FEBRUARY, 1961

ELECTRONICS WORLD

50 CENTS

Complete Directory—HI-FI TURNTABLES

NEW TV DESIGNS FOR 1961

COMMERCIAL SOUND SYSTEM FUNDAMENTALS

HOW TO ADD A HANDSET TO YOUR CB TRANSCEIVER

AN R.F. PLASMA TORCH

GOING "BROKE" ON FILAMENT "BREAKS"?

NEW SYLVANIA 1G3/1B3 HAS BUILT-IN "PROFIT PROTECTION."

It's hard to make a dollar in this TV service business. And call-backs on tubes make it even tougher. That's why Sylvania concentrates on making tubes that perform better and last longer.

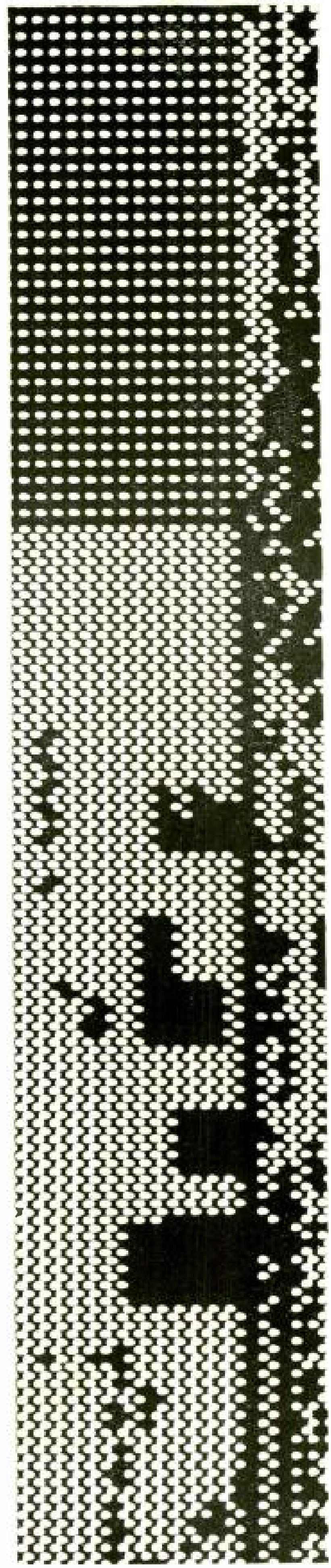
Take the new Sylvania 1G3/1B3, for example. The improved filament has increased life span and operates at reduced temperature. Plate is extra-big. Volume of space between it and the filament is enlarged. (That adds to "cooler" filament operation without lowering emission capabilities, and cuts probability of plate-to-filament arc-over.) Glass envelope has extraordinarily high electrical resistivity. This reduces electrolysis and the development of gas and leakage.

Further, every new Sylvania 1G3/1B3 is tested for emission, for arcing and electrical stability at maximum ratings, and arc-over-proofed at higher-than-rated plate voltages to give extra assurance of long tube life.

So, give yourself a break. Replace defective 1G3/1B3 high-voltage rectifier tubes with the new long-life SYLVANIA 1G3/1B3. Available from your distributor . . . now! Electronic Tubes Division, Sylvania Electric Products Inc., 1740 Broadway, New York 19, N. Y.

SYLVANIA

Subsidiary of **GENERAL TELEPHONE & ELECTRONICS**



ELECTRONICS WORLD 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 $5.00; Pan American Union Countries $5.50; all other foreign countries $6.00.

ELECTRONICS WORLD

FEBRUARY, 1961
VOL. 65 • NO. 2

ZIFF-DAVIS PUBLISHING COMPANY
William Ziff, President; W. Bradford Briggs, Executive Vice-President; Michael Michaelson, Vice-President and Circulation Director; Hershel B. Sarbin, Vice-President; Charles Housman, Financial Vice-President; Richard Kislik, Treasurer.

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

Member
Audit Bureau of Circulations

BRANCH OFFICES: Midwestern Office, 434 S. Wabash Ave., Chicago 5, Ill.; Western Office, 9025 Wilshire Blvd., Beverly Hills, Calif., James R. Pierce, manager.

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

First in radio-television-audio-electronics

CONTENTS

