D should be 1.42 inches. Since there should be no particular problem in working out R_o for any application, spacing D, using ½-inch diameter tubing, is given for several values of R_o: for 200 ohms, 1.3 inches; for 300 ohms, 3 inches; for 400 ohms, 7 inches. If ⅜-inch tubing is used, D will be: for 200 ohms, 1 inch; for 300 ohms, 2.3 inches; for 400 ohms, 5.5 inches.

Coming back to our attempt to obtain maximum gain for channel 4, we now have the elements we need to stack two antennas. Length for each quarter-wave bar is 3.4 feet. As for spacing S between the antennas: at best they should be half a wave apart. The *free-air* half-wave spacing is 7.1 feet. However, the combined length of the two 3.4-foot quarter-wave sections is only 6.8 feet.

Since this discrepancy represents an error of less than 6 per-cent, reducing the spacing between antennas by this small amount to accommodate the size of the stubs will not produce any significant loss of efficiency. If every last drop of gain is considered important, each length of tubing in the stub can be made ¾ of a wavelength, and the stubs can be connected at an angle, as shown in Fig. 1A. If the small compromise is tolerable, however, two lengths of 6.8-foot tubing can be used between the two antennas and the antenna line can be connected at their midpoints.

When the signal from two antennas is still too weak, the obvious solution would be to add a third one. In actual practice, the use of three antennas is rare, but four can be matched conveniently and with good results. The most widely used method of stacking, and also the simplest, is shown in Fig. 3. Here we have doubled up on the two antennas shown in Fig. 1 and, as shown in the table of Fig. 3, the gain increase is again less than double. Where two antennas with half-wave spacing give 3.86 db, four antennas give 6 db. Again a reduction in spacing results in less gain.

The impedance matching problem is treated here in the same way as for the double stack. Consider first the impedance which should appear at the transmission-line terminals T_2 in Fig. 3. To get 300 ohms at this point, each set of matching stubs 3 and 4 must present 600 ohms; but we have shown in Fig. 1 that the impedance which is present at each set of terminal points

(*Continued on page* 142)

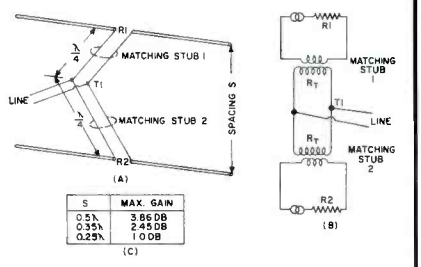


Fig. 1. Matching stubs (A) and antenna spacing are important in stacking. Equivalent electrical circuit (B) for two stacked units. Relationship (C) between gain of an array and antenna spacing.

Fig. 2. Critical values in matching stubs and formulas for deriving them.

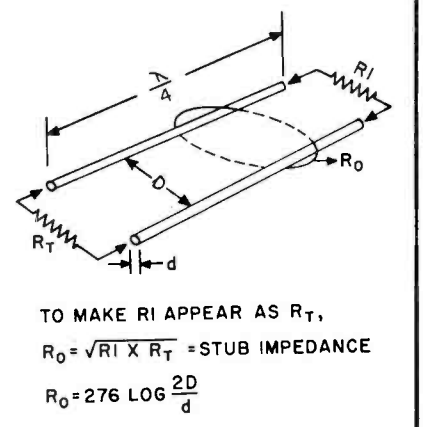
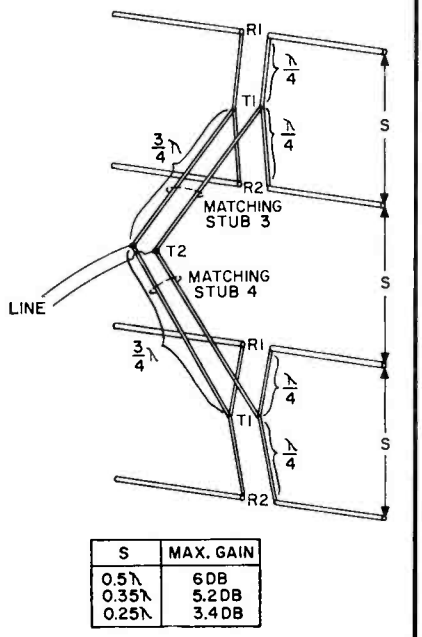


Fig. 3. Development of the matching network for an array of four antennas.



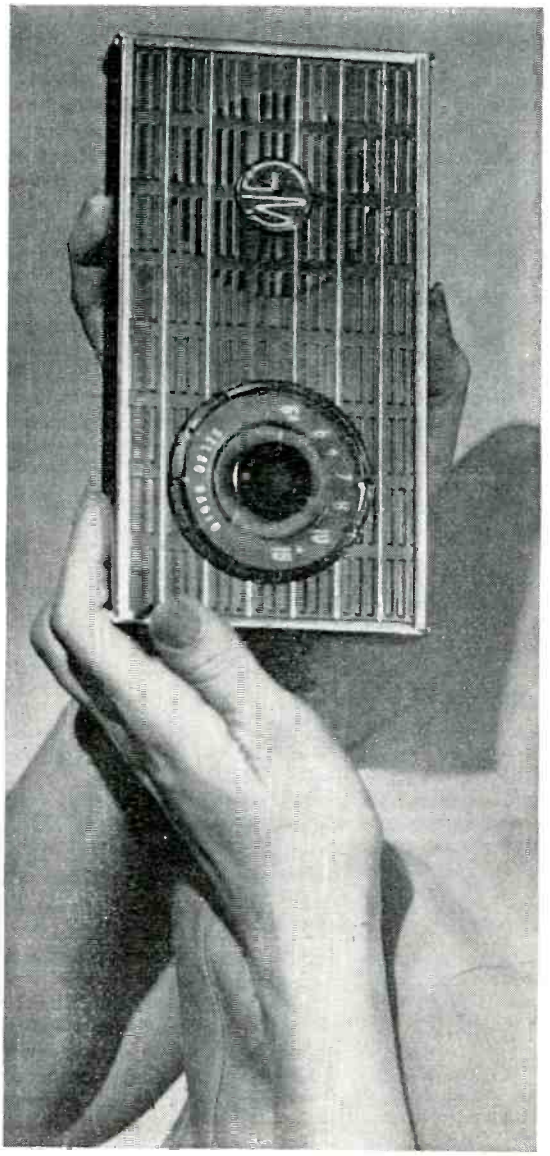
The All-Transistor Portable Car Radio: 1959

By W. C. SAHM
Delco Radio Div., General Motors Corp.

Two separate tuning systems make this unit more like a portable out of the car—and more like an auto radio in it.

Fig. 1. (left) In the car, the radio fits into the glove compartment, out of sight.

Fig. 2. (below) In the portable mode, this year's version is smaller than last year's.



WHAT'S new in automobile radios this year? The fully transistorized car receiver that may double as a compact portable has been around since the 1958 autos began rolling along the nation's highways. With some refinements, it is still the big news for 1959.

As evidence of its acceptance, the auto portable made by *Delco Radio* is being used in three of the *General Motors* lines. *Buick* has joined *Oldsmobile* and *Pontiac* in featuring it as an optional extra. Principal changes involve separate mechanical and electrical tuning arrangements for use in or out of the car. From this major shift, several advantages that did not exist a year ago accrue. (See *"Delco's* Portable Auto Radio," page 44, December, 1957.)

Since a permeability-tuning system is recognized as the preferred one for satisfactory auto-radio operation, the first versions of the auto portable were somewhat larger and heavier than this year's model to accommodate such a front end. With its separate, variable-capacitor tuning system, the new version makes the neat, streamlined package the young lady holds in Fig. 2. Helping to keep the receiver compact in its portable mode of operation is the fact that, like most transistorized portables, it does not include an r.f. stage. The latter, quite helpful for automotive use, is now consigned to the subchassis that remains in the car at all times, to be switched in and out automatically as needed. Shown at the lower left in Fig. 3, this r.f. stage is brought into play through the multicontact connector mounted to the rear of the receiver when the latter is slipped into place in the vehicle.

With the single tuning system used last year, in-car station selection was limited to the simple tuning dial of the

portable. This would not be acceptable to many automobile owners who are accustomed to such features as illuminated, slide-rule dials of generous size and convenient push-button selection of favored stations. The 1959 model thus can provide five push-buttons along with a good-sized manual-tuning dial that remains in the car. A simpler tuning knob, driving the variable capacitor, is built into the portable body.

The independent tuning systems provide another convenience. There is no longer any need to have the portable still accessible when it is plugged into the car. For this reason, the 1959 model is placed in a rack inside the glove compartment (see Fig. 2) instead of fitting into a hole in the instrument panel, as was the case last year. With the glove compartment closed, the radio is out of sight altogether. With the glove compartment locked, the portable is safe.

A number of design changes have been made in the radio's circuits, as well as in its size and physical appearance. The portable itself is a six-transistor radio powered by four 1.5-volt mercury cells. When being used in the automobile, two more transistors—an r.f. amplifier and an audio power amplifier (lower right in Fig. 3)—are added to make an eight-transistor circuit.

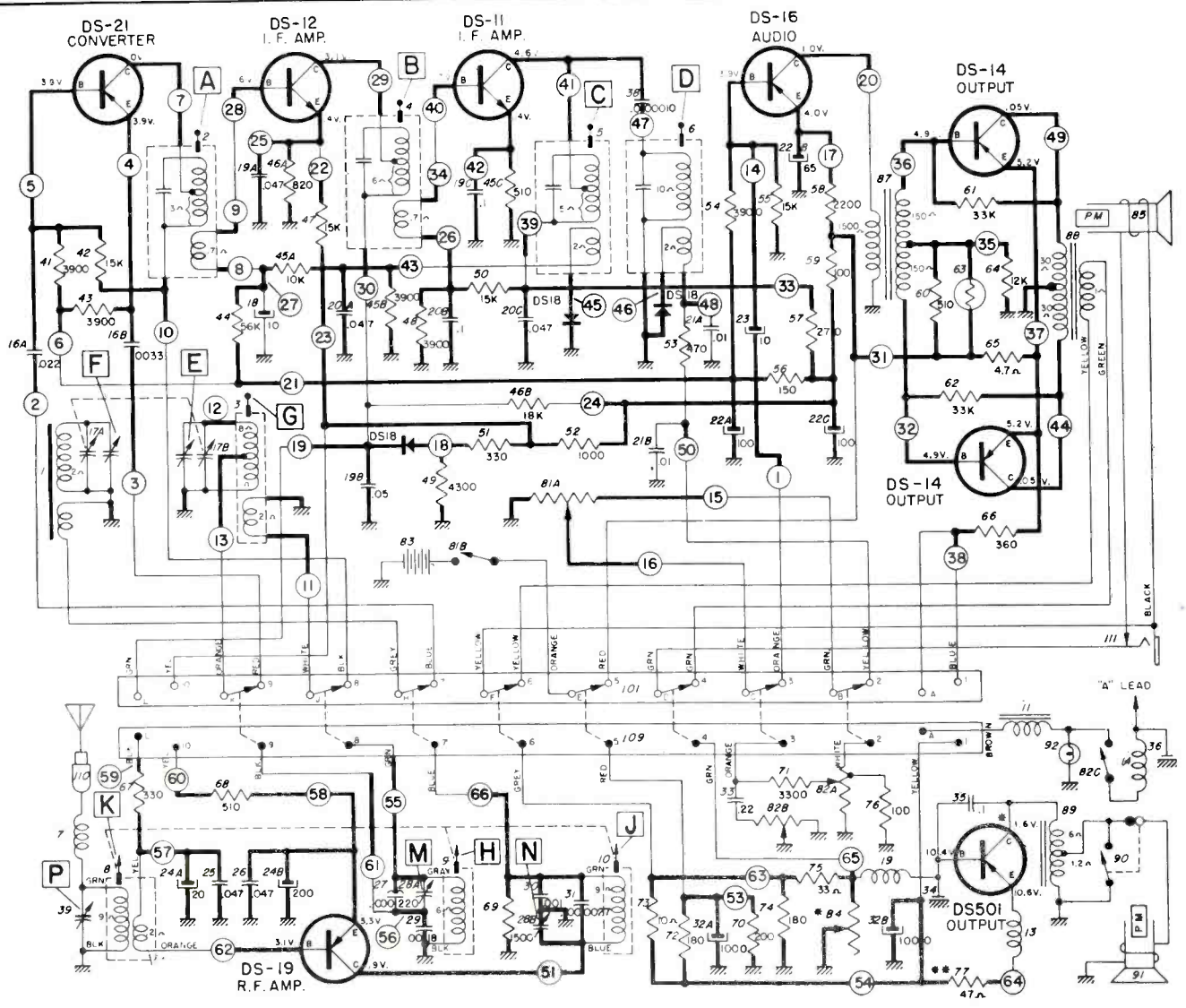
The six transistors in the portable mode provide the same power output as was obtained with *nine* transistors in the 1958 version. This reduction was made possible by eliminating the a.g.c. amplifier and using only an a.g.c. detector diode, by combining the functions of the oscillator and the mixer stages into one converter stage, and by placing the r.f. amplifier in the car, instead of in the portable.

As the portable is plugged into its rack in the glove compartment, the ten-contact female connector in the portable and the male connector in the rack meet to provide all of the necessary switching to change from portable operation to in-car operation. These connectors (the horizontal strips toward the bottom of Fig. 3) accomplish several jobs simultaneously. They disconnect the capacitively tuned oscillator and antenna circuits, the mercury-cell battery supply, the small portable speaker, and the portable volume control with its "on-off" switch. The push-button tuning unit in the car is only one of many features now provided. Power is supplied by the car battery. In place of the portable antenna, a slug-tuned automobile antenna circuit and the r.f. amplifier (DS-19) are used to provide a higher level of input signal to the converter stage. The converter circuit itself is also changed by the connector. The capacitively tuned oscillator circuit is replaced by a slug-tuned circuit. In order that the radio have sufficient power output for easy listening at highway speeds, the connector replaces the portable speaker with an added power amplifier (DS-501, following the push-pull amplifier), which gives the radio a maximum audio output of 6.5 watts, and which feeds a large oval speaker.

The result of these efforts by engineers of *Delco Radio* is a design that retains all of the features expected in a quality automobile receiver with no sacrifice of the advantages found in transistorized portables when the radio is used in that mode of operation.

-30-

Fig. 3. The 1959 version of the "double-life" Delco transistor radio. Circuits for in-auto use only are at the bottom.



The "Inverted L" Ham Antenna

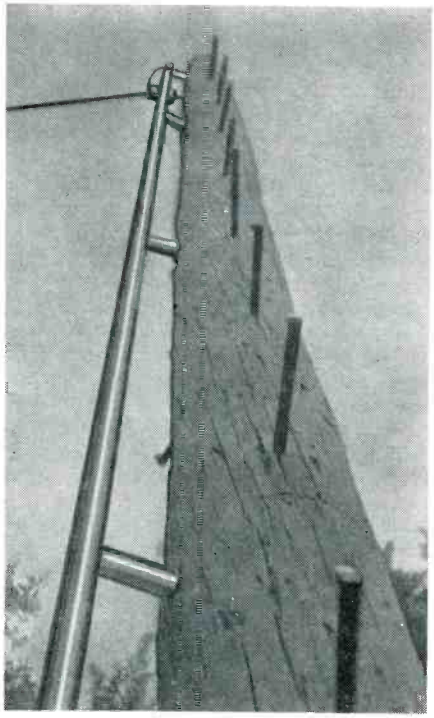
By **ROBERT M. SEE, W5LTD**

Construction of simple antenna and matching network that provides a good compromise in height, cost, and coverage.

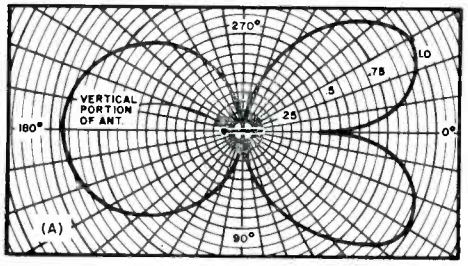
AFTER moving into a new home it was hoped that a satisfactory solution could be found to the problem of installing an amateur antenna without detracting from the appearance of the neighborhood landscaping. This, of course, ruled out any type feedline which would hang suspended and flapping in the Oklahoma breeze. Naturally the buried coax feedline and all-band vertical came to mind. After considerable thought (this is always the hard part), it was decided to modify the vertical radiator to include some horizontal polarization. It was believed that this might increase the field strength, on 80 and 40 meters, over that of a vertical—at least within a 300-mile radius. In other words, we didn't want our signal to skip our local friends. As a consequence, the "Inverted L" antenna—which is a compromise in height, cost, and coverage—was adopted.

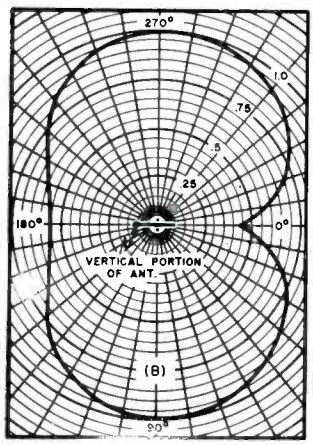
The utility pole was set 5 feet into the ground and has withstood 70 mph wind gusts without guy wires. It is located on the rear of a city lot, nestled in a group of eastern red cedar trees. It takes a sharp eye to detect any discontinuity in the landscape. The XYL believes this to be the best part of the entire installation, however, the author is partial to its operation and the strong signal reports received.

Fig. 1 shows the horizontal radiation patterns on the three bands for which the antenna was designed. It would be possible to operate the antenna on 15 and 10 meters with the proper matching networks but these bands have not been investigated.



Vertical portion of antenna is made of copper water tubing, fastened by stand-off insulators. Matching network is inside rural mailbox at base of antenna. Adjustments are accessible through door and back of mailbox. Switch is for lightning protection.





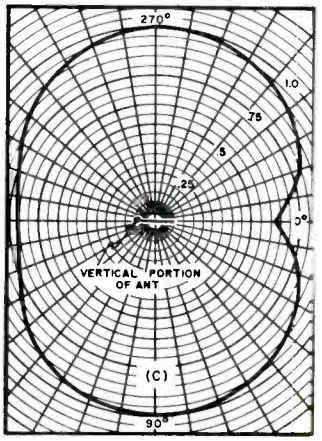
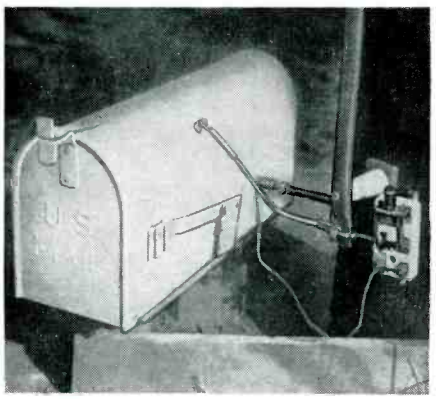


Fig. 1. The horizontal radiation patterns for the "Inverted L" amateur transmitting antenna are shown here on (A) the 20 meter, (B) the 40 meter, and (C) the 80 meter bands. Field strengths shown are all relative. It would be possible to operate the antenna on 15 and 10 meters with the proper matching networks but these bands have not been investigated as yet.

Antenna Construction

The vertical portion of the antenna is made from a 32.5-foot section of ½-inch i.d. copper water tubing. It is mounted on 4-inch ceramic stand-off insulators which are, in turn, fastened to the telephone pole. The copper tubing can be purchased in coils of varying length and was used because it is easy to handle and workable. The horizontal portion of the antenna is 32.5 feet of #12 gauge stranded copper antenna wire. It is connected through an insulator to the top of the telephone pole for mechanical strength and then bonded to the top of the copper tubing. The other end is tied through an insulator to a tree some 40 feet away. The photographs show how the tubing is mounted on the pole and connected to the matching network.

The transmission line is buried about 6 inches in the sod and runs from the house to the base of the antenna where it enters the housing for the impedance matching networks.



The ground radials are made of four lengths of #12 gauge copper wire, 35 feet long. They stretch out in four directions from the base of the pole and are buried about six inches into the turf. They are securely bonded together at the pole to reduce losses and are connected to the matching network by a copper braid. In dry, sandy soil the radials should be made no less than 60 feet long and their number increased to six. It is imperative that the antenna have a good ground system, securely bonded to reduce losses.

The efficiency of this antenna on 80 meters is better than that of the 33-foot and 44-foot verticals because the high current (and high radiation) portion of the antenna has been raised.

Almost any length of wire or antenna configuration can be made to look like 50 ohms or any other transmission line impedance. This is the job of the impedance matching network. Since an r.f. bridge wasn't available, the impedance of the antenna was measured with a *"Q"* meter and a calibrated s.w.r. meter. The results are given here as a matter of information only: 14.2 mc., $Z = 650-j100$ ohms; 7.2 mc., $Z = 5000-j100$ ohms; 3.8 mc., $Z = 26 + j0$ ohms.

As can be seen from the circuit diagram of Fig. 2 and the photographs, bandswitching was handled by three separate switches. If the builder substitutes a ganged switch and a different parts layout, it is suggested that the coils be placed at right angles to each other to reduce mutual coupling.

All components were mounted on a plywood board which is slightly smaller than the inside dimensions of the RFD-type mailbox. The finished unit is slipped into the mailbox which provides excellent protection from the weather.

In the author's unit, C_2 was made up of a 50 $\mu\mu$fd. unit and a 30 $\mu\mu$fd. variable capacitor in parallel since the variable was on hand. The actual capacity needed is 70 $\mu\mu$fd. The 400 $\mu\mu$fd. mica capacitor used as part of C_3 should be of the high-current type. The one used here is a surplus *Sangamo* Type A2LH (2500 volts). The switches should also be able to withstand high current if high power is to be used because they will carry the full antenna current. The switches shown in the photographs were taken from an army surplus antenna tuning unit.

R_1 and RFC_1 were added to the circuit to bleed off any static charge which might develop during thunderstorms. The knife switch mounted on the utility pole is used to short the antenna and protect the station equipment when the station is not on the air during heavy electrical storms. This matching network has handled a 400-watt transmitter for a year and shows no signs of heating or arcing of components.

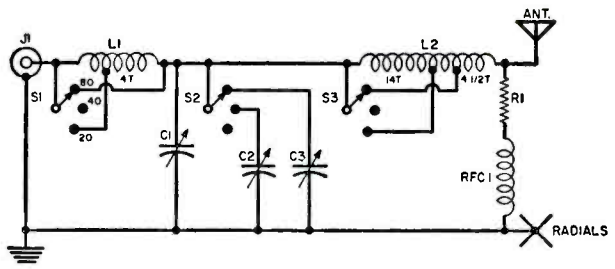


Fig. 2. Complete schematic diagram and parts list for the antenna matching unit.

R_1—10,000 ohm. 5 w. res.
C_1—100 $\mu\mu$fd., 1000 v. var. capacitor
C_2—70-100 $\mu\mu$fd., 1000 v. var. capacitor
C_3—500 $\mu\mu$fd. capacitor (400 $\mu\mu$fd. mica in parallel with 100 $\mu\mu$fd. var. unit)
L_1—6 t. #3905-1 B&W "Inductor," 2½" dia., tapped 4 t. from output end
L_2—22½ t. #3905-1 B&W "Inductor," tapped 4½ t. from ant. end and 14 t. from input end
J_1—Coax receptacle
RFC_1—2½ mhy. choke
S_1, S_2, S_3—Single-pole, 3-pos. low-loss switch (see text)

Calibration

As mentioned earlier, it is not necessary for anyone who plans to duplicate this antenna to do any design work to assure a good impedance match. It is necessary, though, to have a standing-wave indicator in the line while making the adjustments for low s.w.r. on each band. Start your adjustments with the switches set on the 20-meter band. While watching the s.w.r. indicator, rotate C_1 until the lowest reading is indicated. Small variables in the antenna installation may make it necessary to change the taps on the coils one or two turns. If this becomes necessary (it is if the s.w.r. indicator cannot be made to read a low value) the C_1 setting should be re-adjusted for a low reading after the taps are changed. When the s.w.r. has been made as low as possible on 20 meters the procedure is repeated on 40 and 80 meters while adjusting C_2 and C_3 respectively.

In addition to matching the 50-ohm line impedance to the antenna input resistance this network also corrects for reactance in the antenna and thereby affords easier loading to the transmitter. Fig. 3 shows how the s.w.r. varies over the band in the author's installation. As can be seen, the lowest s.w.r. was made to fall in the center of the band because both c.w. and phone operation were to be used. If the builder plans only c.w. *or* phone operation he may shift this low s.w.r. on 80 and 40 by making his adjustments on the frequency to be used.

In conclusion, it might be well to add that if you are the "bandhopping" type of operator, remember that you will have to visit the base of the antenna to switch bands. However, even this small obstacle can be looked upon as a "blessing" when you consider that in this age of automation most of us could use a little exercise!

Although this antenna cannot compete with a good beam, it has proved to be the answer to a serious problem at W5LTD. We have a sneaking suspicion that it will be in use for many years to come since it has provided excellent contacts all over the globe. We believe you will like it as well! —30—

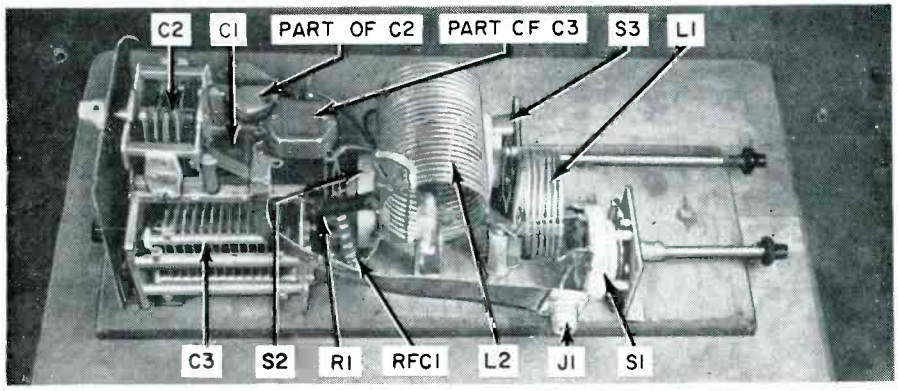
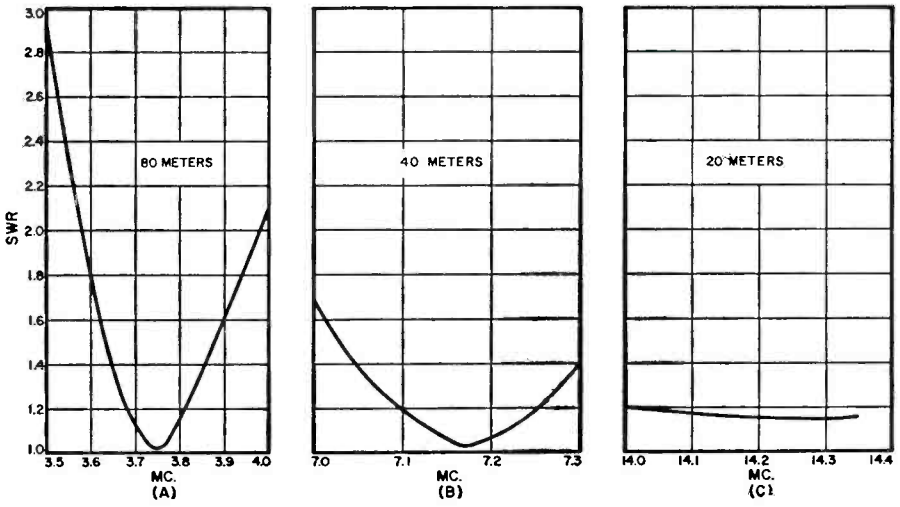
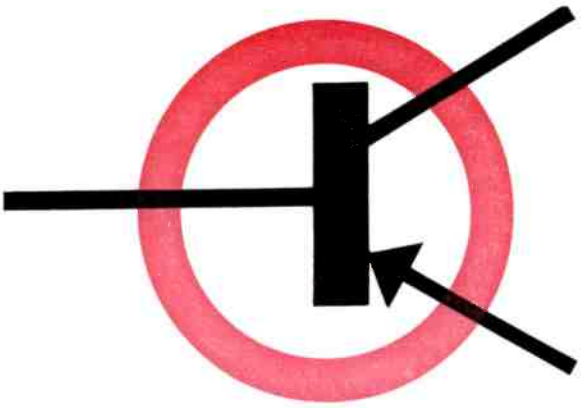


Photo showing the construction of the network, which is built on a plywood board.

Fig. 3. Voltage standing-wave ratio for the antenna on the three ham bands shown.



TRANSISTORS The Inside Story



Don't throw away those defective transistors. You'll learn a lot about them by looking inside their cases.

By **EDWIN BOHR**

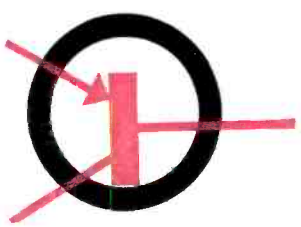
OPENING the case of a transistor provides an educational experience that can not be duplicated in any other way. With the case open, a person can get a first-hand perspective of the actual emitter and collector dot size, the germanium wafer thickness, and the methods of assembly used by the manufacturer.

Of course, we can read about these things but reading lacks the visual impact and stimulation that are so effective in bringing about a quick understanding of transistor construction.

Obviously, transistors that have burned out are the ones to open and examine since they are no longer useful. However, the low cost of transistors now justifies opening even a new transistor. Fusion-alloy transistors sell for under a dollar and grown-junction types for as little as $1.50. These two transistor types, distinctively different in their manufacture, are representative of the bulk of present transistor production.

Except for a very limited production destined for consumption within the *Bell Telephone System*, the point-contact transistor is virtually "extinct." Another type, the surface-barrier transistor, is a fairly recent addition.

Even more sophisticated transistors —the tetrode and diffused-junction varieties—are now seeing use mainly in advanced electronic circuits for specialized applications where expense is no object. So, except for the surface-barrier transistor, let's forget about these latter types and talk about opening up some of the more interesting and available transistors.



Raytheon CK721, CK722

When one of these transistors is opened you may be in for a surprise. While early CK722 transistors were encapsulated in a plastic case that could be removed either by dissolving in solvent or heating and pulling off the case (careful, though, or the junction may be pulled out too), newer units are very different.

The metal case for the newer-type CK722 is really no more than a shell around the subminiature transistor inside. This inside transistor has a case like the 2N130A series of *Raytheon* transistors.

To take a CK722 apart, peel off the thin outside case with ordinary side cutters or needle-nose pliers. Beneath this cover lies a cement filler or coating that can be pushed off easily with the heated end of a gun-type soldering iron.

With the "gunk" removed, the inside transistor case is visible. This 2N130A-type case may be opened by heating the bottom of the shell with a soldering iron and simultaneously pulling gently with pliers. Fig. 1 is a cross-section view of the CK722 package.

Now that the cover is off, the complete transistor assembly can be seen. The germanium has a beautiful lustrous finish that is characteristic of etched germanium.

The emitter and collector dots are seen on either side of the germanium wafer. Somewhat more detail is visible with the aid of a magnifying glass. The larger dot forms the collector junction and the smaller one the emitter.

These emitter and collector dots are indium metal that, under heat, fuses into the *n*-type germanium forming regions of *p*-type germanium that are actually the emitter and collector. Germanium can be either *p* or *n* depending upon the type and relative concentrations of impurities. Arsenic added to the germanium makes it *n*-type and indium added to the *n*-type arsenic-doped germanium changes it to *p*-type.

All *Raytheon* transistors, including

the silicon types, are made by this fusion process.

G-E 2N43, 2N107, 2N135

Like the CK722, these transistors are fused or alloy types but they are hermetically sealed in a welded housing. The germanium base is electrically attached to the case which acts as a heat sink. This type of construction gives the 2N43 a medium-power rating.

The welded hermetic case introduces no soldering fluxes or gasses that could possibly shorten the life of the transistor.

A cloudy jelly-like material, probably a glyptal type, coats the junction. It can be removed with a small brush.

Slight modifications of the dot size and base thickness produce different characteristics. In the 2N135, for example, the dots are made smaller and the *n*-type germanium thickness between the alloyed *p*-type layers is made thinner. All this results in superior high-frequency performance.

To open this transistor case, snip away the welded flange with cutters and the round cover lifts easily. Inside, the germanium wafer mounts on an angle bracket that is spot-welded to the header. Heavy lead strips connect the emitter and collector dots to the posts coming into the case through the glass seals.

Fig. 4 shows the general construction of *General Electric* diffused alloyed transistors.

G-E 2N78, 2N170

The 2N170 is a good example of an inexpensive grown-junction transistor. Grown- and fused-junction transistors are radically different.

Fused junctions are made by growing a large *n*-type crystal, cutting it into hundreds of wafers and then fusing *p*-type impurities into the germanium.

By another method the emitter, base, and collector can be produced within the crystal as it is grown. It can then be cut into hundreds of smaller slices each containing an *n-p-n* junction. These are known as grown junctions. Thus far the grown-junction transistors are made mainly with *n-p-n* junctions.

Using this method, the base thickness can be controlled to very close tolerances. For this reason, grown-junction transistors are particularly suited for high-frequency circuits. In fact, the first high-frequency junction transistors were *all* grown-junction types. However, alloy-junction transistors have now caught up to the grown-junction in this respect.

The grown-junction is already a transistor and it only remains to mount it in a suitable case. The ends of the junction-containing strip of germanium are attached to end tabs. These tabs are the collector and emitter connections.

Since the extremely thin base zone has no distinctive appearance, the base wire is moved along the germanium strip until an electrical measurement indicates the base has been found. The base lead is then welded in place.

General Electric transistors of this type have a characteristically tall rectangular case with rounded corners plus a seal-off tube and bottom-welded flange. The metal header, because of its upside-down dishpan construction, is extremely rigid.

There are quite a few small parts and tabs used in the construction of this transistor type. The germanium strip is secured to tabs extending from the collector and emitter support posts. A metal strip runs parallel to the germanium and allows the base lead to be welded any place along the entire length of the germanium. This is necessary because, in some transistors, the base region may be at an extreme end of the germanium strip.

Like the 2N107, this case is also opened by cutting around the bottom flange. The cover then lifts off easily without damaging the transistor. There is no "jelly" covering of the junction in this type. Fig. 3 shows the construction.

The transistor can be operated with the cover removed for a very effective demonstration. Too, experiments to show moisture contamination and photoelectric effects can be carried out with the cover removed. Fig. 2 shows a simple circuit for demonstrating the photoelectric effect on any exposed transistor junction. Be sure to use a negative collector voltage for *p-n-p* transistors and positive for the *n-p-n*.

Sylvania 2N34, 2N35

The 2N34 and 2N35, appearance-wise, are identical both inside and outside; however, the 2N34 is a *p-n-p* unit and the 2N35 is an *n-p-n* transistor. Most *n-p-n* units are grown-junction, but the 2N35 is an exception. It is a true alloy-junction transistor.

This results in similar characteristics for the two units except for the reversed polarity for bias and supply voltage. Consequently, a 2N34 and 2N35 pair is ideally suited for complementary symmetry circuits.

To open these transistors, unsolder the case at the bottom and pull off the cover. Fig. 5 illustrates the internal assembly.

Sylvania 2N68, 2N95, 2N101, 2N102

The 2N68 is more difficult to open. First, cut off the leads and chuck the case in a metal lathe. By cutting away the soldered seal and part of the aluminum cooling fins, the transistor assembly will drop out, together with a small amount of white powder. Presumably, this white powder is a dessicant.

The 2N68 transistor assembly is relatively large and easily observed. For that reason, the 2N68 insides give a very good display of diffused-junction transistor construction. Furthermore, the 2N68 geometry is pretty repre-

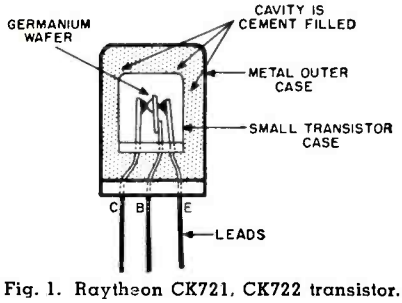
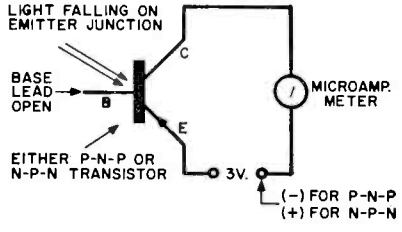
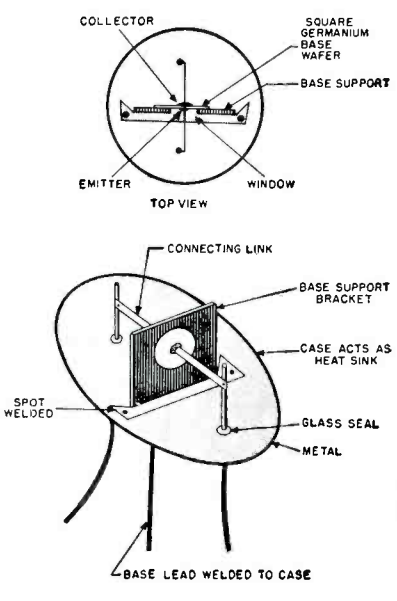


Fig. 1. Raytheon CK721, CK722 transistor.

Fig. 2. Demonstration of the photoelectric effect on an exposed junction is shown.





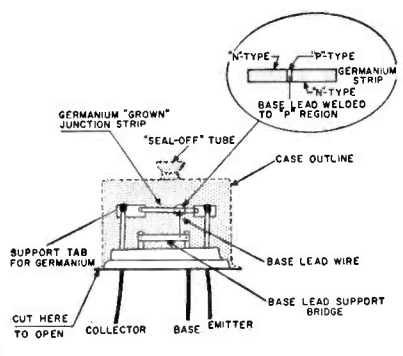


Fig. 3. Mounting for G-E rate-grown "n-p-n" transistors such as 2N78, 2N170, and others.

Fig. 4. General Electric's mounting for diffused-junction types 2N43, 2N107, 2N135.

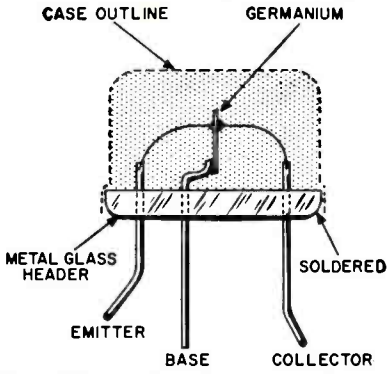


Fig. 5. Sylvania "n-p-n" and "p-n-p" alloy-junction transistors type 2N34, 2N35.

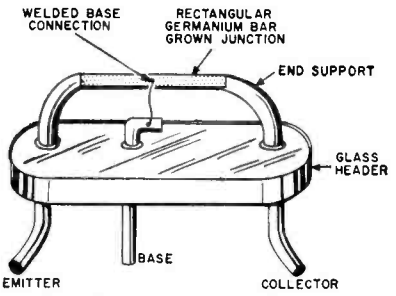


Fig. 7. Bell Labs grown-junction transistor.

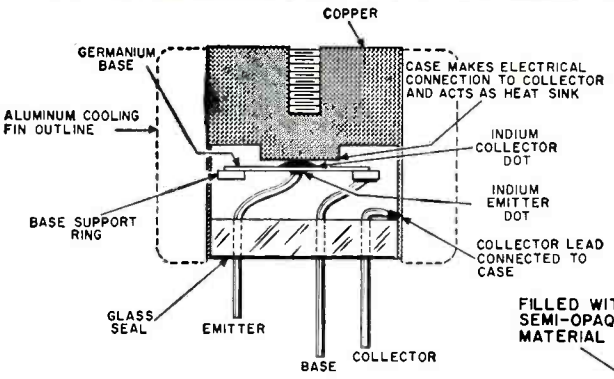


Fig. 6. The internal construction of the Sylvania transistor types 2N68, 2N101, etc.

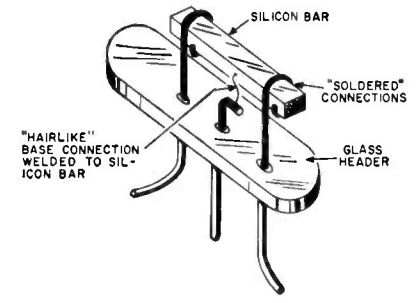


Fig. 8. Texas Instruments grown-junction silicon transistor TI 903, 904, 905, etc.

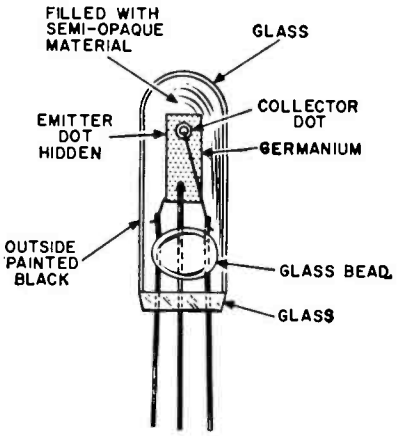


Fig. 9. Amperex glass-cased 2N279, 2N280.

sentative of all power transistors. See Fig. 6.

The base is a square of germanium, roughly the thickness of aluminum foil, made rigid and supported by a metal ring. This ring, in turn, mounts to the base lead coming through the header. The collector makes connection to the heavy copper case, which carries away heat from the junction.

Western Electric 2N27

This is a germanium grown-junction transistor with an interesting holder for the germanium bar. See Fig. 7. The supports at each end make a marvelously exact-fitted connection to the germanium. The base connection is a tiny wire welded to the base region. This type of base connection is characteristic of all grown-junction transistors.

The base connection, smaller than a fuse wire, usually is the part that burns out from an accidental short to the collector or some other high current input pulse. This base connection may be completely missing on some burned out grown-junction transistors.

Texas Instruments 903, 904

These are grown-junction silicon transistors. Internally, the construction is similar to the 2N27 just discussed, however, the silicon bar is soldered to the looped-around emitter and collector leads as shown in Fig. 8.

Silicon transistors are very expensive because of the extreme difficulties in processing the silicon. Silicon has a high melting point and must be heated in a crucible or pot fabricated of material having a melting point slightly higher than that of the silicon itself. Too, silicon is very active chemically and must be grown in an inert atmosphere. The difficulties in handling silicon are tremendous.

One company in the Boston area, where plenty of know-how about these things exists, worked about a year on its first silicon melt.

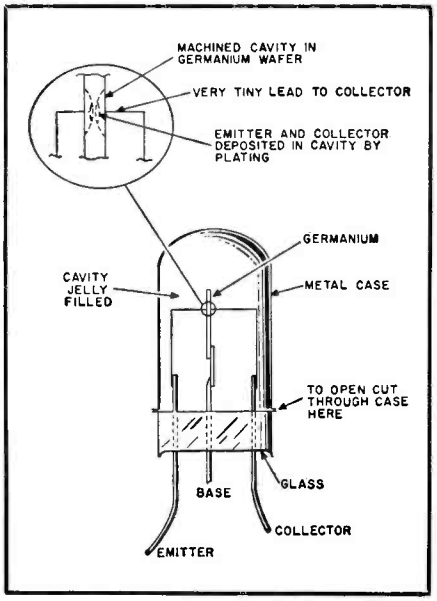
Amperex 2N279, 2N280

Amperex transistors are sealed in a tiny glass tube and look very much like a subminiature vacuum tube. The glass tube is painted black. To see the *p-n-p* fused junction inside, just scrape off the outside paint. See Fig. 9.

The cavity around the transistor junction is filled with an obscuring semi-opaque material; nevertheless, the junction is still visible.

This method of fabrication makes the *Amperex* transistor ideal for classroom demonstration. Anyone can look inside, yet the junction is still protected from moisture and handling by the glass hermetic case. Light falling on the junction has a photoelectric effect and this also makes the 2N279 very interesting in demonstrations.

Fig. 10. Philco surface-barrier SB-100.



Philco Surface-Barrier SB-100

While all the other transistors have contained two types of semiconducting material, produced during the crystal-growing or by fusion-alloy processes, the surface-barrier transistor contains only *n*-type germanium.

The emitter and collector are produced by plating indium metal onto the *surface* of the germanium. The thickness of germanium between emitter and collector is made very small by an electrolytic machining process that produces two dimples in the germanium.

Fig. 10 shows a cross-sectional view of this type of transistor. There are no emitter or collector dots; otherwise, it looks much like a fused-junction transistor.

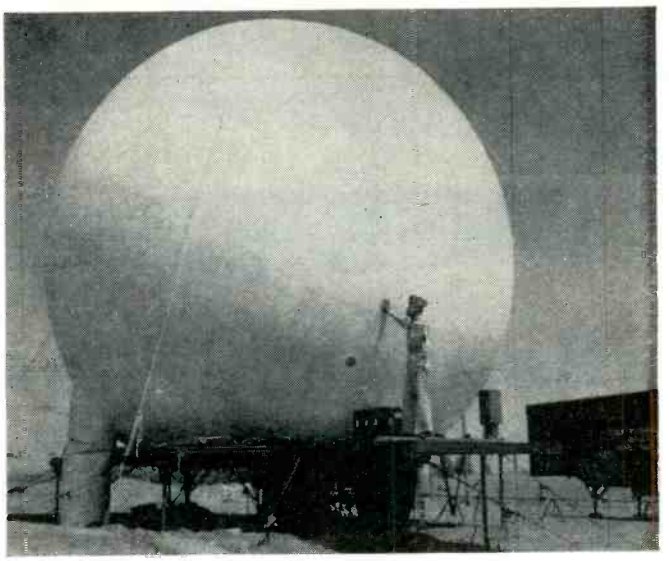
If the transistor is opened and the protective jelly removed, two very tiny dimples with almost invisible lead wires running to them can be seen. The emitter and collector are plated in these dimples and the leads welded to them. The larger dimple, as seen with a magnifying glass, is the collector.

These emitter and collector leads, like the grown-junction base lead, are very easily burned out.

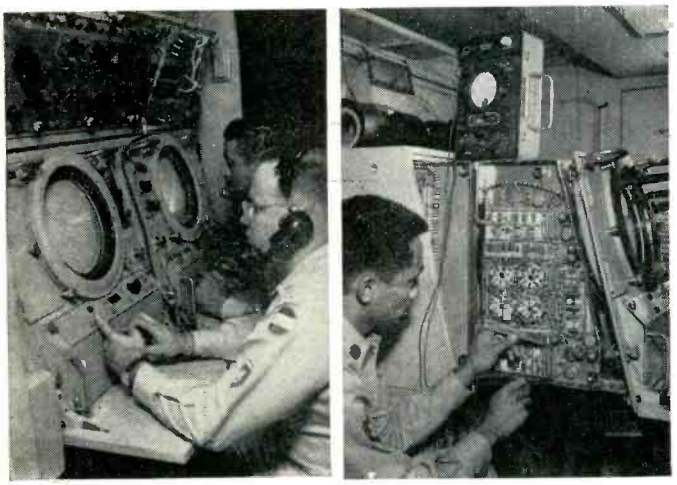
Don't throw away any defective transistors that come your way. Open them and look inside first. It is an educational experience that can not be duplicated by any amount of reading or peering at diagrams! —30—

New Frequency Scanning Radar

Large mobile unit uses single antenna for distance, bearing, and altitude data.



Plastic balloon, resting on mobile trailer bed, protects antenna.



Scope at extreme left shows range and bearing data, while other display shows altitude. At right, entire indicator console has been pulled out on rollers to provide easy servicing.

A NEW frequency scanning radar which detects airborne targets at extreme range and for the first time simultaneously computes distance, bearing, and altitude, was unveiled by the Army. Called "Frescanar," the radar which was developed by *Hughes Aircraft Co.* is the eyes of the "Missile Monitor," an Army air defense guided missile fire distribution system for mobile use with a field army. The entire system consists of one equipment van, one power truck, and one antenna trailer. The equipment van houses all radar gear except the antenna.

In principle, a frequency scanning radar is one that is able to cause the searching radar beam to be moved rapidly without actually moving the antenna physically. This is done by applying a succession of frequencies to a special antenna whose directivity is made sensitive to the applied frequency. By changing the frequencies at electronic speeds, the radar beam is caused to move far more rapidly than is possible by actual physical movement of the antenna. This beam is then able to monitor numerous high-speed aerial targets at many altitudes and bearings.

The special antenna is protected from the wind and weather by a radome of fabricated rubberized nylon—vulcanized to two layers of neoprene-coated fabric—weighing about 600 pounds. The radome is inflated by two air blowers and kept that way by slight pressure from one blower.

Five basic advantages claimed for the new radar system over conventional radars are:

1. Range performance. "Frescanar" concentrates all available power in sharp pencil beams of energy flashing on and off in a fan-shaped array to pinpoint targets at great distance with extreme accuracy.

2. Single antenna and operator. Conventional systems need two or more radars, operators, and master consoles to achieve similar results. The new radar needs only one of each, sharply reducing weight, bulk, and personnel to make transportation with other Army field units easier. Use of transistors further cuts size and increases ruggedness for movement.

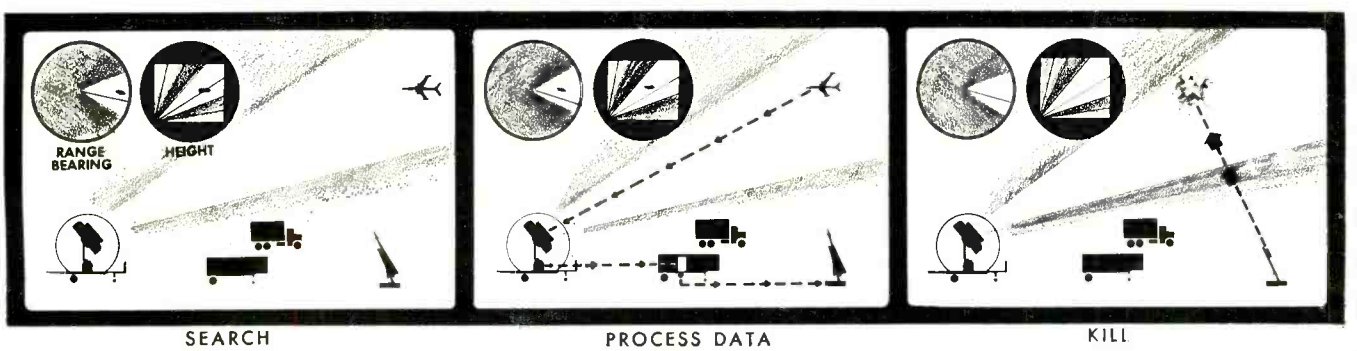
3. Triple function. The frequency scanning radar computes range, bearing, and altitude at the same time.

4. Greater speed. All three types of data—range, bearing, and altitude—are transmitted to missile batteries, helping them to direct missiles on targets much more rapidly.

5. Sees more targets clearer. The electronic beam scans rapidly and greatly increases the number of targets which can be tracked at the same time, provides better separation of closely spaced targets with minimum of ground clutter, and pinpoints targets faster.

All the units in the over-all fire control system are interconnected and can communicate with each other even with part of the system destroyed or inoperative. Thus a fragmented system could still operate. —30—

Target is first detected, the data is processed to missile batteries, which are then fired automatically.



Problems in Horizontal Blanking

By **JESSE DINES**
Author of "Servicing TV Sync Systems"

Blanking networks, increasingly used, prevent many retrace faults. Learn about these circuits. Add them where needed.

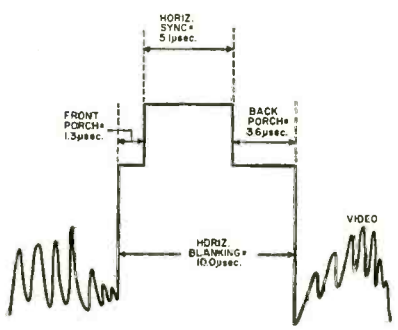
WITHOUT much fanfare, there has been a trend toward incorporation of circuits to remove horizontal retrace lines in TV receivers. Their widespread use in color sets is not hard to understand. However, suppression of the horizontal return trace in monochrome sets was virtually non-existent until recent years. One may wonder why this is so at a time when features of marginal value are being dropped by receiver designers. What troubles, for example, might result if the return trace is not suppressed? Fig. 1 shows two of the difficulties which are possible when, for one reason or another, there is electron-beam conduction in the picture tube during the brief interval of the return trace.

In Fig. 1A, horizontal foldover exists at the left side of the picture and extends over to the extreme right. This particular defect results when the retrace time of the saw-tooth current flowing through the horizontal yoke windings is too slow. In Fig. 1B, a faint, vertical white line appears at the left of the picture. (The fine tuning control was adjusted to accentuate the symptom.) This particular defect was caused by a fault in the horizontal sweep circuit. If the steep, downward slope of the horizontal-sweep sawtooth (the portion representing the return trace) has its shape severely distorted by any defect, such a band may be the result.

Sometimes a bright vertical line or band that is "wavy" appears in the raster at certain times, as when station breaks occur. Excessive retrace time or radiation from the sweep circuit during this period can cause such abnormal picture symptoms. This article explains the reasons for these abnormalities, as well as how to eliminate them.

Fig. 1. Foldover (A, above) and light bars (B, below) may be retrace problems.

Fig. 2. Portion of composite video signal, showing horizontal pulse area.



Horizontal Foldover

To understand what causes foldover due to slow retrace time, examine the horizontal sync and blanking portion of the composite video signal (Fig. 2). Note that the front porch (1.3 microseconds) is narrower than the back porch (3.6 μsec.). This is done to give the retrace more time to end before total blanking time (10 μsec.) ends. This is shown more specifically in Fig. 3 which indicates (A) the composite video signal, (B) horizontal sweep voltage showing trace and retrace portions, and (C) a portion of the raster which is scanned. Proportions have been distorted to highlight certain details at the raster edges.

Consider the normal circumstances first. A raster line is scanned from point 1 to point 4 (beginning of the horizontal sync pulse as shown in Fig. 3B). The time from points 1-2 and 3-4 are blanked out, since horizontal blanking takes place at this time. The raster line produced is shown in Fig. 3C. Retrace begins at point 4 and ends at point 5 which corresponds to point 1, the beginning of trace, for the next scanned line.

As long as the retrace ends before blanking time ends (point X in Fig. 3A), the retrace line will not extend into the video portion of the composite video signal. If the retrace does extend beyond point X, some of the video will be "retraced" and horizontal foldover will occur at the left side of the picture.

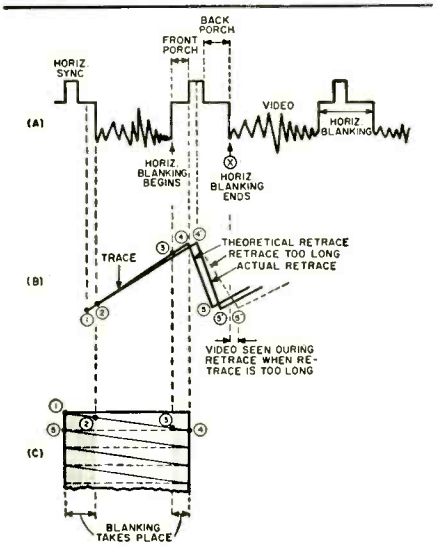
The combined duration of the sync pulse plus the duration of the back porch (refer back to Fig. 2) is equal to 5.1 + 3.6 or 8.7 μsec. This means that, in order *not* to have foldover, receiver retrace time should certainly be no greater than this 8.7-μsec. interval. Actually, it is better to make this period *shorter* than 8.7 μsec. because retrace usually begins at point 4′ (in Fig. 3) and not at point 4. This results from the inherent delay of the sync pulses through r.f., i.f., and particularly the sync-separator circuits of the receiver before the pulses can trigger the horizontal oscillator.

In Fig. 3B, if retrace starts at point 4′ it ends at point 5′ which, although slightly beyond point 5, is still within acceptable limits to prevent foldover. However, if the retrace interval is too great, retrace will terminate at point 5″ and foldover will occur.

Reducing Flyback Time

In receivers without blanking circuits, problems like the one just discussed can often be handled by shortening the flyback period. The retrace time depends on inherent operation of the horizontal sweep (flyback) circuit. Although it is beyond the scope of this article to discuss flyback circuit operation, certain facts will help us understand how retrace is produced. Fig. 4 shows three pertinent waveforms of the flyback circuit. Waveform (A) is the signal fed to the horizontal output tube grid. At point "A," the tube is cut off and the flyback circuit goes into self-oscillation. The oscillatory tank circuit is formed primarily by the inductances and distributed stray capacitances of the flyback transformer, horizontal yoke windings, width coil, and all of their connecting leads.

Fig. 3. Relationship between video being scanned, scanning time including retrace period, and raster display.



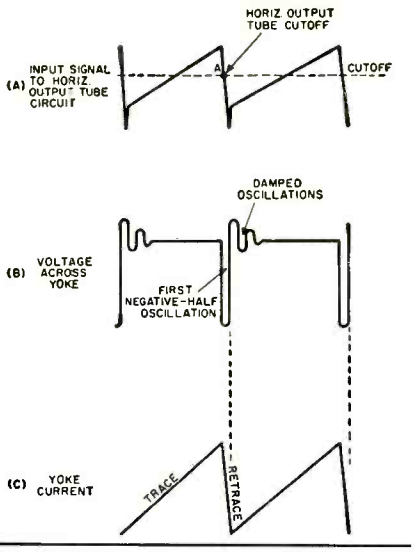


Fig. 4. Key horizontal-sweep waveforms.

The oscillations are damped as indicated by the yoke voltage waveform shown in Fig. 4B. The period of the first negative-half oscillation determines the retrace current through the yoke. See the yoke current waveform shown in Fig. 4C. Thus, the higher the frequency, the shorter the period and the quicker the retrace; conversely, the lower the frequency, the longer the retrace period. Since we want the shortest possible retrace time, the inherent resonant frequency of the flyback circuit must be as high as possible.

A frequency of 70 kc. or higher (even as high as 90 kc.) is necessary to produce the correct retrace time. At a frequency of 70 kc., the period of one-half cycle for retrace is ½ x $1/(70 \times 10^3)$ or approximately 7 μsec. At 90 kc., the retrace time is only 5.5 μsec., which is still better.

How can we keep the resonant frequency of the flyback circuit as high as possible in order to keep the retrace period as short as possible? The answer is by reducing the stray capacitance of the circuit since frequency and capacity are inversely proportional. This, in turn, can be done by keeping the horizontal output tube and high-voltage rectifier plate leads, and other such leads, as far away as possible from the high-voltage cage or other ground points.

A yoke or flyback transformer that has lost some of its efficiency through the accumulation of moisture in its windings must be replaced since the moisture increases the distributed capacitance across the windings. Substituting the output, damper, and/or high-voltage rectifier tubes may decrease retrace time, if the latter is marginal.

In some flyback circuits there is a capacitor connected across two taps of the flyback transformer secondary, frequently across the width coil. Although it serves to increase picture width, it may also increase retrace time. If this capacitor is removed to reduce the flyback interval and too much width loss results, other means can often be employed to restore this loss. These schemes include: decreasing the value of the horizontal-output tube screen-grid resistor, increasing the horizontal drive voltage by re-adjusting the drive control, and/or re-adjusting the width coil.

If such methods fail to remove foldover due to excessive retrace, then a retrace elimination circuit must be employed. Such circuits will be discussed later. Of course, the use of these circuits will also remove that portion of the video information that is folded over on the left side of the picture. However, this loss is not serious since it represents only a very small portion of the entire video signal.

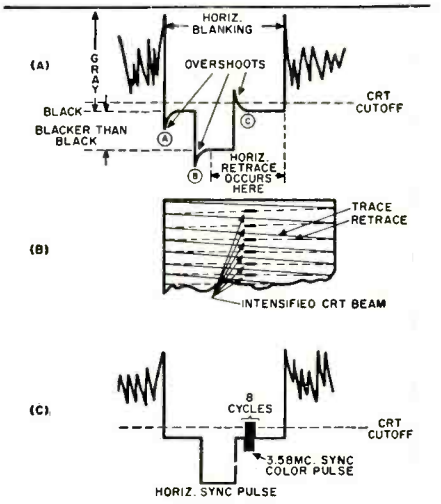
Vertical Line Distortion

Some video amplifiers are designed to "overpeak" signal before feeding this information to the picture tube. Although this tends to sharpen picture quality, it sometimes causes overshooting of the sync and blanking pulses as shown in Fig. 5A. Overshoots "A" and "B" are in the area of picture tube cut-off; thus they have no effect on the tube's beam current. Overshoot "C" extends into the conduction area (gray region of the composite video signal), resulting in picture-tube conduction where cut-off should normally take place.

The effect on the raster is shown in Fig. 5B, where the picture-tube electron beam is momentarily turned on every time it passes near the center of the screen, since overshoot "C" occurs at about the center of horizontal retrace time. The result is a fuzzy rope-like vertical line. To remove this line, a retrace elimination circuit should be used; otherwise, it may be necessary to redesign the video amplifier peaking circuits to remove the overshoot.

Radiation (or spray) from the horizontal sweep circuit into the video cir-

Fig. 5. White, vertical raster lines can be caused by overpeaking of pulses (A, B) or by the color-sync burst (C).



cuits of the receiver can also cause a distorted sync pulse similar to the one shown in Fig. 5A. The same abnormal picture results as for overshoot. If the radiation from the horizontal sweep circuit cannot be removed by shielding or damping the circuit, a retrace elimination circuit should provide results.

In color sets, the 3.58 mc. color sync signal, which appears on the back porch of the horizontal blanking pulse, can also cause one or several vertical lines in the picture when the cut-off level of the picture tube is too close to the sync pulse. This is shown in Fig. 5C.

Elimination Circuits

Fig. 6 shows some horizontal-retrace elimination circuits used in TV sets. The voltage appearing at the output-tube grid in Fig. 6A (*Motorola* TS-525) is fed to the picture-tube control grid through an *RC* network. In Fig. 6B (*RCA* CTC5), a tap on the flyback transformer secondary connects to the first anode of the 21AXP22 color picture tube through a capacitor-divider network. In Fig. 6C (*G-E* 21T7), a separate horizontal blanking tube is used to supply positive blanking pulses to the 21EP4B cathode. The blanking tube, one half of a 12AX7, is a cathode follower whose input comes from the width coil. Note that vertical blanking pulses also feed in at the 12AX7 cathode for the purpose of removing vertical retrace lines.

Another blanking circuit that uses a cathode follower—one half of a 6BL7—is shown in Fig. 6D (*G-E* 15CL100). Its input to the grid comes from a tap on the flyback transformer secondary; its output, taken from the cathode, feeds the three cathodes of the color picture tube. Note that a similar blanking circuit—one half of a 12BH7—is used to feed vertical blanking pulses to the picture-tube cathodes, which results in the composite blanking signal at the junction of R_{472} and R_{474}.

Adding a Blanking Circuit

Any of the retrace elimination circuits just discussed may be incorporated in various receivers. However, one very simple type that can be used is shown in Fig. 7. The high side of the horizontal yoke windings is connected to the picture tube's first anode (or screen grid). The yoke supplies this electrode with a negative-going blanking pulse. It also supplies the first anode with "B+" voltage.

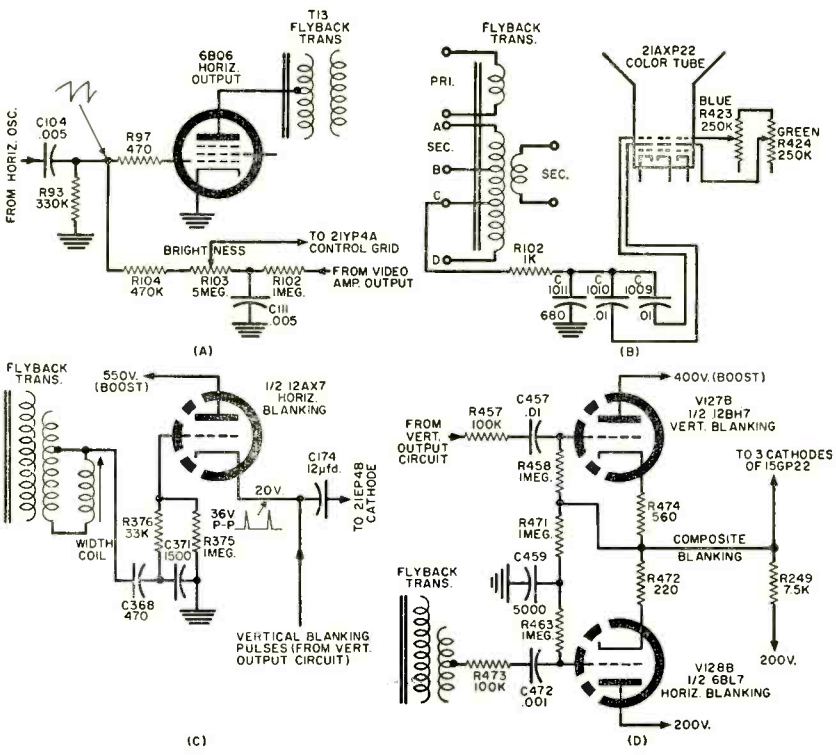
To install the network, remove the yoke balancing capacitor, *C*, which connects across the high side of the horizontal coils. This capacitor is usually 47, 56, or 100 $\mu\mu$fd. In its place, a piece of insulated, shielded cable is used, the distributed capacitance of which serves as the balancing capacitor. The exact length of cable used depends on the value of *C* desired. A wire about 8 to 12 inches long should be suitable. Try different lengths experimentally for best results as indicated by observation of the left-hand side of the raster. (A piece of 75-, 150-, or 300-ohm transmission line can also be used for this purpose but its length should run a foot or more.)

Disconnect the wire that supplied "B+" or boost voltage to the first anode of the picture tube and tape the open end properly with high-voltage tape. Connect the insulated shielded cable, as shown in Fig. 7. The center conductor connects to the high side of the yoke—usually the blue lead or pin number 3. The shielded end of the cable is connected to the center tap of the horizontal coils.

Tape the cable against the neck of the picture tube to hold it in place. Do not ground the shielded end since the cable must be connected in the circuit in exactly the same way as was balancing capacitor *C*. If this is not done, yoke ringing will occur. This results in several vertical lines appearing at the left side of the raster which gradually diminish in intensity as they approach the center.

In some yokes, balance is achieved without a capacitor. These include units in which both horizontal windings are connected in parallel or their center tap connects to a tap on the flyback transformer. In these cases, the method just described for introducing blanking generally cannot be recommended: the capacitance of the added length of wire might actually cause imbalance and disturb the left side of the raster. Instead, separate pickup coils, as shown in Fig. 8, can be used to obtain the blanking pulse.

Fortunately, such coils are commercially available. *RCA*, for example, has put them on the market. Whether the pulse induced in these added windings should be applied to the grid or cathode circuit of the picture tube may be determined experimentally by trying out both connections, reversing polarity of the leads in each case, and thus determining which connection provides the best results. Generally connection should be made to the CRT cathode if video signal is fed to the grid, and connection is best made at the grid if video is applied to the cathode. Detailed instructions for installing the coils are supplied by the manufacturer. —30—



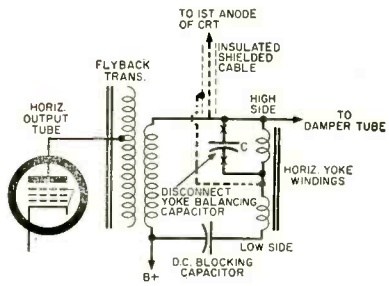
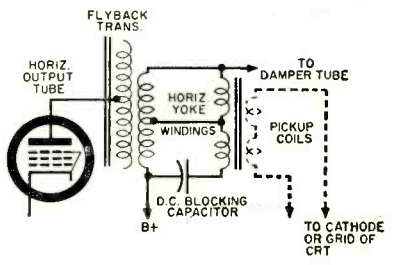


Fig. 7. An easy-to-add blanking circuit.

←Fig. 6. Some horizontal blanking circuits in color and monochrome sets.

Fig. 8. Special coils may be used to pick up the desired horizontal pulse.



SAVE 1/2 THE TIME

Make Twice The Profit!

in TV Trouble-Shooting

THIS EASY
SIGNAL INJECTION
POINT-TO-POINT
DIRECT VIEWING
WAY

MODEL 1075

B&K TELEVISION ANALYST

New Technique Makes TV Servicing Easier, Faster, More Profitable

Thousands of service technicians already save thousands of hours every day with the amazing B&K TELEVISION ANALYST. Enables you to inject your own TV signal at any point and watch the resulting test pattern on the picture tube itself. Makes it quick and easy to isolate, pin-point, and correct TV trouble in any stage throughout the video, audio, r.f., i.f., sync, and sweep sections of black & white and color television sets—*including intermittents.* Makes external scope or wave-form interpretation unnecessary. Enables any serviceman to cut servicing time in half, service more TV sets in less time, really satisfy more customers, and make more money.

MODEL 1075 TELEVISION ANALYST. Complete with standard test pattern, white dot, and white line crosshatch pattern slide transparencies, and one clear acetate. Net, **$259.95**

See your B&K Distributor or Write for Bulletin ST21-N

R.F. AMPLIFIER
Complete r.f. signal at all VHF channels. Isolates tuner trouble to the r.f. amplifier, converter, or to the r.f. oscillator stage.

4.5 MC AUDIO I.F.
Provides FM modulated 4.5 mc sound channel. This audio carrier is modulated from the built-in 400 cycle tone generator.

AUDIO AMPLIFIER AND AUDIO OUTPUT
Injection of 400 cycle tone signal simplifies trouble-shooting this section. Isolates the defect instantly.

CONVERTER

1st, 2nd, 3rd I.F.
Signals available at 20 mc and 40 mc i.f. Checks A.G.C. action. Isolates trouble to individual defective stage, i.f. transformer, or other component.

VIDEO DET.
Reproduces test pattern on picture tube. Injects signals into video detector or video amplifier stage of T/ receiver for fast, visual trouble-shooting and correction. Makes it easy to check bandwidth, resolution, shading and contrast.

VIDEO AMP.

R.F. OSC.

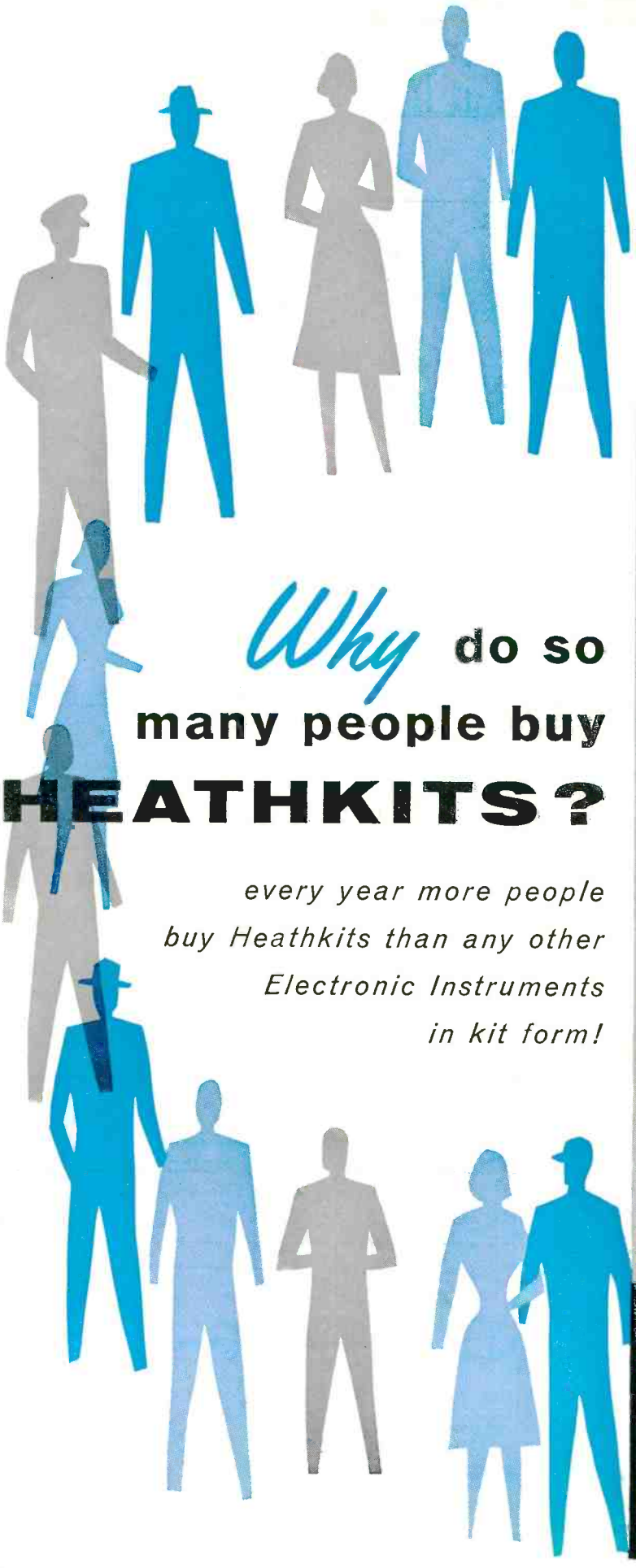
SYNC
Composite sync signals available for checking of these stages.

VERTICAL — Provides separate driving pulse to isolate defect between vertical oscillator and vertical output stage.

HORIZONTAL — Driving pulse applied to output stage produces full sweep and high voltage if output system is working. Eliminates uncertainty of B+ boost affecting horizontal oscillator operation.

B & K MANUFACTURING CO.
3726 N. Southport Ave. • Chicago 13, Illinois
Canada: Atlas Radio Corp., 50 Wingold, Toronto 10, Ont.
Export: Empire Exporters, 458 Broadway, New York 13, U.S.A.

B&K



Why do so many people buy HEATHKITS?

every year more people buy Heathkits than any other Electronic Instruments in kit form!

Here are a few reasons why...

EASY TO BUILD

Heathkits are engineered for easy kit construction. You need no electronic or kit building experience whatsoever to successfully complete your own kit. Use of printed circuit boards and pre-wired, pre-aligned assemblies cut construction time. Manuals are carefully prepared, employing step-by-step instructions written in simple, non-technical language. Large pictorial diagrams and photographs show you exactly where each part goes.

LASTING QUALITY

Only top quality components go into Heathkits, assuring you of a finished product that is unsurpassed in performance, dependability and endurance. Rigid quality control standards are maintained at the Heath factory to see that each component lives up to its advertised specifications. Heathkits are conservatively rated. No performance claims are made that are not thoroughly proven and tested under the most stringent laboratory conditions.

ADVANCED ENGINEERING

Progress in electronics engineering never stands still at Heath. The latest developments in circuit design and components are exploited by Heath engineers, offering you superior performance at lower costs. New advances in all fields of electronics are carefully watched by Heath engineers to keep abreast of the rapidly growing industry. The modern, up-to-date styling of Heathkits make them a handsome addition to your home or workshop.

WORLD-WIDE REPUTATION

A pioneer in do-it-yourself electronics, Heath Company, over more than a decade, has established public confidence in its products both in the United States and abroad. Today, as the world's largest manufacturer of electronic kits, Heath stands as the leader in its field.

GREATER SAVINGS

Do-it-yourself Heathkits save you up to ½ the cost of equivalent ready-made equipment. Direct factory-to-you selling, eliminating middle-man profit, plus the tremendous Heath purchasing power mean even further savings to you. And the convenient Heath Time Payment Plan allows you to use and enjoy your Heathkit NOW, while you pay for it in easy installments.

HEATHKIT®

HEATH COMPANY
Benton Harbor 15, Michigan

a subsidiary of Daystrom, Inc.

TRANSISTOR PORTABLE RADIO KIT

Fun for the whole family, this easy-to-build 6-transistor portable radio is ready to go wherever you go. The modern molded plastic case with pull-out carrying handle and fully enclosed back add beauty and convenience to this splendid kit. Six name-brand (Texas Instrument) transistors are used for good sensitivity and selectivity. The 4" x 6" PM speaker with heavy magnet provides "big set" tone quality. Use of this large speaker and roomy chassis make it unnecessary to crowd components adding greatly to the ease of construction. Transformers are prealigned making the radio ready for use as soon as kit is assembled. A built-in rod-type antenna assures good reception in all locations. Six standard flashlight batteries are used for power, providing extremely long battery life (between 500 and 1,000 hours) and they can be purchased anywhere. Stylish cabinet is two-tone blue molded plastic with gold inlay and measures 9" L. x 7" H. x 3¾" D. Shpg. Wt. 6 lbs.

MODEL XR-1L: Identical to XR-1P except in handsome leather case instead of plastic case. Leather carrying strap included. Shpg. Wt. 7 lbs.

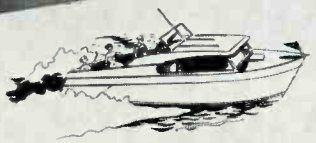
LEATHER CASE: Can be purchased separately if desired. Fits all XR-1P and earlier XR-1 chassis. No. 93-1. Shpg. Wt. 3 lbs. **$6.95.**

HEATHKIT MODEL XR-1P **$29.95**

MODEL XR-1L **$34.95**

NAVIGATE BY PORTABLE RADIO

HEATHKIT MODEL DF-2 **$69.95**



2-BAND TRANSISTOR PORTABLE RADIO DIRECTION FINDER KIT

Enjoy the safety, convenience and entertainment of this self-contained, self-powered, six-transistor superheterodyne radio direction finder. It receives aeronautical and marine beacons as well as standard band broadcasts with startlingly clear tone reproduction over a long range. Covering the beacon band from 200 to 400 kc and broadcast band from 540 to 1620 kc, the DF-2 is designed to take directional "fixes" on both aircraft and marine beacons as well as standard broadcast stations, while providing the entertainment of a high quality transistor portable radio. You are able to receive aircraft weather reports every thirty minutes and constant Coast Guard beacons on the 200 to 400 kc band. A dial light is provided for night operation. Power is supplied by six standard flashlight batteries which will last you up to one year under normal operation. Shpg. Wt. 9 lbs.

MODEL PC-1 **$24.95**

POWER CONVERTER KIT

Now you can operate your TV set, radio, razor, and other AC electrical equipment directly from your 12-volt boat or car battery. With the Heathkit Power Converter you can enjoy the convenience of home electricity whether boat cruising or on automobile trips. Two power transistors are employed for years of trouble-free, dependable service. No moving parts to wear out, no tubes to replace. Shpg. Wt. 8 lbs.

MODEL IA-1 **$59.95**

ELECTRONIC IGNITION ANALYZER KIT

Ideal for use on automobiles, boats, aircraft engines, etc., the IA-1 checks ignition systems with the engine in operation (400 to 5,000 RPM). Shows the condition of coil, condenser, points, plugs and ignition wiring. Shows complete engine cycle or just one cylinder at a time. Two test leads are supplied, each 10' long, which will enable you to reach either the breaker points or the spark plug wires. Shpg. Wt. 20 lbs.

MODEL TI-1 **$25.95**

ELECTRONIC TACHOMETER KIT

Useful on inboard and outboard boats, as well as in automobiles, the TI-1 operates directly from the spark impulse of the engine. Use on any spark ignited 2 or 4 cycle engine of any number of cylinders. Completely transistorized, it works with 6, 8, 12, 24 or 32 volt DC systems. Indicates revolutions-per-minute from 0 to 6,000. Calibration control provided for adjusting to engine type. Easy-to-build and easy-to-install. Shpg. Wt. 4 lbs.

PROFESSIONAL OSCILLOSCOPE KIT

Everything you could possibly want in an oscilloscope is found in the new Heathkit model OP-1. Featured are DC coupled amplifiers and also DC coupled CR tube un-blanking. The triggered sweep circuit will operate on either internal or external signals and may be either AC or DC coupled. The polarity of the triggering signal may also be selected, and any point on the waveform may be selected for the start of the sweep by using the "triggering level" control. An automatic position is also provided, in which the sweep recurs at 50 cycle rate, but can be driven over a wide range of frequencies with no additional adjustment. Prewired terminal boards are used for rapid, easy assembly of all critical circuits. Power supply is transformer operated utilizing silicon diode rectifiers and is fused for protection. Handsome cabinet features silver anodized front panel with red and black lettering and matching knobs. Shpg. Wt. 34 lbs.

HEATHKIT MODEL OP-1 **$179.95**

VARIABLE VOLTAGE REGULATED POWER SUPPLY KIT

Invaluable in experimental and design work, the PS-4 eliminates the need for building up a separate power supply for each new circuit tried. It provides a convenient source of variable regulated B+, variable bias voltage and filament voltage for labs and work shops. The PS-4 supplies regulated B+ output continuously variable from 0 to 400 volts DC at up to 100 ma, bias voltage variable from 0 to —100 volts DC at 1 ma, and filament voltage of 6.3 volts AC at 4 amps. Separate panel meters continuously monitors voltage and current output. Rugged, top-rated components used throughout for long, reliable service. Shpg. Wt. 16 lbs.

HEATHKIT MODEL PS-4 **$54.95**

Your best dollar value...

HEATHKIT®

HEATH COMPANY • Benton Harbor 15, Michigan

a subsidiary of Daystrom, Inc.

TEST OSCILLATOR KIT

Provides the test frequencies most often used by servicemen in repairing and aligning modern broadcast receivers. Five fixed-tuned frequencies (262 kc, 455 kc, 465 kc, 600 kc and 1400 kc) are quickly selected for troubleshooting or alignment of the IF frequency and high and low end of the broadcast band for proper tracking. Shpg. Wt. 4 lbs.

HEATHKIT MODEL TO-1 **$16.95**

HEATHKIT MODEL O-12 **$65.95**

"EXTRA DUTY" 5" OSCILLOSCOPE KIT

Laboratory quality at utility scope price makes this instrument an unusual value. The Heath patented sweep circuit functions from 10 CPS to better than 500 kc in five steps, giving you five times the usual sweep obtained in other scopes. Vertical frequency response extends from 3 CPS to 5 mc +1.5 db —5 db without extra switching. An automatic sync circuit with self-limiting cathode follower provides excellent linearity and lock-in characteristics. Extremely short retrace time and efficient blanking action are characteristic of this scope. Frequency response of the horizontal amplifier is within ±1 db from 1 CPS to 200 kc. Horizontal sensitivity is 0.3 volts RMS-per-inch. Construction is simplified through the use of two etched metal circuit boards and precut, cabled wiring harness. Complete step-by-step instructions and large pictorial diagrams are supplied for easy assembly. An ideal scope for all service applications as well as in standard or color TV servicing. Shpg. Wt. 22 lbs.

MODEL SG-8 **$19.50**

RF SIGNAL GENERATOR KIT

A "must" for any beginning serviceman, this indispensable instrument is used for aligning tuned circuits quickly and tracing signals in faulty RF, IF and audio circuits. Covers 160 kc to 110 mc on fundamentals in five bands and from 110 mc to 220 mc on calibrated harmonics. Coils are prewound and calibrated. Complete with output cable and instructions. Shpg. Wt. 8 lbs.

MODEL AG-9A **$34.50**

AUDIO SIGNAL GENERATOR KIT

This unique generator uses three rotary switches to select two significant figures and a multiplier to determine audio frequency, allowing return to the exact frequency previously measured when making multiple frequency measurements. Covers 10 CPS to 120 kc with less than .1 of 1% distortion between 20 and 20,000 CPS. Shpg. Wt. 10 lbs.

MODEL TS-4A **$49.50**

TV ALIGNMENT GENERATOR KIT

TV service technicians will appreciate the outstanding features found in this sweep generator. Provides essential facilities for aligning FM, monochrome TV or color TV sets. The all-electronic sweep circuit employs a trouble-free controllable inductor which varies frequency by magnetic means. An unusual buy at this low price. Shpg. Wt. 16 lbs.

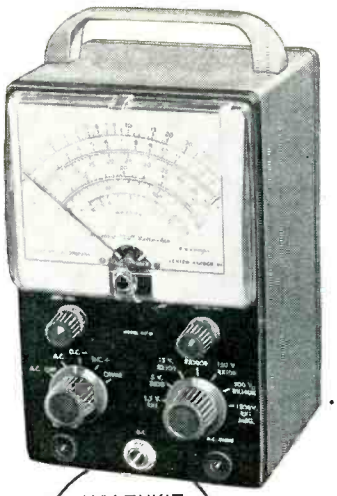
MODEL CD-1 **$59.95**

COLOR BAR AND DOT GENERATOR

The CD-1 combines the two basic color servicing instruments, a color bar and white dot generator in one versatile and portable unit, which has crystal controlled accuracy and stability for steady lock-in patterns. (Requires no external sync leads.) Easy-to-build and easy-to-use. No other generator on the market offers so many features at such a great price saving. Shpg. Wt. 13 lbs.

ETCHED CIRCUIT VTVM KIT

Time proven for dependability, accuracy and overall quality, the V7-A is one of the wisest investments you can make for your electronic workshop or lab. Its multitude of uses will make it one of the most often used instruments in your possession. Use it to measure all operating voltages and potentials such as B+ and AC-DC, or straight AC power supplies, filament voltage, bias voltage, AVC voltage, line voltage, etc. Ideal for measurements in all types of AM, FM and TV circuits. Checks discriminator or detector operation, AVC or AGC performance, while the ohmmeter may be used to measure circuit continuity, circuit resistance, to test out individual components with resistance measurement, or to trace circuit wiring through cables or chassis openings. Front panel controls consist of rotary function switch and a rotary range selector switch, zero-adjust and ohms-adjust controls. Precision 1% resistors are used in the voltage divider circuit for high accuracy and an etched circuit board is employed for most of the circuitry. The circuit board not only simplifies assembly but permits levels of circuit stability not possible with ordinary conventional wiring methods. Shpg. Wt. 7 lbs.



HEATHKIT MODEL V7-A **$25.95**

HEATHKIT MODEL M-1 **$17.95**

HANDITESTER KIT

Ideal for use in portable applications when making tests away from the work bench or as an "extra" meter in the service shop. The combination function range switch simplifies operation. Measures AC or DC voltage from 0 to 10, 30, 300, 1,000 and 5,000 volts. Direct current ranges are 0 to 10 ma and 0 to 100 ma. Ohmmeter ranges are 0 to 3,000 and 0 to 300,000. Top quality, precision components used throughout. Small and compact, take it with you wherever you go. Very popular with home experimenters and electricians. Test leads and 1½ volt size C battery are included with the kit. Shpg. Wt. 3 lbs.

HEATHKIT MODEL MM-1 **$29.95**

20,000 OHMS/VOLT VOM KIT

Portable and accurate, this kit features a 50 ua 4½" meter and 1% precision multiplier resistors for high accuracy. No external power required. Provides a total of 25 meter ranges on a two-color scale. Sensitivity is 20,000 ohms-per-volt DC and 5,000 ohms-per-volt AC. Measuring ranges are 0-1.5, 5, 50, 150, 500, 1,500 and 5,000 volts AC and DC. Measures direct current in ranges of 0-150 ua, 15 ma, 150 ma, 500 ma and 15 a. Resistance multipliers are X 1, X 100 and X 10,000. Covers —10 db to +65 db. Housed in an attractive bakelite case with plastic carrying handle. Batteries and test leads included. Shpg. Wt. 6 lbs.

TUBE CHECKER KIT

Brand new in every respect, the TC-3 features outstanding performance and ease of operation. Sockets are provided for 4-pin, 5-pin, 6-pin, 7-pin, large, 7-pin miniature, 7-pin sub-miniature, octal, loctal, and 9-pin miniature tubes. Protection against obsolescence is provided by a blank socket to facilitate modification for checking newly added tube types. A 10-lever switch makes it possible to connect any element to any other element regardless of the pin numbers involved. A neon bulb indicator shows filament circuit continuity and leakage or shorts between elements. A specially designed spring loaded roll chart mechanism permits the roll chart to run freely throughout its entire length without binding. Thumb wheel drive knobs are provided on both sides of the panel to accommodate the left handed operator. Compact and small in size, the TC-3 is ideally suited for portable applications. Both the roll chart and the meter are illuminated to facilitate use in darkened areas. Shpg. Wt. 12 lbs.

HEATHKIT MODEL TC-3 **$39.95**

MODEL AV-3 **$29.95**

AUDIO VTVM KIT

This vacuum tube volt meter emphasizes stability, broad frequency response and sensitivity for accurate measurement of critical AC voltages. Features a large 4½" 200 ua meter with increased damping in the meter circuit for stability in low frequency tests. Measures AC from a low value of 1 millivolt to a maximum of 300 volts AC (RMS). Voltage ranges are: 0-.01, .03, .1, .3, 1, 3, 10, 30, 100 and 300 volts. Db ranges cover —52 to +52 db. 1% precision multiplier resistors used for maximum accuracy. Frequency response is essentially flat from 10 CPS to 200 kc. Shpg. Wt. 6 lbs.

MODEL CT-1 **$7.95**

IN-CIRCUIT CAPACI-TESTER KIT

This handy kit checks capacitors for "open" or "short" right in the circuit. Detects open capacitors from about 50 mmf, not shunted by an excessive low resistance value. Checks shorted capacitors up to 20 mfd (not shunted by less than 10 ohms). Checks all bypass, blocking and coupling capacitors of the paper, mica or ceramic types. (Does not detect leakage nor check electrolytic condensers.) Electron beam "eye" tube is used for quick indication. A 5-position function switch is featured which controls the power to the instrument and selects the test being made. Easy to build and easy to use. Test leads included Shpg. Wt. 5 lbs.

MODEL BE-5 **$39.95**

LOW RIPPLE BATTERY ELIMINATOR KIT

Completely up to date the BE-5 will power all the newest transistor circuits requiring 0 to 12 volts DC, and the new hybrid automobile radios using both transistors and vacuum tubes. An extra low-ripple filter circuit is employed holding AC ripple down to less than .3%. Doubles as a battery charger or marine converter. Shpg. Wt. 21 lbs.

MODEL T-4 **$19.95**

VISUAL-AURAL SIGNAL TRACER KIT

New in every respect the T-4 features a built-in speaker and electron beam "eye" tube for signal indication, and a unique noise locator circuit. Ideal for use in AM, FM and TV circuit investigation. Transformer operated for safety and high efficiency. Complete with test leads and informative construction manual. Shpg. Wt. 5 lbs.

MODEL C-3 **$19.50**

CONDENSER CHECKER KIT

Check unknown condenser and resistor values quickly and accurately as well as their operating characteristics with this fine instrument. All values are read directly on a calibrated scale. An electron beam "eye" tube indicates balance and leakage. A valuable addition to any service shop or lab. Shpg. Wt. 7 lbs.

"APACHE" HAM TRANSMITTER KIT

HEATHKIT MODEL TX-1 **$229.50**

- Modern Styling
- Rotating Slide Rule Dial
- Compact, Stable, VFO
- Provision for SSB Adapter

This beautifully styled transmitter has just about everything you could ask for in transmitting facilities. The "Apache" is a high quality transmitter operating with a 150 watt phone input and 180 watt CW input. In addition to CW and phone operation, built-in switch selected circuitry provides for single-sideband transmission through the use of a plug-in external adapter. A completely redesigned, compact and stable VFO provides low drift frequency control necessary for SSB transmission. A slide rule type illuminated rotating VFO dial with full gear drive vernier tuning provides ample bandspread and precise frequency settings. The bandswitch allows quick selection of the amateur bands on 80, 40, 20, 15 and 10 meters (11 m with crystal control). This unit also has adjustable low-level speech clipping and a low distortion modulator stage employing two of the new 6CA7/EL34 tubes in push-pull class AB operation. Time sequence keying is provided for "chirpless" break-in CW operation. The final amplifier is completely shielded for greater TVI protection and transmitter stability. A formed one-piece cabinet with convenient access hatch provides accessibility to tubes and crystal socket. Die-cast aluminum knobs and front panel escutcheons add to the attractive styling of the transmitter. Pi network output coupling matches antenna impedances between 50 and 72 ohms. A "spotting" push button is provided to allow tuning of the transmitter before switching on the final amplifier. This feature also enables the operator to "zero-beat" an incoming frequency without placing the transmitter on the air. Equip your ham shack now for top transmitting enjoyment with this outstanding unit. Shpg. Wt. 110 lbs.

$50.00 required on C.O.D. orders. Shipped motor freight unless otherwise specified.

New Styling...
New Features

HEATHKIT®

HEATH COMPANY
Benton Harbor 15, Michigan

a subsidiary of Daystrom, Inc.

HEATHKIT MODEL SB-10 **$89.95**

SINGLE SIDEBAND ADAPTER KIT

Designed as a compatible plug-in adapter for the model TX-1 it can also be used with transmitters similar to the DX-100 or DX-100-B by making a few simple circuit modifications and still retain the normal AM and CW functions. Easy to operate and tune, the adapter employs the phasing method for generating a single sideband signal, allowing operation entirely on fundamental frequencies. The critical audio phase shift network is supplied, completely preassembled and wired in a sealed plug-in unit. Features include single-knob bandswitching for operation on 80, 40, 20, 15 and 10 meters, an easy-to-read panel meter, built-in electronic voice control with anti-trip circuit. Enjoy the advantages of SSB operation by adding this fine kit to your ham shack now. Shpg. Wt. 14 lbs.

MODEL DX-100-B **$189.50**

$50.00 deposit required on C.O.D. orders. Shipped motor freight unless otherwise specified.

DX-100-B PHONE & CW TRANSMITTER KIT

The same fine performance of the time proven DX-100 is retained in the DX-100-B with improvements in the crystal and loading circuits. The one-piece formed cabinet has convenient access hatch for changing crystals, etc. and the chassis is punched to accept sideband adapter modifications. Features a built-in VFO, modulator and power supply, complete shielding to minimize TVI, and a pi network output coupling to match impedances from 50 to 72 ohms. RF output is in excess of 100 watts on phone and 120 watts on CW. Covers 160 through 10 meters. Single-knob bandswitching and illuminated VFO dial and meter face. RF output stage uses a pair of 6146 tubes in parallel, modulated by a pair of 1625's. Designed for easy assembly. Measures 11⅝" H. x 19½" W. x 16" D. Shpg. Wt. 107 lbs.

MODEL DX-40 **$64.95**

DX-40 PHONE & CW TRANSMITTER KIT

Operates on 80, 40, 20, 15, 11 and 10 meters, using a single 6146 tube in the final for 75 watt plate power input CW, or 60 watts phone. Single-knob bandswitching, pi network output, complete shielding, provision for three crystals and VFO. D'Arsonval movement panel meter. Shpg. Wt. 25 lbs.

MODEL DX-20 **$35.95**

DX-20 CW TRANSMITTER KIT

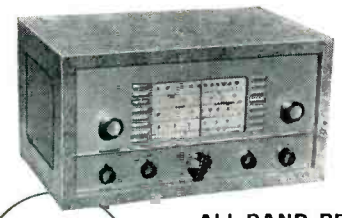
This fine unit covers 80, 40, 20, 15, 11 and 10 meters with single-knob bandswitching. Features a 6DQ6A tube in the final for 50 watt plate power input, pi network output, complete shielding to minimize TVI. Easy to build with complete instructions supplied. Shpg. Wt. 19 lbs.

"MOHAWK" HAM RECEIVER KIT

Designed for ham band operation and for maximum stability and accuracy, the Heathkit "Mohawk" receiver will let you enjoy ham activities to the utmost. This 15-tube receiver features double conversion with IF's at 1682 kc and 50 kc and covers all the amateur frequencies from 160 through 10 meters on seven bands. An extra band is calibrated to cover 6 and 2 meters using a converter. The "Mohawk" is specially designed for single-sideband reception with crystal controlled oscillators for upper and lower sideband selection. A completely pre-assembled, wired and aligned front end coil /bandswitch assembly assures ease of construction and top performance. Many more important features are provided in this outstanding receiver for dependable and effective amateur communications. Ruggedly constructed with well rated components throughout. Shpg. Wt. 66 lbs. Matching accessory speaker kit; optional extra. Model AK-5. $9.95. Shpg. Wt. 8 lbs.

- **Prewired and Aligned Coil/Bandswitch Assembly**
- **Crystal Controlled Oscillators for Drift-Free Reception**

HEATHKIT MODEL RX-1 **$274.95**



HEATHKIT MODEL AR-3 **$29.95**

(LESS CABINET)

ALL-BAND RECEIVER KIT

A fine receiver for the beginning ham or short wave listener. Frequency coverage is from 550 kc to 30 mc in four bands. Features include bandswitch, bandspread tuning, phone-standby-CW switch, antenna trimmer, noise limiter, RF and AF gain controls and headphone jack. Easy to build. Shpg. Wt. 12 lbs.

MODEL QF-1 **$9.95**

"Q" MULTIPLIER KIT

Use with any receiver with IF frequency between 450 and 460 kc to add additional selectivity for separating two signals or to reject one signal and eliminate heterodyne. A great help on crowded phone and CW bands. Not for use with AC-DC type receivers. Simple to connect with cable and plugs supplied. Shpg. Wt. 3 lbs.

"SENECA" VHF TRANSMITTER KIT

Brand new in every respect, the model VHF-1 "Seneca" is the latest addition to our line of ham transmitters. This self-contained 6 and 2 meter transmitter features built-in VFO, modulator, and dual power supply. A pair of 6146 tubes are employed in the push-pull final amplifier stage and features up to 120 watts input on phone and 140 watts input on CW in the 6 meter band. Slightly less in the 2 meter band to prolong amplifier tube life. Panel controls allow VFO or crystal control, phone or CW operation on both amateur bands. Four switch-selected crystal positions. Complete RF shielding to minimize TVI. Spotting push-button provided. The VFO slide rule type dial features edge-lighting and vernier tuning. An ideal transmitter for the ham who wants to extend operation into the VHF region. Shpg. Wt. 56 lbs.

HEATHKIT MODEL VHF-1 **$159.95**

MODEL CA-1 **$13.95**

"AUTOMATIC" CONELRAD ALARM KIT

This easy-to-build device gives instant warning and cuts AC power to your transmitter when a monitored station goes "off-the-air". Use with any radio receiver having an AVC circuit. A sensitivity control adjusts to various AVC levels. Incorporates a heavy duty six-ampere relay and manual "reset" button to reactivate the transmitter. Complete instructions provided for connection to receiver. Shpg. Wt. 4 lbs.

MODEL AM-2 **$15.95**

REFLECTED POWER METER KIT

Check the match of your antenna transmission system by measuring the forward and reflected power or standing wave ratio from 1:1 to 6:1. Handles a peak power of well over 1 kilowatt and may be left in antenna feed line. No external power required. 160 through 6 meters. For 50 or 75 ohm lines. Shpg. Wt. 3 lbs.

MODEL B-1 **$8.95**

BALUN COIL KIT

Unbalanced coax lines can be matched to balance lines of either 75 or 300 ohms by using this balun coil kit. Use without adjustment from 80 through 10 meters at power up to 200 watts. May be located any distance from transmitter or antenna. Protective cover included. Shpg. Wt. 4 lbs.

MODEL VX-1 **$23.95**

ELECTRONIC VOICE CONTROL KIT

This unique device lets you switch from receiver to transmitter merely by talking into your microphone. Provision is made for receiver and speaker connections and also for a 117 volt antenna relay. Adjustable to all conditions by sensitivity and variable time delay controls provided. Shpg. Wt. 5 lbs.

MODEL VF-1 **$19.50**

VARIABLE FREQUENCY OSCILLATOR KIT

Far below the cost of crystals to obtain the same frequency coverage this VFO covers 160, 80, 40, 20, 15, 11 and 10 meters with three basic oscillator frequencies. Better than 10 volts RF output on fundamentals. Requires only 250 volts DC at 15 to 20 ma, and 6.3 VAC at 0.45 a. Illuminated dial reads direct. Shpg. Wt. 7 lbs.

Beautifully Styled With Plenty of Room For The Most Complete Stereo System

MODEL SE-1 (center unit) **$149.95** Shpg. Wt. 162 lbs.

MODEL SC-1 (speaker enclosure) **$39.95** each Shpg. Wt. 42 lbs.

STEREO EQUIPMENT CABINET KIT

This superbly styled cabinet ensemble is designed to hold your complete home stereo hi-fi system, consisting of a "stereo equipment center" flanked by two individual "stereo wing speaker enclosures". The unit has room for all the components required for stereo sound. Although designed to hold Heathkit stereo components, it is not frozen to this arrangement. The kit is supplied with mounting panels precut to accommodate Heathkits, but interchangeable blank panels are also furnished so you can mount any equipment you may already have. The precut panels accommodate the Heathkit AM-FM tuner (PT-1), stereo preamplifier (SP-1 & 2), and record changer (RP-3). Record changer chassis pulls out easily for convenient loading and unloading. Adequate space is provided for record storage and a pair of matching Heathkit power amplifiers (from 12 to 70 watts). The stereo wing speaker enclosures are open backed, cloth grilled cabinets designed to hold the Heathkit SS-2 or similar speaker systems. The cabinets are available in beautifully grained ¾" solid core Phillipine mahogany or select birch plywood suitable for the finish of your choice. The matched grain sliding tape deck access door on top pops-up flush when closed. Entire top features a shaped edge. Hardware and trim of brushed-brass and gold finish. Rich toned grille cloth is flecked in gold and black. No woodworking experience required. All parts precut and predrilled for easy assembly. Maximum overall dimensions (all 3 pieces): 82¾" W. x 36½" H. x 20" D. Center Cabinet: 47½" W. x 36½" H. x 20" D.

CHAIRSIDE ENCLOSURE KIT

Combine all of your hi-fi equipment into one compact control center and, at the same time add a beautiful piece of furniture to your home. The CE-1 is designed to house AM and FM tuners (BC-1A and FM-3A) and the WA-P2 preamplifier along with the majority of record changers which will fit in the space provided. Changer compartment measures 17¾" L. x 16" W. x 9⅜" D. Adequate space is provided in the rear of the unit to house any of the Heathkit amplifiers designed to operate with the WA-P2. Good ventilation is achieved through properly placed slots in the bottom and back of the enclosure. Overall dimensions are 18" W. x 24"H x 35½" D. All parts are precut and predrilled for easy assembly. The Contemporary cabinet is available in either mahogany or birch, and the Traditional cabinet is available in mahogany suitable for the finish of your choice. Beautiful hardware supplied. Shpg. Wt. 46 lbs.

Plan your own Hi-Fi System...

HEATHKIT®

HEATH COMPANY • Benton Harbor 15, Michigan

a subsidiary of Daystrom, Inc.

HIGH FIDELITY RECORD CHANGER KIT

Every outstanding feature you could ask for in a record changer is provided in the Heathkit RP-3, the most advanced changer on the market today. The unique turntable pause during the change cycle saves wear and tear on your records by eliminating the grinding action caused by records dropping on a moving turntable or disk. Record groove and stylus wear are practically eliminated through proper weight distribution and low pivot point friction of the tone arm. Clean mechanical simplicity and precision parts give you turntable performance with the automatic convenience of a record changer. Flutter and wow, a major problem with automatic changers, is held to less than 0.18% RMS. An automatic speed selector position allows intermixing 33⅓ and 45 RPM records regardless of their sequence. Four speeds provided: 16, 33⅓, 45 and 78 RPM. Changer is supplied complete with GE VR II cartridge with diamond LP and sapphire 78 stylus, changer base, stylus pressure gauge and 45 RPM spindle. Shpg. Wt. 19 lbs.

"BASIC RANGE" HI-FI SPEAKER SYSTEM KIT

The popularity of this modestly priced speaker system attests to its high fidelity performance. The SS-2 provides an ideal basic speaker for your home hi-fi system. Flexibility of design allows it to be used as a table top model or as an attractive consolette with optional legs. May also be used as a supplementary speaker in more advanced systems or as replacement speaker for TV sets, etc. The specially designed tweeter horn rotates 90 degrees allowing you to use the speaker in an upright position if desired, as in the Heathkit stereo wing speaker enclosures. Total frequency range is from 50 to 12,000 cycles-per-second. An 8" mid-range woofer covers from 50 to 1,600 CPS while a compression-type tweeter with flared horn covers 1,600 to 12,000 CPS. Both speakers are by Jensen. A variable balance control allows level adjustment of the high frequency speaker. Power rating is 25 watts. Constructed of ½" veneer-surfaced plywood suitable for light or dark finish. All wood parts are precut and predrilled for simple, quick assembly. An added feature of the SS-2 is that, although an outstanding performer in its own right, it may be combined with the SS-1B "range extending" speaker system later to extend the frequency range at the high and low ends of the audio range. Build in just one evening for many years of listening enjoyment. Shpg. Wt. 26 lbs.

ATTRACTIVE BRASS TIP ACCESSORY LEGS convert SS-2 into handsome consolette. 14" legs screw into brackets provided. All hardware included. Shpg. Wt. 3 lbs. No. 91-26. **$4.95.**

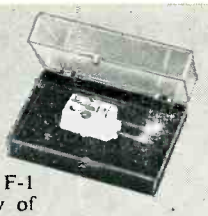
Assemble it in

Just One Evening

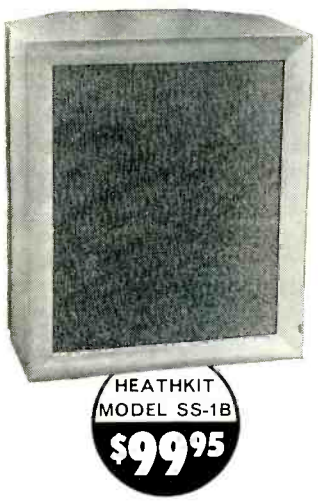
OPTIONAL LEGS
NO. 91-26 **$4.95**

DIAMOND STYLUS HI-FI PICKUP CARTRIDGE

MODEL MF-1 **$26.95**



Replace your present pickup with the MF-1 and enjoy the fullest fidelity your library of LP's has to offer. Designed to Heath specifications to offer you one of the finest cartridges available today. Nominally flat response from 20 to 20,000 CPS. Shpg. Wt. 1 lb.



Extended Frequency Range for Your SS-2

"RANGE EXTENDING" HI-FI SPEAKER SYSTEM KIT

Designed exclusively for use with the SS-2, the SS-1B employs a 15" woofer and a super tweeter horn to extend the range of the SS-2 to an overall response of ±5 db from 35 to 16,000 CPS. When used together the two units form an integrated four-speaker system and are designed to combine into a single piece of attractive furniture. Impedance of the SS-1B is 16 ohms and power rating 35 watts. A control is provided to limit the output of the super tweeter. Constructed of beautiful ¾" veneer-surfaced plywood suitable for light or dark finish of your choice. All parts are precut and predrilled for simple assembly. No woodworking experience required. All hardware included. Shpg. Wt. 80 lbs.

"LEGATO" HI-FI SPEAKER SYSTEM KIT

It is difficult to describe in words the performance of this magnificent speaker system. You may never find absolute perfection in reproduced sound, but the Legato comes as close to achieving it as anything yet devised. Perfect balance, precise phasing, and adequate driver design combine to produce the superb quality of reproduction inherent in this instrument. The crisp, clear high frequencies and rich full bass engulf you in a sea of life-like tone. Two 15" Altec Lansing low frequency drivers cover frequencies from 25 to 500 CPS while a specially designed exponential horn with high frequency driver covers 500 to 20,000 CPS. The unique crossover network is built-in making electronic crossovers unnecessary. The legato emphasizes simplicity of line and form to blend with modern or traditional furnishings. Constructed of ¾" veneer-surfaced plywood in either African mahogany or white birch suitable for light or dark finishes of your choice. All parts are precut and predrilled for easy assembly. Shpg. Wt. 195 lbs.

Easy to buy...
Easy to build
Easy to use...

HEATHKIT®

HEATH COMPANY

Benton Harbor 15, Michigan

High Fidelity AM and FM reception in a Single Set

HEATHKIT MODEL PT-1 **$89.95**

Professional Stereo-Monaural AM-FM Tuner Kit

Enjoy stereophonic broadcasts as well as outstanding individual AM and FM radio reception with this deluxe 16-tube AM-FM-stereophonic tuner combination. Features include three etched circuit boards for high stability and ease of construction, prewired and prealigned FM front end, built-in AM rod antenna, tuning meter, FM-AFC (automatic frequency control) with on-off switch, and flywheel tuning. A multiplex jack is also provided. AM and FM circuits are tuned individually making it ideal for stereo applications since both AM and FM can be used at the same time. A switch selected tuning meter functions on either AM or FM. Cathode follower outputs with individual level controls are provided for both AM and FM. Other features include variable AM bandwidth, 10 kc whistle filter, tuned-cascode FM front end, FM AGC and amplified AVC for AM. Anywhere from 1 to 4 limiters or IF's assure smooth, non-flutter reception on weak or strong stations alike. The silicon diode power supply is conservatively rated and is fuse-protected assuring long service life. Flywheel tuning combined with new edge-lighted slide-rule dial provide effortless tuning. Use of three printed circuit boards greatly simplifies construction. Vinyl-clad steel cover is black with inlaid gold design. Shpg. Wt. 20 lbs.

MODEL FM-3A **$26.95**

HIGH FIDELITY FM TUNER KIT

The Heathkit FM-3A Tuner will provide you with years of inexpensive hi-fi enjoyment. Features broad-banded circuits for full fidelity and better than 10 uv sensitivity for 20 db of quieting. Covers the complete FM band from 88 to 108 mc. Stabilized, temperature-compensated oscillator assures neglible drift after initial warmup. Employs a high gain cascode IF amplifier and has AGC. Power supply is built-in. IF and ratio transformers are prealigned as is the front end tuning unit. Two outputs provided, one fixed, one variable, with extra stage of amplification. Shpg. Wt. 8 lbs.

MODEL BC-1A **$26.95**

HIGH FIDELITY AM TUNER KIT

The BC-1A incorporates many features not usually expected in an AM circuit particularly in this low price range. It features a special detector using crystal diodes and broad band-width IF circuits for low signal distortion. Audio response is ± 1 db from 20 CPS to 9 kc with 5 db of pre-emphasis at 10 kc to compensate for station rolloff. Covers the complete broadcast band from 550 to 1600 kc. Prealigned RF and IF coils eliminate the need for special alignment equipment. Incorporates AVC, two outputs, two antenna inputs and built-in power supply. Shpg. Wt. 9 lbs.

MODEL W-6 **$109.95**

"HEAVY DUTY" 70 WATT HI FI AMPLIFIER KIT

Designed for "rugged duty" called for by advanced hi-fi systems and P.A. networks. Silicon diode rectifiers assure long life and heavy duty transformer provides excellent power supply regulation. Variable damping control provides optimum performance with any speaker system. Quick change plug selects 4, 8 and 16 ohm or 70 volt output and the correct feedback resistance. Shpg. Wt. 52 lbs.

MODEL W-5 **$59.75**

25 WATT HI FI AMPLIFIER KIT

Enjoy the distortion-free high fidelity sound from one of the most outstanding hi-fi amplifiers available today. Features include a specially designed Peerless output transformer and KT66 tubes. Frequency response is ± 1 db from 5 to 160,000 CPS at 1 watt and within 2 db 20 to 20,000 CPS at full 25 watts output. Hum and noise are 99 db below 25 watts. Shpg. Wt. 31 lbs.

MODEL W-4AM **$39.75**

SINGLE CHASSIS 20 WATT HI FI AMPLIFIER KIT

A true Williamson-type high fidelity circuit, the W-4AM features 5881 push-pull output tubes and a special Chicago-Standard output transformer to guarantee you full fidelity at minimum cost. Harmonic distortion is 1.5% and IM distortion is below 2.7% at full 20 watt output. Hum and noise are 95 db below full output. Taps for 4, 8 or 16 ohm speakers. Shpg. Wt. 28 lbs.

MODEL W-3AM **$49.75**

DUAL CHASSIS 20 WATT HI FI AMPLIFIER KIT

Another famous Williamson-type high fidelity circuit, the W-3AM features the famous Acrosound TO-300 "ultralinear" output transformer and 5881 tubes. The power supply and main amplifier are on separate chassis for installation flexibility. Harmonic distortion is less than 1% and IM distortion is less than 1.2% at 20 watts. Shpg. Wt. 29 lbs.

HEATHKIT
MODEL SP-2
(STEREO)
$56.95

Monaural-Stereo Preamplifier Kit (2-Channel Mixer)

This unique kit allows you to purchase it in the monaural model if desired and then add the second or stereo channel later. The SP-2 features 12 separate inputs, six on each channel, with input level controls. Six dual concentric controls consist of: two 8-position selector switches, two bass, two treble, two volume level and two loudness controls, a scratch filter switch and a 4-position function switch. A separate on-off switch is provided. The function switch provides settings for stereo, 2-channel mix, channel A or B for monaural use. Inputs consist of tape, mike, mag phono and three high-level inputs. NARTB equalization and RIAA, LP, 78 record compensation are provided. A remote balance control is included. Printed circuit boards for easy assembly. Built-in power supply. Shpg. Wt. 15 lbs.

MODEL SP-1 (MONAURAL)
$37.95 Shpg. Wt. 13 lbs.

MODEL C-SP-1 (CONVERTS SP-1 TO SP-2)
$21.95 Shpg. Wt. 5 lbs.

HEATHKIT
MODEL WA-P2
$19.75

"MASTER CONTROL" PREAMPLIFIER KIT

Control your hi-fi system with this compact unit. Features 5 switch-selected inputs to accommodate a record changer, tape recorder, AM tuner, FM tuner, TV receiver, microphone, etc., each with level control. Provision also for a tape recorder output. Equalization for records through separate turnover and rolloff switches for LP, RIAA, AES and early 78's. Shpg. Wt. 7 lbs.

MODEL W-7M
$54.95

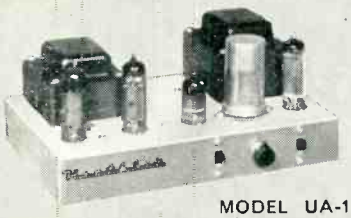
"EXTRA PERFORMANCE" 55 WATT HI FI AMPLIFIER KIT

Enjoy this high fidelity power amplifier at less than a dollar per watt. Full audio output and maximum damping is conservatively rated at 55 watts from 20 CPS to 20 kc with less than 2% total harmonic distortion throughout the entire range. Features famous "bas-bal" circuit, EL-34 output tubes and special 70 volt output. Shpg. Wt. 28 lbs.

MODEL XO-1
$18.95

ELECTRONIC CROSSOVER KIT

This unique instrument separates high and low frequencies and feeds them through 2 amplifiers into separate speakers. Located ahead of the main amplifier, it virtually eliminates IM distortion and matching problems. Note: Not for use with Heathkit Legato speaker system. Shpg. Wt. 6 lbs.



MODEL UA-1
$21.95

"UNIVERSAL" 12 WATT HI FI AMPLIFIER KIT

The versatility and economy of this fine kit make it a truly "universal" hi-fi amplifier. An ideal basic amplifier for any hi-fi system or a perfect addition to gear your present hi-fi system to stereo sound. Uses 6BQ5/EL84 push-pull output tubes for less than 2% harmonic distortion throughout the entire audio range. Shpg. Wt. 13 lbs.

MODEL A-9C **$35.50**

GENERAL-PURPOSE 20 WATT AMPLIFIER KIT

Designed for home installation as well as for PA requirements, the A9-C combines a preamplifier, main amplifier and power supply all on one chassis. Four switch-selected inputs are provided as well as separate bass and treble tone controls offering 15 db boost and cut. Detachable front plate allows for custom installation. Shpg. Wt. 23 lbs.

MODEL SW-1 **$24.95**

SPEEDWINDER KIT

A real timesaver, the SW-1 leaves your tape recorder free for operation while rewinding tape at the rate of 1200 feet in 40 seconds. Prevents unnecessary wear to the tape and recorder. Handles up to 10½" tape reels. Handles 800' reels of 8 and 16 millimeter film as well. Automatic shutoff prevents whipping at end of rewind. Shpg. Wt. 12 lbs.

NO. 401-6
$7.50

12" UTILITY SPEAKER KIT

Replace inferior speakers in radio or TV sets to obtain better tone quality or set up an auxiliary speaker for testing purposes with this convenient, high quality speaker. The speaker will handle up to 12 watts with a frequency response of ±5 db from 50 to 9,000 CPS. Speaker impedance is 8 ohms and has a 6.8 oz. magnet. An outstanding dollar value. Shpg. Wt. 7 lbs.

MODEL TK-1 **$9.95**

COMPLETE TOOL SET

These basic tools are all you need to build any Heathkit. The pliers, diagonal side cutters, 2 screwdrivers, and soldering iron are all of top quality case hardened steel for hard duty and long life. Pliers and side cutters are equipped with insulated rubber handles for safety. A good example of just how easy Heathkit building really is. Shpg. Wt. 3 lbs.

HIGH FIDELITY TAPE RECORDER KIT

The model TR-1A tape deck and preamplifier combination provides all the facilities you need for top quality monaural recording/playback with fast forward and rewind functions. 7½ and 3¾ IPS tape speeds are selected by changing belt drive. Flutter and wow are held to less than 0.35%. Frequency response at 7½ IPS ±2.0 db 50-10,000 CPS, at 3¾ IPS ±2.0 db 50-6,500 CPS. Both units may be mounted together or separately affording high flexibility in every application. Features include NARTB playback equalization —separate recording and playback gain controls —cathode follower output and provision for mike or line input. Signal-to-noise ratio is better than 45 db below normal recording level with less than 1% total harmonic distortion. A filament balance control allows adjustment for minimum hum level. Complete instructions provided for easy assembly. Overall dimensions of tape deck and preamp is 15½" W. x 13½" H. x 8" D. Shpg. Wt. 24 lbs.

HEATHKIT TR-1A
$99.95

Includes tape deck assembly, preamplifier and roll of tape.

HEATHKIT TE-1
$39.95

Tape preamplifier sold separately if desired. Shpg. Wt. 10 lbs.

Many more Heathkits to choose from

hi-fi: Amplifiers—Preamplifiers—Speaker Systems—AM/FM Tuners—Equipment Cabinets—Record Player—Tape Recorder—Electronic Crossover—Stereo Equipment.

test: Oscilloscopes—Voltmeters—RF Signal Generators—AF Generators—Analyzers—Battery Eliminators—Tube Checkers—Condenser Checkers—Computer—Color Bar & Dot Generator—Sweep Generator—Impedance Bridge—Power Supplies—Probe Kits—R/C Decade & Substitution Kits.

ham radio: Transmitters—Receivers—Antenna Accessories—Voice Control—Conelrad Alarm—Variable Frequency Oscillator—SSB Adapter—"Q" Multiplier.

marine: Direction Finders — Marine Converter — Rudder Position Indicator—Fuel Vapor Detector—Charge Indicator—Power Meter.

general: Tool Set—6-Transistor Portable Radio—Radiation Counter—Electronic Timer—Crystal Receiver—Superheterodyne Receiver.

Send for Catalog describing over 100 easy-to-build electronic instruments in kit form. Complete specifications and detailed information on Hi-Fi—Test—Ham and Marine kits.

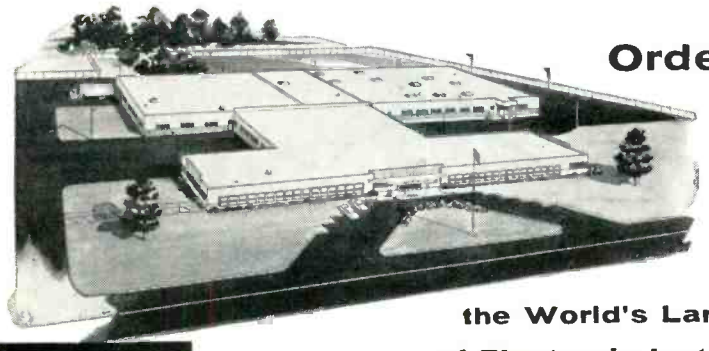
Save with Heathkits... the quality name in kit form electronics.

"BOOKSHELF" 12 WATT AMPLIFIER KIT

Here are a few of the reasons why this attractive amplifier is such a tremendous dollar value. You get rich, full range, high fidelity sound reproduction with low distortion and noise . . . plus "modern styling". The many features include full range frequency response 20 to 20,000 CPS ±1 db with less than 2% distortion over this range at full 12 watt output—its own built-in preamplifier with provision for three separate inputs: mag phono, crystal phono, and tuner—RIAA equalization—separate bass and treble tone controls—special hum control—and it's easy-to-build. Complete instructions and pictorial diagrams show where ever part goes. Cabinet shell has smooth leather texture in black with inlaid gold design. Cabinet measures 12½" W. x 8 3/16" D. x 4⅜" H. Output transformer has taps at 4, 8 and 16 ohms to match the speaker of your choice. An ideal unit to convert your present hi-fi system to stereo sound. Shpg. Wt. 15 lbs.

An Amplifier, Preamplifier all in one!

HEATHKIT EA-2 **$28.95**



Order direct by mail...

Save ½ or more over equivalent ready-made products by buying direct and assembling them yourself. Heathkit Style, Performance and Quality are unsurpassed!

the World's Largest Manufacturer of Electronic Instruments in Kit Form

HEATHKIT®

NOTE: all prices and specifications subject to change without notice.

Enclosed find ( ) check ( ) money order. Please ship C.O.D. ( )

On Express orders do not include transportation charges—they will be collected by the express agency at time of delivery.

On Parcel Post Orders include postage for weight shown. All prices are NET F.O.B. Benton Harbor, Michigan, and apply to Continental U.S. and Possessions only. 20% Deposit required on all C.O.D. orders.

HEATH COMPANY BENTON HARBOR 15, MICH.

a subsidiary of Daystrom, Inc.

Name_____

Address_____

City & Zone_____ State_____

(PLEASE PRINT)

SHIP VIA

- ☐ Parcel Post
- ☐ Express
- ☐ Freight
- ☐ Best Way

QUANTITY	ITEM	MODEL NO.	PRICE
		POSTAGE	
	☐ SEND FREE HEATHKIT CATALOG	TOTAL	

HEATHKITS are also available at your Dealer see listing on next page

World's Fastest Message Printer

New 3000-word-a-minute teletypewriter prints at a speed 20 times faster than most people can talk.

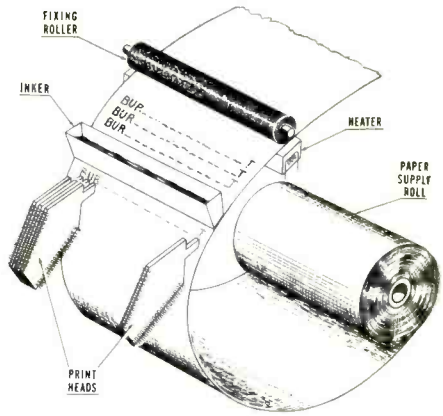
Officer is holding 3000-word message that has been typed by new Army teleprinter in just one minute flat.

A NEW 3000-word-a-minute teletypewriter, the fastest general-purpose message printer in communications history, has been announced by the Dept. of the Army. The printer, developed jointly with the *Burroughs Corp.*, prints four full lines of text a second—50 times faster than a news service teletypewriter, 45 times faster than an average typist, and 20 times faster than most people can talk.

Operating at a lower speed of 750 words a minute for the Army, the new electronic messenger will do the work of eight of today's military printers, promising substantial savings in personnel and equipment. It also gets completed messages to their destination eight times faster. The printer may have broad civilian applications. It can provide the vastly increased message speed long sought by weather forecasting networks, stock exchanges, telegraph offices, and news gathering enterprises.

A standard teletypewriter is an automatic typewriter that responds to electrical signals. Linked by radio or telephone lines, it can print at 60 words a minute messages sent from distant stations. The new teletypewriter does not use ordinary keys for its ultra-fast reception speed. At 750 wpm, they could barely get into the air or would jam up on the first word. Instead, letters are shot at the paper electronically by a bank of electrode "guns." Each "gun," or print head, forms a small charged area in the pattern of a single letter on a high-resistivity coated paper surface. The electrostatic latent image formed by the charge area is made visible by application of powdered ink, permanently fixed by the application of heat.

The recording head is made up of 35 tiny wires leading into and through a triangular-shaped piece of plastic. The wires are polished flush with one corner of the triangle, which is the print head, to form a rectangle seven wires high by five wires wide. This is the matrix—72 of them in a row to form a printing line. They do not touch the paper but are maintained at a fixed distance from the paper surface. Electric pulses selectively charge the proper combination of wires in each head to form an image of a character. It requires only a small fraction of a second to set up the right charge pattern for an entire line of type. During the recording stage, the electrical discharge from the print head to a metal plate is used as the source of charge to form the electrostatic image on the paper. By using a low negative voltage on the point electrodes, tiny, round dots are produced that form the letters. This process is referred to as "electrostatic recording."



A latent electrostatic image, formed by a row of 72 print heads, is made visible by powdered ink, then fixed by heating.

The machine operates from standard code tape, or it can be plugged into long-distance radio or telephone circuits to print out messages sent from across the continent or overseas. Another use of this unique printing technique will be to type out the calculations of new military electronic computers.

In mass production, the high-speed printer is expected to cost half as much as the bank of eight standard printers it can replace. And since there are no moving parts, except for the paper transport, maintenance should be cut by fifty per-cent. Repair of the electronic circuits will be greatly simplified by the system's replaceable plug-in units. —30—

Independent TV-Radio Service Dealers:

THIS AD IS FOR YOU! *

1 DOES HE HAVE AN ESTABLISHED BUSINESS FACILITY?

It takes a big investment to set up a properly equipped TV-Radio service operation. When the Service Dealer has a place of business—particularly in your community — you can be certain he's planning to stay. Your business is important to him. As an independent small businessman in your community he's going to do everything he can to satisfy you. It's the only way he can assure his own future.

2 DOES HE GUARANTEE HIS WORK AND PARTS?

It's standard practice to guarantee work and parts and most qualified dealers do so. Be sure to find out the duration of the guarantee so that you will know just how long you are protected. Remember, however, the guarantee *covers only the parts replaced by the dealer, not everything in the set.* If some other tube or component fails during the guarantee period the dealer cannot be held responsible.

3 DOES HE CHARGE A FAIR PRICE FOR A HOME SERVICE CALL?

Be sure the Service Dealer you choose makes a charge sufficient to cover his time and transportation expenses. Like any other businessman, your Service Dealer has basic costs . . . overhead, rent, taxes, insurance, salaries, etc. . . . expenses that must be considered when he establishes his service call charges.

4 DOES HE PROVIDE AN ITEMIZED BILL?

He should, for his own protection as well as yours. Then you know exactly what work was done, which parts replaced and exactly how much each cost. You both know what replacements are covered by the guarantee in case of an early failure.

If the answer is *yes* to all four of these questions, the chances are you'll receive fast, competent, expert TV-Radio service at prices that are reasonable.

What's more, the chances are he'll be a *Raytheon Bonded Electronic Technician* and that's an added bonus for you. These expert technicians offer a 90 day work and parts guarantee that *is backed by a Bond* issued through one of America's largest insurance companies. They observe a strict 8-Point Code of Business Ethics designed to protect you. For the quick, safe, sure solution to all TV-Radio servicing problems, call a Raytheon *Bonded* Electronic Technician.

For Your Convenience
Raytheon TV-Radio Service Dealers Are Listed In The Yellow Pages of Your Telephone Directory

Raytheon Quality TV and Radio Tubes Mean Better Set Performance for You . . . When a Service Dealer replaces old tubes with Raytheon Tubes you're sure of long life and lasting operation. Produced by Raytheon, pioneers in electronics, these fine tubes are made to the same rigid standards of quality and precision that are designed into the superb Raytheon Tubes, Transistors and Diodes used in 14 of America's major missiles. A lifetime of experience in the development and production of Raytheon Tubes for military, industrial and commercial applications is behind them. That's why you are certain of satisfaction from Raytheon TV and Radio Tubes.

RAYTHEON
Excellence in Electronics

Raytheon Manufacturing Company, Distributor Products Division, 55 Chapel Street, Newton 58, Massachusetts

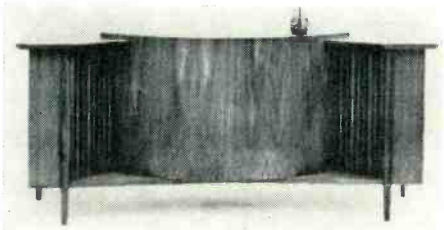
* Raytheon is running this advertisement in the January 19, 1959 editions of NEWSWEEK and TIME magazines to help you. Read it carefully. It makes four simple suggestions to set owners that should result in substantial increases in service business for qualified Independent TV-Radio Service Dealers. It clarifies the set owners' misunderstandings about the standard work and parts guarantee. Giant blow-ups of this advertisement are available from your Raytheon Tube Distributor at no cost to you. Be sure to feature one in your shop window.

Hi-Fi-Audio Product Review

JBL-RANGER "METREGON"

James B. Lansing Sound, Inc., 3249 Casitas Ave., Los Angeles 39, Calif. has recently introduced a new stereophonic loudspeaker system, the "JBL Ranger-Metregon".

The unit contains two complete two-way loudspeaker systems. Sound energy from the speakers is directed



from both sides of the enclosure toward a curved refractor panel. This integrates the two separate stereo channels into a single three-dimensional sound source. This feature is said to eliminate annoying "hole-in-the-middle" effects.

Measuring six feet wide and thirty inches high, the new unit employs an integrated stereophonic reproducer developed by the company in association with Colonel Richard H. Ranger. The enclosure (C45) is available in light or dark walnut, light or dark mahogany, light oak, Salem maple, natural birch, korina, and ebony finishes.

For a data sheet giving complete specifications on this new stereo speaker system, write the manufacturer direct and request additional information on the C45 enclosure.

STEREO-MONAURAL AMPLIFIER

Lafayette Radio, 165-08 Liberty Ave., Jamaica 33, N. Y. is now offering a dual-channel basic power amplifier in kit form as the Model KT-310.

The new amplifier is rated at 18 watts per channel and may be used with a stereo preamplifier to provide two 18-watt stereo channels. It may

also be used monaurally as a single 36-watt power amplifier feeding one or more speakers or as two separate 18-watt monaural amplifiers.

Dual inputs are provided, each with individual volume control. Other controls include a channel-reverse switch and monaural-stereo mode selector. Speaker output impedances (available on each of the two sets of terminals) are 4, 8, 16, and 32 ohms, thus permitting parallel operation of two speaker systems with impedances of up to 16 ohms.

Input sensitivity per channel is .45 volt for full output. Response is flat at better than ±½ db from 35 to 30,000 cps at 18 watts. Harmonic and IM distortion are below 1%. The circuit employs seven tubes including rectifier.

The kit comes complete with perforated metal cage and detailed assembly instructions. Over-all size is 9 3/16" (10 9/16" with controls) x 5¼" x 13¼". Write the company direct for further details and price.

SOUND LEVEL METER

American Research Laboratories, Fort Atkinson, Wisconsin has developed an acoustic sound level meter to meet the requirements of the fast expanding hi-fi and audio amplifier field.

The Model D-50 includes a specially compensated microphone feeding a transistor amplifier. The amplifier is a 4-stage, high-gain, one-piece printed circuit. It has flat response from 200 to 40,000 cps. Below 200 cps the response drops off at 6 db per octave. To compensate for this drop a special equalizing network is inserted between the microphone and the amplifier input. This equalization produces a substantially flat response from 80 to over 10,000 cps. For applications where a greater range is needed, such as running over-all frequency tests on hi-fi equipment, a special chart is provided that shows the instrument response from 50 to about 15,000 cps.

When used to make frequency response tests on hi-fi set ups, this meter will provide a measurement that includes the speaker enclosure and the room acoustics as part of the over-all test.

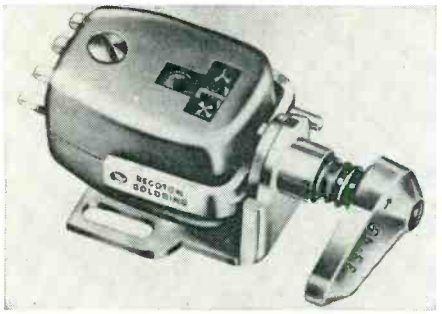
A data sheet giving full details on the unit and its applications is available on written request.

TURNOVER STEREO CARTRIDGE

Recoton Corporation, 52-35 Barnett Ave., Long Island City 4, N. Y. has released its new compatible Series RG-745 magnetic stereo turnover cartridge

which has been designed for use on all turntables and changers and for all speeds and types of records.

Two models are available, the RG-745-1SD "Piggy Back" and the RG745-3SD. Using a diamond .7 mil stylus on



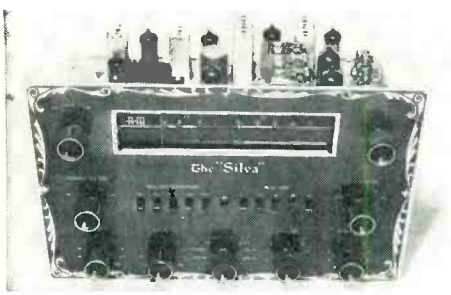
one side of the cartridge, compatible performance may be obtained on either stereo or monaural LP records. On the turnover side is a 1 mil sapphire needle, providing a standby monaural cartridge.

The RG745-3SD is mechanically and electrically the same as the 1SD but carries a .7 mil diamond on one side and a 3 mil sapphire for 78 rpm's on the turnover side.

NEW "CUSTOM" LINE

Pine-eer Furniture, Inc., 4228 West Compton Blvd., Lawndale, Calif. has entered the hi-fi field with a line of components plus the custom cabinets in which to house them.

One of the first items to be placed on the market is an AM-FM tuner which has been tradenamed "The Silva." The circuit provides FM stereo multiplex facilities in addition to covering AM and FM broadcasts. Sensitivity is .77 μv. for 20 db quieting on FM and 3 μv. at 60% modulation for .5 volt output 6 db signal-to-noise ratio. Tuning range is 540 to 1600 kc. and 88 to 108 mc. Frequency response is 20 to 20,000 cps ±½ db on FM and 20 to 10,000 cps on AM. The tuner requires a total of eight tubes and draws 40 watts. A



new a.f.c. circuit combined with a low-drift oscillator provides a 16 db correction which captures and holds a station precisely to a tolerance of ±1 kc.

The companion stereo preamp serves as a master control and preamplifier for both stereo and monaural reproduction. The preamp includes two separate and distinct hi-fi channels on a single chassis plus four stereo outputs and eight equalization settings for all types of recording programming. There are 12 inputs for all signal sources including ceramic phono, mag-

netic phono, tape head, high-level tape, TV, tuner, and multiplex FM. Frequency response is flat from 10 to 65,000 cps ±.1 db with IM of .02% at 1 volt output, each channel.

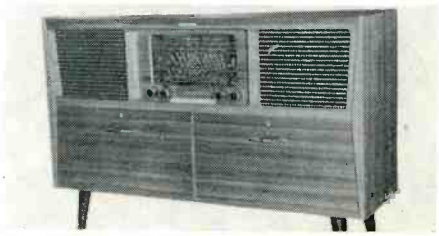
These two units are designed to be mounted on a special chassis panel which is etched to match whatever cabinet style is selected by the customer. Both modern and period enclosures are being offered by the firm, providing equipment and storage space as required.

For additional information on either the hi-fi equipment or the enclosures comprising this new line, write the manufacturer direct.

TANDBERG STEREO CONSOLE

Tandberg of America Inc., 10 E. 52nd St., New York 22, N. Y. has just released a new stereo console which features a built-in intercom system.

The Model 10 console will play back stereo discs and stereo tapes as well as serving as the central sound system for the entire home. Provision is made for the connection of remote speakers



to provide coverage of the living area. The built-in intercom feature permits hook-ups between the console speakers and remote speakers which may be located anywhere in the home.

The AM-FM radio set in the console features a short-wave tuner with four bands and 12-watt amplifier. There are four *Tandberg* speakers in the unit —two 8" and two tweeters with crossover and dividing network. The console is equipped with the company's Model 3-Stereo-4T tape unit with 4-track head and increased range of frequency response as well as a three-speed record changer. Power amplification for the second stereo channel is obtained through the Model 241 preamp.

The console is available in teak, mahogany, walnut, or blonde cabinets with brass-tipped tapered legs.

NORTRONICS STEREO AMPS

The Nortronics Company, Inc., 1015 S. Sixth St., Minneapolis 4, Minn. has announced the development of two new amplifiers designed especially for stereo playback and recording.

The Model PL-100 playback amplifier is a single-channel amplifier with ample gain to match any stereo tape head or stereo phono cartridge. It can also be used as a preamp to drive a more powerful amplifier. An equalization control allows the frequency response to be varied 15 db at 10,000 cps. This unit is housed in a modern-looking gold and black cabinet. It is rated at 3 watts.

The RA-100 recording amplifier is especially adapted to converting tape recorders to stereo recording. Two of the amplifiers will supply any magnetic tape head with all necessary audio, bias, and erase power. The RA-100 has NARTB equalization, a vu meter, and an audio monitor jack for phones or amplifier. The low-level input for

microphones may also be used for tape head or magnetic phono cartridge input for re-recording, copying, or dubbing. It is housed in a companion cabinet to the PL-100.

For full details on either or both of these new amplifiers, write the manufacturer direct.

G-S STEREO CHANGER

Glaser-Steers Corporation, 20 Main St., Belleville 9, N. J. is now offering a new version of its "Seventy-Seven" record changer which has been redesigned for stereo applications.

According to the company, rumble, wow, and flutter have been virtually eliminated by improved motor design. Features of the unit include a stereo-monaural switch on the changer deck, quick-change cartridge holders, double-channel muting switch and *RC* network to eliminate noise during change cycle and at shut-off, service receptacle for automatic amplifier shut-off, automatic and full manual operation at 16⅔, 33⅓, 45, and 78 rpm, four-pole, hum-shielded motor with dynamically balanced rotor, acoustically damped tonearm, variable stylus pressure, and jamproof mechanism.

The base measures 13½" wide, 12" deep with 3" below motorboard and

5½" above board. A wood base, mounting board, and automatic 45 rpm spindle are available as accessories at additional cost.

SMALL "DUCTED-PORT" ENCLOSURE

Argos Products Company, Genoa, Illinois has recently introduced a new small-size speaker enclosure that is especially suited to stereo system applications.

The Model TSE-1 will accommodate an 8" woofer and tweeter. It utilizes

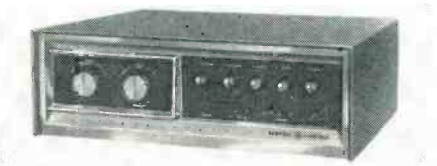
two ducted ports (one on each end) for improved bass response. Although small enough to be used on a bookshelf (24" wide x 11" high x 10½" deep), the TSE-1 is designed for either table or floor use (standing vertically). Two of these units are ideal for stereo because of their small size and modest cost.

The enclosure is covered with heavily ribbed pyroxylin fabric and uses a new decorator pattern grille cloth. It is being offered in either dark mahogany color or blonde. Internal volume of the enclosure is 2165 cubic inches.

G-E STEREO AMPLIFIERS

The Specialty Electronic Components Dept., *General Electric Company,* W. Genesee St., Auburn, N. Y. has announced the availability of two new "Stereo Classic" stereophonic hi-fi amplifiers, the Model MS-4000 and MS-2000.

The former is a 40-watt model with two integrated 20-watt channels while the latter features two integrated 14-watt channels to provide 28 watts. Each model has two power amplifiers and two preamp control units on a single chassis. Both were designed to



handle stereo disc material as well as stereo and monaural tape and broadcast, and monaural disc program material.

Each amplifier incorporates an unusual and effective balance control which allows the listener to adjust the sound volume from both speakers for best stereo perspective. This adjustment is comparatively fine near the center point of the control, gradually raising the output from one speaker by one decibel while fading the other. As the knob is turned to its limit, the "faded" speaker is dropped to zero output. The other four of the seven knob controls are integrated dual types for simultaneous adjustment of both stereo channels. These knobs control volume, bass, treble, and contour.

Other features of these units include channel reversing to switch either channel to either speaker, rumble filter effective on all inputs, an independent switch position and input for monaural cartridges, low hum and noise, and better than 40 db channel separation.

Further information on these two new stereo amplifier/control units is available from the company.

LOW-HUM AUDIO TUBE

The Electron Tube Division of *Radio Corporation of America,* Harrison, N. J. has introduced a new triode-pentode tube which has been especially designed for high-fidelity audio applications where low hum and noise are primary design criteria.

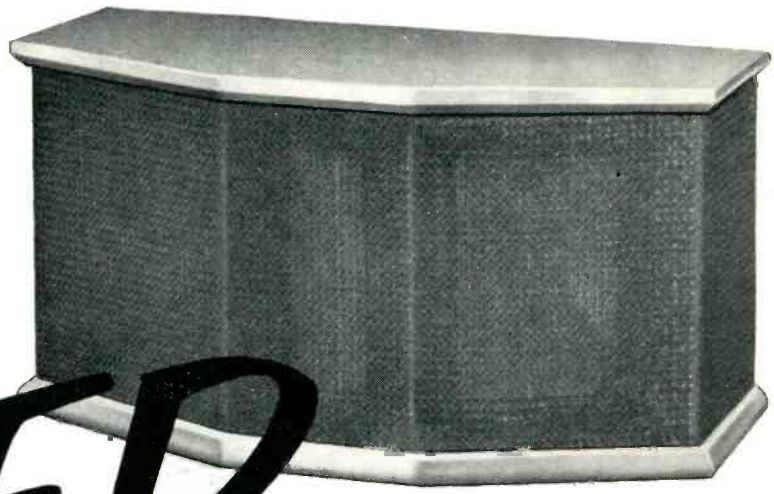
The *RCA*-7199 plus a pair of the new 7027 high-perveance beam power tubes

Of All TWEETERS Tested...

RADIO SHACK'S

$27.50

REALISTIC ELECTROSTAT-3



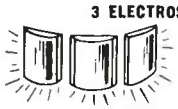
11⅞" w 5⅞" h 4½" d
Order No. 36CX017Y

RATED BEST!

by national consumers' publication!

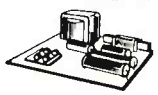
Rated "SUPERIOR" To Tweeters
COSTING $150.00 and MORE!

3 ELECTROSTATIC ELEMENTS!



Wide 120° sound dispersion angle is attained by the exclusive Realistic three-off-set element design.

BUILT-IN AC POWER SUPPLY!



Provides all of the voltage necessary for true electrostatic speaker operation. Double fused for absolute safety!

COMPATIBLE TO ANY SPEAKER!

Regardless of size, shape or cost, the ELECTROSTAT-3 will measurably improve any speaker system!

RECOMMENDED INSTALLATION ACCESSORIES FOR THE REALISTIC "ELECTROSTAT-3"

Crossover Network Kit

Includes coils, condensers and L pad. Complete with simplified assembly instructions. Ship. Wt. 2 lbs. Available for either 8 or 16 ohms. Ship. Wt. 2 lbs.

Order No. R-4850 8 ohms **$4.95**
Order No. R-4851 16 ohms **$4.95**

University N2B Crossover Network

Order No. 31CX494 Wt. 2¼ lbs. **$13.72**

Mallory "L" Pad Attenuators

Order No. 09B803 8 ohms, ½ lb. **$2.67**
Order No. 09B882 16 ohms, ½ lb. **$2.67**

REALISTIC in brand name, REALISTIC in price, REALISTIC in its smooth performance up to and *beyond* the range of human hearing, the fabulous Electrostat-3 is nationally recognized and "tops" among tweeters. Like all Realistic components—speakers, tuners, amplifiers, turntables—the Electrostat-3 is designed by Radio Shack audio engineers and *sold only by Radio Shack* by mail-order or through its three stores. Realistic products bring music lovers "wired hi-fi" *at or below* its kit prices and without sacrifice of any *essential* physical or electrical function!

IMPROVES EVEN THE FINEST SPEAKER SYSTEMS!

Designed to fill a void in the reproduction of high fidelity sound, the Realistic ELECTROSTAT-3 will extend the range of any speaker or speaker system to beyond 25,000 cycles. Its unbelievably wide sound dispersion angle opens a new world of acoustic brilliance!

When used with any of the finer high compliance speaker systems such as the KLH, Acoustic Research or the Realistic "Delta-7", the ELECTROSTAT-3 adds a smooth and silky high frequency response from 5000 cycles to the upper limit of audibility . . . and beyond!

EASY TO CONNECT AND USE!

The ELECTROSTAT-3 comes complete with simplified installation instructions for any speaker or system. All that is necessary is to plug in the AC power cord, connect an 8 or 16Ω crossover network, (see Realistic Crossover Kit at left) and enjoy the finest high frequency response ever heard! An 8Ω, 5000 cycle crossover network is recommended for the AR-1, AR-2 and KLH-6, and a 16Ω, 5000 cycle network for the KLH-4 and the Realistic "Delta-7".

Order By Mail

NO DELAY!
We Ship the Same Day
We Receive Your Order!

FREE!
NEW 1959 CATALOG
- 232 brand new pages!
- 84 Hi-Fi-Stereo systems!
- 30,000 electronic items!

RADIO SHACK CORPORATION

730 Commonwealth Ave., Boston 17, Mass. 167 Washington St., Boston 8, Mass.
230-240 Crown St., New Haven 10, Conn.

recently released by the company will provide from 30 to 40 watts amplifier output.

This new triode-pentode is of the nine-pin miniature type and utilizes a 6.3-volt, 450 ma. heater. It features a pentode unit with controlled sharp cut-off characteristics and a high transconductance (7000 μmhos) to provide high gain at low distortion. The triode unit has an amplification factor of 17.

Some of the important design features include folded-coil (single-helical) heaters in both the pentode and triode units to assure low hum; cage assembly mounted on short, stiff stem leads to reduce noise and microphonic effects; interelectrode coupling and possibility of shorts minimized by suitable location of stem leads; internal shield to minimize electrical coupling between triode and pentode units; separate cathodes for each unit; and a new cage structure having fewer welds to increase reliability.

4-CHANNEL HEAD KIT

Bell Sound Systems, Inc., 555 Marion Road, Columbus 7, Ohio has announced the availability of a 4-channel-head conversion kit which can be installed on any of the firm's stereo tape transports to handle the playback of 4-track stereo tapes.

Although the current absence of 4-track open-ended tapes from the market makes the immediate employment of the conversion kit problematical, the company has taken this step to protect both past and future customers against obsolescence.

ESL STEREO TONEARM

Electro-Sonic Laboratories, Inc., 35-54 36th St., Long Island City 6, N. Y. has announced the development of a new tonearm which has been designed to accommodate all standard stereo cartridges.

The "Gyro-Balance" arm is all new. With it turntable leveling is unnecessary—according to the company—since the unit will play records at any angle up to 90 degrees! The arm is designed to track properly at two grams. Ball-bearing construction is used throughout for both vertical and horizontal motions. This tonearm is also suitable for monophonic applications.

Write the manufacturer direct for complete specifications and price.

AUDIO CATALOGUES

CBS STEREO CARTRIDGE DATA

CBS-Hytron, Danvers, Mass., is offering copies of a one-page data sheet giving complete specifications, an outline drawing, a frequency response curve, and installation instructions for its "Constant Displacement Stereo Cartridge, Model SC-1."

This data sheet is available from the firm's Advertising Service, Parker St., Newburyport, Mass. Please specify Bulletin E-289.

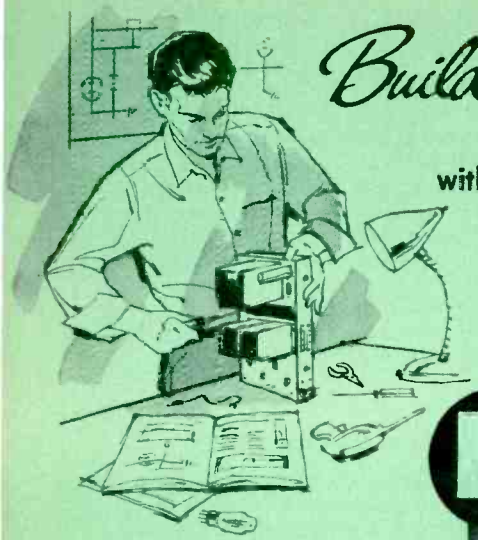
JBL SPEAKER DATA

James B. Lansing Sound, Inc., 3249 Casitas Ave., Los Angeles 39, Calif. has issued an illustrated folder on its *"JBL-Ranger Paragon,"* model 44000.

The speaker system is designed as an integrated stereophonic reproducer and houses a 150-4C low-frequency driver, the 375 high-frequency driver, 075 ring radiator, and N500H and N7000 dividing networks.

For copies of the brochure on the enclosure and data sheets on the speaker components used in the system, write direct to the manufacturer at the above address. —30—

Using only one-tenth watt of power, this small transistorized radio transmitter beamed signals 16,000 miles in what is believed to be a new distance record for low-power radio transmission. With only two RCA "drift" transistors (circled), the transmitter sent a message from Ontario, California to Johannesburg, South Africa. The ham radio unit, constructed by one of our authors, Don L. Stoner, measures 3 by 4 by 6 inches without its 15-volt battery pack. Complete construction information appeared in our associate publication "Popular Electronics" (the August, 1958 issue) under the title "The Semiconductor Space Scanner."



Build the Best...build knight®-kits

A PRODUCT OF ALLIED RADIO

with exclusive "CONVENIENCE ENGINEERING" for easiest building

SAVE UP TO *50%*

KNIGHT-KIT design goes beyond handsome styling, advanced circuitry and guaranteed specifications. KNIGHT-KIT "convenience engineering" means just that...it goes deep-down, with special attention to those small but vital details that count...details such as carded and identified resistors, plastic-bagged hardware, precut and stripped wire—details that make assembly far easier, that assure absolute accuracy, and finally reward you with proud enjoyment of the superior performance designed into your KNIGHT-KIT.

America's Low-Cost **HI-FI**
anyone can afford
THERE'S NOTHING FINER

STEREO High Fidelity...build your own at great savings

Stereo Preamp Control Center Kit

In a class by itself—a control center that will do **anything** and **everything** you want. Features complete input flexibility—5 Stereo inputs (including tape heads), additional 4 inputs for monaural; all can be permanently connected and controlled from single switch. Six record equalizations for monaural; RIAA for Stereo. Volume, bass and treble controls on concentric shafts with special clutch for both individual channel and overall control. Single switch selects straight Stereo; Stereo Reverse, either channel separately, or either channel into monaural output. Continuously variable loudness control; cathode follower output and special recorder outputs; hum-free (DC on all tube filaments). Exclusive printed-circuit switches and boards. Custom styled case, 4¼ x 13 x 8". Shpg. wt., 17½ lbs.

Model Y-776. Net only ... $62.50

Easy Terms: Only $6.25 Down

60-Watt Stereo Basic Amplifier Kit

Absolutely the finest dual amplifier you can build—equal to highest-priced factory-built units. Ideal for use with the KNIGHT-KIT preamp, either as two 30-watt stereo amplifiers or 60-watt monaural amplifier. Exceptional response from 10 cps to 42,000 cps. Phenomenal 0.08% distortion at full 60 watts. Includes static plate current balancing adjustments for each channel; absolute stability under all operating conditions; custom-quality transformers. Also has special built-in circuitry, with easy external adjustment, for precise balance of gain on each channel to achieve perfect monaural performance. Two printed-circuit boards for easy assembly. Beautiful black and chrome; 9 x 14 x 8¼". (Less cover.) 36 lbs.

Model Y-777. Net only ... $84.50

Easy Terms: Only $8.45 Down

Y-779. Gray metal cover. 4 lbs. Net.... **$6.50**

Deluxe FM-AM Hi-Fi Tuner Kit

The best-looking, best-performing FM-AM tuner kit for the money. You'll enjoy building it; you'll be proud of its performance and beauty. FM sensitivity is a remarkable **2.5 microvolts for 20 db of quieting.** AM is **3 microvolts for 10 db signal-to-noise ratio.** Outstanding features include: single large printed-circuit board with most critical wiring already done; AFC (with disabling feature); flywheel tuning; precisely pre-aligned RF and IF coils—no further alignment needed; tuned RF stage on FM; drift-compensated oscillator; neon glow tuning pointer; cathode follower output; rotatable built-in AM antenna. Beautiful French-gray case, 4¼ x 13¼ x 8". Ready for interesting easy assembly. Shpg. wt., 12 lbs.

Model Y-787. Net only ... $49.95

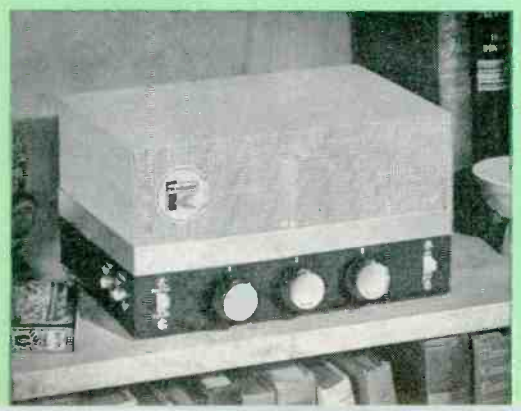
Easy Terms: Only $5.00 Down

EXCLUSIVE PRINTED CIRCUITRY

KNIGHT-KITS incorporate the latest technical advances; many include exclusive printed-circuit switches, as well as printed circuitry. You save time and you can't go wrong.

EXCLUSIVE CUSTOM STYLING

KNIGHT-KIT hi-fi components, as easy to look at as they are to assemble, are professionally designed to take their place alongside the finest of home furnishings. You'll be proud of your finished work.



Top-Value 12-Watt Complete Amplifier Kit...Best Buy in Hi-Fi

True Hi-Fi for only $19.95 (less cover)

Only $2.00 Down

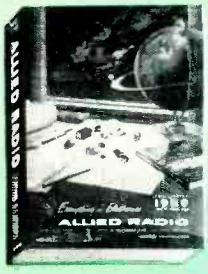
Never before has there been so much solid hi-fi value and quality performance at such low cost. Features smooth, clean output for truly rich reproduction. **Guaranteed specifications:** frequency response, 30-15,000 cps ± 1½ db at half power; less than 1% distortion at full power. Has **15 db of inverse feedback.** Has preamp stage equalized for magnetic cartridges; inputs for phono and tuner; separate bass and treble controls with both boost and attenuation, push-pull EL84 output tubes; virtually hum-free performance. Handsomely styled to look well anywhere; size with cover, 5 x 9¼ x 7". 7½ lbs.

Model Y-784. 12-Watt Amplifier Kit, less cover. Net only ... $19.95

Y-783. Attractive French-gray cover for above. 3 lbs. Net only ... **$3.95**

EASY TERMS ON knight-kit ORDERS AS LOW AS $20

the kits with the GUARANTEED* *specifications*



SEE ALLIED'S 1959 CATALOG FOR COMPLETE DETAILS

For full descriptions of the KNIGHT-KITS below, see the 452-page 1959 ALLIED Catalog. If you haven't a copy, send for it today—use coupon on following page.

there's a money-saving knight-kit for every quality Hi-Fi need

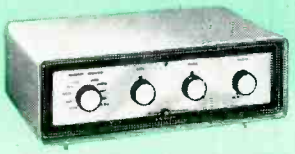
***MONEY-BACK GUARANTEE**

Every KNIGHT-KIT meets or exceeds published specifications, or we refund your money in full.

Universal Stereo Control Kit

Provides full centralized stereo control (volume, balance and channel selection) for use with any two amplifiers. Handles up to 20 watts program material. Unit simply connects between speakers and output terminals of amplifiers (no amplifier rewiring needed). Lets you balance speaker system volume; provides master gain control for overall volume (can be used remotely); lets you play either channel monaurally through one or both speakers; provides channel reversal; phase reversal switch for best overall performance. 4½ x 7¾ x 4". 3½ lbs.

Model Y-778. Net only . . . **$9.95**



18-Watt Hi-Fi Amplifier Kit

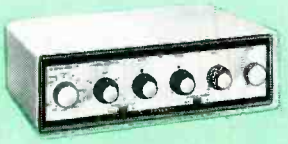
Superb hi-fi specifications; deluxe custom styling. Includes 8 inputs for every desired signal source; full equalization; printed-circuit switches and boards for easy assembly. Shpg. wt., 15 lbs.

Model Y-797. Net only **$39.95**

Deluxe Hi-Fi Preamplifier Kit

Quality audio control center. 15 combinations of equalization; 8 inputs including tape head; DC on all tube filaments; printed-circuit switches and boards. Custom-styled. 12½ lbs.

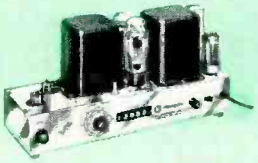
Model Y-754. Net only **$39.95**



30-Watt Hi-Fi Amplifier Kit

Linear-deluxe Williamson-type circuit. Clear, rich 30 watts output; full equalization; 8 inputs; level and loudness controls; DC on filaments of preamp tubes; rumble filter; variable damping. Exclusive printed-circuit switches and boards. Custom-styled. 32 lbs.

Model Y-762. Net only **$76.95**



25-Watt Hi-Fi Basic Amplifier Kit

Williamson-type circuit. Response, ±0.5 db, 9-70,000 cps at half power. Includes balance control; calibrated damping control; potted output transformer. Shpg. wt., 25 lbs.

Model Y-793. Net only **$44.50**

Hi-Fi Basic FM Tuner Kit

Authentic Hi-Fi FM response. Includes AFC; flywheel tuning; pre-aligned RF and IF coils. 4 microvolt sensitivity guaranteed. Printed-circuit board for easy assembly. Custom-styled case. Shpg. wt., 12 lbs.

Model Y-751. Net only **$38.95**

2-Way "Ducted Port" Hi-Fi Speaker System Kit

Pre-finished enclosure; easy to assemble. Hi-fi response, 45-14,000 cps. Includes 12" woofer and horn-type tweeter. Available in mahogany, blonde or walnut (specify finish). 26 x 29 x 14". Shpg. wt., 33 lbs.

Model Y-789. Net only **$49.95**

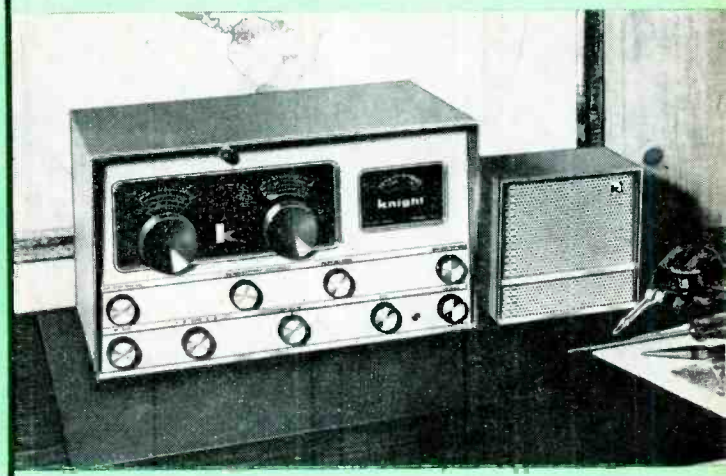
Deluxe "Ducted Port" 3-Way Speaker System Kit

Pre-finished enclosure, ready for quick assembly. Includes famous KNIGHT 3-way, 12" speaker. Response, 35-15,000 cps. Features "ducted port" for excellent bass response. Available in mahogany, blonde or walnut finish (specify). Shpg. wt., 47 lbs.

Model DZ-262. Net only **$73.45**

knight-kits for the Radio Amateur

with designed-in value Hams appreciate



Amateur Communications Receiver Kit

IT'S THE BEST • BUILD IT YOURSELF AND SAVE!

Has all the selectivity, sensitivity and features of high-priced commercial units. Covers 540 kc to 31 mc in 4 ranges; calibrated, electrical bandspread on 80-10 meter Ham bands; slug-tuned Hi-Q coils; continuous, VR tube-regulated B+ applied to HF oscillator; built-in Q-multiplier; delayed AVC; provision for Y-256 crystal calibrator (below). Sensitivity, 1.5 microvolts for 10 db signal-to-noise ratio. Selectivity: variable from 300 cps to 4.5 kc at 6 db down. Exalted BFO injection for SSB. Controls: Main tuning, bandspread, band selector, BFO pitch, RF gain, AF gain, BFO-MVC-AVC-ANL, off-stby-rec-cal, ant. trim.—plus Q mult. controls: null-off-peak, selectivity, tune. Phone jack on front panel. Exclusive printed-circuit bandswitch; printed-circuit boards. Handsome metal cabinet, 10 x 10 x 16½". (Less speaker and S-meter.) 23 lbs. **$104.50**

Model Y-726. Net only . . . . . .

Easy Terms: Only $10.45 Down

Y-727. S-Meter Kit for above. 1 lb. Net **$10.75**

Y-728. 4" speaker in matching cabinet. 3½ lbs. Net . . . **$7.50**

POPULAR AMATEUR knight-kit VALUES!

50-Watt CW Transmitter Kit

Ideal for the novice. Convenient bandswitching, 80 through 10 meters. Efficient pi-network antenna coupler; effective TVI suppression. Uses 807 in final. Shpg. wt. 18 lbs.

Model Y-255. Net only **$38.95**

Self-Powered VFO Kit

With built-in power supply. High stability; excellent keying; full TVI suppression. Planetary vernier drive. Calibrated for 80, 40, 20, 15 and 10 meters; output on 80 and 40 meters. Shpg. wt., 11 lbs.

Model Y-725. Net only **$29.50**

Z-Bridge Kit

Accurately measures SWR from 1 mc to 150 mc. Also measures antenna impedance. Has coax input and output. Invaluable for attaining peak antenna efficiency. Shpg. wt., 1½ lbs.

Model Y-253. Net only **$5.85**

100-kc Crystal Calibrator Kit

Crystal frequency standard for any receiver, at very low cost. Gives marker every 100 kc up to 32 mc. Trimmer for zero-beating with WWV. With crystal. Shpg. wt. 1 lb.

Model Y-256. Net only **$10.95**

ORDER FROM ALLIED RADIO • 100 N. WESTERN AVE. • CHICAGO 80, ILL.

Fascinating knight-kits for Hobbyists

Fun to build... with performance you'll proudly demonstrate

KNIGHT-KITS are the first choice of hobbyists, experimenters and students because they're truly "convenience-engineered" for easiest assembly, absolute dependability and finest performance. You'll have more building fun, you'll have more enjoyable performance, you'll save more with KNIGHT-KITS.

with exclusive "Convenience Engineering" for assured build-your-own success...

"Span-Master" 4-Band World-Wide Receiver Kit

Imagine the thrill of hearing overseas broadcasts on a precision receiver you've built yourself! At the flip of the bandswitch, you tune in the world—continuous 4-band coverage from Broadcast to 30 mc—fascinating foreign broadcasts, ships-at-sea, aircraft, police and marine radio, amateur reception on 80, 40, 20, 15 and 10 meters—all this wonderful short-wave, plus enjoyable local broadcast reception. Features sensitive regenerative circuit, easy bandspread tuning; built-in 4" Alnico V speaker; headphone terminals; speaker cutout switch. Controls: Main Tuning, Bandspread, Bandswitch, Volume, Coarse and Fine Regeneration. Easy to build from marvelous instruction manual. Handsome cabinet; 6¾ x 13¾ x 6¼". For 110-125 v. AC. Shpg. wt., 7 lbs.

Model Y-258. Net only..... $24.95

Easy Terms: Only $2.50 Down

"Space Spanner" Receiver Kit

Thrilling 2-band receiver, easy to build, fun to operate—a terrific value. Bandswitch selects exciting short-wave, including foreign broadcasts, amateur, aircraft, police and marine radio (6.5 to 17 mc), and standard broadcast. Highly sensitive regenerative circuit. Built-in 4" PM speaker and beam-power output for strong volume. Has headphone jacks and switch to cut out speaker. Easy to assemble from step-by-step instructions. Handsome cabinet, 7 x 10½ x 6", AC or DC operation. Shpg. wt., 7½ lbs.

Model Y-259. Net only..... $18.95

"Ranger" Clock-Radio Kit

You'll be proud of the performance of this easy-to-build clock-radio. Provides wonderful broadcast band reception. Includes Telechron clock with sleep-switch timer plus automatic radio wake-up/alarm switch. Radio automatically shuts off at night and wakes you in morning; also turns on appliances automatically. Module plug-in circuits and printed-circuit board for quick, easy assembly. Beautiful blue and white plastic cabinet. 6 x 9⅝ x 5⅜". For 60 cycle AC only. Shpg. wt., 5 lbs.

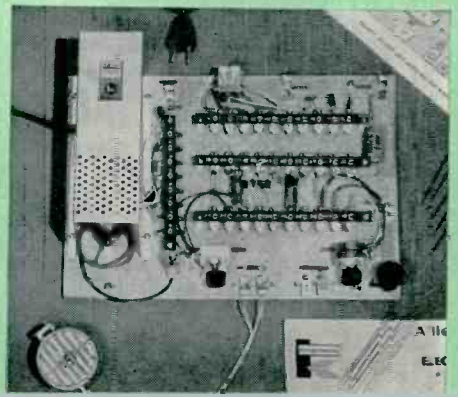
Model Y-737. Net only..... $24.95

Easy Terms: Only $2.50 Down

12-In-1 Electronic Lab Kit

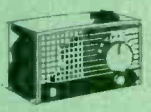
Fascinating way to learn electronics—build any one of 12 practical circuits! Change circuits just by relocating a few wires. Safety-designed; no voltage exceeds 25v. Makes any one of the following: AM radio, amplifier, code oscillator; home "broadcaster"; electronic timer, switch or flasher; voice-operated, capacity-operated or photoelectronic relay; CW "transmitter"; light control oscillator. With all parts, mike, phototube, instructions for each project. For 110-125v. AC. Shpg. wt., 3½ lbs.

Model Y-272. Net only..... $14.95



Widest choice of quality Hobbyist Kits

"Ranger III" AC-DC Radio Kit



Superhet broadcast band receiver. Built-in antenna; AVC; Alnico V speaker. Black plastic cabinet. AC or DC. Shpg. wt., 4½ lbs.

Model Y-736. Net only.... $16.95

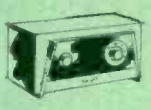
"Ocean Hopper" Receiver Kit

Regenerative receiver for broadcast, long wave and short wave reception from 155 kc to 35 mc. With coil for broadcast band. For AC or DC. Shpg. wt., 7 lbs.

Model Y-749. Net only.... $15.95

Y-748. Set of plug-in long wave and short wave coils. Net... $2.95

"Ranger III-PC" AC-DC Radio Kit



Printed-circuit broadcast band superhet. Easy to assemble. Has AVC, built-in loop antenna, Alnico V speaker. Ivory plastic cabinet. AC or DC. Shpg. wt., 4 lbs.

Model Y-738. Net only.... $18.95

"Ranger" Radio-Intercom Kit

It's a broadcast band radio—it's an efficient 2-way intercom—both in one! Ivory plastic case for Master station/Radio; smartly styled Remote station. With 50-ft. cable. AC or DC. Shpg. wt., 8 lbs.

Model Y-739. Net only.... $27.50

"Trans-Midge" Radio Kit

Tiny 1-transistor radio for local broadcast reception. Works for months from single penlight cell supplied. Handsome plastic case. Fascinating to build. (Requires headphones and antenna.) 8 oz.

Model Y-767. Net only.... $2.45

10-Circuit Transistor Lab Kit

Builds any of 10 favorite projects. Entire kit on a printed circuit board. Just plug in leads to change from project to project. 3 lbs.

Model Y-299. Net only.... $15.75

1-Transistor Radio Kit

Offers fine local broadcast headphone reception. Printed circuit board for easy assembly. Works for months from penlight cell supplied. (Antenna and headphones required.) Shpg. wt., 1 lb.

Model Y-765. Net only.... $3.95

and Experimenters — knight-kit Quality Test Instruments

BETTER BY FAR...ADVANCED DESIGN...GUARANTEED SPECS

DO THE EASY ASSEMBLY...SAVE OVER 50%

MONEY-BACK GUARANTEE

Every KNIGHT-KIT meets or exceeds published specifications—or we refund your money in full.

EASY TERMS on orders as low as $20

5-Transistor Superhet Radio Kit

Quality personal portable. Printed circuit for easy assembly. Built-in antenna; 3½" speaker; prealigned IF's; phono jack; 200-hour battery playing life. Handsome ivory and gold styling. Less battery ($1.43). 2 lbs.
Model Y-771. Net only. **$25.95**

2-Transistor Pocket Radio Kit

Excellent for local broadcast reception. Newest printed-circuit board for easy assembly. Built-in antenna; miniature dynamic earphone; plays for months from single battery. In handsome carrying case; only 4 x 3¾ x 1¾". Less battery ($1.25). 1½ lbs.
Model Y-263. Net only. **$11.50**

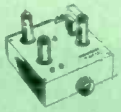
2-Way Intercom System Kit

Complete 2-station system; low-cost, easy to assemble. High gain, clear toned, sensitive. Has 2-stage amplifier and 4" PM speakers. Handsome metal cabinets. Includes master, remote and 50-ft. cable. AC or DC. 8 lbs.
Model Y-297. Net only. **$14.95**

Electronic Photoflash Kit

Fast 1/700th-of-a-second flash; 50 watt/second output. Synchronizes with any camera with X or O shutter. Less battery. Shpg. wt., 4 lbs.
Model Y-244. Net only. **$29.50**

Wireless Broadcaster—Amplifier Kit



Play music or make announcements through your radio set, using mike or phono—no connection to set needed. Use also as audio amplifier. Has built-in preamp. AC or DC. Shpg. wt., 3 lbs.
Model Y-706. Net only. **$11.95**

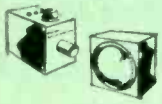
Transistor Code Practice Kit

Ideal for beginners learning code. 500 cps tone. Single penlight cell supplied operates unit for months. Jacks for headphones; screw terminals for key. Shpg. wt., 1 lb.
Model Y-239. Net only **$3.95**

Crystal Set Kit

Gives clear headphone reception of local broadcast stations. Sensitive crystal diode; efficient "Hi-Q" coil. (Antenna and headphone required.) Shpg. wt., 1 lb.
Model Y-261. Net only. **$2.35**

Photoelectronic Relay Kit



Ultra-sensitive relay at very low cost. Fine for automatic control of lights, door openers, as a burglar alarm, etc. Shpg. wt., 3½ lbs.
Model Y-702. Net only. **$13.50**
Y-703. Light Source only. . . . . **$ 6.75**

Vacuum Tube Voltmeter Kit

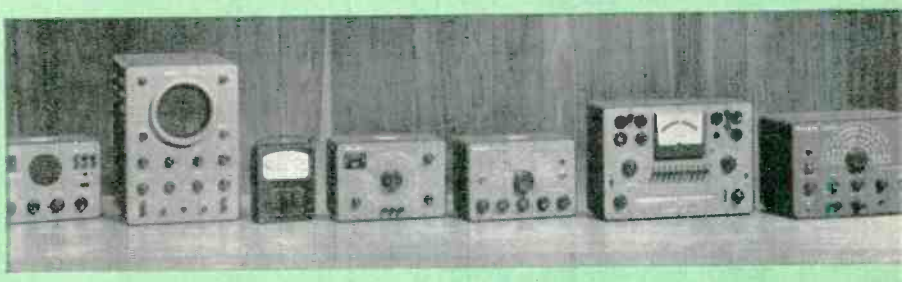
Top buy in a quality VTVM. Entire chassis is printed-circuit board—easy to assemble. Balanced-bridge, push-pull circuit; 1% film-type resistors; 200 μa movement; 4½" meter; includes zero center scale and direct-reading db scale. Polarity reversing switch. Input Res.: 11 megs. DC and AC rms, 0-1.5-5-15-50-150-500-1500; AC Peak-to-Peak, 0-4-14-40-140-400-1400-4000; Response, 30 cycles to 3 mc; Ohms, 0-1000-10K-100K and 0-10-100-1000 megs; db, —10 to +5. Includes battery and test leads. For 110-125v., 50-60 cycles. Shpg. wt., 6 lbs.
Model Y-125. Net only. . . **$25.75**

Easy Terms: Only $2.58 Down

Lowest Cost Tube Checker Kit

A really tremendous value in a quality tube checker. Checks over 400 tubes. Features "Flip-Card" charts with tube settings in loss-proof pull-out storage drawer. Has sockets for 7-pin miniature, 9-pin miniature, octal and loctal base tubes. Checks for cathode emission, filament continuity, shorted elements. Meter has "Replace-Good" scale and special scale for checking diodes. With quick-setting, universal-type selector slide switches. Includes "Hi-Lo" line-voltage regulator switch. Compact and light—use anywhere. With tube charts. 6½ lbs.
Model Y-707. Net only. . . **$19.95**

Easy Terms: Only $2.00 Down

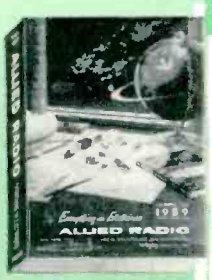


there is a knight-kit to fill every test equipment need

For detailed descriptions, see the 1959 Allied Catalog.

5" Wide-Band 'Scope Kit	$65.75	High-Gain Signal Tracer Kit	$26.50
5" General Purpose 'Scope Kit	42.00	Audio Generator Kit	32.95
20,000 Ohms/Volt VOM Kit	29.50	Resistor-Capacitor Tester	19.50
1,000 Ohms/Volt VOM Kit	16.95	"In-Circuit" Capacitor Checker Kit	12.50
'Scope Voltage Calibrator Kit	12.75	Flyback Checker Kit	19.50
Counter Tube Checker Kit	29.75	Transistor & Diode Checker Kit	8.50
Portable Tube Checker Kit	34.75	Resistance Substitution Box Kit	5.95
TV-FM Linear Sweep Generator	44.95	Capacitance Substitution Box Kit	5.95
RF Signal Generator Kit	19.75	6V-12V Battery Eliminator Kit	32.95

Free! **1959 452-PAGE ALLIED CATALOG**



See pages 241-273 for detailed descriptions of all KNIGHT-KITS: Hi-Fi, Hobby, Test Instrument, Amateur. The 1959 Allied Catalog is your complete Buying Guide to the world's largest stocks of everything in Electronics.

38 years of experience in electronic kit design

ORDER BLANK **ALLIED RADIO** Dept. 131-A9

100 N. Western Ave., Chicago 80, Ill.

Ship me the following KNIGHT-KITS:

Quantity	Description	Model No.	Price

$. . . . . enclosed. (For parcel post include postage; express is shipped collect.) All prices Net F. O. B. Chicago

☐ My Down Payment in the amount of $. . . . . is enclosed. Send Time Payment form

☐ Send FREE 452-Page 1959 Allied Catalog

Name_____

Address_____

City_____ Zone_____ State_____

Industrial Tubes

(*Continued from page* 40)

radio engineering field. In the process of developing insulators for the high-frequency conductors used in radio transmission, the insulators became very hot despite the fact that they were poor electrical and thermal conductors. Investigation revealed what proved to be the basic theory behind dielectric heating.

To simplify the explanation, we will translate the high-frequency conductor into a parallel-plate capacitor with the insulator as the dielectric material between the plates. When voltage is applied to the plates of the capacitor, the electrons in the insulating material are attracted towards the positive plate while the atomic nuclei are attracted toward the negative plate. Both reactions occur simultaneously and are accompanied by an energy conversion which is manifested as heat. If the voltage polarity applied to the plates is reversed, the electrons and nuclei will also reverse direction and produce more heat. As the frequency of polarity reversal increases, so will the amount of heat produced.

Unlike induction heating, dielectric heating reaches all parts of a homogeneous material equally. In fact, because heat can escape faster from the surface of a work piece, it is possible to have higher temperatures at the center. One case is reported where the center of a 2-inch thick plywood board was actually charred while the surface was unmarked. This characteristic involves both advantages and disadvantages; the thorough, rapid heating is a definite advantage while the necessity for careful control and possible reduction of power input is a disadvantage.

We are now in a position to look at some of the uses for dielectric heating. The largest areas of application are moisture removal, wood gluing and laminating, plastics processing and sealing, and food processing. Although the materials handled in these areas are obviously different, they all have one characteristic in common; each and every one of them is a poor thermal conductor. In fact, it is the ability to heat materials which are poor thermal conductors that makes dielectric heating such an important industrial tool.

For instance, consider the problem raised when wood pulp is shipped from the mill to the paper plant. Since wood pulp consists of wood fibers in a water solution, a significant percentage of the shipping costs is for hauling water. Naturally a solution to this problem would be to eliminate the water before shipment and put it back in at the paper plant. But how? The conventional equipment to handle this job would be both enormous and expensive. On the other hand, a 20-kilowatt dielectric heater (size about 6 x 4 x 4 feet) will remove one pound of water per minute at room temperature with a power input of only 40 kilowatts per hour. In addition, the dielectric heater raises the temperature of the water at a much faster rate than the wood fibers, thus the fibers remain relatively cool and unharmed. Conventional methods do not have that safety feature.

One of the most attractive features about dielectric heating is its relatively low-power requirements. Not

Table 2. Power and frequency ranges of industrial equipment discussed in text.

PROCESS	FREQ. RANGE[1]	APPROX. POWER[1]	APPLICATIONS[2]
Induction Heating	10-500 kc. or more	25 kw.	Small soldering and welding units
Dielectric Heating	1-500 mc. or more	2 kw.	Restaurant ovens ("Radarange")
Ultrasonics	20-30 kc.[3] or 400 kc.	1 kw.	Clothes and dish washers, small industrial cleaners

NOTES: 1. These are most popular ranges. See text for other ranges; 2. Immediate areas of opportunity for the technician starting now; 3. 20-30 kc. for magnetostriction transducer, 400 kc. for piezoelectric.

Table 3. Listing of heating times and power requirements for solder operations.

PROCESS	HEATING TIME (sec.)	POWER REQUIRED (kw.) steel	brass	copper
Soft Soldering at 370°F (per in.^{2} area)	20	2.0	4.0	8.4
	40	1.0	2.4	5.5
Silver Soldering at 1300°F (per in.^{2} area)	20	8.0	16.0	33.6
	40	4.0	9.6	22.0

only is it a very efficient source of heat, but it uses considerably less floor space than an equivalent conventional source. For example, the most commonly used generator is the 2-kilowatt model which is about equal in size to a modern TV console—a relatively small package for the heat produced.

Ultrasonics

Ultrasonics is concerned with the use of mechanical vibrations at frequencies above the audible range. The difference between audible sound and ultrasonics lies only in the ability of the human ear to respond. Many ultrasonic generators operate between 20,000 and 30,000 cps while some operate as high as 400,000 cps.

The equipment consists of an electronic generator of high-frequency energy and a transducer to convert the electronic oscillations to mechanical vibrations. The generator is simply a power oscillator and is very similar to the induction and dielectric heating generators. The transducer is a device that converts electrical energy to mechanical energy. An ordinary loudspeaker is one example of a transducer. This transducer uses air as the medium being operated on while the medium used for most ultrasonic transducers is a liquid, frequently water. The ultrasonic transducer is in direct contact with the liquid and either produces "cavities" in the fluid or waves, which travel through the liquid without disturbing it. As the holes or cavities in the water collapse, a turbulence is created which provides a gentle, effective scrubbing action. The scrubbing is so effective that it will even remove radioactive particles and yet it is gentle enough to clean a delicate missile control while it is still assembled. Cleaning is the largest industrial application for ultrasonics, although ultrasonic drills and soldering irons are also used.

There are many applications for the non-violent ultrasonic waves. The largest application in this category is underwater detecting equipment, such as sonar, depth indicators, and fish finders. Other uses are for liquid level sensing, non-destructive testing, and gauging.

Of the three high-frequency industrial applications, ultrasonics has the lowest power consumption. The most popular size is 1 kilowatt and some recent applications use less than 200 watts. The lower-power equipment is portable, being not much larger than a table radio.

Conclusion

Now that we have had a brief look at some industrial uses for electronics, we can get a small idea of the immensity of the field. We can see that there are a good many uses for electron tubes that are not directly related to consumer products, such as radio and TV receivers. The technician who wants to expand his scope would certainly do well to learn as much about these applications as he can. —30—

Service Association of the Month

ASSOCIATED RADIO & TV SERVICEMEN OF ILLINOIS

ALTHOUGH not a large group in terms of numerical strength, ARTS of Illinois has made its presence felt on more than one occasion since its inception six years ago. The circumstance of its birth centers about an effort being made at that time to get service-licensing legislation approved by the Illinois state legislature.

Howard Wolfson, a small, independent service dealer in Chicago who is now ARTS chairman, had little to do with association activities up to that time. However, he had deep convictions concerning the regulation of business by government. He felt that TV service licensing, to begin with, was discriminatory. With a long tradition of unfettered operation of those engaged in service and repair, whether it be of watches, autos, washing machines, or anything else, singling out of the TV technician for control would be to make him a scapegoat. In any case, interference from government could only bring harm to the industry, which must look to other approaches for the solution to its problems.

Disturbed over the threat he felt licensing to be for TV service, Wolfson began to contact other dealers in the state, by telephone, by mail, and in person, to let them know about the proposed legislation and to sound them out on their own attitudes. The group of like-minded dealers he got to join with him at that time to work for the defeat of the bill formed the basis for ARTS. The group stands today, along with such other groups as TEAM of St. Louis, as a leader in the fight against any licensing as being repressive, restrictive, and discriminatory.

ARTS relies heavily on the power of communication. It keeps in contact with many other groups in all parts of the country on matters of mutual concern. It played a key role, for example, in the formation of the American Electronic Alliance in 1956, and again in the more recently formed Midwest Electronic Alliance. Although its stand on licensing and other basic issues has kept it from affiliating with NATESA, it has worked with many local groups in and out of that national body.

"Back-door" selling by jobbers and bait advertising have been some of its targets. In connection with the latter, it has been one of the groups that have actively cried out against ads in telephone directories by service establishments that use such gimmicks as "free estimates" and "free service calls." Publishers of the directories and the telephone companies have agreed with the complainants that such advertising is not in the public interest and have stated that they will discourage it.

On the technical side, ARTS conducted one of the first color training schools for service in the midwest in 1954. It is now conducting a similar technical series on transistors.

Elected annually in September, its officers now include Howard Wolfson, chairman; Joseph Ehlinger, vice chairman; Yuki Minaga, secretary-treasurer; George Neize, sgt.-at-arms; Anthony Mallin, historian; and John Sotor, public relations. Its 30-odd members are all full-time service business men with full-fledged establishments. Located at 433 S. Wabash Ave., Chicago 5, Ill., it issues its publication, "Common Sense," on a rather individual schedule. This mimeographed paper does not have a regular publication date: it comes out whenever its members have something to say.

ARTS feels that the industry will prosper through the constant education of shop owners, technicians, and the public. -30-

Would you like us to feature your association here? Send in the coupon!

Service Editor
RADIO & TV NEWS
1 Park Avenue
New York 16, New York

We want to tell you more about our association. Please send us your questionnaire.

Name of Association .....

Mailing Address .....

.....

Name of President or Corresponding Sec'y .....

Service-Business Problems

(*Continued from page 50*)

their percentages of call-backs by taking more time to check and analyze each set. Other dealers keep a close check on the stability of tubes by brands and types and standardize on those that show up best in performance and reliability.

A serious problem that confronts all dealers—large and small—is the relatively low wage scale for TV technicians employed in the independent service industry. The U. S. Department of Labor, through its Bureau of Apprenticeships, has shown a keen interest in helping to develop standards and apprenticeship-training courses for TV technicians. Most of this effort will be lost to the independent service industry unless dealers generally give serious thought to the adoption of service pricing schedules that are commensurate with the actual costs of operating in today's market.

The endless demands on the time of all people who operate small businesses make bookkeeping, cost accounting, and analysis a chore they must fit into the odd moments they can snatch between doing other things. Since accurate records are the only "road maps" a dealer can have to show him where he is headed business-wise, slipshod record-keeping often greases the path to failure. Excellent bookkeeping services are now available everywhere at a very nominal cost and many dealers have turned this specialized function over to them.

Old customers, who are the mainstay of many small service businesses, often pose a serious credit problem. How to collect a service bill from a slow-pay old customer without offending him is a problem that stymies many. Since the bulk of service work of all types is now handled on a strictly COD basis, a dealer faced with a lot of old customer-credit business could profit from the use of some of the standard collection systems now available that nudge slow-pay accounts without offending them.

At the end of our list of service management problems, we come to the accumulation of completed service jobs which, for one reason or another, customers have not picked up or paid for. These are comparable to the "layaway" headaches the average retailer finds piled on his shelves, on which the customers have paid inadequate small deposits. Numerous plans have been developed to anticipate such delays, to collect in advance for the time involved in handling the work, and to get customers to pick up the sets promptly after completion of the work. These will be covered in a future article.

This, in brief form, covers ten of the current top problems faced by managers of electronic service businesses. They will be discussed in greater detail in subsequent issues. —30—

Test Bench PUZZLER: No. 4

By **WAYNE E. LEMONS**

The a.g.c. played hide-and-seek only with the set in the cabinet—but the cause was really simple!

THIS DEFECT was simple—after we found it. Most of them are. The symptoms were loss of sync and improper a.g.c. action, with a capricious addiction to a sort of motorboating instability. The latter indication was much like that encountered on this KCS103 and other *RCA* receivers when the stability or noise-limiter control is misadjusted.

Some rough cases leave you swearing at the service business in general. This was one of them. In addition to being intermittent, it was also temperamental, obstinately refusing to show up except when the chassis was inside its cabinet with all screws inserted *and* tightened!

We began by checking the a.g.c. voltage at the tuner (a convenient terminal), where practically none was found. Rotating the a.g.c. control had no effect. Next, using a socket adapter, we shorted the grid of the a.g.c. keyer tube (point 1 in the diagram) to the cathode. Since this zero-biased the keyer, it should have produced maximum conduction of this stage, if the keyer were operating properly, with a high negative voltage on the a.g.c. line as a result. This step did produce an appropriately high negative voltage. In that case, we reasoned, the keyer was not getting proper conduction bias.

Using the socket adapter again—and holding our breath, hoping the set wouldn't decide to start working normally again—we checked voltage at the plate of the 6AW8A video amplifier, point 2. The reading was below the normal 122 volts expected here. The tuner was then switched off-channel. The change in plate potential at point 2 produced by this switch was less than five volts. This could mean a high resistance in the plate circuit of this stage or inadequate grid bias.

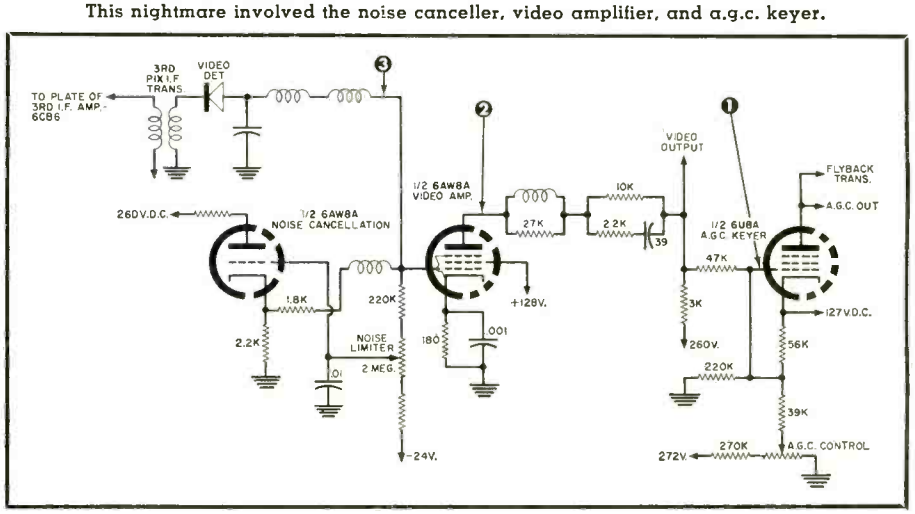
In this circuit, which is shown here in simplified form although no important elements have been left out, the video amplifier grid is biased directly by the germanium-diode video detector. Thus a stronger signal will normally cause the grid to go more negative. Measured with a strong signal coming in, the grid voltage was about −2.5 volts. With the receiver switched off-channel, there was practically no change in this reading.

Now convinced that the diode itself was defective, we made a resistance check from the grid of the video amplifier (output of the detector, point 3) to ground. 4000 ohms was measured one way; with the ohmmeter leads reversed, the reading was 2500 ohms. Since this seemed like the trouble, the chassis was pulled from the cabinet, the diode was replaced, the set was restored to the cabinet, and turned on. It worked—for almost an hour. Then, the same symptoms appeared.

A re-check of the set brought us right back to the detector, where readings were as noted earlier.

You have all the facts available to the service technician before he finally won his bout with this dog. What do you think the trouble was? In case you're getting ideas, it was not *a case of the replacement diode being as bad as the original. As the author states, it was really a simple thing. However, if you've had your share of rough jobs for the day, you can get the answer quickly by turning to page 156.*

This nightmare involved the noise canceller, video amplifier, and a.g.c. keyer.



Within the Industry

(*Continued from page 24*)

division has been made known . . . **GEORGE TALLENT** has been elevated to the post of manager of quality control, semiconductors, *CBS-Hytron* . . . *Magnetic Amplifiers, Inc.* has appointed **ROBERT O. BAXTER** assistant treasurer . . . **STEWART NELLIS** has been named sales manager of *Technical Wire Products, Inc.* . . . **DAN W. BURNS** and **ROBERT T. CAMPION** have been elected vice-presidents of *The Siegler Corp.* . . . **WILLIAM T. WELSH** has become vice-president and sales manager of *Cook Electric Co.* . . . **A. D. BOBROW** has been appointed director of automotive sales of *Van Norman Industries, Inc.* . . . *Zenith Radio Corp.* announces the appointment of **HAROLD F. DRISCOLL** as advertising manager . . . *RCA* has named **CHARLES M. ODORIZZI** as group executive vice-president, consumer products and services . . . *Sylvania Home Electronics* named **G. T. STEWART** manager of national distribution. —30—

ARMY MARS TECHNICAL BROADCASTS

Here is the January schedule for the First Army MARS SSB Technical Net whose purpose is the dissemination of technical knowledge by radio communication.

Transmissions are on Wednesday evenings, 9 P.M. (N. Y. Time, EST) on 4030 kc. upper sideband.

Jan. 7—"The Modern Approach To Front End Receiver Design" by M. M. Klein, Manager, Engineering, Research and Development, Lewyt Mfg. Corp.

Jan. 14—"TRAK—Morse Code To Tele-Printer Converter" by T. Waldron, Group Leader, Information Conversion Group, CGS Laboratories.

Jan. 21—"Phone Patches" by Robert W. Gunderson, Editor, Braille Technical Press.

Jan. 28—"Measurement of Nuclear and X-Ray Radiation" by William Minowitz, Physicist, Nuclear Products Division, Amperex Electronics Corp. —30—

Robert C. Sprague, right, chairman of the board of the Sprague Electric Company, is shown congratulating Harry Kalker, president of its subsidiary, Sprague Products Company, on its 25th Anniversary. The firm was founded under Mr. Kalker's direction in 1933 as the distributor division of parent organization. The actual Anniversary took place in the fall of last year.

Low-Cost Stereo

(Continued from page 45)

in Fig. 3. Balance between channels is achieved by the control at the extreme right, R_7, R_8 in the front view. Separate bass and treble controls are used for each channel, at the author's preference, in order to retain flexibility and experiment with intentional tone unbalance of the two channels. However, the individual may prefer single bass and treble controls. If so, he may replace R_{12}, R_{33}, R_{35}, and R_{14} with dual 50,000-ohm pots. To properly adjust the amplifier, set all controls except "gain" at mid-range and set "gain" at a very low level. Using a tone test record (stereo if available, but monaural will do) plug in one input and adjust bass and treble for flat output (or accent highs or lows if preferred). Then plug in the other input and remove the first, adjusting the other bass and treble. Now check the volume from each channel to see if they are equal. If possible do this with a tone record input and an a.c. meter across the voice coil. If this is not feasible, judgment by listening will suffice temporarily. Adjust the balance control until the two outputs are equal. Now over-all gain of the system can be adjusted with the master gain control. There is a possibility that the two sections of the pot used for this control may not have equal resistance throughout their entire ranges, resulting in system unbalance at certain gain settings. About the only solution here is to try another pot, or be content to rebalance the amplifiers at these points. Theoretically, if bass or treble is readjusted, both channels should be changed by the same amount. It has been interesting, however, to experimentally unbalance the tone controls and observe results on various records.

Note that the balance control provides full range from zero to full output for each channel. This, of course, results in a loss of over-all available gain. The author prefers this system since there is a great surplus of gain and full range is desired to experiment with effects and to demonstrate with one channel cut off. If less flexibility and more gain is desired, simply change R_7, R_8, to 100,000 ohms and add 470,000-ohm resistors in series with the low side of R_7, R_8 to ground. This will allow variation in gain of each channel of about ± 20% and will nearly double the preamplifier gain. Such gain is unnecessary and is, in fact, unusable unless a lower output cartridge and more powerful speakers are used, but it is mentioned here to clarify the design.

The Speakers

The speaker system consists of two 6- by 9-inch oval speakers in conventional bass reflex cabinets built into opposite ends of the wall, as shown in Fig. 4. Anyone using an automobile rear-seat speaker will verify that the oval speakers sound pretty good and they proved to be satisfactory in this application. The cost of sound-absorbing insulation in the speaker cabinets was saved by stapling egg cartons of the soft paper variety to the walls.

If you choose small low-cost speakers, remember the amplifiers deliver 10 watts output at full volume. Keep your volume control down to a reasonable level to avoid ruining speakers which may be rated at only 5 watts.

Speaker Placement

Proper phasing of the speakers is obtained by listening for maximum sound reinforcement midway between the two speakers and reversing the leads to one of them, if necessary, to obtain this reinforcement. Improper phasing will leave a "hole" in the music at this central point. A monaural record is helpful in checking for proper speaker phasing.

Referring again to the room diagram of Fig. 4, it is now believed by some that the speakers should be aimed straight out from the wall—not at 45° angles as was once thought. The room is a 12- by 14-foot family room, panelled in knotty pine—a good reflector of the highs. An excellent stereo effect is achieved in most of the room as indicated in the diagram. A "listening test" of the system was made by several friends. Besides being highly pleased with the stereophonic sound, they commented that the panoramic effect when playing monaural records make this unit sound better than most single-channel high-fidelity systems they had previously heard. —30—

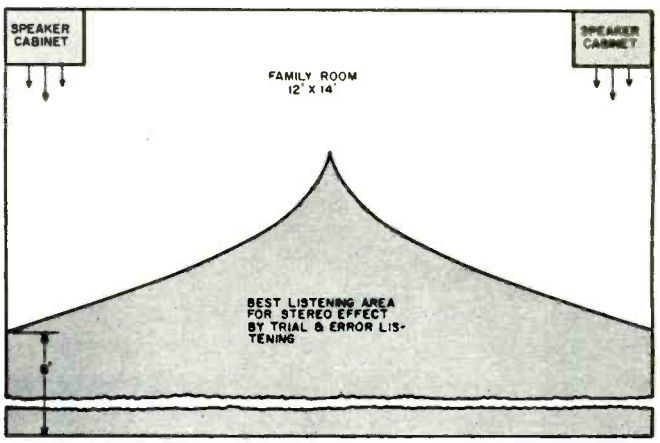


Fig. 4. The speakers are placed along the 12-foot wall of the 12x14 foot room. The area for the best stereo listening is shown shaded in the illustration here.

Transistorized Midget TV

This G-E design works well on battery power.

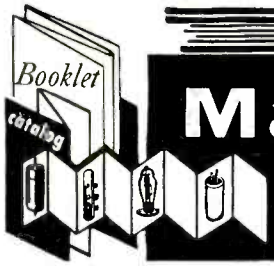
TV not much larger than a v.t.v.m.!

WHAT IT believes to be the world's first battery-powered TV set that falls into the truly compact, personal-portable classification is now being demonstrated by the *General Electric Company*. Completely transistorized, the Lilliputian receiver weighs 10 pounds and is about the size of an automatic toaster. It can be operated from house current as well as from its integral battery.

A *G-E* spokesman points out that the tiny set is a developmental model, not yet ready for consumer introduction. Nevertheless, it is fully operative, with sensitivity and performance claimed to equal that of a conventional full-sized TV set. It does a good job on its built-in antenna.

Only 8¾ inches high, 7¼ inches wide, and 7¼ inches deep, this eye-catcher is covered in vinyl plastic and is equipped with a carrying strap. Its 22 transistors work with a picture tube that has a diagonal measurement of 8 inches. No other tubes are used in the design. Power is supplied by a rechargeable silver-cadmium battery that will provide three to four hours of continuous viewing pleasure. The set can then be recharged while it is being used on house current.

When will the set go on the market? Blocking a price low enough to be accepted by consumers right now is the current cost of transistors. However the competitive effect of low-priced, imported transistors and other developments, one spokesman ventured, are cutting down this cost factor rapidly. As a result, 1961 may well be the year for mass production of these handy sets at reasonable prices. —30—



Manufacturers' Literature

RCA TUBE TYPES

RCA has published a revised and expanded edition of its illustrated catalogue on "Photosensitive Devices and Cathode-Ray Tubes."

The 32-page booklet presents technical data, basing diagrams, and brief text descriptions on more than 130 of the firm's tube types. Photographs of representative tubes are shown throughout the publication.

The booklet is available from the company's Electron Tube Division, Harrison, N. J. at a cost of 30¢.

SOLDERING TOOL CATALOGUE

A new comprehensive catalogue illustrating and describing the complete line of *Vulcan Electric Company's* soldering tools is now available.

Specifications and prices are included, as well as technical information on screw and plug tips.

The booklet is available upon request to the company, 88 Holten St., Danvers, Mass.

COIL BOOKLET

A new specifications booklet, "Tungsten Coils for Vacuum Metallizing," has been made available by *Sylvania Electric Products Inc.*

Containing information on all standard vacuum metallizing coils manufactured by the company, the booklet lists each coil according to dimensions and type of material rather than by arbitrary code number.

Copies may be obtained from the firm's Chemical and Metallurgical Division, Towanda, Pa.

NEW G-E PUBLICATION

The extension of high reliability manufacturing techniques to commercial receiving tubes is described in a new *General Electric* publication (ETR-1541-2).

The 24-page booklet discusses the use of gold and silver in grids, anti-lint and dust measures, testing procedures, and design and engineering considerations in connection with the firm's line of television receiving tubes.

Copies are available through the company's receiving tube department, Owensboro, Kentucky.

TWIST-PRONG CAPACITOR GUIDE

Cornell-Dubilier Electric Corp. has released a 52-page booklet listing over 3300 manufacturers' part numbers, ratings, and sizes for twist-prong replacement capacitors used by 97 TV set manufacturers.

A simplified "rotational stock number" system permits orderly shelf arrangement and fast handling of the units in logical sequence according to rating.

Write to the company at South Plainfield, N. J. for additional information.

MICROTRAN BROCHURE

Microtran Company, Inc. announces a 4-page brochure listing many new types of transformers added to its catalogue line.

Typical schematic and circuit diagrams are also shown in conjunction with converter transformers.

The brochure is available free of charge. Write directly to the company at 145 E. Mineola Avenue, Valley Stream, N. Y.

SUPREME MASTER INDEX

Supreme Publications, 1760 Balsam Rd., Highland Park, Ill. has published its "1958 Master Index" to all of its radio and television manuals. The Index covers 17 radio volumes and 13 TV manuals.

The 48-page booklet cross-references all material in the available radio and TV manuals. By direct reference to volume and page numbers, the task of finding needed material is greatly simplified.

Readers of our publication may obtain single copies at a special cost of 5¢ in stamps for postage. Write directly to the publisher of the Index for your copy.

NATIONAL CO. BROCHURE

A new, 4-page catalogue, Bulletin No. 58-2, is now available from the *National Co., Inc.,* Malden 48, Mass.

The booklet describes a complete line of wear-resistant, steel threaded inserts for use in aluminum or brass. Five types of captive nuts and a line of studs are catalogued.

RECEIVING TUBE CHART

A receiving tube interchangeability chart listing 122 replacements for 180 popular television and radio types is now available from *General Electric Company.*

The pocket-size chart (ETR-1749) is offered as a time-saver for service technicians who may be in immediate need of a tube for which they have no direct replacement on hand.

This brochure is available through the company's authorized tube distributors.

NEW "SENCORE" LITERATURE

Service Instruments Corp. has announced the availability of a new, multicolored catalogue on its line of test instruments.

The brochure includes photographs of each of the firm's products and also photographs showing the particular product in use. Complete information is included, with schematics.

Write direct to the firm at 171 Official Road, Addison, Illinois.

TRANSISTOR GUIDE

Sylvania Electric Products Inc. has designed a brochure which includes complete ratings and characteristics on nearly 100 EIA registered transistors.

The 20-page catalogue includes corresponding outline and socket specifications for each entry. Also incorporated is a section devoted entirely to a transistor interchangeability guide designed to assist in the identification of more than 600 transistor types.

The brochure, "*Sylvania* Transistors —Characteristics and Interchangeability Guide," is available at a cost of 10¢. Write direct to the company at 1740 Broadway, New York 19, N. Y.

TUBE TESTER BOOKLET

Century Electronics Co., Inc. announces the availability of a new and revised printing of its book entitled "Operating a Successful Tube Tester Route."

The 12-page booklet includes such points as financing, buying tubes, how to sign up locations, how to service locations, financing for expansion, record keeping, etc.

Copies are available free of charge. Mail your request directly to the company at 111 Roosevelt Ave., Mineola, N. Y.

TRIPLETT CATALOGUE

The Triplett Electrical Instrument Company, Bluffton, Ohio, has released its new catalogue, No. 37-T.

This brochure covers electronic, electrical, radio, and television test equipment.

PACKAGED ELECTRONIC CIRCUIT GUIDE

The fifth edition of the *Centralab* "PEC" Packaged Circuit Guide is now available. The new 16-page guide is one-third larger than the previous edition and contains complete replacement information on packaged circuits used in equipment of over 200 manufacturers.

A special feature of this new brochure is a cross-reference chart showing the company's appropriate replacement for units of other manufacturers.

Copies are available without charge from electronic parts distributors or from the company, a Division of *Globe-Union, Inc.,* 900 E. Keefe Avenue, Milwaukee 1, Wisc.

"FLIP-CHART"

Tung-Sol Electric Inc. announces publication of a new 30-page "flip-style" chart showing electrical and physical characteristics of the most important electron tubes having industrial, special purpose, and military applications.

The attractive chart, T-24, is printed on heavy duty coated stock, indexes industrial tubes by class, and gives technical information pertinent to each type within the class.

The chart may be obtained without cost from the firm's distributors as well as from the company at 95 Eighth Ave., Newark 4, N. J.

TRANSFORMER CATALOGUE

The 1959 edition of the "Stancor" Transformer Catalogue is now available. The 32-page, two-color brochure covers over 750 of the company's transformers for industrial, communications, television, and radio applications.

An important feature of this catalogue is a new indexing system, making it easy to locate the appropriate unit.

Copies are available at no charge from the firm's distributors or directly from the manufacturer, *Chicago Standard Transformer Corp.,* 3501 Addison St., Chicago 18, Ill.

SILICON SOLAR CELLS

The Semiconductor Division of *Hoffman Electronics Corp.,* 930 Pitner Ave., Evanston, Ill., has issued a four-page brochure detailing the electrical and physical characteristics of its standard line of silicon solar cells.

Bulletin 32-58 gives complete design parameters as well as application notes on nine types of cells. —30—

SUPERIOR'S NEW MODEL TW-11

STANDARD PROFESSIONAL TUBE TESTER

★ Tests all tubes, including 4, 5, 6, 7, Octal, Lock-in, Hearing Aid, Thyratron, Miniatures, Sub-miniatures, Novals, Sub-minars, Proximity fuse types, etc.

★ Uses the new self-cleaning Lever Action Switches for individual element testing. Because all elements are numbered according to pin-number in the RMA base numbering system, the user can instantly identify which element is under test. Tubes having tapped filaments and tubes with filaments terminating in more than one pin are truly tested with the Model TW-11 as any of the pins may be placed in the neutral position when necessary.

★ The Model TW-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. All tube listings printed in large easy-to-read type.

★ 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.

Model TW-11 — TUBE TESTER . . . Total Price $47.50 — Terms: $11.50 after 10 day trial, then $6.00 per month for 6 months.

EXTRAORDINARY FEATURE

SEPARATE SCALE FOR LOW-CURRENT TUBES. Previously, on emission-type tube testers, it has been standard practice to use one scale for all tubes. As a result, the calibration for low-current types has been restricted to a small portion of the scale. The extra scale used here greatly simplifies testing of low-current types.

The Model TW-11 operates on 105-130 Volt 60 Cycles A.C. Comes housed in a beautiful hand-rubbed oak cabinet complete with portable cover.

$47.50 NET

SUPERIOR'S NEW MODEL 82

Multi-Socket Type TUBE TESTER

TEST ANY TUBE IN 10 SECONDS FLAT!

(1) Turn the filament selector switch to position specified. (2) Insert tube into a numbered socket as designated on our chart (over 600 types included). (3) Press down the quality button —

***THAT'S ALL!* Read emission quality direct on bad-good meter scale.**

Model 82 — TUBE TESTER . . . Total Price $36.50 — Terms: $6.50 after 10 day trial, then $6.00 monthly for 5 months.

Production of this Model was delayed a full year pending careful study by Superior's engineering staff of this new method of testing tubes. Don't let the low price mislead you! We claim Model 82 will outperform similar looking units which sell for much more — and as proof, we offer to ship it on our examine before you buy policy.

Primarily, the difference between the conventional tube tester and the multi-socket type is that in the latter, the use of an added number of specific sockets (for example, in Model 82 the noval is duplicated eight times) permits elimination of element switches thus reducing testing time and possibility of incorrect switch readings.

To test any tube, you simply insert it into a numbered socket as designated, turn the filament switch and press down the quality switch—THAT'S ALL! Read quality on meter. Inter-element leakage, if any indicates automatically.

- Tests over 600 tube types.
- Tests OZ4 and other gas-filled tubes.
- Employs new 4" meter with sealed air-damping chamber resulting in accurate vibrationless readings.
- Use of 22 sockets permits testing all popular tube types and prevents possible obsolescence.
- Dual Scale meter permits testing of l current tubes.
- 7 and 9 pin straighteners mounted on panel.
- All sections of multi-element tubes tested simultaneously.
- Ultra-sensitive leakage test circuit will indicate leakage up to 5 megohms.

Model 82 comes complete, housed in portable, hand-rubbed oak cabinet with removable cover. Only **$36.50 NET**

SHIPPED ON APPROVAL

NO MONEY WITH ORDER — NO C.O.D.

Try for 10 days before you buy! If completely satisfied, send down payment after trial and pay balance at indicated monthly rate — NO INTEREST OR FINANCE CHARGES ADDED. If not completely satisfied, return to us, no explanation necessary.

See page 111 for complete details

MOSS ELECTRONIC, INC. 3849 TENTH AVE., NEW YORK 34, N. Y.

SUPERIOR'S NEW MODEL 83

C.R.T. TESTER

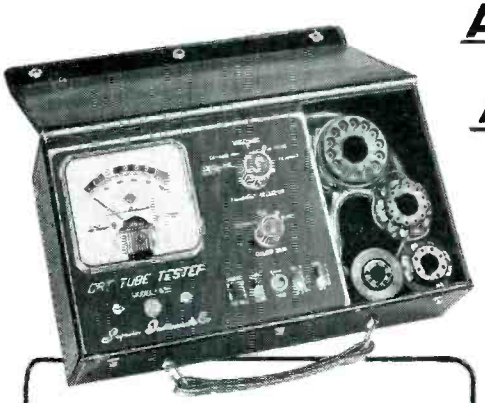
Tests and Rejuvenates ALL PICTURE TUBES

ALL BLACK AND WHITE TUBES

From 50 degree to 110 degree types—from 8" to 30" types.

ALL COLOR TUBES

Test ALL picture tubes—in the carton—out of the carton—in the set!



Model 83 — C.R.T. TUBE TESTER . . . Total Price $38.50 — Terms: $8.50 after 10 day trial, then $6.00 monthly for 5 months.

- Model 83 is *not* simply a rehashed black and white C.R.T. Tester with a color adapter added. Model 83 employs a new improved circuit designed specifically to test the older type black and white tubes, the newer type black and white tubes and all color picture tubes.
- Model 83 provides separate filament operating voltages for the older 6.3 types and the newer 8.4 types.
- Model 83 employs a 4" air-damped meter with quality and calibrated scales.
- Model 83 properly tests the red, green and blue sections of color tubes individually—for each section of a color tube contains its own filament, plate, grid and cathode.
- Model 83 will detect tubes which are apparently good but require rejuvenation. Such tubes will provide a picture seemingly good but lacking in proper definition, contrast and focus. To test for such malfunction, you simply press the rej. switch of Model 83. If the tube is weakening, the meter reading will indicate the condition.
- Rejuvenation of picture tubes is not simply a matter of applying a high voltage to the filament. Such voltages improperly applied can strip the cathode of the oxide coating essential for proper emission. The Model 83 applies a *selective* low voltage *uniformly* to assure increased life with no danger of cathode damage.

Model 83 comes housed in handsome portable Saddle Stitched Texon case—complete with sockets for all black and white tubes and all color tubes. Only **$38.50**

SUPERIOR'S NEW MODEL TV-12

TRANS-CONDUCTANCE TUBE TESTER

Model TV-12—TUBE TESTER . . . Total Price $72.50 — Terms: $22.50 after 10 day trial, then $10.00 monthly for 5 months.

TESTING TUBES

★ Employs improved **TRANS-CONDUCTANCE** circuit. An in-phase signal is impressed on the input section of a tube and the resultant plate current change is measured. This provides the most suitable method of simulating the manner in which tubes actually operate in Radio & TV receivers, amplifiers and other circuits. Amplification factor, plate resistance and cathode emission are all correlated in one meter reading.

★ **NEW LINE VOLTAGE ADJUSTING SYSTEM.** A tapped transformer makes it possible to compensate for line voltage variations to a tolerance of better than 2%.

★ **SAFETY BUTTON** — protects both the tube under test and the instrument meter against damage due to overload or other form of improper switching.

★ **NEWLY DESIGNED FIVE POSITION LEVER SWITCH ASSEMBLY.** Permits application of separate voltages as required for both plate and grid of tube under test, resulting in improved Trans-Conductance circuit.

TESTING TRANSISTORS

A transistor can be safely and adequately tested only under dynamic conditions. The Model TV-12 will test all transistors in that approved manner, and quality is read directly on a special "transistor only" meter scale.

The Model TV-12 will accommodate all transistors including NPN's, PNP's, Photo and Tetrodes, whether made of Germanium or Silicon, either point contact or junction contact types.

ALSO TESTS TRANSISTORS!

Model TV-12 housed in handsome rugged portable cabinet sells for only **$72.50 NET**

SHIPPED ON APPROVAL

NO MONEY WITH ORDER — NO C.O.D.

Try for 10 days before you buy! If completely satisfied, send down payment after trial and pay balance at indicated monthly rate — NO INTEREST OR FINANCE CHARGES ADDED. If not completely satisfied, return to us, no explanation necessary.

See page 111 for complete details

MOSS ELECTRONIC, INC. 3849 TENTH AVE., NEW YORK 34, N. Y.

SUPERIOR'S NEW MODEL 77

VACUUM TUBE VOLTMETER

WITH NEW 6" FULL-VIEW METER

Model 77 — VACUUM TUBE VOLTMETER . . . Total Price $42.50 — Terms: $12.50 after 10 day trial, then $6.00 monthly for 5 months.

Compare it to any peak-to-peak V. T. V. M. made by any other manufacturer at any price!

- Model 77 completely wired and calibrated with accessories (including probe, test leads and portable carrying case) sells for only $42.50.
- Model 77 employs a sensitive six inch meter. Extra large meter scale enables us to print all calibrations in large easy-to-read type.
- Model 77 uses new improved SICO printed circuitry.
- Model 77 employs a 12AU7 as D.C. amplifier and two 9006's as peak-to-peak voltage rectifiers to assure maximum stability.
- Model 77 uses a selenium-rectified power supply resulting in less heat and thus reducing possibility of damage or value changes of delicate components.
- Model 77 meter is virtually burn-out proof. The sensitive 400 microampere meter is isolated from the measuring circuit by a balanced push-pull amplifier.
- Model 77 uses selected 1% zero temperature coefficient resistors as multipliers. This assures unchanging accurate readings on all ranges.

AS A DC VOLTMETER: The Model 77 is indispensable in Hi-Fi Amplifier servicing and a must for Black and White and color TV Receiver servicing where circuit loading cannot be tolerated.

AS AN AC VOLTMETER: Measures RMS values if sine wave, and peak-to-peak value if complex wave. Pedestal voltages that determine the "black" level in TV receivers are easily read.

AS AN ELECTRONIC OHMMETER: Because of its wide range of measurement leaky capacitors show up glaringly. Because of its sensitivity and low loading, intermittents are easily found, isolated and repaired.

SPECIFICATIONS

• **DC VOLTS** — 0 to 3/15/75/150/300/750/1,500 volts at 11 megohms input resistance. • **AC VOLTS (RMS)** — 0 to 3/15/75/150/300/750/1,500 volts. • **AC VOLTS (Peak to Peak)** — 0 to 8/40/200/400/800/2,000 volts. • **ELECTRONIC OHMMETER** — 0 to 1,000 ohms/10,000 ohms/100,000 ohms/1 megohm/10 megohms/100 megohms/1,000 megohms. • **DECIBELS** —10 db to + 18 db, + 10 db to + 38 db, + 30 db to + 58 db. All based on 0 db = .006 watts (6 mw) into a 500 ohm line (1.73v). • **ZERO CENTER METER** — For discriminator alignment with full scale range of 0 to 1.5/7.5/37.5/75/150/375/750 volts at 11 megohms input resistance.

Model 77 comes complete with operating instructions, probe and test leads. Use it on the bench—use it on calls. A streamlined carrying case, included at no extra charge, accommodates the tester, instruction book, probe and leads. Operates on 110-120 volt 60 cycle. Only .....

$42.50 NET

SUPERIOR'S NEW MODEL 79 **SUPER-METER** — WITH NEW 6" FULL-VIEW METER

A Combination VOLT-OHM MILLIAMMETER.

Plus CAPACITY, REACTANCE, INDUCTANCE AND DECIBEL MEASUREMENTS.

Also Tests SELENIUM AND SILICON RECTIFIERS, SILICON AND GERMANIUM DIODES.

Model 79 — SUPER-METER . . . Total Price $38.50 — Terms: $8.50 after 10 day trial, then $6.00 per month for 5 months.

The Model 79 represents 20 years of continuous experience in the design and production of SUPER-METERS, an exclusive SICO development.

In 1938 Superior Instruments Co. designed its first SUPER-METER, Model 1150. In 1940 it followed with Model 1250 and in succeeding years with others including Models 670 and 670-A. All were basically V.O.M.'s with extra services provided to meet changing requirements.

Now, Model 79, the latest SUPER-METER includes not only every circuit improvement perfected in 20 years of specialization, but in addition includes those services which are "musts" for properly servicing the ever increasing number of new components used in all phases of today's electronic production. For example with the Model 79 SUPER-METER you can measure the quality of selenium and silicon rectifiers and all types of diodes—components which have come into common use only within the past five years, and because this latest SUPER-METER necessarily required extra meter scale, SICO used its new full-view 6-inch meter.

Specifications

D.C. VOLTS: 0 to 7.5/15/75/150/750/1,500.
A.C. VOLTS: 0 to 15/30/150/300/1,500/3,000.
D.C. CURRENT: 0 to 1.5/15/150 Ma. 0 to 1.5/15 Amperes.
RESISTANCE: 0 to 1,000/100,000 Ohms. 0 to 10 Megohms.
CAPACITY: 001 to 1 Mfd. 1 to 50 Mfd.
REACTANCE: 50 to 2,500 Ohms, 2,500 Ohms to 2.5 Megohms.
INDUCTANCE: .15 to 7 Henries, 7 to 7,000 Henries.
DECIBELS: —6 to +18, +14 to +38, +34 to +58.

The following components are all tested for QUALITY at appropriate test potentials. Two separate BAD-GOOD scales on the meter are used for direct readings.

All Electrolytic Condensers from 1 MFD to 1000 MFD.
All Selenium Rectifiers. **All Germanium Diodes.**
All Silicon Rectifiers. **All Silicon Diodes.**

Model 79 comes complete with operating instructions and test leads. Use it on the bench—use it on calls. A streamlined carrying case included at no extra charge accommodates the tester, instruction book and test leads.....Only

$38.50 NET

SHIPPED ON APPROVAL
NO MONEY WITH ORDER—NO C.O.D.

Try for 10 days before you buy! If completely satisfied, send down payment after trial and pay balance at indicated monthly rate — NO INTEREST OR FINANCE CHARGES ADDED. If not completely satisfied, return to us, no explanation necessary.

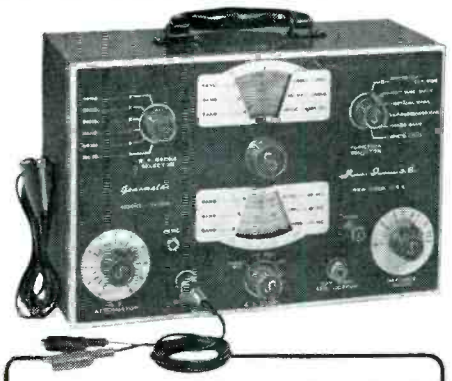
See following page for complete details

MOSS ELECTRONIC, INC. 3849 TENTH AVE., NEW YORK 34, N. Y.

SUPERIOR'S NEW MODEL TV-50A

GENOMETER

7 Signal Generators in One!



Model TV-50A GENOMETER . . . Total Price $47.50 — Terms: $11.50 after 10 day trial, then $6.00 monthly for 6 months.

√ R.F. Signal Generator for A.M.
√ R.F. Signal Generator for F.M.
√ Audio Frequency Generator
√ Bar Generator
√ Cross Hatch Generator
√ Color Dot Pattern Generator
√ Marker Generator

A versatile all-inclusive GENERATOR which provides ALL the outputs for servicing:

A.M. Radio • F.M. Radio • Amplifiers • Black and White TV • Color TV

Specifications

R. F. SIGNAL GENERATOR: The Model TV-50A Genometer provides complete coverage for A.M. and F.M. alignment. Generates Radio Frequencies from 100 Kilocycles to 60 Megacycles on fundamentals and from 60 Megacycles to 180 Megacycles on powerful harmonics.

VARIABLE AUDIO FREQUENCY GENERATOR: In addition to a fixed 400 cycle sine-wave audio, the Model TV-50A Genometer provides a variable 300 cycle to 20,000 cycle peaked wave audio signal.

BAR GENERATOR: The Model TV-50A projects an actual Bar Pattern on any TV Receiver Screen. Pattern will consist of 4 to 16 horizontal bars or 7 to 20 vertical bars.

CROSS HATCH GENERATOR: The Model TV-50A Genometer will project a cross-hatch pattern on any TV picture tube. The pattern will consist of non-shifting, horizontal and vertical lines interlaced to provide a stable cross-hatch effect.

DOT PATTERN GENERATOR (FOR COLOR TV) Although you will be able to use most of your regular standard equipment for servicing Color TV, the one addition which is a "must" is a Dot Pattern Generator. The Dot Pattern projected on any color TV Receiver tube by the Model TV-50A will enable you to adjust for proper color convergence.

MARKER GENERATOR: The Model TV-50A includes all the most frequently needed marker points. The following markers are provided: 189 Kc., 262.5 Kc., 456 Kc., 600 Kc., 1000 Kc., 1400 Kc., 1600 Kc., 2000 Kc., 2500 Kc., 3579 Kc., 4.5 Mc., 5 Mc., 10.7 Mc., (3579 Kc. is the color burst frequency).

The Model TV-50A comes complete with shielded leads and operating instructions. Only

$47.50 NET

For the first time ever: ONE TESTER PROVIDES ALL THE SERVICES LISTED BELOW!

SUPERIOR'S NEW MODEL 76

ALL PURPOSE BRIDGE

Model 76 . . . Total Price $26.95 — Terms: $6.95 after 10 day trial, then $5.00 monthly for 4 months.

IT'S A
CONDENSER BRIDGE
with a range of .00001 Microfarad to 1000 Microfarads (Measures power factor and leakage too.)

IT'S A
RESISTANCE BRIDGE
with a range of 100 ohms to 5 megohms

IT'S A
SIGNAL TRACER
which will enable you to trace the signal from antenna to speaker of all receivers and to finally pinpoint the exact cause of trouble whether it be a part or circuit defect.

IT'S A
TV ANTENNA TESTER
The TV Antenna Tester section is used first to determine if a "break" exists in the TV antenna and if a break does exist the specific point (in feet from set) where it is.

CAPACITY BRIDGE SECTION
4 Ranges: .00001 Microfarad to 1000 Microfarads. Will also locate shorts and leakages up to 20 megohms. Measures the power factor of all condensers from .1 to 1000 Microfarads. (Power factor is the ability of a condenser to retain a charge and thereby filter efficiently.)

RESISTANCE BRIDGE SECTION
2 Ranges: 100 ohms to 5 megohms. Resistance can be measured without disconnecting capacitor connected across it. (Except, of course, when the R C combination is part of an R C bank.)

SIGNAL TRACER SECTION
With the use of the R.F. and A.F. Probes included with the Model 76, you can make stage gain measurements, locate signal loss in R.F. and Audio stages, localize faulty stages, locate distortion and hum, etc. Provision has been made for use of phones and meter if desired.

TV ANTENNA TESTER SECTION
Loss of sync., snow and instability are only a few of the faults which may be due to a break in the antenna, so why not check the TV antenna first? 2 Ranges: 2' to 200' for 72 ohm coax and 2' to 250' for 300 ohm ribbon.

Model 76 comes complete with all accessories including R.F. and A.F. Probes; Test Leads and operating instructions. Nothing else to buy. Only

$26.95 NET

SHIPPED ON APPROVAL
NO MONEY WITH ORDER — NO C.O.D.

MOSS ELECTRONIC, INC.
Dept. D-555 3849 Tenth Ave., New York 34, N.Y.

Please send me the units checked on approval. If completely satisfied I will pay on the terms specified with no interest or finance charges added. Otherwise, I will return after a 10 day trial positively cancelling all further obligation.

Name .....

Address .....

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

All prices net. F.O.B., N. Y. C.

- ☐ **Model TW-11** ..... **Total Price $47.50**
  $11.50 within 10 days. Balance $6.00 monthly for 6 months.
- ☐ **Model 82** ..... **Total Price $36.50**
  $6.50 within 10 days. Balance $6.00 monthly for 5 months.
- ☐ **Model 83** ..... **Total Price $38.50**
  $8.50 within 10 days. Balance $6.00 monthly for 5 months.
- ☐ **Model TV-12** ..... **Total Price $72.50**
  $22.50 within 10 days. Balance $10.00 monthly for 5 months.
- ☐ **Model 77** ..... **Total Price $42.50**
  $12.50 within 10 days. Balance $6.00 monthly for 5 months.
- ☐ **Model 79** ..... **Total Price $38.50**
  $8.50 within 10 days. Balance $6.00 monthly for 5 months.
- ☐ **Model TV-50A** ..... **Total Price $47.50**
  $11.50 within 10 days. Balance $6.00 monthly for 6 months.
- ☐ **Model 76** ..... **Total Price $26.95**
  $6.95 within 10 days. Balance $5.00 monthly for 4 months.

Mac's Service Shop

(*Continued from page 56*)

"Well, that's one way to test 'em," Barney observed.

"Yes, but it's not very practical. Until I find a better solution, I'm going to use the old tried and true method of substitution without fooling around with useless resistance checks."

"You spoke about the capacitor feeling warm after the set had been turned on and that checks with what a fellow was telling me about these units the other day. He claims that quite often you can see a little arc inside a bad capacitor if you look closely in a very dim light. He says the glow of the arc will show up right through the case. But enough of this talk about the hot high-voltage circuits. Come on down to the level of this little a.c.-d.c. receiver and tell me if you hear anything wrong with the tone quality."

Mac listened critically to the little receiver as he ran the volume up and down. "No," he said slowly; "should I?"

"Well, the boy who brought it in said that after it was on a few minutes it became so mushy you could hardly understand it. I've had it on for an hour and I can't see anything wrong. Just to be on the safe side, I checked the coupling capacitors for leakage and the speaker cone for proper centering. Nothing is wrong in either department."

"How old would you say that boy was?"

"Around sixteen, but what's that got to do with the price of hay in China?"

"What would you say was the favorite program of the teenagers?"

"That disc jockey program that comes on at eleven p.m."

"That's probably the only time the kid uses this radio. Now what is different about using a radio late at night and using it during the day?"

"I give up, Mr. Bones. What *is* different about using a radio late at night and using it during the day?"

"Ever check the line voltage late at night?"

"Yeah-h-h! It goes away up. Let me plug this thing into the variable-voltage transformer and raise the line voltage up to about 125 volts. There we are."

It was only a minute or so until the clear sound of the radio began to blur a little and in no time at all it was distorting so badly that speech could scarcely be understood. Mac did not need to tell Barney what to do next. He removed the 50C5 tube and put in a new one. Now the radio continued to play clearly even at the elevated line voltage.

"The old story of secondary emission causing the plate current to run away," Barney said. "The only difference is that the condition does not start until the line voltage is increased. Man, you've really got to be on your toes in this racket. I suppose if I hadn't told

you a *boy* brought the radio in we never would have found what was wrong with it."

"Oh, I wouldn't say that," Mac demurred. "Elevating the line voltage should be a standard procedure in any radio that is said to distort after it has been on for a few minutes if that symptom fails to show up in a normal bench check. And if that doesn't make the set distort, try lowering the line voltage. In some instances a weak tube will cause distortion when its filament voltage is lowered."

"You know," Barney said slowly, "I'll bet Sherlock Holmes would have made a wonderful service technician. He believed that every detail that could be observed, no matter how minute, was significant. It certainly is in radio and TV work."

"Righto, Dr. Watson!" Mac said with a very poor imitation of a British accent; "and now if you will hand me my spyglass and my fore-and-aft hat, we'll start on *The Strange Adventure of the Errant Electrons!*" —30—

Sun	Mon	Tue	Wed	Thu	Fri	Sat
					4	5
						12
						19
						26

CALENDAR of EVENTS

JANUARY 16-18

High-Fidelity Show. Sponsored by Rigo Enterprises, Inc. Leamington Hotel, Minneapolis, Minn. Details on exhibition space from sponsors at 500 N. Dearborn St., Chicago 10, Ill.

JANUARY 28-29

Midwest Welding Conference. Sponsored by Armour Research Foundation and Chicago Section of American Welding Society. Illinois Institute of Technology, Chicago. Program details available from Conference Secretary, Armour Research Foundation of IIT, 10 W. 35th St., Chicago 16, Ill.

First International Symposium on Nuclear Fuel Elements. Sponsored by Columbia University and Sylvania-Corning Nuclear Corp. New York, N. Y. Dr. Henry H. Hausner, Secretary, 730 Fifth Ave., New York 19, N. Y.

FEBRUARY 5-8

International High Fidelity Music Festival. Shoreham Hotel, Washington, D. C. Open to public. Contact M. Robert Rodgers, director of Festival, at 2101 16th St., N.W., Washington 9, D. C., for full details.

FEBRUARY 8-14

National Electrical Week. Sponsored by National Electrical Week Committee, 290 Madison Ave., New York 17, N. Y. Purpose is to enhance public appreciation of electricity and contributions of the electrical industry to the Nation's progress and economy.

FEBRUARY 12-13

Solid State Circuits Conference. Sponsored by PGCT, AIEE, and University of Pennsylvania. University of Pennsylvania, Philadelphia. Arthur B. Stern, General Electric Co., Bldg. 3, Syracuse, N. Y., for additional program information.

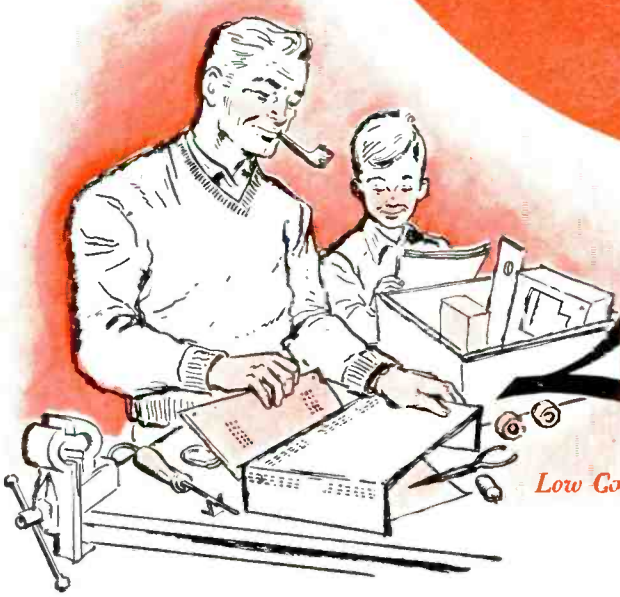
NEW! "Do-It-Yourself" LAFAYETTE Kits

LAFAYETTE'S 1959 CATALOG
260 GIANT-SIZE PAGES
FREE!

Complete listings of the NEWEST in Stereo and Monaural Hi-Fi, Short Wave, Audio, Transistor, and many other Lafayette electronics kits as well as thousands upon thousands of standard brand nationally advertised kits and electronic parts and components are described in LAFAYETTE'S GIANT NEW 260-PAGE CATALOG. SEND FOR IT—IT'S FREE! Just fill in coupon below and present it at any Lafayette store, or paste it on a postcard and send it to us. THAT'S ALL YOU HAVE TO DO to get your FREE 1959 LAFAYETTE CATALOG!

LAFAYETTE RADIO ELECTRONIC KITS

- Include the very latest electronic advances.
- Are constantly being modernized by Lafayette's own Engineering Department, by a leading consulting engineering firm, and by your own recommendations.
- Are a product of Lafayette's 38 years of Electronic Leadership.



Low Cost Kits For Everyone!

Lafayette Radio

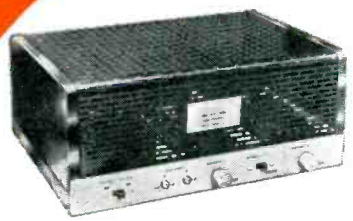
Educational, Practical, FUN To Build!

LEARN ELECTRONICS BY BUILDING A LOW COST LAFAYETTE KIT

KITS FOR BEGINNERS • 10-In-1 Lab Kit • Transistor Code Practice Oscillator • AC-DC Broadcast Receiver • 3-Way Broadcast Receiver • 5-Watt Push-Pull AC-DC Amplifier • 7-In-1 Radio Lab Kit • 2-In-1 Kit • Germanium Diode Radio • 1-Transistor Pocket Radio • 2-Transistor Pocket Radio

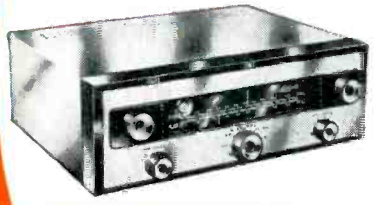
HI-FI KITS • Stereo Master Audio Control Center & Preamplifier • Stereo Remote Control Center—Electronic Stereo Adapter • 36-Watt Basic Stereo Amplifier • AM-FM Stereo Tuner • Preamp-Audio Control Center • 70-Watt Power Amplifier • 4-Watt Stereo Amplifier • Speaker Enclosure Kits

ADVANCED KITS • Broadcast-Shortwave Receiver • Electric Brain Kit • 10-Watt Push Pull Hi-Fi Amplifier • 15-In-1 Transistor Experimenter's Kit • 4-Band Broadcast-Shortwave Receiver • Photocell Electronic Relay • 6-Transistor Superhet Receiver • 3-Transistor Pocket Radio • 3-Transistor Hi-Fi Preamplifier • 2-Transistor Reflex Radio With Sun Battery • Transistor Code Practice Oscillator • Radio Control Transmitter • Transistor-Diode Checker • Multitester Semi-Kit • 4-Transistor Telephone Pickup Amplifier

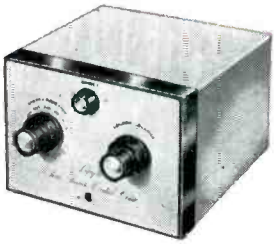


36-WATT STEREO BASIC POWER AMPLIFIER KT-310 47.50

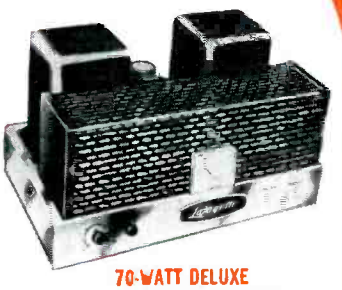
STEREO MASTER AUDIO CONTROL CENTER-PREAMP KT-600 79.50



STEREO AM-FM HIGH FIDELITY TUNER KT-500 74.50



STEREO REMOTE CONTROL CENTER ELECTRONIC STEREO ADAPTER KT-315 27.50



70-WATT DELUXE BASIC AMPLIFIER KT-400 69.50

4-WATT STEREO PHONO AMPLIFIER KT-126 18.95

DELUXE MASTER AUDIO CONTROL CENTER-PREAMPLIFIER KT-300 39.50

EASY-TO-BUILD LAFAYETTE KITS Enjoy and Save

LAFAYETTE KITS SAVE YOU REAL MONEY. You save up to 50% or more when you build a low-cost Lafayette kit as against factory-wired units of equal or even lesser quality. You save also because Lafayette manufactures these kits and sells them *direct to you*, eliminating the usual dealer's markup.

LAFAYETTE KITS ARE YEARS AHEAD. Every latest advance in electronics finds its way into educational and practical Lafayette Kits. Lafayette was FIRST in TRANSISTORS, and Lafayette is now FIRST in STEREO HI-FI!

LAFAYETTE KITS ARE EASY TO BUILD. Whether you are a beginner or an engineer, a novice or advanced amateur, there are Lafayette kits you can build, learn from, and use. Detailed instructions with clear, large blow-ups and dozens of illustrations describe minutely every step of the kit assembly so that there are seldom any questions.

LAFAYETTE KITS ARE AVAILABLE ON OUR EASY PAY PLAN. SEE OUR FREE GIANT-SIZED 260-PAGE 1959 CATALOG FOR DETAILS.

LAFAYETTE RADIO STORE LOCATIONS

JAMAICA 33, N. Y.
165-08 Liberty Ave.
AXtel 1-7000
Open FRIDAY 'till 8:45 P.M.

NEW YORK 13, N.Y.
100 6th Ave.
WOrth 6-5300
Open THURSDAY 'till 8:45 P.M.

BRONX 58, N. Y.
542 E. Fordham Rd.
FOrdham 7-8813
Open THURSDAY 'till 8:45 P.M.

NEWARK 2, N. J.
24 Central Ave.
MArket 2-1661
Open WEDNESDAY 'till 8:45 P.M.

PLAINFIELD, N. J.
139 W. 2nd St.
Plainfield 6-4718
Open THURSDAY 'till 8:45 P.M.

BOSTON 10, Mass.
110 Federal St.
HUbbard 2-7850
Open MON.-WED. 'till 8:45 P.M.

ASK FOR THE FREE 260-PAGE GIANT NEW 1959 LAFAYETTE CATALOG

Fill in and present the coupon below at any Lafayette store for your FREE Catalog, or simply paste the coupon on a postcard and mail it to the address on the coupon. Our catalog is FREE for the asking!

FREE

CUT OUT AND PASTE ON POST CARD

LAFAYETTE RADIO, Dept. RA
P.O. Box 511, Jamaica 31, N. Y.

SEND FOR THE WORLD'S LEADING ELECTRONICS, RADIO, T.V., INDUSTRIAL, AND HI-FI GUIDE

☐ Send FREE LAFAYETTE Catalog 590

Name .....

Address .....

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

The Heater-Cathode Leakage Problem

By **MANNIE HOROWITZ**
EICO

One of the baffling causes of audio circuit hum can be cured with a little thought and care.

THE quality of a high-fidelity amplifier is determined by two major criteria. The first important one is just how much of the original signal it will reproduce faithfully. The second, and equally important factor, is its freedom from unwanted interference generation. One of the primary forms of undesirable interference is hum.

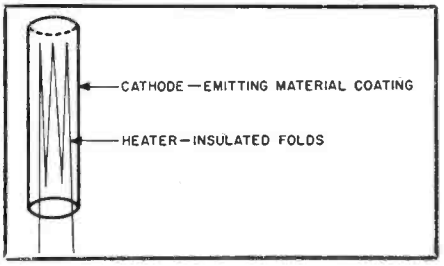
This interference is most obvious when introduced into low-level amplifiers such as reluctance-cartridge phono preamplifiers or tape-head preamplifiers. Any hum originating in this stage is amplified by all succeeding stages. It is therefore more important to keep hum at a minimum in this section than in any other part of the amplifier.

Hum can be caused by several factors. Poor filtering of the "B+" power supply is the most obvious cause. An equally obvious one is pickup from stray a.c. fields such as power and heater leads as well as induction from power transformers. A more elusive, but extremely important, factor is the ground loop caused by fields set up in the metal chassis. The factor to be discussed, heater-cathode leakage, is perhaps the greatest cause of occupational headaches among tube engineers, audio engineers, and audiophiles.

The actual construction of the heater-cathode section of a vacuum tube is simple. The cathode is a thin cylindrical-shaped piece of metal. The outside is coated with an emitting material which supplies the electrons for the vacuum tube. Some of the trouble begins when this emitting material "spills over" to the inside of this cylinder.

To heat this cathode, there are several folds of insulated (usually with an aluminum oxide coating) wire placed within the cylinder (Fig. 1). This wire serves the sole purpose of heating the cathode. Being placed within this cylinder, the heater wire touches the inside of the cathode in several places.

Fig. 1. Heater-cathode construction.



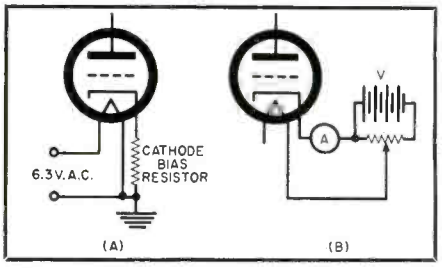


Fig. 2. (A) Heater-cathode circuit. The a.c. from heaters can appear across bias resistor if tube is leaky. (B) Circuit to get cathode current as a function of applied voltage between heater and cathode. Reversing battery polarity shows current in a reverse direction. Refer to text.

When a tube is defective, electrons can flow from the heater to the cathode or in the reverse direction from the cathode to the heater. Fig. 2A shows just what happens when there is current flowing in either direction, under the condition that one side of the heater leads is grounded.

The cathode, the heater, and the cathode bias resistor go to make up a complete diode circuit. It is undesirable that any of the a.c. on the heater goes through the cathode resistor. If there is no conduction between the heater and cathode, no a.c. can appear there. However, if there is any conduction between these electrodes in either direction, the path is closed. The variation in conduction, due to a.c. cyclical variations in the heater, will modulate the electron stream between heater and cathode in either direction. This sinusoidal voltage variation will appear as a 60-cycle voltage across the cathode bias resistor which, in turn, will be amplified by the tube.

Cause of Leakage

Heater-cathode leakage can result from several different types of tube deficiencies. If there is any emitting material inside the cathode cylinder, there may be conduction from the cathode to the heater. In a similar manner, the heater insulation may be imperfect, permitting electrons from the hot heater wire to reach the cathode.

LORAN APN/4 OSCILLOSCOPE

Easily converted for use on radio-TV service bench.

Completely Assembled

LIKE NEW! Supplied with 5" Scope, type 5CPI only **$14.95**
Excellent. Used $10.95

TS-100/AP OSCILLOSCOPE (worth $750) OUR LOW PRICE $33.33

Can be used with linear sweep or general purpose test scope. Cables included. Also used with circular sweep as precision range calibrator. Self-contained in metal case 8" x 12½" x 16" deep. For 110 V 50 to 1200 cycles AC. Excellent used, like new, with all tubes including crystals and C. R. Tube.

SCR-522 2-METER RIG!

Terrific buy! VHF Transmitter-receiver, 100-156 Mc. 4 channels, Xtal-controlled. Amplitude modulated voice. They're going fast! Excellent condition.

SCR-522 Transmitter-Receiver, complete with all 18 tubes, top rack and metal case.
COMBINATION ..... Special **$33.33**

Receiver only, with all tubes $19.50
Transmitter Only, with all tubes $22.25
Accessories for above available.

LORAN R-65/APN-9 RECEIVER & INDICATOR

Used in ships and aircraft. Determines position by radio signals from known xmitters. Accurate to within 1% of distance. Complete with tubes and crystal. Exc. used. Value $12.00. Our Price **$89.50**

BC-620 FM TRANSCEIVER, 20-28 Mc. BRAND NEW **$9.95**

PE-120 6-12V POWER SUPPLY, with Tubes and Vib. NEW **$11.95**
Shock Mt. Rack, NEW $2.95

BC-652A RECEIVER

Hot Special! 2 to 6 Mc Receiver, 2-band, complete with all tubes and 12V dynamotor. Fine for 80-meter Ham band. Marine etc. Provides for CW, MVC, AVC. Speaker jack and two headphone jacks. Like New, only **$29.50**

ARB Receiver 4 band 195-9050 Kc, with all Tubes, Like New **$17.95**
Brand New, with Tubes and Dynamotor $34.50

LORAN APN-4 FINE QUALITY NAVIGATIONAL EQUIPMENT

Determine exact geographic position of your boat or plane. Indicator and receiver complete with all tubes and crystal.
INDICATOR ID-6B/APN-4, and **RECEIVER** R-9B/APN-4, BRAND NEW .. only **$48.49**
Complete Kit of Accessories for Above: PE-206 Inverter, Set Of Plugs, Visor for Indicator, Operation Manual, ALL BRAND NEW **$49.50**

SPECIAL APN-9A LORAN Receiver less tubes, NEW (demilitarized) Indicator, ... **$24.50**

I-152-AM ALTIMETER INDICATOR

Brand New, With Tubes. Only **$17.95**

DYNAMIC HANDMIKE, with "Press-to-talk" Switch on handle, cord and plug—BRAND NEW, only $2.95

DYNAMIC HANDMIKE, aircraft, made by Telephonics Corp. Press-to-talk switch on mike. BRAND NEW **$4.95**

Hi-Fi DYNAMIC HEADSET with Cushions

Freq. Range: 40-14000 CPS. No Distortion. BRAND NEW **$7.95**

MICROPHONES

Model	Description	Excellent Used	BRAND NEW
T-17	Carbon Hand Mike	$4.95	$6.95
T-30	Carbon Throat Mike	.39	.79
T-45	Army and Navy Lip Mike		1.33
T-24	Carbon Mike		5.95
TS-9	Handset		3.88
RS-38	Navy Type	2.79	4.95

HEADPHONES

Model	Description	Excellent Used	BRAND NEW
HS-23	High Impedance	$2.25	$4.75
HS-33	Low Impedance	2.79	4.75
HS-30	Low Imp. (featherwt.)	1.25	1.99
H-16/U	High Imp. (2 units)	3.75	7.95

TELEPHONICS—600 ohm Low Impedance HEADSETS. BRAND NEW, PER PAIR $3.45
CD-307A Cords, with PL55 plug and JK26 Jack ..... .99
Earphone Cushions for above—pair ..... .50

FL-5 FILTER 79c

WILLARD 6-VOLT MIDGET STORAGE BATTERY

3 Amp. Hour. **BRAND NEW.** 3⅝" x 1-13/16" x 2⅜". Uses Standard Electrolyte ..... Only $2.69

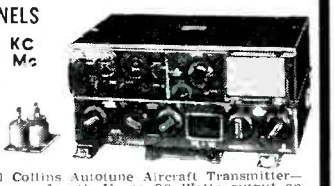
2 VOLT BATTERY "PACKAGE"

1—2V. 20 Amp. Hr. Willard Storage Battery $2.79
1—2V. 7 prong Synchronous Plug-in Vibrator 1.49
1—Quart Bottle Electrolyte (for 2 cells) 1.45
ALL BRAND NEW!
Combination Price **$5.45**

HERE'S THE SEASON'S BEST BUY!

AN/ART-13 TRANSMITTER

11 CHANNELS
200-1500 KC
2 to 18.1 Mc
OUR PRICE **$57.50**
Complete with Tubes



Navy Model Collins Autotune Aircraft Transmitter—one of the very finest! Up to 90 Watts output on CW, MCW or Voice. Easily preset frequencies. Simple operation. Sub-assembly construction for quick repair. This is a Sensational Smash Value at our low price! Exc. used. Orig. Cost $1800). Limited Quantity. 3 Antenna Condensers ... **$1.95**

NEW VALUES—JUST ARRIVED! BC-312 RADIO RECEIVER FOR VEHICLES

6 Bands 1500 KC to 18 Mc. continuous tuning. Phone and CW, internal dynamotor. Swell ham mobile receiver very clean, diagram included. Complete with Tubes and 14 V Dynamotor. Exc. Used **$49.50**

BC-312 AC Model, with 110 V AC Power Supply RA20 ..... $59.50

BC-348 SUPERHET RECEIVER. Locally controlled 8-tube 6-band receiver for aircraft, communications type, for voice, tone and CW. 200 to 500 Kc and 1.5 to 18 Mc. For operation on 24 V DC with self-contained dynamotor. Complete with tubes.
Exc. used **$69.50**

AN/ARN-7 AIRCRAFT NAVIGATIONAL INSTRUMENT. Superhet radio receiver. Range 100 Kc to 1750 Kc in 4 bands.
Exc. used **$59.50**

AR/ARN-6 RADIO COMPASS EQUIPMENT. Frequency 100 to 1750 Kc in 4 bands. 24 V DC operation.
Exc. used **$119.50**
BRAND NEW $169.50

BC-733 VHF 10-TUBE AIRCRAFT RECEIVER. 6-channel xtal control. Freq. 108.3 to 110.3 Mc. Dual filter range. Easily converted for tracking Sputniks!
Exc. used **$9.95**
BRAND NEW $12.95
Dynamotor for above 12/24 V.—New $5.95

AN/APR-4 RECEIVER only. 38 to 4000 Mc in 5 tuning unit ranges. High precision laboratory instrument used to monitor or indicate frequency of any signals within its range. Includes wide and narrow band IF strip selected from panel. Outputs provided for attachments to pulse analyzer, panadapter, etc. **$69.50**
Input 115 V 60 cy, BRAND NEW
Tuning Units for above—each $39.50

AN/ARC-1 Airborne radiophone ground to plane Revr-Xmitter. 10-channel xtal controlled, easily converted to 20 or 50 channel. VHF 100 to 156 Mc AM. Complete with tubes, mtg rack, dynamotor. OUR LOW PRICE **$79.50**
Exc.

AN/ARN-5A AIRCRAFT RECEIVER. 11 tube superhet, 3-crystal control UHF for static-free reception.
Exc. used with tubes **$16.95**
BRAND NEW $19.95

BC-645 XMTR RECEIVER

15 Tubes 435 To 500 MC

BRAND NEW

Can be modified for 2-way communication, voice or code, on ham band 420-450 mc. citizens radio 460-470 mc, fixed and mobile 450-460 mc. television experimental 470-500 mc. 15 tubes (tubes alone worth more than sale price!): 4—7F7, 4—7H7, 2—7E6, 2—6F6, 2—955 and 1—WE316A. Now covers 460 to 490 mc. Brand new BC-645 with tubes, less power supply in factory carton. **$29.50**
Shipping weight 25 lbs. .....
PE-101C DYNAMOTOR for BC-645, has 12-24V input (easy to convert for 6V Battery operation) ..... only **$7.95**
UHF ANTENNA ASSEMBLY, for BC-645 .. $2.45
Complete set of 10 Plugs for BC-645 ..... **$5.50**
CONTROL BOX for above $2.25
SHOCK MOUNT for above 1.25
CONVERSION BOOKLET. Instructions for most useful surplus rigs **$2.50**

BC-659 TRANSMITTER & RECEIVER

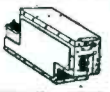
27 to 38.9 Mc F.M. Two preselected channels crystal controlled. 5 to 10 watts. Complete with speaker, tubes. Brand New **$11.95**
Exc. Used $7.95

Vibrator Supply for 6-12-24 Volts, NEW ... **$9.95**

Please include 25% Deposit with order—Balance C.O.D. 50c Handling Charge on all orders under $5.00. All shipments F.O.B. Our Warehouse, N.Y.C.

G & G Radio Supply Co.
Telephone: CO 7-4605
51 Vesey St., New York 7, N. Y.

ARC-5/R28 RECEIVER



2-meter Superhet. 100 to 156 Mc in 4 crystal channels. Complete with 10 Tubes. **BRAND NEW** **$24.45**
110V AC Power Supply Kit for above $9.75

ARC-5/T-23 TRANSMITTER

100-150 Mc Includes 2—832A, 2—1625 Tubes. **BRAND NEW** **$21.50**
SPECIAL OFFER! Limited quantity ARC-5/T23 xmitters.
BRAND NEW, less tubes $7.95
Excellent Used, less tubes $5.95

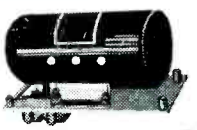
ARC-5 MARINE RECEIVER-TRANSMITTER

Navy Type Comm. Receiver 1.5 to 3 Mc BRAND NEW with 6 tubes **$16.95**

Navy Type Comm. Transmitter 2.1-3 Mc BRAND NEW with 4 tubes and Xtal **$12.45**

MODULATOR for above, new with tubes $4.95

MOBILE-MARINE DYNAMOTOR



Input 12V DC. Output: 625 V DC @ 225 Ma, for press-to-talk intermittent operation. Shpg. wt. 14 lbs. **OUR LOW PRICE** ... **$7.88**

OTHER DYNAMOTOR VALUES: Type	Input	Output	Excellent Used	BRAND NEW
DA-19-A	28V 11A	400V .400A	$4.99	$6.95
DM-28	28V	224V .07A	2.95	4.95
DM-32A	28V 1.1A	250V .05A	2.95	5.95
DM-33A	28V 5A	575V .16A		
	28V 7A	540V .25A	1.95	3.95
DM-34D	12V 2A	220V .080A	4.25	5.50
DM-37	25.5V 9.2A	625V .225A	5.95	8.95
DM-40	14V 3.4A	172V .138A	1.75	3.45
DM-53A	28V 1.4A	220V .080A	3.95	5.95
PE-73C	28V 20A	1000V .350A	8.50	11.50
PE-86	28V 1.25A	250V .050A	2.95	5.24
PE-186	28V 11A	400V .400A		6.95
2880	14V 2.4A	250V .060A		5.95

SCR-274 COMMAND EQUIPMENT

ALL COMPLETE WITH TUBES

Type	Description	Used	Like NEW
BC-453	Receiver 190-550 KC	$14.95	$16.95
BC-454	Receiver 3-6 Mc	9.95	12.95
BC-455	Receiver 6-9 Mc	10.95	13.50
BC-450	3-Receiver Control Box	1.49	1.95

110 Volt AC Power Supply Kit, for all 274-N and ARC-5 Receivers. Complete with metal case, instructions **$7.95**
Factory wired, tested, ready to operate ... $11.50

SPLINED TUNING KNOB for 274-N and ARC-5 RECEIVERS. Fits BC-453, BC-454 and others. Only **49c**

BC-457 TRANSMITTER—4-5.3 Mc. complete with all tubes and crystal. BRAND NEW .. **$7.88**
BC-458 TRANSMITTER—5.3 to 7 Mc. Complete with all tubes and crystal.
BRAND NEW **$7.88**
BC-459 TRANSMITTER—7-9.1 Mc. complete with all tubes and crystal.
BRAND NEW **$12.95**
ARC-5 T-19 TRANSMITTER—3 to 4 Mc. BRAND NEW complete with all tubes & crystal **$8.88**
BC-456 Modulator ..... USED 3.45 NEW 4.95
BC-451 Transmitter Control Box .. 1.25 NEW 1.49

UNIVERSAL POWER SUPPLY KIT For All Command Transmitters and others with similar power requirements. Input: 117V 60 cycles AC. Outputs: 450 V DC @ 150 Ma., 250 V DC @ 50 Ma., 24 V DC @ 2 Amps. Specially designed for Command Xmitter power requirements, but can be used on other similar equipment. Carefully designed, uses quality components. A really substantial, good-looking unit, very low priced! **$29.50**

BC-906 FREQ. METER—SPECIAL!

Cavity type, 145 to 235 Mc. BRAND NEW, complete with antenna. Manual included.
OUR LOW PRICE **$9.99**

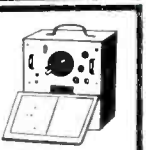
BC-603 FM RECEIVER

10-channel push button tuning or continuous tuning, 20-28 Mc. Complete with speaker, tubes, squelch. Exc. **$10.95**
BRAND NEW $14.95
12 or 24V Dynamotor for Above
Exc. Used $4.25 ..... Brand New $5.50

AC POWER SUPPLY FOR BC603, 683

Interchangeable, replaces dynamotor. Has On-Off Switch. NO RECVR CHANGE NEEDED. Provides 220VDC @ 80 Ma. 24VAC @ 2 Amps. Complete kit, with easy instructions **$8.45**
Wired $10.49
Complete 240-page Technical Manual for BC-603, 604 ..... $2.95

BC-221 FREQUENCY METER



SPECIAL BUY! This excellent frequency standard is equipped with original calibration charts, and has ranges from 125 Kc to 20,000 Kc with crystal check points in all ranges. At our smashing low price it's FIRST COME FIRST SERVED! Hurry, quantity is limited! Like New ... Only **$88.88**
BC-221 Modulated Type $129.50

CABINET for above BC-221 ..... **$3.99**
Original 1000 Kc Crystal for BC-221. BRAND NEW $8.45

SCHEMATIC DIAGRAMS For any equipment on this page, each .. **65c**

Direct conduction between elements can take place due to low resistance paths in sockets, tube bases, as well as impurities in the heater coating.

There can also be hum caused by the heater leads that extend below the level of the cathode cylinder. Being exposed, electrons may be conducted to the cathode leads, besides the other element leads or the electrodes themselves.

Possible Solutions

Whatever the cause, it is obvious that heater-cathode leakage is undesirable.

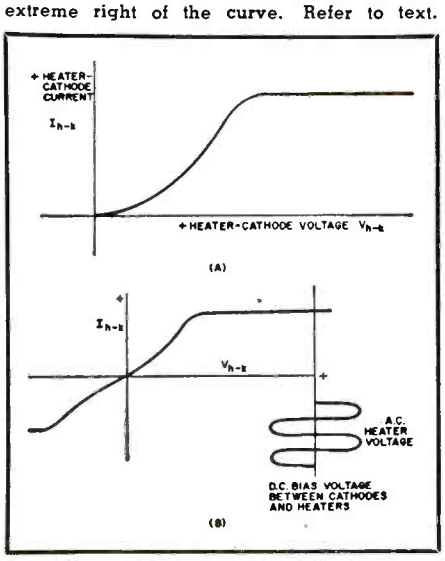
The first step toward minimizing this defect must be taken by tube manufacturers. The most popular tube used in the low-level preamplifier stage is the 12AX7. Although American manufacturers are working hard to cure this defect, there has been no complete solution as yet. Better 12AX7's are still imported from Europe. These are identified as ECC83's. However, the European imports vary in the amount of leakage among tubes of the same type and are thus not 100% reliable.

An obvious solution is to use transistors instead of tubes. Unfortunately, these are relatively noisy—a type of interference more undesirable than 60-cycle hum.

Since, at the present time, tubes must be used for best results, many preamplifiers have been designed with d.c. on the heaters. In this way, no a.c. is introduced into the first stage.

Although an excellent solution, it has several important drawbacks. Unless well filtered, this system can introduce 120-cycle hum due to full-wave bridge rectification. Hum at 120 cycles is more objectionable than the 60-cycle variety. It is also undesirable because of the high cost of supplying a well-filtered heater voltage. Despite these disadvantages, a d.c. heater supply is still a common and good solution.

Fig. 3. (A) Curve of heater-cathode current vs heater-cathode voltage, based on circuit of Fig. 2B. (B) Heater-cathode current vs voltage, with voltage applied in either direction. Note a.c. voltage variation without current variation at the extreme right of the curve. Refer to text.



Another solution, equally effective, becomes obvious when the problem is given further study.

In a tube which exhibits heater-cathode leakage, the heater and the cathode make up a diode. As in the case of any other diode, a d.c. voltage can be placed between the elements, with an ammeter in the circuit (Fig. 2B). As the d.c. voltage is increased from zero to several volts, the current climbs steadily. A point is then reached where there are no more electrons available at the heater to reach the cathode. This is known as the point of saturation. Here, any increase in voltage does not, at the same time, mean an increase in current (Fig. 3A).

Assume, now, that the battery is reversed. In this instance, electrons flow from the cathode to the heater —possibly due to emitting material on the inside of the cathode cylinder. The curve will follow a pattern similar to that of Fig. 3A, but in the reverse direction. The combined curve with the battery at both polarities is shown in Fig. 3B.

With this in mind, we can proceed to a solution which is frequently applied in practice. When the heater is grounded on one side, the maximum potential difference between the cathode and heater is the heater voltage at the peak of the a.c. cycle. This, of course, assumes that the cathode bias voltage in Fig. 2A is negligible. In accordance with Fig. 3B, this peak a.c. voltage variation means a high current variation.

Assume that there were a means of center-tapping the heaters, with the center arm being connected to ground. Fig. 4 shows two examples of this—one using a center-tap on the heater winding of the power transformer and the other using a pot across the heaters with the center arm connected to ground. The voltage swing between any part of the heater and ground or cathode (cathode voltage being negligible) is then halved at peaks in the cycle. Due to the shape of the curve (Fig. 3A), halving the voltage decreases the current swing by half. Thus there is less than half the a.c. variation appearing across the cathode resistor than in the first case.

The so-called hum-bucking potentiometer in this arrangement is of further help in reducing hum. The two halves of the heaters are out-of-phase. A careful adjustment of this control will not only cancel out hum due to this phase difference, but may introduce enough balance or unbalance to cancel hum due to extraneous pickups.

With a little thought, this method can be extended to give results comparable or even surpassing those achieved with d.c. heaters.

Fig. 3B reveals two flat regions beyond which any increase in voltage does not show any increase in current. One of these regions is in the positive half while the other is in the negative half.

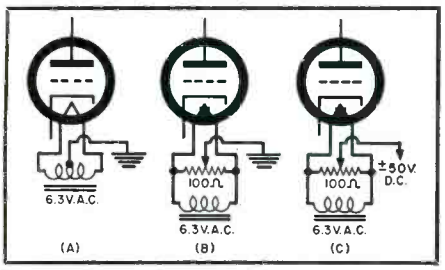


Fig. 4. (A & B) Methods of center-tapping heaters to ground or zero voltage. (C) Heaters center-tapped to "B+" or "B—" voltage for results obtained in Fig. 3B.

Suppose that the heaters were set at a high positive voltage with respect to the cathode (Fig. 4C). Let us set this voltage somewhere at the center portion of the flat part of the diode curve in Fig. 3B.

Due to heater-cathode leakage, assume a sinusoidal voltage appears between the heater and the cathode, as indicated in Fig. 3B. However, instead of varying sinusoidally around the zero volt point (as when no positive voltage is applied to the heaters) it will vary around the high d.c. voltage. Observing the curve at this point, a variation in voltage does not result in any variation in current. The a.c. voltage will produce a d.c., ripple-free, current. This d.c. will go through the cathode resistor of Fig. 2A, rather than the a.c. that would ordinarily pass through this resistor. No a.c. through the resistor means no hum voltage to be amplified by the tube.

This bias voltage should be made as high as possible for best results. The limiting factor is the lowest heater-cathode breakdown voltage for any tube connected to this particular heater group. This breakdown voltage is listed in the tube manuals.

That the same results are achieved with the heaters set at either a high positive or high negative voltage with respect to the cathode, is obvious from Fig. 3B. As long as this voltage is on the flat portion of the curve in either direction, ripple elimination is accomplished. The added effect of cancellation from a hum-bucking potentiometer is useful here as well as for the original grounded case.

All of these methods fall short when there is excessive tube leakage. Excessive leakage in any form means unwanted current through the cathode bias resistor, resulting in a change of the point of operation for the tube that is used.

As for any other function in any type of electrical apparatus, a good tube is necessary for good results. No circuit will operate properly when defective components are used.

In summary then, we have discussed some causes of the heater-cathode leakage problem along with some of the solutions. These include the use of special low-noise preamplifier tubes, the use of well-filtered d.c. on the heaters, the installation of a hum-bucking potentiometer, and the application of a d.c. biasing voltage. —30—

By BERT WHYTE

THE recent New York High-Fidelity Show clearly established that the stereophonic disc has come of age and is certainly here to stay. In the ensuing weeks since the Show the over-all stereo disc situation has sorted itself out even more. People are beginning to realize what is necessary for good stereophonic reproduction in terms of equipment and at the same time, the experience of their listening has taught them which companies are making the most representative and good type of stereophonic disc, and which are not.

Now, I make these assertions from having talked to a great many people. I must confess that since for the most part these are people in my immediate circle of friends, their tastes and interests are along similar lines to my own but they may not necessarily be a reflection of the taste of the general public. These people share my enthusiasm for the stereophonic revolution, but they contend that there has been such a mad, frantic scramble on the part of equipment manufacturers and record companies to produce the materials of the stereophonic revolution, that much common sense, good taste and honest policy has gone by the board. They contend that sometime after this fall, perhaps after Christmas, there will be a decline of interest and of sales in stereophonic equipment. They say the general public is being oversold on stereophonic sound, that the general public is having difficulty in understanding what stereophonic sound is all about and that many so-called salesmen in establishments which have never before been in the retailing of anything as complicated as stereophonic sound have given out a great deal of misleading and inaccurate information which confuses the issue still further. From the record end of the matter, they point out that there is a great deal of poor stereophonic sound being produced and, in fact, allege that a surprising percentage of what is sold as a stereophonic disc is, in fact, nothing of the sort and is a phony gimmick-up sort of two-channel monaural sound.

These allegations, as I said, were quite shocking to me, and while I have not had a chance to thoroughly investigate them on the basis of an admittedly abbreviated inquiry, I would say that there is both substance and exaggeration in their claims. I think they overlook one very basic fact about stereophonic reproduction, whether it be from tape, disc, or whatever. This is, that given the most untutored but normal ear, belonging to a person who at least has no aversion to music, and further, given a reasonable and honest facsimile of stereophonic sound, it is not difficult to appreciate the difference and express the preference for stereophonic over monaural reproduction. When I brought up this point with my friends, they said "Yes, you are right, but only to the extent that the average man you are talking about has been exposed to stereophonic sound while in the company of either a friend or an honest, reliable salesman, who takes the time and trouble to explain the mechanics of stereophonic sound." "To go a step further," said one of my friends, "to successfully inculcate in any person the idea of stereophonic sound, it is even necessary to teach this person the mechanics of listening."

This is a hard argument to refute, and while we could go on arguing pro and con about this all day, I think the whole matter will eventually boil down to this. I stand by my guns that if nothing else, the normal ear and an open mind can, and do, appreciate and prefer stereophonic sound to monaural sound. Those establishments which do not have the proper sales personnel who are thoroughly familiar with all the ramifications of stereophonic sound and who can easily impart this knowledge to a perspective customer, will simply fall by the wayside and cease to be a factor in stereophonic merchandising. The fact that many more different types of retail establishments are presently trying to cash in on the stereophonic boom, does not alter this fact. It is up to them to be as well equipped as most component high-fidelity retailers, in matters of equipment and personnel.

The situation is really not new and has its analogy a few years ago when we were dealing with monaural high fidelity. A very large section of the public became aware of the differences between true component high-fidelity and the generally less satisfactory "packaged" hi-fi, and things soon sorted themselves out. Up to the inception of the stereophonic disc, there were more and more members of the general public who were learning anew the old adage that you can't get something for nothing that good monaural high-fidelity systems were generally not cheap and were not usually sold by appliance dealers or any other sort of establishment which had neither the personnel nor the stock to satisfy the requirements.

Some alarmists have pointed out that the present stereophonic disc boom is going to be the biggest challenge the legitimate component high-fidelity retailer has ever had to face. Their contention is that stereophonic sound, even from the cheaper package stereophonic systems, is infinitely better than the packaged monaural "hi-fi" systems. They say that the difference is so startling that the equipment literally sells itself, and that for this reason, packaged stereophonic equipment will be sold successfully in the appliance dealer, department store, etc. with far less trouble than had been the case with monaural high fidelity. There is undoubtedly a germ of truth in this. It would be foolish to

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 publishers of this magazine.

say that many retail establishments which have never sold quality sound may not be successful in merchandising stereophonic equipment. If, however, my friends are even 50 percent right in their allegations concerning the adaptability of the average person to stereophonic listening, this would seem to afford the legitimate high-fidelity dealer the best opportunity to thoroughly entrench his position as a purveyor of quality high-fidelity sound.

No good high-fidelity components retailer can long stay in business if he is not thoroughly equipped with knowledgeable personnel and the best of equipment to offer to the public. Backed up by an aggressive and courageous advertising program he can regain, or at very least, retain his influence in the high-fidelity scheme of things. It may be a corny cliche, but it is pretty certain that you can't fool all of the people all of the time. If, what my friends contend is true, I still can only see a period of "agonizing reappraisal" in which industry and the public will sort itself out in its attitudes toward stereophonic sound. If after this readjustment, some of the impetus is removed from the stereophonic boom, on the basis of our similar experiences with monaural high fidelity, there will still be more than enough business to keep all segments of the industry very happy for a long time.

One final point that my friends made, in which unhappily I must concur, is that there are indeed some discs being sold as stereophonic which are nothing but tricked-up two-channel sound. This, above all, could do the most harm to the whole stereophonic boom as even with the improvement that two channels does afford monaural sound, it has nowhere near the dramatic impact of true stereophonic sound. Naturally, if a good many of the general public is exposed to this phony stereophonic sound, word-of-mouth being what it is, this will tend to alienate many people from stereophonic sound before they have had a chance to evaluate it for themselves.

I realize this has been more of a philosophic dissertation this month than is usual, and that a great deal of it may not apply directly to you. But there is no denying that the general public cannot be ignored by any group and any decisions made regarding the general public will ultimately reflect on the segments of the public more intimately concerned with matters electronic. The old saw is that "time will tell," but this reporter will go out on a limb and state that in spite of all the "signs and alarms" the stereophonic boom may stagger a bit, but will quickly recover itself and continue unabated for some time to come.

TCHAIKOVSKY
OVERTURE 1812
CAPRICCIO ITALIEN
MARCHE SLAV
London Symphony Orchestra conducted by Kenneth Alwyn. London CS-6038. Price $4.98.

It goes without saying that pot-boiler though this may be, it will undoubtedly prove a best seller as a stereo disc. Naturally, any discussion of the "1812 Overture" must inevitably come in for comparison with the famous *Mercury* version incorporating the real cannon fire. Here, too, real cannon fire has been utilized and as played through a really big stereophonic system, the results are quite impressive but even with the blandishments of stereo, the *Mercury* cannons still have the greater weight and punch. Add to this the fact that the wild clangour of bells in the *Mercury* version is mild in comparison on this disc. However, apart from these two points the "1812" takes on a breadth and grandeur in the stereophonic process, impossible to achieve even in as good a version as *Mercury* monaural. The directional qualities

were excellent with the heavy and stirring brass nicely balanced against the strings and woodwinds. The "Capriccio Italien" and "Marche Slav" are both stereo spectaculars, and though reproduced from a stereo disc have a very wide dynamic range and abound with much brilliant discussion which will delight the high fidelity enthusiast. The performance by Kenneth Alwyn is straight forward and competent, but hardly inspired. He makes too much of crossing all the "T's" and dotting all the "I's" and is too fussy where he should be fervent. In spite of this, with the over-all excellence of the sound, and the fact that there was little if any diminution in level as compared to the monaural version, this is certainly to be judged one of the most exciting stereophonic discs yet released.

PROKOFIEV
PETER AND THE WOLF
LIEUTENANT KIJE SUITE
Vienna State Opera Orchestra conducted by Mario Rossi. Boris Karloff narrates the first selection. Vanguard Stereolab VSD 2010. Price $5.95.

Yes, you are reading this caption right. It is indeed our erstwhile ghoulish friend Boris Karloff narrating the popular Prokofiev children's piece. And does he scare our little friends? But of course not. As probably many of you know, friend "Frankenstein" off the screen is a gentle man who speaks with an excellent English accent, albeit with a slight lisp, and who is generally regarded as one of the more cultivated men in Hollywood. He affords an easy, well-modulated delivery and indulges in no phony histrionics. His is an appealing version and with the other excellent features of the disc, this is sure to be a popular item. Rossi conducts the work with considerable authority, but for my taste, at least, is a bit on the slow side. The stereo sound is excellent, with good instrumental separation, excellent directional effects, and with no apparent "hole in the middle." On the other side of the disc the good "Lt. Kije" gets taken for his umpteenth outing and although I prefer the recent Reiner version with the Chicago Symphony, this must be judged as a good and successful recording. Here the emphasis is on orchestral sonorities and some of the effects in brass and percussion are quite startling, especially in the stereo medium. Over-all level was down a few decibels from its monaural counterpart, but this is not serious. The disc tracked well and there were no spurious modulations as a result of poor cutting.

LISZT
FOUR HUNGARIAN RHAPSODIES FOR ORCHESTRA
Vienna State Opera Orchestra conducted by Anatole Fistoulari. Vanguard Stereolab SRV 108 SD. Price $2.98.

Vanguard, continuing its policy of producing spectacular demonstration discs, which for advertising purposes they peg at equally spectacular prices, has come up with its first stereo demonstrator. You may not care for such ancient corn balls as the Liszt "Hungarian Rhapsodies", but from a merchandising viewpoint, the use of such war horses is justified. In any case, I think you will be quite surprised how different the "Rhapsodies" can sound when you hear them on a stereophonic system. They are imbued with new life and gusto and it is almost as though you were hearing them for the first time. Fistoulari is a good man for this sort of thing and his readings have plenty of verve and spice. Soundwise, this is big close-up recording with excellent orchestral definition but, at the same time, clever utilization of acoustics have resulted in a very spacious, airy, stereo sound. Instrumental separation was very good, as well as the directional effects; dynamic range was reasonably wide, and

again, the over-all level was only slightly below that of a monaural disc. At the $2.98 price, and with the excellence of the performance and sound, this is sure to be much used for the purpose for which it was intended, namely a good introduction and demonstration of *Vanguard* stereophonic sound.

HAYDN
SYMPHONY NO. 94, 99
Vienna Philharmonic Orchestra conducted by Josef Krips. London Stereo CS-6027. Price $4.98.

This disc will be in refutation to those who say that the music of the classic masters gains very little in the stereo medium. It is true that the larger and more colorful orchestration of the more modern scores certainly is productive of more excitement in stereophonic sound, but after all, there is more to music than mere excitement. In the case of Haydn, we do not have the flamboyance of a lot of brass and percussion, but there is a much more literal recreation of the Haydn orchestra in stereo than there is in monaural. The sense of direction is in no way diminished, the instrumental separation is just as pronounced, and above all, the rounded spacious fullness, the sense of live presence which characterizes an on-the-spot performance, is certainly audibly discernible. The strings and woodwinds which play so important a part in these Haydn scores are exceptionally smooth, beautifully proportioned, and afford a sense of realism never possible in any monaural version I have ever heard. Krips turns in completely sympathetic performances of both symphonies, a bit slower paced, perhaps, than most other versions, but this is all to the good in expositional terms. Each section is given its proper values in relations to the others and the whole is a logical and handsomely wrought musical edifice. As always, Krips manages to elicit superb string playing from the Vienna Philharmonic and we must also acknowledge a debt to the orchestra for the wonderful pure-toned sonority of the woodwinds. If the bulk of stereophonic discs have thus far been a bit too spicy for your particular musical appetite, the quiet beauty of these two Haydn symphonies should prove to you that stereophonic sound can be palatable for all forms of music.

ALBANIZ
IBERIA, NAVARRA
FALLA
THREE CORNERED HAT: DANCES INTERLUDE AND DANCE FROM LA VIDA BREVA
Chicago Symphony Orchestra conducted by Fritz Reiner. Victor Stereo LSC-2230. Price $4.98.

This album is sold under the generic title of "Spain!", and as you can see by the contents, the title is certainly justified. The music is, of course, a natural for stereophonic reproduction with its dazzling orchestral colors. This is virtuoso music and since Reiner has transformed the Chicago Symphony into one of the most virtuoso orchestras now extant, they sail through these difficult scores with consummate ease. Probably the most effective piece here is the "Iberia Suite," with the "En Corpus Christi de Sevilla" a stunning example of the ultra sonorities that can be produced by stereophonic sound. The over-all sound is of the high quality we have come to expect from Reiner and the Chicago group, aided as always by the incomparable acoustics of Chicago's orchestra hall. However, the quality of stereo from this *Victor* disc leaves something to be desired. It is noticeably down in level from its monaural counterpart, and I encountered some of that annoying "swish-swash" modulation which is indicative of cutting difficulties and/or pressing difficulties

with the disc. It is conceivable that this occurred in only a small percentage of the discs and perhaps the copy that you buy will not be so afflicted. If you have a stereo system which is quiet enough to withstand a healthy boost in the volume control, you will find this disc one of the most spectacular examples of stereophonic reproduction.

I wouldn't swear to this, but my own feeling on this is that one can get so enamoured with the fabulous acoustics of Orchestra Hall that there is a tendency to strike out in new musical directions in order to produce these incredible and fascinating sonorities. Having recorded stereo in this hall myself, I can understand this fascination and can only say "Bravo" for this new facet of Reiner and hope that we shall have a great deal more of the same.

BARTOK

CONCERTO FOR ORCHESTRA

Chicago Symphony Orchestra conducted by Fritz Reiner. Victor Stereo LSC-1934. Price $4.98.

Here is more of Fritz Reiner and the Chicago Symphony in stereophonic sound and once again, it is with the type of repertoire that shows off everything to best advantage. Those of you who have had stereo tape machines will remember this as one of *Victor's* very early stereophonic tape releases. Now transferred to stereo disc, it has lost relatively little in the process and must be considered one of the most successful of *Victor's* transfers from their early stereo tape material. This is all the more remarkable because, as far as I know, this recording was made in the old two-channel stereo recording process which the company employed prior to its three-channel "ghosted-image" technique. There is excellent directivity to the sound and in spite of the fact that it is two-channel, the "hole-in-the-middle" problem has been rather well solved. Instrumental separation was excellent and even at that early stage of the stereo game *Victor* had learned to utilize those wonderful Orchestra Hall acoustics to promote an uncanny sensation of depth in their recording.

With the virtuosity of the Chicago players at his bidding, this is an extraordinary musical experience. This stereo disc has a minor deficiency in level and a modicum of some of the other faults that can befall a stereo disc, but all in all, they are not so serious as to bother anyone but the most hypercritical and cranky of audiophiles. No doubt in time there will be better recordings and possibly better performances of this wonderful work, but it will take a mighty strong combination of both to supplant this recording as a very choice item.

—30—

Level Indicator for Hi-Fi

RADIO & TV NEWS LAB TESTED

ONE of the most annoying problems in hi-fi stereo operation is obtaining perfect balance between the left and right channels. This problem is particularly difficult when some of the audio equipment is in one room and the speakers are in another. One would most likely find himself walking back and forth several times before balance is obtained. It isn't a question of obtaining a setting for one record or tape and then assuming that it will hold true for other recordings since balance between channels varies considerably from one tape or disc to another.

Actually any type of a.f. voltmeter can be used across the output terminals of the power amplifiers to solve this problem. However, expensive units are not a necessity. One of the most reasonable on the market today, and one that we have just checked out, is the *Lafayette Radio* Model TM-40. This is an extremely low-cost unit which combines in a single housing two separate meters, each with its own range control. The meters can be used across any voice coil terminals—4, 8 or 16 ohms. Zero db reading on each meter is obtained at 1.2 volts. The range controls, which are basically sensitivity controls, provide means of adjustment should higher output voltages be attained. They also permit the meters to be adjusted for equal readings with equal sound outputs from both speakers. Since balancing is basically the only requirement in this type of installation, absolute accuracy is not important in that only relative level of the two channels is required.

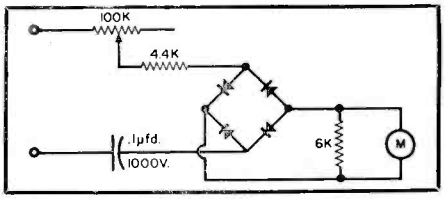
Should one want to make a frequency check of his hi-fi system, the meters should be used with the level control at mid-position. Frequency accuracy is within ±1 db from 30 to 20,000 cps at this point. However, with the level control at maximum position, the accuracy drops off considerably. It is down −10 db at 30 cps.

TM-40 stereo balance meter. Lafayette Radio also has available Model TM-20 which incorporates one instead of two meters. Two of these single units can be used for stereo but by itself it is applicable to monophonic operation, particularly to check recording level.

These meters also have many other applications. They can be used to indicate levels when recording on tape or disc or they can be used to check balance at outputs of preamplifiers, tuners, or even at individual amplifier stages.

—30—

Wiring diagram of the single meter indicator. The stereo unit uses two similar assemblies. Only exception in circuit diagram is that in the stereo unit the 6000 ohm shunt across the meter is omitted.



It's packed with career facts!

SEND FOR THIS

FREE

BOOKLET TODAY

Turn this page

See what the rapidly expanding field of ELECTRONICS offers you

1st Class
Permit No. 288-R
Washington, D. C.

BUSINESS REPLY CARD
No Postage Stamp Necessary If Mailed in United States

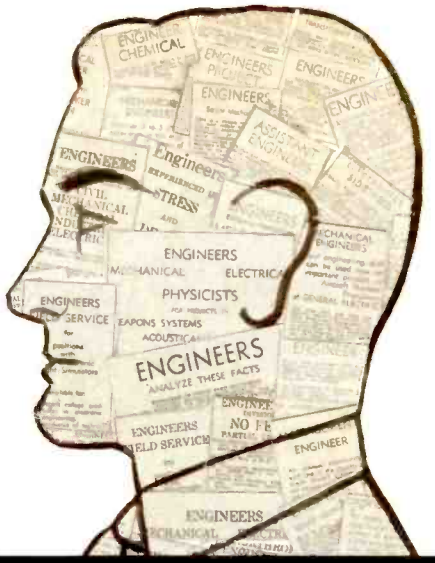
4¢ Postage Will Be Paid By

CAPITOL RADIO ENGINEERING INSTITUTE

CREI

3224 SIXTEENTH STREET, N.W.
WASHINGTON 10, D. C.

IF JOBS LIKE THESE ARE "ON YOUR MIND"...



. . . but you can't qualify because you lack

ADVANCED TECHNICAL KNOWLEDGE . . .

SEND NOW FOR CREI'S NEW FREE BOOKLET

It's crammed with facts and data—containing a time-proved plan to make you ready for the big jobs and a high-salaried career now being offered in

ELECTRONICS—TELEVISION—BROADCASTING—GUIDED MISSILES—INSTRUMENTATION
RADAR—COMPUTERS—AUTOMATION—ASTRONAUTICS—SERVOMECHANISMS
AERONAUTICAL ELECTRONICS—TELEMETERING—COMMUNICATIONS—MANUFACTURING

The want ads above are real ones . . . they appear almost daily in magazines and newspapers—all over the country. They show how desperately the electronics industry needs trained men. On the other hand, they give you a good idea of what opportunities await you—if you get advanced technical training now. And no wonder trained men are needed! Look what's happening in "astronautics," of which the earth satellite is just the most recent, but by no means ultimate example. Computers, Radar, Aeronautical electronics—all are booming—all need trained electronics men. Top manufacturers sold upwards of 13.5 billions of dollars worth of electronic equipment in 1957. By 1965 it's expected the radio-electronics industry will do about 22 billion dollars of business per year.

What do these figures mean to you? They mean that thousands of new electronic jobs have been added to the great, expanding field of electronics.

LITERALLY THOUSANDS ARE NEEDED!

You are needed—for development, research, design, production, testing, inspection, manufacture, broadcasting, telecasting, servicing. But you can qualify only if you take time to advance your knowledge . . . if you take 2 minutes right now to write for the free CREI booklet, with no obligation.

SHORTEST DISTANCE TO A GOOD CAREER IS CREI TRAINING

If you follow the plan outlined in our *free* booklet, you will be in line for promotion and pay increases in short order. Read what these typical CREI graduates have to say:

"In this time of less than two years, I have almost doubled my salary and have gone from wire-man to engineering assistant and now to junior engineer. I have CREI to thank."—Frank A. Eckert, 22 Clover Lane, Levittown, Pa.

"I chose CREI training upon recommendation of two top engineers. Before I completed the course, I became transmitter chief of a 5 kw station. I am now employed as a technician at a 100 kw TV station and in spare time have a good TV sales and service business."—Arlie D. Patton, 203 Burke Ave., San Antonio, Tex.

By method, experience, and personnel—CREI is equipped to teach you what you will need when you translate your study into work. As proof that CREI knows what industry wants, many leading companies recommend CREI training for their own personnel. Among them: All American Cables and Radio, Inc.; Canadian Broadcasting Corporation; Columbia Broadcasting System; Gates Radio Company; Federal Electric Corp.; The Martin Company; Douglas Aircraft Co.; U. S. Information Agency (Voice of America); Canadair Limited; Trans-Canada Air Lines; United Air Lines. Their choice of training for their own personnel is a good cue for your choice of a school.

TOP FIRMS LOOK FOR CREI MEN

A CREI diploma itself is ample proof to many leading companies that a man is worth hiring. Moreover, employers contact us regularly for graduates to fill good jobs. Our placement bureau maintains contact with industry, and cooperates with employers and graduates in making satisfactory placements. This free service is available to students, as well as graduates.

What do you want? To pass FCC exams? Start your own business? CREI has helped others reach these goals, and can help *you*. Or, do you want to go after good-paying electronics jobs, secure, permanent careers like those advertised above? *Whatever* your choice, CREI can help you as it has helped thousands of men—provided you have the ambition to follow the plan.

CREI ALSO OFFERS RESIDENCE TRAINING

CREI Residence School in Washington, D. C. offers training at same high technical level. Classes start at regular intervals. Qualified residence school graduates earn degree: "Associate in Applied Science." Check coupon if you prefer residence study, or Write: Capitol Radio Engineering Institute, 3224 16th St., N. W., Washington 10, D. C. You can qualify for CREI home study training if you have had electronic education, or experience in electronics—and realize the need of a high level technical knowledge to make good in the better electronic jobs. (Electronics experience is not required for admission to CREI Residence School.)

WAR VETERANS

If you are eligible for training under the new G.I. Bill of Rights, check the coupon for full information.

BRAND NEW COURSE: AUTOMATION AND INDUSTRIAL ELECTRONICS ENGINEERING TECHNOLOGY. Complete course, covers all phases of automation. Special emphasis on theory, functioning and applications of servomechanisms and computers. Also noteworthy: Lessons on machine control, instrumentation, data-processing and telemetry.

FREE BOOKLET! MAIL THIS POSTAGE-FREE POST CARD TODAY

CAPITOL RADIO ENGINEERING INSTITUTE
ECPD Accredited Technical Institute Curricula • Founded 1927
3224 16th St., N.W., Washington 10, D. C.

Dept. 111-F
(R. E. Jan. 59)

RG$_2$

Please send me your course outline and FREE illustrated Booklet "Your Future in the New World of Electronics" . . . describing opportunities and CREI home study courses in Electronic Engineering Technology.

CHECK FIELD OF GREATEST INTEREST
- ☐ Radar, Servo and Computer Engineering Technology
- ☐ Electronic Engineering Technology
- ☐ Broadcast (AM, FM, TV) Engineering Technology
- ☐ Television Engineering Technology
- ☐ Aeronautical Electronic Engineering Technology
- ☐ Automation and Industrial Electronics Engineering Technology

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

Street.....

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

Check: ☐ Home Study ☐ Residence School ☐ Korean Veteran

To help us answer your request intelligently, please give the following information:

EMPLOYED BY .....

TYPE OF PRESENT WORK .....

EDUCATION:

YEARS HIGH SCHOOL .....

OTHER .....

ELECTRONICS EXPERIENCE .....

.....

.....

PHOTOPLASTIC SPECIAL DIALS

By **RONALD L. IVES**

A method of "customizing" dials with markings not found on standard dial plates and decals.

IN THE construction of amateur, hi-fi, and special commercial electronic equipment, the need frequently arises for dials with calibrations and markings not found on standard dial plates and decals. This need is commonly met by using a hand-drawn or typewritten dial plate. This is usually neither artistic nor workmanlike and customers often object to the black-line-on-white format which results.

Experience has shown that a white-line-on-black special dial, with a protective cover disc of plastic, looks workmanlike if skillfully made, and meets with customer approval. A method for making these "photoplastic" dials will be outlined here.

Using any good grade of white drawing paper, lay out the dial, to several times the finished scale, using blue pencil for the layout lines that are not to appear on the finished dial and black India ink for line work wanted in the end product. Apply lettering by any desired method. Guided lettering, such as *LeRoy,* is fairly good; stick-up lettering, using any one of the prepared "Trans-Adhesive" letters, such as *Artype, Zip-A-Tone,* or *Monsen* type (obtainable at most artists' supply stores) will usually look better. In a pinch, letters and numbers cut from slick-paper magazine pages and fastened in place with rubber cement, can be used. The appearance of a finished dial pattern is shown in Fig. 1. Layout lines in this diagram have been retouched so that they will reproduce. In actual practice, the blue layout lines "drop out" in copying.

From this dial pattern, make a negative photostat. If the dial is a "one shot" proposition, make the photostat to the desired finished size. If many dials are to be made, or maximum quality is desired, make it the same size as the original. Appearance of the negative photostat is shown in Fig. 2. Note that the guide lines have "dropped out" here because photostat paper sees blue as white. Unwanted lines can be removed from the negative photostat by touching up with black India ink.

When multiple prints are to be made of the same dial, the negative photostat is copied on lithographers' film to final size, producing a photographic negative from which any number of contact prints can be made quickly and cheaply. Prints made on glossy paper and with adequate contrast, have a much better appearance than those made on photostat paper and usually last longer

Fig. 1. The drawing shown below is a finished dial pattern, showing layout lines, which are drawn in blue pencil.

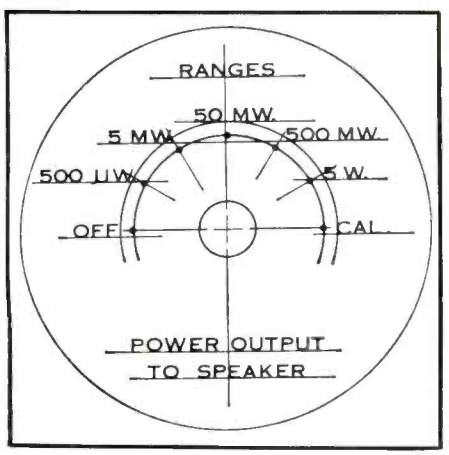
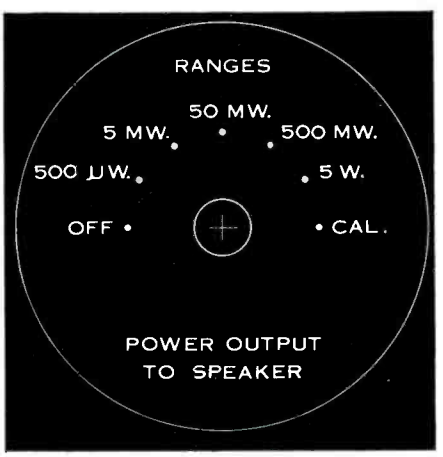


Fig. 2. Negative photostat of original dial pattern. Blue layout lines disappear as they do not photograph.



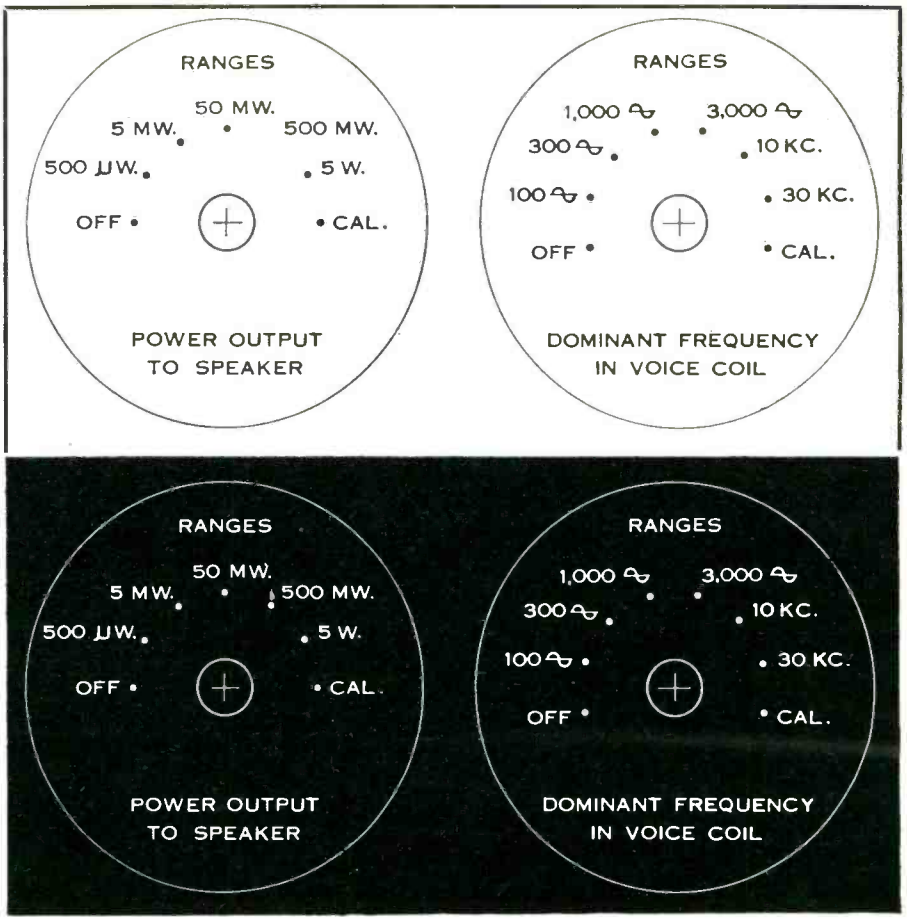


Fig. 3. (Upper section) Kodalith transparency made from a photostat negative of a pair of special dials. (Lower section) Here are the final glossy prints that have been made by means of a contact print from transparency.

(50 or more years as against about 5 years). Appearance of the lithographers' (*Kodalith*) negative and final print for a pair of special dials is shown in Fig. 3.

The protective cover plate for these dials consists of a disc of clear plastic the diameter of the dial, with a center hole large enough to clear the control shaft. Thickness can be anything desired, but from 3/32" to 1/8" works well in practice.

Dials are usually mounted between the panel and the cover plate and held in place by the control center nut. If desired, they may be cemented to the cover plate by use of clarified beeswax, applied while warm (about 130° F.); or by judicious use of polystyrene cement. This latter is somewhat tricky to apply, requiring care to eliminate air bubbles and even more care to prevent smearing cement on the plate face, but gives a seal which should last virtually a lifetime.

The trimmed outer periphery of the dial should be blackened with India ink, to prevent a white line between the cover plate and the panel.

The finished appearance of a special dial made in this manner is shown in Fig. 4. Because of the relative ease with which they can be made; the wide variety of figures, symbols, and captions which can be placed on them; and their workmanlike appearance, photostatic special dials seem to be the answer to the recurrent troublesome problem of "no standard dial plate available." —30—

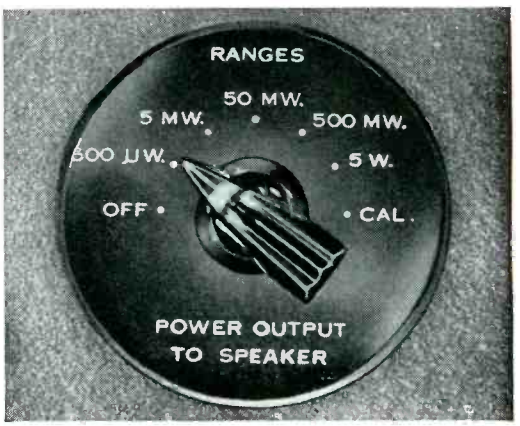


Fig. 4. Finished appearance of a special dial made according to the above description. A protective cover made of a disc of clear plastic is used. A center hole in the plastic disc is made large enough to clear shaft of the operating control.

48¢ ea. for any tube

$45.00 Per Hundred

STANDARD LINE ELECTRIC COMPANY

FREE POSTAGE IN U.S.A. & TERRITORIES

FREE TUBE BRIGHTENER ON ORDERS OF $10.00 OR MORE

ANNOUNCING OUR NEW PRICE SCHEDULE

Effective July 25, 1958 all tubes (Radio & Television receiving) will be sold and shipped at the fantastic price of only .48c ea. or $45.00 per hundred. Any "on hand" orders at that time will receive credit for future purchases.

THE TUBES ADVERTISED HEREIN ARE NOT NECESSARILY NEW TUBES BUT MAY BE ELECTRICALLY PERFECT FACTORY SECONDS OR USED TUBES AND ARE SO MARKED

All TV & Radio Tubes are tested by our supplier under actual conditions in Radio & TV chassis or in Hickock Tube Testers Model 533A.

And, of course, the famous Standard Line guarantee remains in effect: All tubes guaranteed to be replaced free if they fail to function efficiently within one year's time. (defective tubes must be returned intact, postage paid. Refunds will be cheerfully made within five (5) days if not completely satisfied.)

0B2	3AL5	5V6GT	6BE6	6S4	7F7	12Q7	32L7GT
0Z4	3AU6	5W4GT	6BF5	6S8GT	7F8	12SA7	35/51
1A5GT	3AV6	5X4G	6BG6G	6SA7	7G7	12SG7	35A5
1A7GT	3BA6	5X8	6BH6	6SB7Y	7H7	12SJ7	35B5
1B3GT	3BC5	5Y3GT	6BH8	6SC7	7J7	12SK7	35C5
1C5GT	3BE6	5Y4G	6BJ6	6SF5	7K7	12SN7GT	35L6GT
1C6	3BN6	5Z3	6BK5	6SF76SG7	7L7	12SQ7	35W4
1C7	3BU8	5Z4	6BK7	6SH7	7N7	12SR7	35Y4
1H4G	3BY6	6AB	6BL7GT	6SJ7	7Q7	12V6GT	35Z4GT
1H5GT	3BZ6	6AB4	6BN6	6SK7	7R7	12W6GT	35Z5GT
1L6	3C2	6AC7	6BQ6GT	6SL7GT	7S7	12X4	#37
1LA4	3CB6	6AF4	6BQ7	6SN7GT	7V7	12Z3	#39/44
1LA6	3CF6	6AG5	6BR8	6SQ7	7W7	14A7	#41
1LB4	3CS6	6AG7	6BS8	6SR7	7X6	14AF7	#42
1LC5	3DT6	6AH4GT	6BY5G	6T4	7X7	14B6	#43
1LC6	3Q4	6AH6	6BZ6	6T8	7Y4	14F7	#45
1LH4	3Q5GT	6AK5	6BZ7	6U4GT	7Z4	14F8	#47
1LN5	3S4	6AK6	6C4	6U5	8AW8	14H7	50A5
1N5GT	3V4	6AL5	6C5	6U8	12A8	14N7	50B5
1P5GT	4BC8	6AL7GT	6CB5	6V3	12AB5	14Q7	50C5
1Q5GT	4BQ7A	6AM8	6CB6	6V6GT	12AQ5	14S7	50C6G
1R5	4BS8	6AN8	6CD6G	6W4GT	12AT6	17AX4GT	50L6GT
1S5	4BU8	6AQ5	6CF6	6W6GT	12AT7	17DQ6	50Y6
1T4	4BZ7	6AQ6	6CG7	6X4	12AU6	19AU4	50Y7
1T5GT	4CB6	6AQ7GT	6CG8	6X5GT	12AU7	19BG6G	#57
1U4	5AM8	6AR5	6CH8	6X8	12AV6	19C8	#58
1U5	5AN8	6AS5	6CL6	6Y6G	12AV7	19J6	#80
1V	5AQ5	6AS8	6CM6	7A4	12AX4GT	19T8	#81
1V2	5AS8	6AT6	6CM7	7A5	12AX7	19X8	117L7GT
1X2	5AT8	6AU4GT	6CN7	7A6	12AZ7	25AC5	117N7GT
2A3	5AV8	6AU5GT	6CU6	7A7	12B4	25AV5GT	117P7GT
2A5	5AW4	6AU6	6DG6	7A8	12BA6	25AX4GT	117Z3
2A7	5AZ4	6AU8	6DQ6	7B4	12BE6	25BK5	117Z4GT
2AF4A	5BK7	6AV5GT	6DT6	7B5	12BF6	25BQ6	117Z6GT
2B7	5BR8	6AV6	6E5	7B6	12BH7	25CD6G	807
2BN4	5BQ7	6AW8	6H6	7B7	12BK5	25CU6	9002
2D21	5BZ7	6AX4GT	6J4	7B8	12BQ6	25L6GT	9003
2E5	5CG8	6AX5GT	6J5	7C4	12BR7	25W4GT	9006
2X2A	5J6	6AZ8	6J6	7C5	12CA5	25Z5	
3A2	5T8	6BA6	6K6GT	7C6	12CU6	25Z6	
3A3	5U8	6BC5	6K7	7C7	12DQ6	#27	
3A4	5U4G	6BC8	6L6	7E6	12J5	#30	
3A5	5V4G	6BD6	6L7	7E7	12L6GT	#31	

ALL RECEIVING TUBES SENT POSTAGE PAID.

Please send 25c handling for orders under $5.00 Send 25% deposit on C.O.D. orders and please send approximate postage on Canadian and foreign orders.

Above is only a partial list — order any type at the same price or send for free tube list and order blank. We have over 5,000 tube types on hand or at easy access, including special purpose, industrial and transmitting tubes which are slightly higher.

ALL TUBES GUARANTEED ONE FULL YEAR...

NOTE: When ordering receiving tubes be sure to enclose 48c for each tube or $45.00 per hundred.

Thousands of TRADE-IN TVs

Please Specify Console or Table Model When Ordering
Reconditioned By Factory Trained Technicians! Guaranteed To Be In Working Condition When You Receive Them!

10"	$25.00	19"	$56.00
12"	$30.00	20"	$63.00
14"	$35.00	21"	$70.00
16"	$42.00	24" (when available)	$95.00
17"	$49.00	27"	$129.00

Get yourself a second set or buy some for re-sale!

All TVs sent motor freight or Railway Express F.O.B. our warehouse. Sorry, no A.P.O. shipments.
FREE INDOOR ANTENNA with each TV Purchase

below is our new price schedule of pix tubes. These famous make tubes contain all new parts with the exception of the glass bulb which does not wear out.

Any 10" Tube	$ 9.95	Any 16" Tube	15.95
Any 12" Tube	10.95	Any 17" Tube	18.29
Any 14" Tube	13.95	Any 19" Tube	20.29
		Any 21" Tube	24.29

Prices On Larger Tubes On Request

Remember
Only 48¢ ea.
$45 Per Hundred
ANY TYPE
ANY QUANTITY

Remember — NO Dud Required.
All tubes guaranteed one year.
Picture Tubes shipped F.O.B. Harrison, N. J.

STANDARD LINE ELECTRIC COMPANY

432 HARRISON AVENUE, HARRISON, N. J. - Phone: HUmboldt 4-4997

New Tube Tester Data

These new test readings will help you keep the roll chart of your EICO tube checker up to date.

EICO MODEL 625 **

Tube	Shunt	Fil.	Sel.	Up	Down
1AF5	100	1.4	1	3	1
1AF5	25	1.4	1	4,5,6	1
		(Good = 100)			
1DN5	20	1.4	1	2,3,6	1
1DN5	55	1.4	1	4	1
1G3	69	1.4	4	10	2
1J3	100	1.4	4	10	2
		(Good = 200)			
1K3	100	1.4	4	10	2
		(Good = 200)			
2CY5	25	2.5	3	1,5	2,4,7
2E26	22	6.3	3	3,5,10	1,2,4,6
3AF4	24	3.3	2	1,2,6,7	3,5
3BN4	25	2.5	2	2,5,7	1,3,6
3CY5	20	3.3	3	1,5	2,4,7
3DK6	24	3.3	2	1,5	2,3,6,7
4AU6	26	3.3	2	1,2,5,6	3,7
4BN6	100	5.0	1	2,5,6,7	1,3
		(Good = 500)			
4BU8	25	3.3	2	2,7,8	1,4,9
4BU8	25	3.3	2	2,3,7	1,4,9
4CB6	24	5.0	2	1,5,6,7	2,3
4DT6	15	3.3	1	1,5,6	2,3,7
5BT8	26	5.0	2	6,8	4,7,9
5BT8	48	5.0	2	1	3,4
5BT8	48	5.0	2	2	3,4
5CL8	22	5.0	2	1,2	4,3
5CL8	22	5.0	2	6,7,9	4,8
5CM8	15	5.0	1	2,6,7	3,4
5CM8	15	5.0	1	1,9	4,8
5CQ8	14	5.0	1	1,9	4,8
5CQ8	14	5.0	1	2,3,6	4,7
5CR8	24	5.0	2	2,6,7	3,4,8
5CR8	26	5.0	2	1,9	4,8
5CZ5	35	5.0	1	1,9	3,4,6,7
5DH8	24	5.0	2	1,2	3,4
5DH8	24	5.0	2	6,7,9	3,4,8
6BN7	30	6.3	2	1,2	3,4
6BN7	23	6.3	2	7,9	4,6
6BW8	25	6.3	2	6,9	4,7
6BW8	25	6.3	2	1	2,4
6BW8	25	6.3	2	5	2,4
6BY8	26	6.3	2	1,7,8	2,3,4,9
6BY8	15	6.3	1	6	3,4
6BZ8	24	6.3	2	1,2	3,4
6BZ8	24	6.3	2	6,7	4,8
6CL5	20	6.3	3	1,4,5,8,10	2,3,6
6CL8	17	6.3	3	1,2	3,4
6CL8	23	6.3	2	6,7,9	4,8
6CM8	15	6.3	1	2,6,7	3,4
6CM8	15	6.3	1	1,9	4,8
6CN7*	29	3.3	3	7,8	4,5,6
6CN7*	14	3.3	1	2	3,4,5
6CN7*	14	3.3	1	1	3,4,5
6CQ8	15	6.3	1	1,9	4,8
6CQ8	15	6.3	1	2,3,6	4,7
6CR8	25	6.3	2	2,6,7	3,4,8
6CR8	25	6.3	2	1,9	4,8
6CU8	25	6.3	2	2,3,7	4,6
6CU8	25	6.3	2	8,9	1,4
6CX8	27	6.3	2	2,3	1,4
6CX8	20	6.3	3	7,9	4,6,8
6CY5	25	6.3	3	1,5	2,4,7
6CY7	15	6.3	1	1	4,9
6CY7	15	6.3	1	6,7	4,8
6CZ5	35	6.3	1	1,9	3,4,6,7
6DA4	20	6.3	3	5	3,7
6DB5	25	6.3	3	3,6,9	2,4,7
6DE7	20	6.3	3	6,7	4,8
6DE7	23	6.3	3	1,2,3	4,9
6DG6	26	6.3	2	3,4,5	2,8
6DK6	15	6.3	1	1,5,6	2,3
6DQ5	45	6.3	3	4,8,10*	1,2,3,5,6*
6DS5	38	6.3	1	5,6	1,2,3,7
6DT8	45	6.3	1	1	2,3,4
6DT8	45	6.3	1	6	4,7,8
6EA8	19	6.3	3	1,9	4,8
6EA8	19	6.3	3	2,3,6	4,7
8AU8	26	7.5	2	2,3	1,4
8AU8	17	7.5	3	7,8,9	4,6
8BN8	15	7.5	1	7,8	4,9
8BN8	15	7.5	1	1	2,4
8BN8	15	7.5	1	6	3,4
8CG7	29	7.5	2	1,2	3,4
8CG7	29	7.5	2	6,7	4,8
8CM7	25	7.5	2	1,8	9,4
8CM7	29	7.5	3	6,7	3,4
8CN7	21	7.5	1	1,2	9
8CN7	25	7.5	1	7,8	9
8CX8	27	7.5	2	2,3	1,4
8CX8	20	7.5	3	7,9	4,6,8
8SN7	30	7.5	2	1,2	3,7
8SN7	30	7.5	2	4,5	6,7
10C8	30	7.5	2	6,7,8	4,9
10C8	25	7.5	2	1,2	3,4
10DE7	30	7.5	3	6,7	4,8
10DE7	25	7.5	3	1,2,3	4,9
11CY7	17	7.5	1	1	4,9
11CY7	17	7.5	1	6,7	4,8
12AE7	19	*6.3	3	1,2	3,9
12AE7	19	*6.3	3	6,7	8,9
12AL8	27	12.6	3	2,6	4,7
12AL8	33	12.6	2	1,8	4,9
12BL6	15	12.6	1	1,5,6	2,3,7

* Center-Tapped Filament.

** Complete up-to-date roll charts are now available for EICO tube testers 625 (chart 625-06) and 666 (chart 666-03). For further information, write directly to Electronic Instrument Company, 33-00 Northern Boulevard, Long Island City 1, New York.

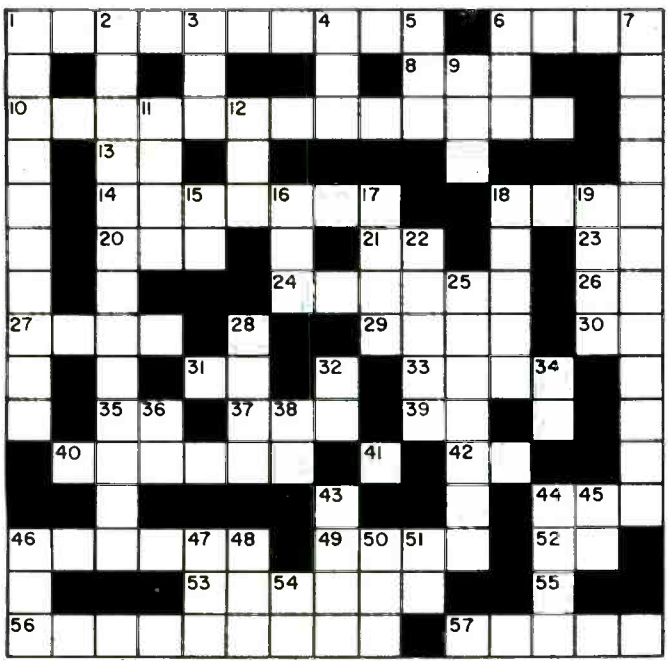
Electronic Terminology

By JOHN J. GILL

HERE'S another chance to try your hand at solving a puzzle while the coil dope dries! All of these terms should be thoroughly familiar to the practicing technician so try whipping through this. If you run into any snags, the answer can be found on page 156.

ACROSS
1. Bridge for measuring resistance.
6. A hot cathode will ——— electrons.
8. Beam, as in CR tube.
10. Coil with strong field.
13. Element No. 27. (Abbr.)
14. The higher audio frequencies.
18. Electron stream.
20. No. 2 in color code.
21. North Dakota. (Abbr.)
23. Relaxation oscillator. (Abbr.)
24. Seventh word in phonetic alphabet.
26. Type of circuit. (Abbr.)
27. Code sign.
29. Metallic conductor.
30. Look.
31. Fifty-one (Roman Numeral).
33. I saw (Latin).
35. Type of modulation.
37. Federal radio-TV regulatory body. (Abbr.)
39. Electrodynamic. (Abbr.)
40. Broadcasting room.
42. Direct current. (Abbr.)
44. Control on color TV.
46. Resistance box.
49. ——— distance.
52. One of the baseball leagues. (Abbr.)
53. Reply to call.
55. Inductance (symbol).
56. Sends back information from satellite.
57. Not c.w.

DOWN
1. Used for measuring dielectric losses.
2. Type of speaker.
3. Carbon tetrachloride (slang).
4. Unit of resistance.
5. Unit of energy.
6. Tuning indicator.
7. A temperature determining device.
9. Signal interceptor. (Abbr.)
11. Center of transformer.
12. Part of airplane wing.
15. Electrodynamic. (Abbr.)
16. A list of radio stations.
17. Denotes weak signal on TV.
18. To discharge filter capacitors through a resistor.
19. Ham organization. (Abbr.)
22. Voltage fed to output stage.
25. Meter for checking frequency.
28. Wide-range reproduction.
32. Not d.c.
34. Frequency used in superhet. (Abbr.)
36. Amplification factor.
38. Business organization. (Abbr.)
41. Current (symbol).
43. Measure of loss due to mismatch of impedance in line.
44. Undesirable effect in TV pic.
45. Electronic equipment testing group. (Abbr.)
46. Another code sign.
47. River retainer.
48. Point of compass. (Abbr.)
50. Code sending device.
51. E = ———.
54. Not a sinner. (Abbr.)

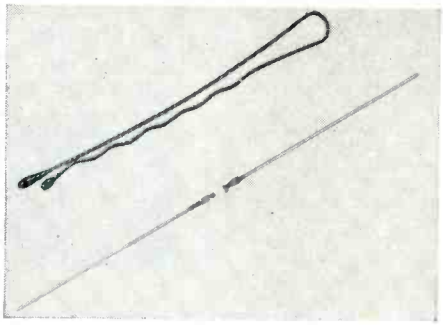


What's New in Radio

POINT-CONTACT DIODES

Erie Resistor Corp. of Erie, Pa. has announced a new line of miniature germanium point-contact diodes which has been especially developed for general purpose and computer applications.

The new units are encapsulated in hermetically sealed glass cases measuring .265 inch long by .105 inch diam-



eter with a minimum lead length of 1¼ inches. The units are color coded in accordance with EIA standards.

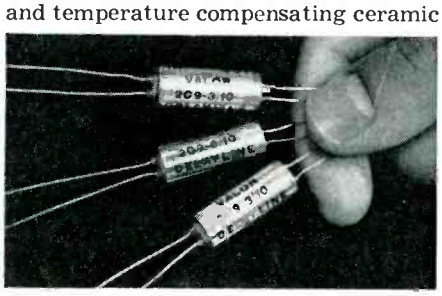
The general-purpose diodes feature high electrical stability and outstanding recovery characteristics while the computer types offer superior temperature characteristics in addition to these features, according to the company.

For full details on these eleven new miniature point-contact diodes, write the manufacturer direct.

SUBMINIATURE DELAY LINES

Valor Instruments, Inc., 13214 Crenshaw Blvd., Gardena, California is currently offering a new line of seven precision lumped-constant delay lines which are suitable for transistor and printed-circuit applications.

These delay lines consist of subminiature powdered-iron toroidal inductors and temperature compensating ceramic



disc capacitors in a lumped-constant configuration which is phase- and frequency-compensated for optimum pulse response.

The units are packaged in a 1" x .4" metal tube with glass-to-metal end seals to bring out the pigtail-type leads. The seven units in the series provide characteristics ranging from .1 microsecond delay at .03 μsec. rise, and 500 ohms impedance; to .7 μsec. delay, .23 μsec. rise, and 1600 ohms impedance. The entire group of seven delay lines is available in kit form.

Write the manufacturer for any additional information required.

"CONDUCT-A-LITE"

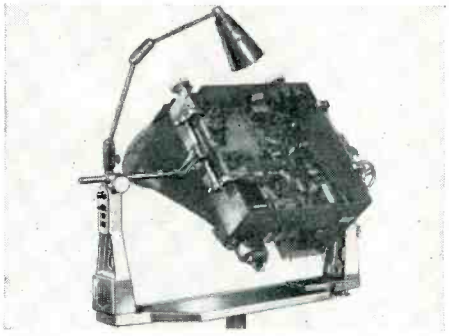
Yates Manufacturing Co., 340 W. Huron St., Chicago 10, Ill. has just introduced a new instrument especially developed for the service technician and others who work with electronic equipment.

The unit consists of a 6" conductor rod, a 4" curved conductor section, a $1\frac{5}{16}$" clip-on mirror (similar to a dental mirror), and a 2-cell "Conduct-A-Lite." The entire instrument is housed in a shirt-pocket-sized plastic kit and is powered by two standard penlite batteries.

It can be used for the inspection of recessed surfaces, cavities, tubes, and the underside of component parts in a chassis. For full details on this service tool, write the manufacturer direct for information and prices.

"TEL-A-TURN"

Rogers Manufacturing Company, 214 S. Main St., Lindsey, Ohio is now mar-



keting a new TV service cradle—the "Tel-A-Turn."

Designed by a practicing service technician to speed troubleshooting and repair jobs, the new device will hold popular size chassis measuring from 9" to 25". Full rotation and locking in any position are additional features of the device.

The unit includes a switch with indicator light on a cheater cord for safety and easy energizing and de-energizing of work. An adjustable swivel lamp permits direct lighting of the section being serviced. There is a built-in PM speaker with clipped leads to eliminate speaker removal from the customer's set.

The entire cradle moves on 2½" ball-bearing, rubber casters for noiseless mobility.

The manufacturer will supply a

colorful data sheet on this device to those making a direct request.

"CITIZENS BANDER"

International Crystal Manufacturing Co. of Oklahoma City, Okla., is now marketing a 27 mc. transmitter-receiver for operation in the new Citizens band.

The "Citizens Bander" meets all FCC requirements for equipment operating in this band. It is crystal-controlled with a tolerance of .005% and a maximum input of 5 watts. In addition, it has a double conversion superhet receiver and is operable on 115 volt a.c. It is also available for 6- or 12-volt d.c. operation. It can cover all 22 channels in the new Citizens Band and has a full 2-watt low-distortion audio output.

Range of the new unit is up to ten miles. License is granted without examination or code test. Form 505, properly executed and forwarded to the FCC in Washington, will produce the necessary authorization.

COIL WINDING MACHINES

Industrial Winding Machinery Corporation, Suite 3410, 120 Wall St., New York 5, N. Y. is now offering a line of coil winding machines manufactured by *Willy Aumann* and imported from West Germany.

Among the units being offered is the Model WG 300 which is designed for single or multiple winding. Continuous adjustment of traverse pitch from .002" to .049" is available in two stages with the machine running or at rest. The wire can be positioned by a roller button or by a fork guide depending on the gauge of the wire being wound. The support for the wire guides moves in a sintered metal bearing and is of substantial cross-section to prevent any vibration which might lead to uneven winding.

The standard machine is designed for a maximum traverse width of 4.92" which has been found adequate for most normal requirements. Longer windings are available on special order. Winding speeds of 6500 and 3800 rpm; 1500, 750, and 350 rpm; 3750, 2700, 1200, and 850 rpm; and 3750, 2700, 750, and 350 rpm are available, all infinitely variable. Layer winding assemblies range from .0006" to .004" diameter minimum to .006" to .079" diameter maximum.

For a data sheet on the Model WG 300 or other units in this line, write the U. S. distributor direct, outlining your coil winding requirements.

REPLACEMENT "PEC'S"

Centralab, a division of *Globe-Union, Inc.,* 900 E. Keefe, Milwaukee 1, Wis., has announced the availability of eight new "PEC" packaged circuits for re-

placement applications in *Philco, RCA, Motorola, Packard Bell,* and *G-E* sets.

Full information on the new units, PC-336 through PC-343, is included in the company's Bulletin No. 42-578, which is currently available from distributors or the manufacturer direct.

HIGH CURRENT RECTIFIERS

International Rectifier Corporation, 1521 E. Grand Ave., El Segundo, Calif., is now offering a new silicon radio-TV rectifier which features forward current ratings up to 750 ma. to meet the requirements of TV sets having higher than 500 ma. rectification needs.

Featuring eyelet construction, the new "Unistac TV-500" eliminates the need for special sockets, drilling, or conversion kits. To provide optimum reliability at elevated temperatures, the unit employs a silicon diode mounted on a finned heat exchanger designed to assure maximum convection cooling.

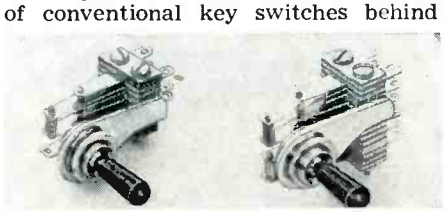
One of these units in a half-wave circuit will deliver 750 ma. and 130 volts d.c. with an input voltage of 117 volts r.m.s. Two units in a half-wave voltage doubler circuit will deliver 750 ma. and 240 volts d.c. with an input voltage of 117 volts r.m.s.

The new rectifier is now available at parts distributors throughout the country.

SHALLOW LEVER SWITCH

Switchcraft, Inc., 5555 N. Elston Ave., Chicago 30, Ill., has added a new series to its line of lever-action switches.

The Series 12000, small in size, is mounted by means of a single fastener and requires only one-fourth the depth of conventional key switches behind the panel. The new "Lev-R" switches are available in 2- and 3-position types, locking and non-locking, and a 3-position type, locking one side and non-lock other side.



Features include relatively long springs without any "forms" at point of flexing to insure suitable spring action for long life; soft, easy action with real detent "feel" on locking types; springs assembled into a conventional stack assembly and insulated from each other; silver contacts rated at 3 amps, non-inductive load. Palladium contacts for low-current, low-voltage applications and special circuits are also available.

ATR'S UNIVERSAL INVERTER

American Television & Radio Co. is now offering a new "universal" inverter which will operate from 6- or 12-volt car batteries, a boat storage battery, or a home electric plant.

Especially designed to operate standard 60-cycle a.c. tape recorders, television sets, dictating machines, p.a. systems, record players, electric razors, and various household appliances, this new *ATR* line is available in output wattages ranging from 80 to 600 watts.

In addition, the new units are completely shielded to eliminate r.f. interference, are instant starting, provide frequency stability, and include a built-in power factor corrector utilizing a simple toggle switch.

Complete descriptive material on this new line is available from the company at 300 E. 4th Street, St. Paul 1, Minn.

REPLACEMENT RECTIFIERS

The Semiconductor Products Department of *General Electric Company,* Syracuse, N. Y., has revised its line of snap-in germanium rectifiers to permit their direct substitution for selenium rectifiers in television sets.

This new development permits one 400 ma. half-wave rectifier (1N1008) and one 400 ma. double rectifier (1N1016) to supplant the entire line of five replacement types. This germanium TV rectifier line was revised to help technicians reduce the number of electronic components which must be carried on service calls.

Both units deliver 400 ma. d.c. output current into a load at 70 degrees C or 158 degrees F. Both are rated at a peak inverse voltage of 380 volts and an r.m.s. input voltage of 130 volts. Neither device need be derated since there is a complete absence of aging characteristics.

TRANSITRON'S "REF-AMP"

Transitron Electronic Corporation, Wakefield, Mass., has developed a new device which combines, in a single package, a voltage reference zener diode and an amplifying transistor.

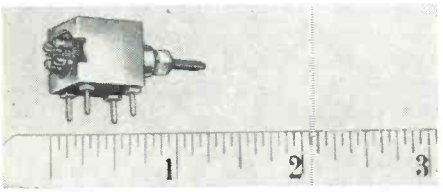
Known as the "Ref-Amp," this unit provides a combined temperature coefficient as low as .002% per degree C over a temperature range of —55 degrees C to +100 degrees C. Regulator circuits, normally requiring ten or more components, may now be designed with only one transistor, one "Ref-Amp," and four resistors.

According to the company, this reduction in components increases reliability, doubles loop gain, and reduces

space requirements. The package is engineered for chassis or printed circuit mounting in any position. Detailed technical design data is contained in Bulletin TE-1352, which will be supplied on request.

SHIELDED COIL FORM

Cambridge Thermionic Corporation, 445 Concord Ave., Cambridge 38, Mass., is now in production on a new horizontally mounted r.f. shielded coil form that is ideally suited for printed circuit work.



The new unit is a completely shielded coil form assembly using internal powdered iron components of unique design. It is ideal for i.f. strip work where ease of tuning, compactness, and dependability under rigorous service conditions are required, according to the company.

The assembly can be chassis mounted for conventional circuitry by means of a #2-56 screw or it can be mounted for printed circuit wiring by four pins. Required mounting holes are on .400" by .300" centers. The mounted assembly is ½" wide by ½" high. A positive compression-type tuning core lock is provided.

Currently the coil forms are available in three materials: paper base phenolic for the coil winding (#2560), "Polypenco" (#2561), and "Kel-F" for coil winding (#2562). The company will supply complete data on request.

DUAL-HEAT SOLDERING GUN

Weller Electric Corporation, Easton, Pa., has introduced a new dual-heat soldering gun kit which is of special interest to service technicians.

The new unit has "Triggermatic" control which provides 90 watts in the first trigger position and 125 watts in the second position. Also included are a pre-focussed spotlight and a newly designed copper, iron-plated tip which is said to give greater heat transfer and longer life.

The kit comes completes with gun, a supply of solder, a brush for cleaning connections, and one of the firm's soldering aids. Model 8200K is now available at distributors, craft shops, and hardware outlets.

PHONE PATCH

Raypar Incorporated, 7800 W. Addison St., Chicago 34, Ill., has recently introduced a new device for patching a telephone line into a radio transmit-receive system so that two-way conversation is afforded between the telephoned party and a remote station.

The Model TE-1 employs a hybrid transformer in a balanced-bridge circuit to permit automatic voice control of the transmit-receive functions. It is easily attached to popular communication equipment by means of their external connections.

Complete details on the new phone patch are included in Bulletin TE-558-10 which is available from leading distributors or from the manufacturer direct.

SENSITIVE MIDGET RELAY

Kurman Electric Co., 191 Newel St., Brooklyn 22, N. Y., is now offering the Series 23D low-cost, dust-protected midget relay to the trade.

This lightweight unit is designed especially for plate circuit, photoelectric, and remote control applications where space economy and current drain are major design criteria. Sensitivity is as low as 6 mw., s.p.d.t., with a maximum coil dissipation of 2¼ watts. Contacts can carry 2-amps, 115-volt a.c. or 28-volt d.c. Some of the features of this relay include adjustable contacts, high-speed operation (down to 1 millisecond), and high-speed keying. Coils can be wound up to 13,000 ohms for a.c. or d.c.

The company will supply further details as required. —30—

Service Industry News

EFFORTS to order our own lives will characterize us all as long as we are members of the human race. However, an outside event comes along every once in a while to remind us that we must also do some adjusting to our environment. With the service industry still divided on what to do about test-them-yourself, drug-store tube checkers, just such an outside event may strengthen the arguments of those whose stand is: "If you can't beat 'em, join 'em."

Raytheon Manufacturing Co. recently announced its Tube Mart, which is planned for the service dealer. It consists of a combined tube tester, to be operated by the set owner himself, and a tube rack. Tube Marts are designed to be placed in any type of location, but only under the control of legitimate service dealers. They will be available to such dealers through regular *Raytheon* distributors. There is space on each Tube Mart for dealer-imprinted leaflets that direct tube purchasers to him for service required beyond simple tube replacement. In addition to the promotional value, it is hoped that dealer control of these testers will put back in his pockets the profits he has been losing on tube sales through purely non-technical outlets.

The adoption of this technique for selling tubes by even this single manufacturer could have considerable impact on service-industry attitudes toward self-testers. In addition, we have learned that other leading tube makers are considering programs similar to the *Raytheon* plan. Many of them are concerned with the fact that uncontrolled testers of the sort now in use are being employed to market tubes of questionable quality. They hope to win the support of the service industry in keeping the public oriented toward name-brand tubes.

New State Group

A new star recently took its place in the constellation of statewide service associations. Preliminary steps were taken recently to form the North Carolina Federation of Electronic Associations which is to be incorporated as a not-for-profit organization.

At the organizational meeting held in Greensboro, N. C., Garland Hoke, president of the Durham association, was elected president of the NCFEA; Joe Woods of the Greensboro group was named vice president; Charles Mac Broom of the Durham association was selected to serve as secretary; and Edmund Barbour of the Fayetteville local was elected treasurer. Elected directors included: Ken LaRue of Charlotte, Herbert H. Griffin of Lenoir, and R. B. Corn of Raleigh. Present address of the NCFEA is: Garland E. Hoke, President, P. O. Box 222, East Durham Station, Durham, N. C.

The Big IDEA

The annual convention of the Indiana Electronic Service Association, held early in the fall, brought together an imposing group of service-association leaders from many sections of the country. The three-day affair was climaxed by a short meeting of the directors of the Midwest Electronic Alliance followed by an all-day, informal discussion of national service problems and possible solutions.

The purpose of the informal conference, which drew association leaders from many parts of the country, was to hear the details of a proposed plan developed jointly by the Texas Electronics Association and the Television Service Association of Michigan. The program presented at the Indianapolis meeting is to be handled by a representative group of association officers and called the Committee for Independent Dealers' Electronic Activities (IDEA). It was especially emphasized that the informal cooperation that will occur in this new development is not intended to serve as a vehicle for the formation of another national service association.

In explaining the purpose of IDEA, Karl Heinzman, president of TSA of Michigan and a member of the committee, said:

"The service dealer must be recognized as an important small businessman and, as such, he should have a voice in the very things that affect his destiny.

"The mushrooming of set manufacturers' service facilities across the country, together with parts warranties and 'free service policies,' and, in many cases, open attacks against the local independents by the set manufacturers, are producing near-irreparable harm to the business of the independent service dealer.

"With the rapid growth of the service industry, it is now essential to have better communications between the manufacturer and the independent service dealer. More than ever before, the independent service dealer is in need of a spokesman to present his side of the picture to the manufacturer, the public, and the legislatures, both state and federal.

"IDEA is and will function as a committee—not as an association—empowered to speak for state and local independent associations and represent the

service dealer on a united, national front."

It is felt by members of the committee that there now are more than 30,000 full-time service businesses in operation across the country, each with an investment of at least $10,000. In addition, there is believed to be another forty thousand or more servicing dealers and competent part-timers whose investments are less than that. The steady down-grading of the independent service dealer's required price structure through manufacturers' "free service" deals and other sales gimmicks is placing these investments in serious jeopardy, it is claimed.

Emphasizing that the IDEA is not now nor intended to become a national association, the acting chairman, Tilman Babb of *Wilshire Television*, Dallas, Texas, and an official in the Texas Electronics Association, pointed out that the IDEA program would fail if it is permitted to get entangled with association politics. He said it is designed to be, and must be, a *team* effort in which individual service dealers can participate along with national, state, and local associations, for the sake of united action on an important issue.

"The independent service dealer is now fighting with his back to the wall," Mr. Babb said. The objectives of IDEA are simple, straightforward, right to the point. Those objectives are to put the brakes on all forces that are undermining the independent service industry. Associations are mighty important in helping to create a healthy business atmosphere for service dealers in the local communities where our businesses are located. IDEA will not encroach on the prerogatives of service associations at any level—local, state or national. IDEA is a program in which every service dealer can freely cooperate, regardless of his association affiliations, because it will be fighting against the forces that are subtly undermining his business."

Association officials who participated in the informal discussions at the Indianapolis meeting included Horace Childers, Tilman Babb, and Marvin Tappe of the Texas Electronics Association; Karl Heinzman, Harold Chase, Jack Barton, and Pat Laforet, of the Television Service Association of Michigan; Vincent Lutz and Frank J. Moch of NATESA; Robert Steer of the Television Service Association (TELSA) of Connecticut; John Hemak of the Minnesota Television Service Engineers; Carl Stallfus and Vern LaPlante of the Electronic Technicians Association of Toledo; Howard Wolfson of the Associated Radio & Television Servicemen of Chicago; John Graham of the ARTSD News of Columbus, O.; W. C. Pecht, of TEAM, St. Louis, Mo.; Charles A. Conwell, Frank Teskey, and Robert A. Sickels of the Indiana Electronic Service Association.

In the wake of the meeting in the capital city of Indiana and the formation of the IDEA Committee, it is said that there has been a rapid spread of

support across the country for the IDEA program. In the light of this enthusiastic response, the Committee announced plans to hold a meeting in some mid-western city in the late fall for the purpose of mapping out a program to cut down the role of TV manufacturers in set servicing. In the meantime, the committee conducted another meeting in New York City. Additional facts made available at this time included the point that, with interest in IDEA still growing, 22 service organizations representing about 3000 service dealers have already pledged participation. The basic program will be built around improving industry relations, public relations, and legislative relations. To obtain recognition of the large and respectable service industry, IDEA must be sold to the public, as well as to the industry itself.

The address of the IDEA Committee is: Tilman Babb, Acting Chairman, Committee for the IDEA, 6114 Mockingbird Lane, Dallas, Texas.

Manufacturers' Service

Resentment against set manufacturers' expanding participation in the consumer service field through inboard service and extended parts warranties, was reflected in condemnatory resolutions and retaliatory programs adopted by associations in widely scattered sections of the country. Delegates representing fifteen chapters of the Federation of Radio-Television Service Associations of Pennsylvania, recently gave their unanimous approval to a program designed to sell service in situations where normally they would recommend the purchase of a new set. The theme of the FRTSAP program is—"Don't be a salesman for a new TV set—sell service, sell yourself."

The Radio & Television Association of Santa Clara Valley, Room 467A Porter Building, San Jose, Cal., recently mailed a letter of protest against "unrealistic service allowances on warranties" to all major TV set manufacturers. Distributors serving the area also received copies of the letter along with an urgent request to back the association stand because "it is unfair for the manufacturer to maneuver any group into a position where they are expected to make good on claims over which they have no control, without full compensation.

"We have no quarrel with the responsible manufacturer's warranty supported by a workable allowance," the letter stated in part. "But since the independent service shop has no hand in factory quality control, we cannot help but feel warranties and attendant costs are the full responsibility of the manufacturer involved."

The Electronic Association of Missouri, 4134 Easton, St. Louis 13, Mo., passed a resolution at a recent meeting to the effect that members of TEAM shall not be obligated to honor any parts or labor warranty which exceeds the standard RETMA 90-day term on parts and one-year warranty on picture tubes. —30—

FM Multiplex

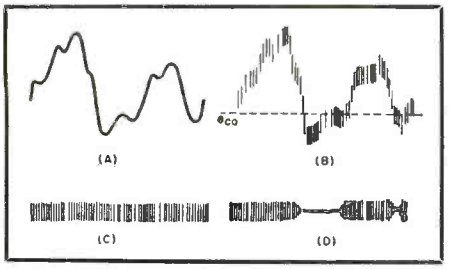
(*Continued from page 59*)

transmission. Appropriate muting circuits (of the squelch type) in the subscriber's receiver may then eliminate any random noise components which might become apparent during these periods.

The last mentioned point represents the second important consideration with regard to crosstalk from the simplex channel into the multiplex channel. While crosstalk may seem to be an important factor in the multiplex transmissions where the information being broadcast on the two channels is not related, this problem becomes less significant in the case of stereophonic broadcasts. Since the material on both the simplex and multiplex channels is closely related, both harmonically and rhythmically, one can tolerate a far greater amount of crosstalk between channels without seriously impairing the usefulness of the transmission. One possible alternative to the problem of retaining the marketability of presently operating multiplex services has been the proposal that stereo transmissions be made with an AM subcarrier rather than with the FM subcarrier method now authorized in the SCA band. This restriction would then guarantee that commercial programming would not be received in any useful form by the home listener with an AM stereo multiplex adapter.

With respect to the cross modulation picture in general, it may be said that practical operation of FM stations with non-related primary and secondary channel services has given indication that the −60 db main-channel interference limitation is readily achieved with subcarrier deviations under ±10 kc. at 15% main-carrier modulation by the subcarrier. As far as the multiplex channel itself is concerned, the empirical results seem to be somewhat less favorable in many cases. Crosstalk from the main channel into the secondary channel may average around 40 db below maximum output level of

Fig. 5. Illustrating separation of simplex audio and subcarrier information in the multiplex adapter. (A) shows an audio signal at the output of the FM tuner discriminator when no subcarrier is being transmitted. When the subcarrier is transmitted, it emerges on top of the audio signal as shown in (B). Proper separation of the subcarrier from the main channel audio is shown in (C). Amplitude distortion of the composite signal (B) may result in subcarrier "drop-out" as in (D).



the subcarrier receiver, with over-all distortion levels running a few percent. These figures represent results obtained with a carefully aligned receiver system and with subcarrier deviation and modulation values of ±10 kc. and 15% respectively. The significance of proper receiver alignment will be discussed in following installment of this series.

Stereo Transmission Systems

Before considering some of the transmission systems that might be adopted for stereo broadcasting with FM multiplex, it would be well to evaluate the practices in use at the present time. Many broadcasting organizations which have both an FM and AM outlet have been transmitting stereophonic material by the AM/FM method shown in Fig. 3A. This technique can give surprisingly good results in primary signal areas if certain precautions are taken at both the receiver and transmitter. For one, it is desirable to use an AM tuner of the t.r.f. type rather than the superheterodyne receivers now in general use. Almost all conventional superhets have rather narrow i.f. bandpass characteristics in order to achieve the highest possible gain per stage. On the transmitter side, many AM stations tend to lean quite heavily on volume compressors in order to extend their effective signal area. Use of such compressors can be quite detrimental to optimum stereo transmission, since their counterparts in FM transmitters —the modulation (deviation) limiters —do not ordinarily possess the same dynamic characteristics. The common misconception concerning bandwidth allocations of AM transmitters will not be discussed here, except to indicate that most large AM broadcasting stations transmit an audio spectrum which compares favorably with their FM transmissions.

The transmission system shown in Fig. 3A and its equivalents which may employ two separate AM or FM stations (or even two multiplex channels on one FM transmitter) to accomplish the same end, has been criticized on one major count—that the listener with a single standard receiver can, at best, receive only half of the information being transmitted. Naturally most stereophonic recordings do not have absolute separation of the two stereo channels (except for special effects) so that in most cases the omission can be considered negligible. However, this is no reason to assume that the listener with one receiver should not be entitled to receive as well-balanced a program as does the listener with two tuners. One of the ways that this fault may be partially overcome is through the method diagrammed in Fig. 3B. Here the two stereo channels are cross mixed in an amplifier system similar to that shown in Fig. 2 so that the effective separation of the stereo channels is reduced. This means that there will always be some material from Channel A (normally the FM channel) present in Channel B (normally the AM channel) even though on the stereo tape or disc being transmitted there is no pickup at all on Channel B. This holds true in the reverse case as well. Although this system may go a long way toward satisfying the listener with only one receiver, it also tends to cancel the illusion of depth which, after all, is the reason for transmitting stereo in the first place. By recording AM/FM stereo transmission on tape and then comparing the channel separation off-the-air with those on the original tape or disc, the author has observed many instances of such manipulations by broadcast stations. It is, of course, possible, up to a point, to use the cross-mixing amplifier configuration of Fig. 2 to return these transmissions to their original state.

As would be expected, multiplex operations may lend themselves to the same kind of transmissions as have just been outlined, *i.e.,* one stereo channel may be fed to the main FM carrier and the other to the subcarrier system. See Fig. 3C. This method again suffers from the same fault previously explained in that the listener with a "normal" FM receiver is not able to receive the subcarrier modulation component.

A fourth system, based on analogue computer techniques, has been proposed where the single-receiver listener is assured of a well-balanced program even though he may not choose to use the stereo information. This system is basically simple in operation although the methods used may not be familiar to the average audiophile. In a matrix amplifier (similar again to that shown in Fig. 2) the two stereo channels (live, disc, or tape) are combined to create two signals which represent the vector sum and difference in the two stereo pickups. Algebraically, these signals can be represented as $(A+B)$ and $(A-B)$, the letters representing the two stereo channels. The former component is fed to the main carrier modulator and the latter to the subcarrier system. Since the listener with the conventional home receiver cannot decode the subcarrier signal, he receives only the main channel information; however, in this case he enjoys a composite signal derived from equal portions of the two stereo channels. Although he may not have as perfect a signal as he might normally obtain as a result of careful mixing and blending in the recording studio or concert hall (microphone placement for optimum stereo reproduction does not always coincide with the placement for best monaural listening), he is far better off than with just one half of the transmitted information, which he would be receiving with the previously discussed systems of stereo transmission.

Concerning the resolution of the matrixed signals into their original A and B components, this is readily accomplished by simple means in the multiplex adapter. See Fig. 4. By suitable detection of the subcarrier we may obtain the difference signal $(A-$

B). This component, although not normally usable in the ordinary sense, may be added to the main-channel signal $(A+B)$ to give: $(A-B)+(A+B)=2A$. Similarly, the difference component may be subtracted from the main-channel signal to give: $(A+B)-(A-B)=2B$. The factor (2) is a relative term and need not enter into the basic considerations. Although the re-combination process may seem complex, it will be shown that for a frequency-modulated subcarrier system it is possible to design a simple detector circuit which will provide both polarities of difference signal to enable a relatively straightforward resolution of the two stereo channels.

Before discussing the basic considerations involved in designing a multiplex adapter, brief mention should be made of bandwidth requirements of the "sum and difference" method of stereo transmission. Consider the situation which exists when a subject is placed exactly between two stereo pickup microphones. The sum channel would contain an audio component made up of the vector sums of the two microphone outputs which would be equal. Depending on the fidelity of this process, the transmission would be a good description of the program content, as it were. The difference channel meanwhile would transmit the vector subtraction of the two microphone outputs which, in this case, would be zero. This means that the entire informational content of the program is being transmitted by the sum channel and the integrity of the transmission would depend wholly on the fidelity of the main FM carrier system which broadcasts this component. Notice that in practical applications there is no situation where the sum channel would contain zero information as long as there was a significant component of difference signal.

Although the illustration just given represents a specific situation, it serves to make one point clear. It can now be realized that if the difference channel were to be limited in audio bandwidth there might conceivably be a reduction in *directional resolution* of a stereo transmission, but never a reduction of the characteristic content of the basic program material. If it is further considered that the high-frequency crosstalk in typical stereo disc recordings may run as high as 5 db at 10 kc., it becomes understandable that band limitation in the difference channel might easily be condoned or even desirable from certain standpoints. Of course, the "crosstalk" in a good two-channel tape recording or a live broadcast from a "dead" studio might be considerably less; however, the acoustic considerations evolving from practical situations and also the inability of the ear to resolve direction at low frequencies still casts serious doubt on the justification for full bandwidth transmission of the subcarrier channel in the "sum and difference" system of FM multiplex.

(*Concluded next month*)

Right Way to Stack Antennas

(*Continued from page* 61)

marked T_1 is 300 ohms. As was demonstrated for the double stack, the matching stub to transform 300 ohms into 600 must have a characteristic impedance of 424 ohms itself. We have shown how this matching-stub impedance is determined by the diameter and spacing of the conductors. In other words, the same matching-stub impedance can be used for stubs 1, 2, 3, and 4! The difference between the primary stubs (1 and 2) and the secondary stubs (3 and 4) is that the latter could not possibly be a quarter wavelength long since the separation between the connecting points will be about a half wave long. A half-wavelength line does not provide the desired impedance transformation. It is thus necessary to make each of the secondary stubs 3 and 4 three-quarters wavelength long. The extra length can be taken care of by bending the bars themselves or by bringing them back towards the antenna supporting mast.

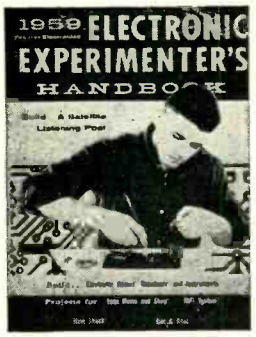
It is possible to use other systems for devising the stubs, including one in which half-wave elements are used. However, determination of values becomes more involved, and the values for D and d become such that special construction requirements must be considered.

Whenever antennas are stacked for additional gain, the accompanying changes in bandwidth and directivity cannot be neglected. These side effects may be helpful in some locations but in others they can be harmful. One important result of stacking is the reduction in antenna bandwidth. Since the matching stubs must be designed for a single frequency, optimum impedance match really is limited to a relatively narrow frequency band. As the impedance match gets worse above and below the design frequency, reflections occur which reduce signal strength and can even cause ghosts to appear. The more antennas that are stacked together, the greater will be the bandwidth reduction. As a general rule, it is safe to say that a given antenna which has uniform gain over the low TV band will have good gain only over a single channel when four such antennas are stacked. In the case of the high TV band and the u.h.f. band, the *percentage* of bandwidth reduction is the same. However, since each channel occupies a smaller percentage of the carrier frequency, the apparent bandwidth reduction due to stacking is less pronounced.

Another effect of stacking is the narrowing of the main lobes in the antenna's sensitivity pattern. The increase in antenna gain is accompanied by a distortion of the beam into a narrower angle and this requires that the antenna be oriented more exactly. This change in directivity is most pronounced in the vertical plane —30—

50

new projects for "do-it-yourselfers"



The 1959 ELECTRONIC EXPERIMENTER'S HANDBOOK will be coming your way soon! If you like to build useful, money-saving electronic devices and experiment with new projects, the ELECTRONIC EXPERIMENTER'S HANDBOOK is for you. Each project has been pre-tested by the readers of Popular Electronics. You'll find step-by-step instructions, hundreds of illustrations and diagrams. Last year's edition of the ELECTRONIC EXPERIMENTER'S HANDBOOK was a sellout at many newsstands. Be sure to reserve your copy of this year's edition now!

over **175** *pages*

FOR YOUR HI-FI. Transistorized preamp and control unit. One-tube hi-fi AM tuner. Tuner and audio radio. Make your own phonograph arm. Hi-fi slave. Switch to stereo. Slot-box your speaker. Personal stereo player. Suit your volume with a T-pad.

FOR YOUR HOME. Build a "conversation piece." Electronic secretary. Flash light with transistors. Trap unwanted stations. Conelrad your home. Battery-operated proximity relay. Make your own disc records. A clown for the kids. Two-set coupler. Simpla-timer. Transistorized photoflash. Electric shutter release.

FOR YOUR CAR AND BOAT. Transistors replace wall outlet. Convert transistor set for car. "Auto-Fi." Transihorn.

RECEIVERS. Build a "Half-Pack." Monoceiver to pull in DX. Pocket FM receiver Converter for daytime DX.

ELECTRONIC GAMES. The Quizzomat. A lively "Warmth Meter." Win at Nim with Debicon. Tic-Tac-Toe mate. Compute with Pots. Games with Nixie tubes. Bullets of light. Catch the vanishing ball.

FOR YOUR WORKSHOP. Pocket size test instrument. Square-wave generator for audio tests. Check your A.C. Calibration. Transistor Test Power Supply.

FOR YOUR HAM SHACK. Simple R.F. meter. The semi-conductor space spanner. Card file transmitter.

FOR THE EXPERIMENTER. How to make parts substitutions. How to use Decals. Put Pots to work. Collection of tips and techniques.

The 1959 edition of the ELECTRONIC EXPERIMENTER'S HANDBOOK will be on sale soon—only $1. Reserve your copy today at your newsstand or radio parts store.

Ziff-Davis Publishing Company
434 South Wabash Avenue, Chicago 5, Illinois

New Stereo System For AM Band

Experimental system puts each of the stereo channels on one of the AM sidebands.

A NEW experimental radio broadcasting system that provides stereophonic sound through a single receiver and dual speakers on the regular AM broadcast band has been demonstrated to broadcasters by the *Radio Corp. of America*. With the system, only a single AM broadcast station is employed to give the stereo effect.

The operation of the AM stereo system is as follows. Two separate sound channels, picked up by two separate microphones or from a stereo tape or disc at the studio, are transmitted on the regular broadcast frequency. A standard AM signal is made up of a carrier wave and two symmetrical sidebands equally spaced above and below the carrier wave. In the stereo system demonstrated by *RCA*, each of the stereo channels is carried by one of these sidebands.

In the special AM stereo receiver, the two sidebands are separated and fed to two speakers, left and right, to reproduce the stereo effect picked up at the studio. In the present conventional AM receiver, there would be no separation of the two sidebands, so that the program would be heard in conventional fashion without the stereo effect. Note that the conventional receiver would then be reproducing the entire program content, that is, the sum of the left and right channels, rather than simply one of these channels. The special stereo receiver can also pick up non-stereo broadcasts and play them through either speaker or both, without any stereophonic effect.

Examination of the block diagram (not shown) of the receiver shows common r.f. amplifier, converter, and i.f. amplifiers for both channels. After the common i.f. amplifiers, the composite signal is applied to two separate sideband selectors, detectors, a.f. amplifiers, and speakers. In this way, each sideband is handled separately so that the information on the lower sideband, for example, is fed to the left speaker and information on the upper sideband is fed to the right speaker.

For the demonstration, music from a stereo tape, broadcast over a lab-type AM stereo transmitter, was picked up by the special receiver feeding dual speakers. The receiver also picked up a regular AM broadcast from WRCA in New York to demonstrate its compatibility.

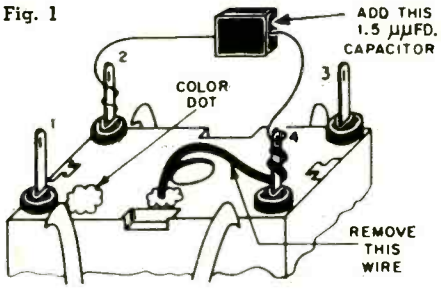
It must be emphasized that this represents an experimental, laboratory demonstration of equipment that may not be available for commercial use for some time to come. —30—

DUMONT: I.F. XFORMER FAULT

Breakdowns occasionally occur in the video i.f. transformers used in the model RA-112 series and RA-113 series. These are likely to involve a breakdown in the ceramic coupling capacitor inside the i.f. can. For example, arcover is possible between the silvered ceramic tube of this component and the bare wire that fits into it. In later versions of these transformers, the wire has been coated to minimize this possibility. In any case, whatever the cause for the capacitor breakdown, it is comforting to know that replacement of the entire transformer is not necessary.

By external manipulation, the wire in the ceramic tube may be removed, thus taking the capacitor out of the

Fig. 1



circuit effectively. A substitute capacitor can then be added, also externally. The wire, shown in the bottom view of the transformer (Fig. 1), is readily accessible for removal. After this step, connect a 1.5 $\mu\mu$fd., 400-volt capacitor (*Stackpole* type GA-3 or equivalent) between pins 2 and 4, as shown. This connects it between grid and plate terminals. Naturally, alignment should be checked after the change. A slight touch-up of the grid and plate coils will probably be found necessary.

EMERSON: ERRATIC COLOR

Sometimes, although colors may be reproduced on the screen, they may not be distributed to correspond with the picture content. Whether this loss of color synchronization is constant or occurs on an intermittent basis, the first possibility to consider on receiver models C-502A through C-507A is that L_{22} needs re-adjustment. The slight adjustment that may be required can be accomplished without test equipment during reception of a color TV broadcast. Manipulate L_{22} for optimum color lock. This is the position that will produce good pull-in as well as good color hold once synchronization is achieved.

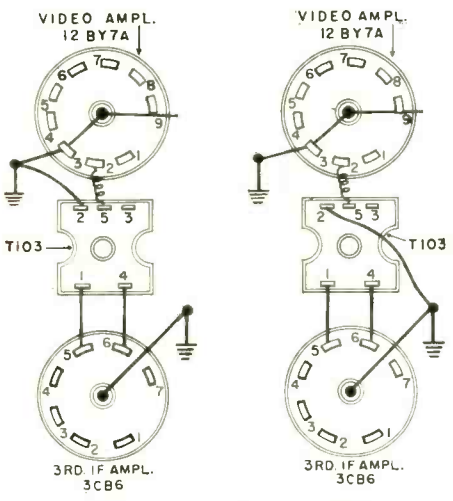
If a 920-kc. beat interference pattern mars the picture during color reception, this is also probably a matter of adjustment. This pattern (about 3

black bars per inch along any horizontal scanning line) is at the difference frequency that occurs when the 4.5-mc. audio i.f. carrier and the 3.58-mc. color subcarrier are permitted to heterodyne. The 41.25-mc. sound trap, T_2, is used to tune out this interference. The top of T_2 is adjusted carefully for maximum rejection of the beat pattern while a color broadcast is observed. Make certain that the fine-tuning control has been adjusted for best color reception.

TVI ON CROSLEY

If persistent interference is noted on channel 6, or sometimes on channel 7, in receivers using the J-21 series of custom chassis, it may be of internal origin. Included in this group are chassis 472, 473, 476, and 477. The interference arises in this way: the second detector acts as a harmonic generator for the i.f. signal that is fed to it. Harmonics may be radiated from this circuit back to the antenna input.

If interference results from this cause, it can usually be corrected by physically changing the ground lead



from the detector. This is the lead from lug No. 2 of i.f. transformer T_{103}. As shown in Fig. 2A, the lead is removed from its old ground connection near the video amplifier and rewired to another ground lug near the 3rd i.f. amplifier Fig. 2B.

SHORTS IN MAGNAVOX TUNERS

Examination of 700584-6 tuners being returned for replacement, with the notation that they are "shorted," indicates that many of them could be repaired in the field quite simply. The short can occur when one of the r.f. plate coils makes contact with the low-potential end of R_9, the 10,000-ohm resistor feeding 140 volts to the mixer stage. When this happens R_{501}, the 2200-ohm resistor outside the tuner, burns. Simply bending the coil away slightly to clear the short and then replacing R_{501} should be the only remedial measure required. This is quicker and less expensive than replacing the tuner, even if it is still in warranty, as a replacement would involve an alignment check of the receiver. —30—

Single Push-Pull Stage

(*Continued from page 49*)

frequency component almost in phase. Any distortion of these components in the amplifier *is* cancelled by the push-pull transformer in the same way as a regular push-pull output.

Then, in the final amplifier circuit, overall feedback, from the individual speaker connections, goes back into the amplifier to linearize each channel *as an entity,* regardless of its division into mono and stereo (or push-pull and push-push) components.

The major form of distortion reduced by the normal push-pull output transformer is this lower frequency component. The push-pull transformer here does it too, both as regards harmonic and IM components. Distortion higher up, which gets more complicated anyway, is taken care of by the feedback, as it also is in any normal amplifier.

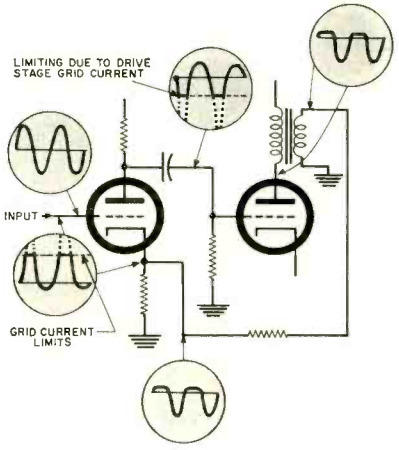
2. Will not the loudspeakers, connected as at Fig. 4, reproduce the stereo out-of-phase?

This is a matter of phasing, *at both input and output.* Most three-terminal pickups are phased so that lateral motion of the stylus gives two outputs that are positive at the same time (Fig. 5). In this system, the pickup has to be connected so, for lateral motion, one output is positive at the instant the other is negative.

In the phonographs using this amplifier, the pickup is phased correctly for the purpose. Using the amplifier with other pickups is no problem when there are four terminals, so the user can phase his pickup to suit.

If you've become used to thinking the way most systems are connected is *standard,* then this system will seem non-standard to you in this respect. But it really depends which you start off with as the standard. From the viewpoint of the cutter, or pickup, basic symmetry would require the up-and-down component to be the in-phase, or *push-push element,* which

Fig. 7. Waveforms in single-ended amplifier with feedback when the output tube is driven beyond cut-off. See text.



agrees with this system, and makes the more generally accepted connection "non-standard".

As far as *functioning* is concerned, all that matters is that it be connected the *right* way, which only has to be done once, when setting up the system.

At the loudspeaker end, if identical units are used, the opposite end of the voice coil(s) have to be connected to the ground bus on the left and right systems. But, again, once the system has been phased, everything works correctly. The thing is purely relative.

3. One reason, or advantage of push-pull operation is improved efficiency of the output stage. This is achieved by working at, or nearer, class B operation. In view of the fact that this system uses a push-push component, can it utilize this advantage properly?

Class B is a theoretical condition, postulated on plate characteristics that make an abrupt, or discrete transition from straight lines representing constant a.c. resistance, to a cut-off condition, representing infinite resistance (Fig. 6). No tubes ever made operate just this way.

But working well "round the bend" as a single-ended tube can result in excessive curvature. And the parallel, or vertical component does pass through this amplifier as a "single-ended" operation. Let's give a little thought to what can happen in a single-ended amplifier of this type with feedback.

Assume it is biased to a point well in the curvature, and that a signal comes through that drives it "round the bend"—in fact well into cut-off. Feedback tries to offset the waveform inside the amplifier that is distorted in the opposite way (Fig. 7). But it can only work on parts of the waveform that get through. For the part beyond cut-off there is no feedback.

So the internal waveform becomes exaggeratedly asymmetrical the opposite way. As has been proved many times, such an asymmetrical component in a waveform is equivalent to a change in d.c. bias; in this case it will work progressively, like a "pump", until the feedback can "get to work" on the whole waveform.

In effect, the feedback will use the time constant of the coupling between drive and output stage to alter the bias just enough to allow the stage to handle the signal completely, so it can work on linearizing all of it.

But, if this were the only means, and the time constant is made long enough to represent a good bass response (which is needed for the push-pull mode), quite a bit of distortion can occur *before* the bias gets readjusted. Fortunately, however, with the circuit shown in Fig. 4, another effect can take charge meanwhile.

When the large signal first "strikes", its first positive excursion at the grid of the drive stage (Fig. 7), it won't be offset by corresponding feedback at the cathode, because the output tubes will run well into cut-off. Consequently, *from the point where the output tubes*

cut off, the grid voltage here will rise sharply positive, and due to grid current, will temporarily bias this stage back by a corresponding amount. With proper choice of time constants, this will pass a similar temporary bias to the output stage—positive, so the output stage can immediately handle the whole signal.

So, after the first quarter wave of a big vertical component (unless it runs the output tubes into the positive grid region now, in which case, the signal is just too much anyway), the output tubes find the right bias for the signal coming through by means of the feedback action. From then on the feedback maintains a correct balance in bias adjustment.

4. Doesn't having the tubes handle a "double" signal—push-push as well as push-pull—limit the maximum power of the amplifier as compared with normal push-pull operation, in spite of any self-adjusting action?

To tackle this question I went to the Mullard "Technical Handbook of Receiving Valves" to see what I could expect of a couple of EL84's.

In Class AB, self-biased push-pull, with 300 volts on the plates, they give 17 watts. A figure is not given for the same operating condition in parallel, but an inspired guess from figures given for a single tube operating at 250 volts suggests they would give around 13 watts under this condition.

Working in this circuit, if a pure signal is fed in, in-phase in both channels, so as to work the tubes in push-pull, they will give their rated 17 watts, into the rated resistance load. This will be shared between the left and right channel, after an appropriate loss in the output transformers.

Similarly, if one channel is reversed in phase, to be equivalent to a vertical cut, the tubes should deliver 13 watts into the same kind of load. So, when someone asks whether this mode of operation will limit the power, do they want to get 17 + 13 watts = 30 watts, for the same money they can normally get 17 watts?

Actually, under the hypothetical conditions represented in such tests, the amplifier should always be able to deliver somewhere between 13 and 17 watts, according to phase angle between channels.

But actual stereo program does not possess a single frequency with known or constant phase difference between

channels. Different components will have different phase angles, at quite random distribution. But this is nothing new. The same invalidation of wattage ratings occurs with normal amplifiers.

An amplifier is never called upon, in musical program, to deliver 17 watts pure sine tone into a resistance load. It's called on to deliver a multiplicity of complex tones into a loudspeaker. *If it had a resistance load,* the maximum peak power of the complex wave would be just twice the average power of the theoretical sine-wave output. That's about as nearly as we can relate the measured results to practical performance.

With the combined stereo amplifier, if both loads were pure resistances, the maximum peak power delivered to the two channels combined will be somewhere between 26 watts minimum (2 x 13) and 34 watts maximum (2 x 17). Different proportions of different component frequencies may get delivered to each channel, but this is the maximum peak power of the composite, still assuming that inaudible resistance load.

5. What about crosstalk in a combined amplifier like this?

The original claim is that the separation between the channels "on the average is better than 25 db". There is something about the crosstalk question that needs clarifying here. *How much separation do you actually require anyway?*

The answer to this question requires qualification. It depends on what the crosstalk is. If it is pure crosstalk—left program breaking through to right, or vice versa, 10 to 12 db separation is quite adequate. But if it should happen to be distortion components of left program showing up in right, then 30 or 40 db is not good. So, when you measure crosstalk, do you have simple crosstalk, or instead do you have *cross-intermodulation?*

Pickups, as well as combined amplifiers, will need more careful scrutiny from this viewpoint. There is no reason why a combined amplifier should not have a separation of better than 25 db that is pure crosstalk, due to slight imbalances and tolerances on transformer ratios, etc. Actually, a complicated mechanical structure with non-linear compliances controlling its motion is much more likely to produce the cross-intermodulation variety than a combined amplifier, in which transfer is more or less like simple break-through from one channel being handled by the amplifier to the other.

But now we are getting onto much bigger questions that open up avenues for further work before we can say we know all about these stereo problems. Meanwhile, the single stereo amplifier definitely works, and provides certain economies that make it quite worth while.

We can expect to see shortly announcements of commercially available equipment using these principles. —30—

Low-Ripple Eliminator

(Continued from page 41)

case was worked out by L. C. Cowles in his December 1952 article in *The Proceedings of the I.R.E.* Fig. 4 shows the simplest practical circuit with input impedance Z_i and load impedance Z_o, both assumed to be resistive. The voltage source (at any frequency f) is E_i and the output voltage is E_o. It can be verified by network theory that at any desired frequency, say f_o cps, the output voltage will be zero providing the capacitance C (in farads) and the resistance R (in ohms) are related in the manner indicated by the following equation:

$$1 / (2\pi f_o) = RC \quad . \quad . \quad . \quad . \quad . \quad (1)$$

This is the same as saying that the ripple voltage will disappear at the output providing the reactance of C is equal in magnitude to the resistance of R.

What can one say about the d.c. voltage across the load resistor Z_o? This is easily determined by considering the closed loop *abcd* in Fig. 4, since this is the only path accessible to direct current. The total resistance around the path is $Z_o + 2R + Z_i$ so the voltage drop appearing across the load Z_o is simply:

$$E_o\ (d.c.) = Z_o E_i\ (d.c.) / (Z_o + 2R + Z_i) \quad . \quad . \quad . \quad . \quad . \quad (2)$$

Construction of "A" Supply

The 6.3-volt secondary winding of the power transformer was chosen as the a.c. source to provide the energy for the "A" supply. There were two principal reasons for this choice: (1) standard size components are preferred wherever possible and a 6.3-volt secondary is always available and (2) if a higher a.c. voltage source were used than was needed, the excess energy would only have to be dissipated as heat and thus wasted, not to mention the high-wattage resistors that would be required. It must be remembered that the same current would be necessary (about ¼ ampere) irrespective of the voltage source.

If a selenium rectifier operating series-half-wave from this low-voltage secondary were to charge a 100 μfd. capacitor to peak, the maximum available d.c. voltage would be 6.3 times $\sqrt{2}$ or about 8.9 volts. This, therefore, would be the value assigned to E_i (d.c.) in equation (2). The output voltage E_o (d.c.) required at the load is about 1.5 volts. The load itself, Z_o, is 6.0 ohms. When these values are substituted in equation (2) one obtains the following:

$$1.5 = (6.0)\ (8.9)\ / (6.0 + 2R + Z_i)$$

or, after collecting terms:

$$Z_i = 29.6 - 2R \quad . \quad . \quad . \quad . \quad . \quad (3)$$

A selenium rectifier was available which was rated at 250 ma., but its internal impedance Z_i was about 100 ohms. This was obviously too high for the present application because it would require R in equation (3) to be *negative!* The rectifier was built to

withstand line voltage, however, and consisted of five plates (or leaves) connected in series. A single plate, therefore, should be able to withstand about 25 volts which would certainly be safe enough for our purposes. The important thing about a single plate is that its internal impedance would *also* be diminished to a respectable value of about 20 ohms without in any way detracting from the current handling ability of the original rectifier stack. This value for Z_i substituted in equation (3) yields a resistance of about 5 ohms for R which works out quite well. Equation (1) can now be used to determine the nearest value of C for effective suppression of the 60-cycle ripple. It turns out to be 500 μfd. which is not especially bulky at low-voltage ratings (*e.g.,* 15 volts). Consequently, the selenium rectifier selected for the "A" supply was carefully disassembled by removing the rivet which holds the plates together. A single plate was re-assembled using the original solder lugs and insulated washers. The new assembly was held together with a 6-32 machine screw and nut, care being taken to insulate the threads of the screw from the rectifier plate. The modified rectifier is partly visible between the decks of the chassis in Fig. 1.

The precise matching of resistances with reactances is quite critical for optimum ripple suppression. For this reason it was decided to use a suitable resistance wire in order to determine the exact resistances necessary. Manganin wire (made by *Wilbur B. Driver Co.,* Newark, N. J.) was chosen because of its extremely low temperature coefficient. Size 32 was convenient, having a specific resistance of 4.52 ohms per foot. The radio, itself, was used instead of a dummy load during this final determination of the amount of resistance wire needed. A length of slightly more than a foot was used at first, corresponding to the nominal value of 5 ohms for R. Using the ear as an indicator, it was not difficult to tell that 4½ ohms for each of the series arms and 2¼ ohms for the shunt minimized the hum to such a degree that it was hardly detectable! The d.c. voltage measured across the real load turned out to be 1.3 volts instead of 1.5. This was considered to be close enough, especially since the radio's performance is, after all, the best criterion of acceptability. The amount of wire required for each resistance was then wound around a suitable form. Large carbon resistors (*i.e.,* large, physically, as well as high in ohms) served this purpose quite nicely. Fig. 2 is a bottom view of the "A" supply showing the compact arrangement of components. The hand-wound resistors just described are clearly visible in the foreground.

A schematic diagram of the complete power supply ("A" and "B") is shown in Fig. 3. The radio has been performing daily for about six months in a very satisfactory manner powered by this equipment. —30—

bold new editorial feature

for RADIO & TV NEWS

To showcase the entire Electronics World even more effectively, RADIO & TV NEWS will be larger, more colorful and better-than-ever during 1959!

Here's what's in store for regular readers of the world's largest-selling technical electronics magazine:

MORE EDITORIAL MATERIAL — to enlarge on the scope of present coverage with a greater number of articles on subjects of interest to you.

SPECIAL INSERTS AND "FOLD-OUTS" — to provide valuable, instructive charts — ready for wall mounting.

SPECIAL ISSUES — to give complete coverage in depth to the important fields of servicing and high fidelity.

MORE COLOR PAGES — to make RADIO & TV NEWS brighter and easier to read.

HEAVIER COVER STOCK — to help prevent damage and fraying of copies mailed to subscribers.

Specifically, here are the highlights of what is coming up in RADIO & TV NEWS:

FEBRUARY ISSUE — on sale January 29

Special "fold-out" SOUND CHART that portrays dramatically such features as the Fletcher-Munson curve, frequency range for all musical instruments and human voices, threshold of hearing and feeling, sound level of music and speech.

Special report on ULTRASONICS, with particular emphasis on industrial applications and the future of this exciting new field.

MARCH ISSUE — on sale February 26

Authoritative TV FREQUENCY SPECTRUM AND INTERFERENCE CHART on VHF TV frequency spectrum. Of particular interest to the service technician, this "fold-out" shows how various TV channels are affected by common interferences caused by other broadcast signals.

Special report on INFRARED covering the most up-to-date information on developments in this new field. Describes how every animate and inanimate object known to man radiates Infrared. A real eye-opener about present-day miracles that sound like science-fiction to the uninformed.

All told, in the months ahead, RADIO & TV NEWS will continue to be the most authoritative and informative magazine in the field — a delight to read. To make expanded coverage possible and to meet today's ever-increasing publishing cost, the cover price of RADIO & TV NEWS will be raised to 50c effective with the next (February) issue.

But, subscription prices will not be raised for the time being — to allow regular readers of RADIO & TV NEWS to take advantage of the present low rates. So, if you're not yet a subscriber to RADIO & TV NEWS, now's the time to act before subscription rates, too, are increased.

CURRENT SUBSCRIPTION RATES

$4 one year $7 two years $10 three years

RADIO & TV NEWS
434 South Wabash Ave., Chicago 5, Ill.

Long Distance SSB Tropo-scatter Link

First single-hop system is now undergoing tests over a 640-mile distance.

RECORD completion and installation of the world's first single-hop long distance, single-sideband, tropospheric-scatter communications system has been announced by the *General Electric Co.* The long-range system was designed and developed by Massachusetts Institute of Technology's Lincoln Laboratory and *G-E* for the U. S. Air Force. The new scatter hookup is undergoing tests at domestic sites over an unprecedented 640-mile distance between Millstone Hill, near Boston, Mass., and Sauratown Mountain, near Winston Salem, N. C. It is a prototype of the first such over-the-horizon communications system to be used by the Air Force as the main communications between advanced Arctic bases for the military.

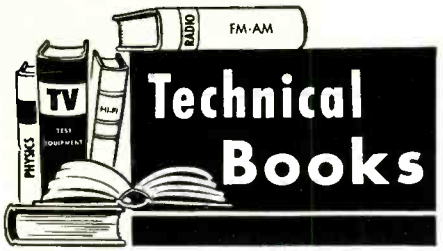
Six to eight years of normal development time are usually allotted for projects of this nature. However, due to urgent need for this equipment, the scatter link was completed in a record 1½ years, from drawing board to installation. The equipment was manufactured under a $10-million contract.

The main advantages of the system are its extreme reliability of communications and its ability to span long distances, which is important in inaccessible areas where erection and maintenance of microwave repeater stations would be impossible.

In the new Air Force system, two huge super-power transmitters are used at each site. Each transmitter has a potential output of 50 kw. The transmitters send simultaneous signals to two antennas where they are focused by two giant 120-foot high parabolic reflectors and beamed skyward. The antenna gain is about 20,000 times. Thus, at full power, the equipment is transmitting one billion watts of effective radiated power.

The huge antenna reflectors at each site are precisely aimed at an identical area in the troposphere. Here the signal paths criss-cross. Although much of the power is lost at this point, some is scattered or reflected back to the receiving antennas. Since the system is two-way, each site is designed to receive and transmit simultaneously. Twenty-four separate voice and teletypewriter channels are provided.

The equipment was designed for simplicity of operation and ease of maintenance. Thus, it can be operated safely by personnel with a minimum of training. Built-in safety devices assure protection from personal harm while the system is in operation. —30—



"FUNDAMENTALS OF RADIO AND ELECTRONICS" edited by William L. Everitt. Published by *Prentice-Hall, Inc.*, New York. 792 pages. Price $11.00, Second Edition.

As one of the "best sellers" in the technical book field and a familiar volume to several generations of radio and electronic students, this up-to-date and completely rewritten edition is sure to be hailed by teachers and "students" alike.

While the first edition of this text (1942) was adequate for its period the almost unbelievable strides in the field of radio and electronics since that time has dictated the release of this updated volume. Although still under the aegis of Dr. Everitt, dean of the College of Engineering, University of Illinois, the services of five contributing authors have been enlisted to handle specialized subject matter.

The text is divided into 22 chapters and an appendix and covers mathematics needed in radio and electronics, d.c. circuits, circuits with time-varying voltages, vacuum-tube and transistor principles, rectified power supplies, the transmission and recording of sound, audio and video amplifiers, pulse and switching circuits, electromagnetic waves, the transmission and reception of signals by radio, AM detectors, AM radio transmitters and receivers, FM, monochrome and color TV, vacuum-tube instruments, u.h.f. and microwave circuits, radio wave propagation, radio antennas, radar, and industrial applications.

Since the use of higher mathematics has been avoided throughout the text there is no reason why the serious student shouldn't be able to use this volume as a "do-it-yourself" training manual in the field of radio and elementary electronics. Test questions at the end of each chapter encourage such usage.

* * *

"JONES NORTH AMERICAN AM-FM RADIO — TV STATION LISTINGS" compiled and published by *Vane A. Jones Co.*, Indianapolis, Ind. 64 pages. Price 50 cents. Paper bound, issued quarterly.

The demand for country-wide radio and TV station listings apparently continues unabated.

This pocket-sized list carries FM stations by states and provinces, a geographical listing of AM stations by states and provinces, a listing of AM stations by frequencies, and a listing of AM stations by call letters. Since this edition covers the U.S. and its Possessions, Canada, Cuba, Mexico, and

the West Indies, it should meet the needs of even the most avid television DX fan or the collector of freak skip transmissions on the FM band.

* * *

"THE JUNCTION TRANSISTOR AND ITS APPLICATIONS" edited by E. Wolfendale. Published by *The Macmillan Company,* New York. 390 pages. Price $7.50.

This volume represents the cumulative experience of a group of *Mullard* engineers and physicists who have been engaged on research and development of semiconductor devices and their application for a number of years.

These eight men, along with their editor, have covered the subject thoroughly from the physics of the device and its characteristics to specific applications in a variety of circuits. The chapter on physics is on a high technical level and was included primarily for physicists. Its contents can be bypassed by the student or electrical engineer since the balance of the text is complete in itself.

The book covers general four-terminal networks and the transistor equivalent circuit; direct-current biasing and audio-frequency amplification; high-frequency amplification; class C amplification; sinusoidal oscillators; amplitude modulation and demodulation; the junction transistor in nonlinear circuits; and transistor d.c. converters. An appendix covers transistor measurements of various parameters and characteristics.

Treatment of the subject is mathematical and at an engineering level. An engineering degree or at least junior standing in an engineering college is pre-requisite to an understanding of the text. For those engaged in transistor research or the application of transistors in various circuits, this report on British progress along these lines should be of vital interest.

* * *

"PIN-POINT RECORD CHANGER TROUBLES IN 5 MINUTES" by Coyne Staff. Published by *Coyne Electrical School,* Chicago. 292 pages. Price $3.95. Spiral bound.

The success of the first volume of the "Pin-Point" series has dictated the application of the same technique to the servicing of record players and their associated amplifiers.

This volume covers all of the mechanisms made in the United States as well as the foreign makes which enjoy widespread American distribution. The material covers hi-fi turntables as well as single-, three-, and four-speed changers. There are over 400 time-saving photographs and illustrations to help the technician track down service faults as well as 58 specially developed trouble "Check Charts." Accompanying the "Check Charts" are explanations of troubleshooting short cuts based on years of actual field experience.

The text is divided into four sections covering record changer mechanisms, tone-arm servicing, amplifier servicing, and record-changer servicing. This latter section is arranged alphabetically by manufacturer for fast identification.

The spiral binding which permits the book to lie flat on the service bench is an added boon to the busy technician.

* * *

"OSCILLOSCOPE TECHNIQUES" by Alfred Haas. Published by *Gernsback Library, Inc.,* New York. 218 pages. Price $2.90. Soft cover.

This is a handy reference book for the practicing technician or experimenter who has occasion to use an oscilloscope in his work.

It may also serve to lend encouragement to many technicians who are a little afraid of the oscilloscope, and because of this fear, they are not getting the full benefit from a piece of test equipment whose versatility is probably unmatched in the field of electronics. The scope certainly should be more widely employed than it is.

The text covers the CR tube, oscilloscope circuitry, accessories used with scopes, how to measure electrical magnitudes, networks and waveforms, the display of characteristics, fundamental electronic circuits, checking receiver circuits with the scope, waveforms in monochrome and color TV, and scope fault patterns. The text is well illustrated but a little retouching on some of the many scope waveforms shown would have been very helpful to the user of this book.

* * *

"CIRCUIT ANALYSIS OF TRANSMISSION LINES" by John L. Stewart. Published by *John Wiley & Sons, Inc.,* New York. 181 pages. Price $5.50.

The neophyte engineer and the serious service technician will both find this volume of value since it covers a specialized field about which there is far too little published material available.

The treatment is practical and those with a good grounding in electronics and a working knowledge of mathematical operations should have no difficulty handling the subject matter. The text covers an introductory section in which the nature of waves is discussed. Then the author moves on to consideration of transient waves and their calculation; sinusoidal waves; standing waves, transmission efficiency, and impedance matching; lines as resonators; equivalent lumped circuits; measurements and standing-wave ratio; the circular transmission-line chart; finishing up with a four-part appendix which includes transmission line data needed by the student (characteristic impedance, skin effect, proximity effect, and attenuation in standard cables).

The text can be used either as a practical handbook for communication transmission lines or as a stepping stone to work with microwave systems.

* * *

"RADIO VALVE DATA" compiled by "Wireless World" staff. Published by *Iliffe & Sons Ltd.,* London. 136 pages. Price 5 s. Paper bound. Sixth Edition.

This is the sixth appearance of a

OLSON Ships All Orders Same Day Received!

8 Olson WHOLESALE CATALOGS

$1

• RADIO • TV
• TOOLS • HI-FI
• APPLIANCES, ETC.

SAVE UP TO ½

Nationally Known Brands...
• GE • RCA • MAGNAVOX
• NORELCO • UNIVERSITY
• JENSEN and many more!

Our $1,000,000.00 inventory includes 2,500 Super Values in Hi-Fi's, Tools, Appliances, Speakers, Amplifiers, Antennas, Tubes, Etc.—made by manufacturers such as GE, RCA, Magnavox, Bogen, Garrard, University, Norelco, Jensen, Stewart-Warner, and many others.

HERE'S OUR OFFER

Send $1.00 with the coupon at right and we will mail you the 8 Wholesale Catalog issues, one every 6 weeks. We will deduct the $1.00 from your first order and still send you the remainder of the catalogs FREE! If you are not 100% satisfied, return the first catalog and we will send you your $1.00 back. Every item sold is 100% guaranteed.

FREE OF CHARGE!

Order merchandise from this page and we will send you all 8 catalogs (one every 6 weeks) FREE OF CHARGE!

New! MINIATURE TAPE RECORDER

OVER 50% OFF

- Size: 4¾"x8"x9½"
- Weighs Only 10 lbs.
- Dual Speed, Dual Track
- Push Button Operation

Regular $169.50
Stock No. AM-133

Silent running. Smaller than the smallest portable typewriter. Simple, foolproof operation by unique picture push-button controls, fast acting, with instant breaking. Full 2.5 watts of power with response of 75 to 7500 cps. Two speeds, 1⅞ or 3¾ I.P.S. Plays standard 3" reels, giving up to 1 hour and 20 min. recording time. Magic eye level indicator and built-in clock type tape counter. Complete with microphone, take-up reel, 3" tape, pigskin leatherette carrying case with snap lock and key, and instructions. For 110 volts AC. Shpg. wt. 14 lbs.

ACCESSORIES

300' of Scotch Brand Tape on 3" reel. **Stock No. TA-1** Lots of 12, ea. **$1.11** $1.24
12 Volt Inverter to operate recorder in auto. **Stock No. RA-258** $13.17

OLSON PRICE $82.88 SAVE $86.82

General Electric VR-II CARTRIDGE With FREE Diamond Stylus

Popular, new VR-II series G.E. cartridge, with dual sapphire stylus plus diamond 1 mil (LP) clip-in stylus for this G.E. cartridge. Frequency response 20 to 20,000 cps. Tracking pressure: 4-6 grams.

Stock No. PC-46
Reg. $19.90

$8.77

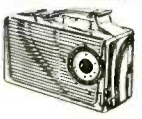
New! NORELCO HI-FI CARTRIDGE

- With 1 Mil (LP) Diamond Stylus
- Response 10 to 20,000 cps ± 2DB

Stock No. PC-47

Output 35 millivolts at reference level of 10 CM/second velocity. Tracking force 5 grams or less depending on arm. DC resistance 1,200 ohms. Ideal load resistance: 68,000 ohms. Mtg. ctrs. ½". In leather case with mounting hardware. Reg. $29.95

$7.93 3 for $23



SUPERHETERODYNE PORTABLE RADIO

Latest superheterodyne circuit using 4 low battery drain tubes. Sensitive loop antenna, high signal to noise ratio and built-in speaker assures amazing volume and practically no interference. Standard broadcast band (530 to 1600 KC). Size: 6¼"x4"x2". Less batteries. Shpg. wt. 3 lbs.

Stock No. RA-310
Reg. $19.95

BATTERIES FOR ABOVE

67½ Volt "B" (1 req'd) **Stock No. BA-49** $1.29
Burgess 2R or Eveready 950 (1 req'd) **Stock No. BA-25** 13c

$10.99 3 for $31.50

STEREOPHONIC AMPLIFIER With 6 Tubes

Only 7½x3⅛x4". Completely wired and ready to connect to stereo changer or tuner. Rated at 0 watts each channel with response of 50-12,000 cps. May be phased and connected together for monaural use giving 4 watts output. Speaker output 3.2 ohms. With 2 ea. 35W4, 12AV6, 50C5, line cord, and speaker leads. Shpg. wt. 8 lbs.

Stock No. AM-124

$16.88

New! TAPE HEAD DEMAGNETIZER

Prevents Hi-Frequency Loss & Tape Noise

The audio head demagnetizer prevents noise that is picked up from the tape after prolonged use. Keeps the noise level down and protects tapes from partial erasures. Just connect to 110 volts and pass over tape heads. For 110 volts, 60 cps. Shpg. wt. 3 lb.

Stock No. RP-143
Reg. $10.00

$5.88

7-Piece Hex Nut DRIVER SET

Fully insulated, color size keyed shafts with easy-grip handles. Shaft length 2½". Comes in handy plastic tool roll. Sizes: 3/16", 1/4", 5/16", 11/32", 3/8", 7/16" and ½".

Reg. $9.00
Stock No. TL-174

$2.19 3 for $6.00

Magnavox 12" HI-FI SPEAKER SYSTEM

Custom designed Magnavox system, consists of 12" woofer with special non-polarized capacitor attached to frame, and 2 matched 4" hard cone tweeters. 12" woofer has heavy cadmium plated frame, 1" voice coil with dust cover. 4" "Deep Throat" tweeters reinforce midrange and assure clean, crisp highs. Response 45 to 17,000 cps. with 15 watt power handling capacity. Ideal for stereophonic systems where two matched speaker systems are required. With instructions. Shpg. wt. 8 lbs.

Stock No. AS-404
Reg. $20.25

$11.88 3 sets for $33

SPECIAL ENCLOSURE FOR ABOVE

Completely assembled, wood grain plastic covered. Speaker board with holes cut out, ready to install. Size: 23⅜"x13½"x19¼". Shpg. wt. 26 lbs.

Blonde Stock No. CA-120
Mahogany Stock No. CA-121

$18.95

OLSON Stores In:

AKRON
73 E. Mill St.

CHICAGO
4101 N. Milwaukee

CHICAGO
123 N. Western

CLEVELAND
2020 Euclid Ave.

PITTSBURGH
5918 Penn Ave.

MILWAUKEE
423 W. Michigan

BUFFALO
711 Main St.

IT'S EASY TO ORDER FROM OLSON'S

How to order: Order directly from this ad. For convenience use this order blank. Fill in columns below with quantity desired, stock number, description, and price. You may send remittance with order (include enough for postage or parcel post shipment), or if you prefer send a $2.00 deposit with your order and Olson will ship C.O.D. for the balance. Mail your order to: T-19 Forge St., Akron 8, Ohio.

MONEY BACK GUARANTEE: Everything you order from Olson is guaranteed as advertised. If you are not more than satisfied, you may return merchandise for cash refund.

Minimum Order $5.00

Quan.	Stock Number	DESCRIPTION	Price Each	TOTAL

☐ Here is my order for merchandise from this page. This entitles me to the 8 FREE Wholesale catalog issues.

☐ Enclosed find $1.00 for the 8 Wholesale catalog issues to be sent to me one every 6 weeks.

T-19

NAME_____

ADDRESS_____

CITY_____ ZONE___ STATE_____

Total		
Add Postage		
TOTAL AMOUNT		

Olson Radio Warehouse

**T-19 FORGE ST.
AKRON 8, OHIO**

manual which first made its debut in 1949 and has since sold over 175,000 copies in its various editions. The present volume includes characteristics on some 3000 tubes, transistors, rectifiers, and CRT's.

In addition to providing specifications on these components as made by some 20 British or British-based firms, the book lists basing information and equivalents. U. S.-made tubes are represented in each category covered: rectifiers, tetrodes and pentodes, output tubes, thermionic diodes, semiconductor diodes, transistors, amplifier tubes, transmitting tubes, tuning indicators, television CRT's, display cathode-ray tubes, etc.

Judging by the number of requests we receive for operating characteristics on British tubes, this book should enjoy a brisk sale in the U. S.

Those who work on British-built electronic equipment of all types should find this volume of more-than-passing interest. It may be ordered from the publisher at Dorset House, Stamford St., London S.E.1. —30—

Answer to Puzzle appearing on page 131

W	H	E	A	T	S	T	O	N	E	■	E	M	I	T
I	■	L	■	E	■	■	H	■	R	■	Y	■	■	H
E	L	E	C	T	R	O	M	A	G	N	E	T	■	E
N	■	C	O	■	I	■	■	■	■	T	■	■	■	R
B	■	T	R	E	B	L	E	S	■	■	B	E	A	M
R	■	R	E	D	■	O	■	N	D	■	L	■	R	O
I	■	O	■	■	■	G	E	O	R	G	E	■	R	C
D	A	S	H	■	H	■	■	W	I	R	E	■	L	O
G	■	T	■	L	I	■	A	■	V	I	D	I	■	U
E	■	A	M	■	F	C	C	■	E	D	■	F	■	P
■	S	T	U	D	I	O	■	I	■	D	C	■	■	L
■	■	I	■	■	■	■	V	■	■	I	■	H	U	E
D	E	C	A	D	E	■	S	K	I	P	■	A	L	■
O	■	■	■	A	N	S	W	E	R	■	■	L	■	■
T	E	L	E	M	E	T	R	Y	■	P	H	O	N	E

PHOTO CREDITS

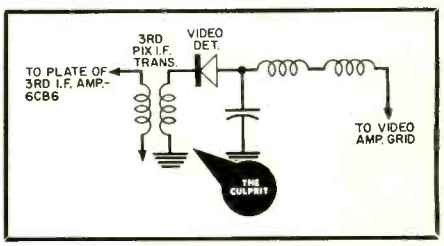
Page	Credit
37, 39	Amperex Electronic Corp.
38, 40 (right)	Induction Heating
40 (left)	Blackstone Washing Machine
52 (lower right)	RCA
(left & upper right)	Jerrold Electronics Corp.
54, 55, 70, 105	General Electric Co.
62	Delco Radio Div., General Motors Corp.
69	Hughes Aircraft Co.
86	Burroughs Corp.
103	Sprague Electric Co.
124	Lafayette Radio
156	Sylvania Electric Products Inc.

SOLUTION TO BENCH PUZZLER NO. 4

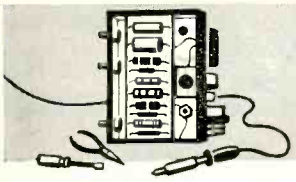
(*See page* 102)

Have you come across an interesting service job lately? Send it to the "Puzzler" Editor, RADIO & TV NEWS, *using this format. We will pay for items used at regular rates. Others will be returned.*

TAKING another look at that part of the circuit which is reproduced here, we realized something. While we had to use the top-of-the-chassis method to check out the diode, this measurement to ground would be valid *only* if the secondary of the i.f. transformer had continuity. The trouble turned out to be an intermittently poor connection to this secondary. In fact, the reading across the winding was a few thousand ohms. The repair was indeed simple: a cold solder joint in the 3rd video i.f. transformer was sweated.



Sylvania Electronic Tubes, a division of Sylvania Electric Products Inc., has moved into this handsome 190,000-square-foot plant in Altoona, Pa. where a wide variety of receiving tubes, subminiature tubes, TV picture tubes, and CR tubes will be manufactured. The new structure is fully air-conditioned, thus insuring constant temperature and humidity control. The plant contains approximately 110,000 square feet of production space and features one of the most modern systems for d.c. voltage generation and distribution. The new plant was designed by the firm's Facilities Planning Office in Williamsport, Pennsylvania.



ELECTRONICS MARKET PLACE

RATE: 50¢ per word. Minimum 10 words. March 1959 Issue closes January 9th. Send order and remittance to: RADIO & TV NEWS, One Park Ave., N. Y. C. 16, N. Y.

FOR SALE

RADIO & TV Tubes at manufacturers prices. Guaranteed—Send for free price list. Edison Electronic Tube Co., Menlo Park, N. J.

GOVERNMENT Sells — Surplus Electronics; Walkie-Talkies; Transceivers; Test Equipment; Oscilloscopes; Radar; Voltmeters; Misc.—Fraction of Army costs—Buy direct now from U. S. Government—"Depot List & Procedure" $1.00—Brody, Box 8-RT, Sunnyside 4, New York.

TUBES—TV, Radio, Transmitting And Industrial Types At Sensibly Low Prices. New, Guaranteed, 1st Quality, Top Name Brands Only. Write For Free Catalog or Call WAlker 5-7000, Barry Electronics Corp., 512 Broadway, New York 12N, N. Y.

TELEVISION Sets $11.95. Plus shipping. Jones TV, Saratoga, Pa.

TELEVISION & Radio Tubes, Parts and Supplies Guaranteed. Hi-Quality Tube Co., Inc., 284 Lafayette St., Rahway, New Jersey.

GOVERNMENT Surplus Snooperscopes, parabolic reflectors, Receivers, Transmitters. Picture list 5¢. Meshna, 580 N. Lynn, Malden 48, Mass.

WHOLESALE Prices transistor supplies, Stereo, Hi-Fi amplifiers, changers, speakers, Eico kits, tubes. Schaak Electronics, 3867 Minnehaha Ave., Minneapolis 6, Minnesota. PA 9-8382.

WHY guess? Build Impedance Bridge for measuring inductance, capacitance, resistance. Description, circuitry, photos, $3.00 postpaid. Lester, 3820 Purdue, Houston, Texas.

FREE Fluorescent Lighting Catalog. Inexpensive kits, parts, fixtures. Shoplite, 650N Franklin, Nutley 10, New Jersey.

EMERGENCY TV-FM Antenna. Installed in minutes $1.25 ppd. Dealers invited. Trimark Products, 320 Depot Rd., Huntington Station, New York.

FOR Sale 700 New Tubes; Pentron PMD1 Tape Recorder like new; Recordio portable 78 Disc Recorder; Misc. Test Equipment; Speakers; complete Fotofacts; Amplifier System. Write. Edward B. Everhart, Smyrna, Delaware.

MILITARY communications receivers such as 388's, 389's, 390's, 51J's, both sold and serviced. Gizmos & Such, Still River, Massachusetts.

TRADE-IN TV $6 up, Also Color. Write, Justis, Newport, Delaware.

WANTED

WANTED: Heathkit discontinued WA-P1 preamplifier with manual. David Kaiser, 150 Dorchester Road, Rochester 10, New York.

CASH Paid! Sell your surplus electronic tubes. Want unused, clean transmitting, special purpose, receiving, TV types, magnetrons, Klystrons, broadcast, etc. Also want military & commercial lab test and communications gear. We swap too, for tubes or choice equipment. Send specific details in first letter. For a fair deal write, wire or telephone. Barry, 512 Broadway, New York 12, N. Y. WAlker 5-7000.

CYLINDER and old disc phonographs. Edison, Conqueror, Idelia, and Oratorio models. Berliner Gramophones and Zono-o-phones, Columbia cylinder Graphophones, and coin-operated cylinder phonos. Want old catalogues and literature on early phonos prior to 1919. Will pay cash or trade late hi-fi components. Classified Box 50 % Radio & TV News, 1 Park Ave., N. Y. C. 16, N. Y.

WANTED! Special Purpose Vacuum Tubes; Klystrons, Magnetrons, Power Tubes; Lab Test Equipment: X, S, K bands, Signal Generator, Slotted Lines; Aircraft Communications Equipt. We pay top prices fast! REpublic 5-0215. V & H Radio-Electronics, 2033 W. Venice Blvd., Los Angeles 6, Calif.

NOTICE

In replying to box numbers be sure to address letters to

RADIO & TV NEWS

1 Park Ave., New York 16, N. Y.

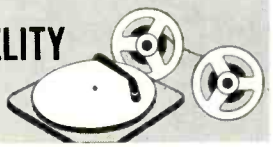
Note: This does not apply to box numbers where city and state are shown

LABORATORY Quality Equipment and Military Surplus Electronics bought, sold. Engineering Associates, 432 Patterson Road, Dayton 9, Ohio.

RADIO ENGINEERING

ELECTRONICS! Associate degree—29 months. Technicians, field engineers, specialists in communications, missiles, computers, radar, automation. Start February, September. Valparaiso Technical Institute, Dept. N, Valparaiso, Indiana.

HIGH-FIDELITY



INDUCTORS for Crossover networks. 118 Types in stock. Send for brochure. C & M Colis, 3016 Holmes Ave., N. W. Huntsville, Alabama.

DISGUSTED with "Hi" Hi-Fi Prices? Unusual Discounts On Your High Fidelity Requirements. Write. Key Electronics, 120 Liberty St., New York 6, N. Y. EVergreen 4-6071.

WORLD Renowned Hartley Speakers now available to Dealers, Servicemen, Custom Installers, lowest franchise requirements in high fidelity. Write Hartley Products Company, 521 East 162 Street, New York 51, N. Y.

PRICES! Try Ours! Everything in Hi-Fi. Factory-sealed components. Send for free catalog. Audion, 25T Oxford Road, Massapequa, L. I., N. Y.

UNUSUAL Values. Hi-Fi components, tapes and tape recorders. Free catalog. TV and Stereo Center, 51 W. 35 St., N. Y. C. 1.

SAVE Money. Get our quotations before you buy. Write to Dept. T, Professional HiFi, Box 62, Canal St. Station, N. Y. C. 13.

TAPE & RECORDERS

RECORDERS, Tape Decks, Stereo, Tapes, Accessories, Excellent Values, Catalogue. Efsco, 270S Concord, West Hempstead, N. Y.

DISCOUNTS to 50%, recorders, tapes, hi-fi components, consoles, photograph equipment. Request specific prices only. Free Stereo Catalog. Long Island Audio & Camera Exchange, 3 Bay 26th Street, Brooklyn 14-N, N. Y.

RECORDERS, HiFi, Tapes, Free Wholesale Catalog. Carston, 215-R East 88 St., N. Y. C. 28.

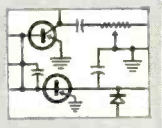
TAPE Recorders, hi-fi components, tapes. Unusual Values. Free catalog. Dressner, 69-02 R, 174 St., Flushing 65, N. Y.

AMPEX, Concertone, Crown, Ferrograph, Presto, Tandberg, Pentron, Bell, Sherwood, Rek-O-Kut, Dynakit. Others. Trades. Boynton Studio, 10RT Pennsylvania, Yonkers, N. Y.

REPAIRS and SERVICING

ALL Makes High Fidelity Speakers Repaired. Amprite, 70 Vesey St., N. Y. 7, N. Y. BA 7-2580.

INSTRUCTION



ENGINEERING Degrees Earned through Home Study. Electronics, Electrical, Mechanical, Civil, Physics. When writing, specify course desired. Pacific International College of Arts and Sciences, primarily a correspondence school. Residence classes also carried. 5719-C Santa Monica Blvd., Hollywood 38, California.

GUIDED Missile Fundamentals. Covers aerodynamic principles and electronic guidance systems. 575 pages! Profusely illustrated! $3.50, handling 25¢. Liebert-Keidel Books, Box 32, Darby, Pennsylvania.

TECHNICAL INSTITUTES

ELECTRONIC And Aeronautical Engineering Technology. Two Year Courses. Bachelor of Science Degree in three years. Northrop Institute in Southern California prepares you for highly paid positions in Aviation and Electronic industries. Employment assistance during school and after graduation. Approved for Veterans. Write for free catalog. Northrop Aeronautical Institute, 1183 Arbor Vitae, Inglewood 1, California.

BUSINESS OPPORTUNITIES

TV Picture tube rebuilding plant and training program still available for many territories. Investment $8,000-$11,000. Annual volume $25,000 to $100,000. Windsor Co., 999 N. Main St., Glen Ellyn, Illinois.

HELP WANTED

POSITION Open. Technician as assistant in electronics service shop. Salary range $3600/year. Apply to Dean Virgil W1 Adkisson, Research Coordinator, University of Arkansas, Fayetteville.

MISCELLANEOUS

DECALS—Trademarks, Service, Sales, etc. Write Allied Decals, Inc., 8378 Hough, Cleveland, Ohio.

NEW Organ Builders Manual—Guide to assembling your own electronic organ. 123 pages, profusely illustrated. $2.00 postpaid. Electronic Organ Arts, Box 41084, Los Angeles, Calif.

HOME Brewed Wines, Beers. Complete Book $1.00. ABC Publications, Box 849, San Francisco 1-EN, California.

PHONOGRAPH Records cheap, postpaid. Catalogue. Paramount, Box 242-N, Williamsport, Penna.

INDEX OF Advertisers

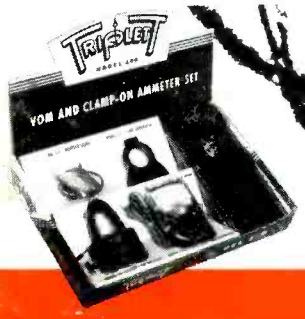
JANUARY 1959

While every precaution is taken to insure accuracy, we cannot guarantee against the possibility of an occasional change or omission in the preparation of this index.

Have 310 • Will Travel...

Light!

- Hand size, but with the features of a full-size V-O-M.
- 20,000 ohms per volt DC; 5,000 AC.
- EXCLUSIVE SELECTOR SWITCH speeds circuit and range settings. The first miniature V-O-M with this exclusive feature for quick, fool-proof selection of all ranges.
- SELF-SHIELDED Bar-Ring Instrument; permits checking in Strong Magnetic Fields.
- Fitting interchangeable test prod tip into top of tester makes it the common probe, thereby freeing one hand.
- Unbreakable plastic meter window.
- BANANA-TYPE JACKS—positive connection and long life.



MODEL 100

Actual Size
$34.50 Net
Carrying Case $3.20

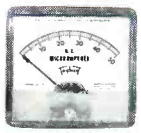
The most comprehensive test set in the Triplett line is Model 100 V-O-M Clamp-On-Ammeter Kit, now available at distributors. The world's most versatile instrument—a complete accurate V-O-M plus a clamp-on-ammeter with which you can take measurements without stripping the wires. Handsome, triple-purpose carton holds and displays all the components. Model 310 miniaturized V-O-M, Model 10 Clamp-On-Ammeter, Model 101 Line Separator, No. 311 extension leads and a Leather Carrying-Case, which neatly accommodates all the components. Model 101 literally makes it possible to separate the two sides of the line when using Model 10. Extension leads permit use of Model 10 at a distance from the V-O-M. Complete Model 100 is only $59.50.

TRIPLETT

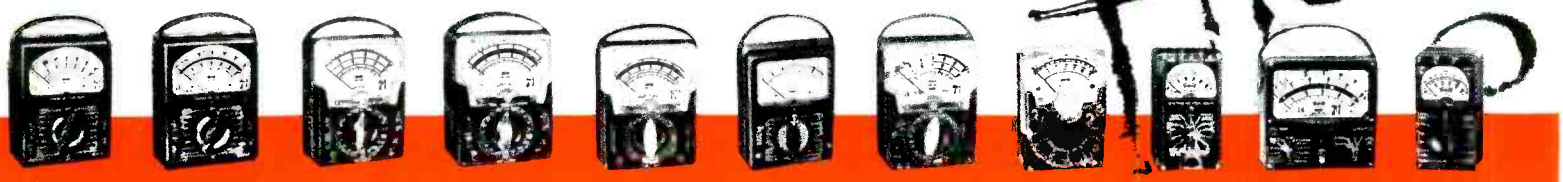
For full information see your Triplett distributor

or write

TRIPLETT ELECTRICAL INSTRUMENT COMPANY • BLUFFTON, OHIO



PANEL METERS / AND A VOM FOR EVERY PURPOSE AND EVERY PURSE



630 | 630-A | 630-PL | 630-APL | 630-NA | 630-T | 631 | 310 | 666-HH | 625-NA | 666-R

one of these Electro-Voice microphones will meet your needs best

CHOOSE FROM THE WORLD'S MOST COMPLETE LINE: ELECTRO-VOICE THE CHOICE OF PROFESSIONALS

Whatever your microphone problem, Electro-Voice has the solution. Because only Electro-Voice offers you such a wide selection to choose from, and only Electro-Voice has spent years of painstaking research to bring you microphones which rate BEST in every category.

Choose from carbon, crystal, ceramic or dynamic E-V microphones; choose any pick-up pattern: non-directional, cardiod, or differential Electro-Voice has them all. Look at this chart . . . and choose the BEST. And, for detailed information regarding special applications, write

Electro-Voice INC., BUCHANAN, MICHIGAN

NONDIRECTIONAL MICROPHONES pick up sound equally well from all directions. In this diagram of a pick-up pattern, the omnidirectional microphone is in the center. Diagrams of pick-up patterns are often called polar patterns.

CARDIOID (UNIDIRECTIONAL) MICROPHONES, so named because their polar pattern is heart shaped, pick up sound arriving at the front and reject sound arriving at the back. Proper placement of cardioid microphones reduces pick-up of ambient noise and echoes, minimizes risk of feedback.

DIFFERENTIAL MICROPHONES have a noise-cancelling pick-up pattern. Sound waves originating from a point more than a few inches away from the microphone enter both sides of the case at the same time and cancel each other. When sound source is close to microphone, the sound waves do not cancel. Differential microphones are ideal for use in areas of high surrounding noise.

ACOUSTALLOY DIAPHRAGM IN ALL DYNAMIC MICROPHONES. Armstalloy—the virtually indestructible diaphragm material—gives peak-free response, prevents popping as commonly experienced by explosive syllables "B" and "P" in ribbon-type microphones. Because Acoustalloy gives improved response, operators can work with confidence under rigorous program conditions.

ELECTRO-VOICE MICROPHONES FOR EVERY PURPOSE

MODEL NUMBER	667	666	665	655C	654	649A	646	635	664	636	630	647	623	611	605	615	911	926	920	715	727	924	912	951	6225KK	625SKK	606	648	602	602TR	210KK	205KK	205STCKK
PICKUP PATTERN	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
BROADCAST—TV																																	
Telecast	•	•	•	•	•	•	•																										
Studio	•	•	•	•	•	•	•	•																									
Remote		•	•	•	•	•	•	•	•	•	•	•																					
PUBLIC ADDRESS																																	
Auditorium	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•									
Stadium		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•									
Hotel, Motel																									•	•	•	•					
Mobile																																	
Broad Coverage—Stage	•	•	•	•	•				•	•	•													•									
Localized—Stage	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Paging									•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Church, Pulpit		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•									
COMMUNICATIONS																																	
Railroad																									•	•	•	•	•	•			
Emergency—Fixed									•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
Emergency—Mobile																									•	•	•	•	•	•	•	•	•
Marine																									•	•	•	•	•	•			
Aircraft—Ground Station									•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•			
Aircraft—Airborne																									•	•	•	•	•	•	•	•	•
Bus, Taxi—Mobile																									•	•	•	•	•	•			
Inter-Communication									•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•			
Amateur—Fixed									•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•									
Amateur—Mobile																									•	•	•	•	•	•	•	•	•
RECORDING																																	
Studio Recording	•	•	•	•	•				•	•															•	•							
Disc—Professional	•	•	•	•	•				•	•																							
Tape—Professional	•	•	•	•	•				•	•																							
Tape—Home									•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•			
DICTATING MACHINES																																	
SOUND LEVEL MEASUREMENT				•	•			•		•																							
GENERATING ELEMENT																																	
Dynamic	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•									•	•	•	•	•	•			
Crystal																	•	•	•														
Ceramic																				•	•	•	•	•									
Carbon																															•	•	•

BROADCAST AND TV MICROPHONES

Model 666
Dynamic, Cardioid
Rejects unwanted sound—doubles the working distance—wide range. Floor or desk stand and boom mount available.

Model 667
Dynamic, Cardioid
Variable response—low noise—transistorized—shockproof. Controls compensate for varied acoustic conditions found in TV, broadcast, recording.

Model 665
Dynamic Cardioid
Economical—high value—top performance. Similar to 666 but designed for less exacting conditions.

Model 655C
Dynamic, Nondirectional
Widest range—to 22KC for TV, broadcast and recording. Can be hand-held or mounted on floor or desk stand.

Model 654
Dynamic, Nondirectional
Similar to 655C except designed for all-around use; economical.

Model 646
Dynamic, Nondirectional
Compact lavalier for chest, desk or hand use. Designed for broadcast, TV or PA use.

Model 648A
Dynamic, Nondirectional
Exceptionally small; highest quality lavalier that can be easily concealed anywhere for chest or hand use.

Model 635
Dynamic, Nondirectional
For TV, broadcast, recording; ideal for remote use—rugged. May be hand held or mounted on desk or floor stand.

PUBLIC ADDRESS, RECORDING AND GENERAL PURPOSE MICROPHONES

Model 664
Dynamic, Cardioid
Designed for rugged use in any PA, recording or communications situation. Doubles working distance—minimizes feedback.

Model 636
Dynamic, Nondirectional
World's finest for wide range PA, recording and general purpose. Slim style does not hide entertainer.

Model 630
Dynamic, Nondirectional
Favorite for years in PA, with recording, amateurs and broadcast applications.

Model 647
Dynamic, Nondirectional
A versatile PA lavalier for chest, desk or hand use, indoors or outdoors.

Model 623
Dynamic, Nondirectional
Handsome modern styling. Designed for PA general use or recording.

Model 611
Dynamic, Nondirectional
Under the performance for general sound pick-up, PA, recording and amateur uses.

Model 911
Crystal, Nondirectional
For economical PA, home recorders, amateur uses. Desk or floor stand mounting.

Model 605
Dynamic, Nondirectional
A small, convenient microphone for PA, general purpose, or paging. Desk or floor stand mount.

Model 615
Ceramic, Nondirectional
An inexpensive microphone for general PA, home recording and amateur uses. Hand held, or mounted on desk or floor stand.

Model 951
Crystal, Cardioid
For widest variety of PA, general purpose and amateur uses. Increases working distance—retards feedback.

Model 926
Crystal, Nondirectional
Excellent for PA, general purpose, paging, home recording and amateur use.

Model 920
Crystal, Nondirectional
All direction pickup for conferences, discussions, home recording and PA.

Model 727
Ceramic, Nondirectional
Designed for PA, paging, recording and amateur uses. Hand held, desk or stand mounted.

Model 924
Crystal, Nondirectional
Small lavalier for chest or hand use, home recording, PA and amateur applications.

Model 912
Crystal, Nondirectional
An inexpensive microphone for general PA, home recording and amateur uses. Hand held.

Model 718
Ceramic, Nondirectional
Suitable for paging, home recording and amateur use. Can be hand held or desk mounted.

COMMUNICATION MICROPHONES

Model 210KK
Carbon, Nondirectional
Single button microphone for general replacement and amateurs.

Model 900D
Dynamic, Nondirectional
A rugged mobile microphone. Offers flat response and light weight.

Model 205KK
Carbon, Differential
Noise cancelling close talking microphone for Private Aircraft or any noisy vehicle. Discriminates against all noise from any direction.

Model 205STCKK
Carbon, Differential
A noise cancelling microphone for commercial aircraft. Has CAA type certificate 1040.

Model 802
Dynamic, Differential
Noise cancelling, hand held, microphone for mobile or fixed station use.

Model 800TR
Dynamic, Nondirectional
Same as 800D but has built-in transistor amplifier. Works in carbon microphone input to give high quality sound.

Model 802TR
Dynamic, Differential
Same as 802 but has built-in transistor amplifier. Works in carbon microphone input.

SPECIAL PURPOSE MICROPHONES

Model 606
Dynamic, Differential
Noise cancelling microphone for stand use under high ambient noise.

Model 648
Dynamic, Nondirectional
For intercom, paging or PA. Mount on stand, boom, gooseneck or Model 448 boom.

Model 622SKK
Dynamic, Nondirectional
Handset type microphone for paging, intercom and communications uses.

Model 625SKK
Dynamic, Differential
Noise cancelling handset for use under high noise conditions.

Model 805
Crystal, Contact
Mounts directly on body of guitar, banjo, mandolin, violin or any vibrating musical instrument.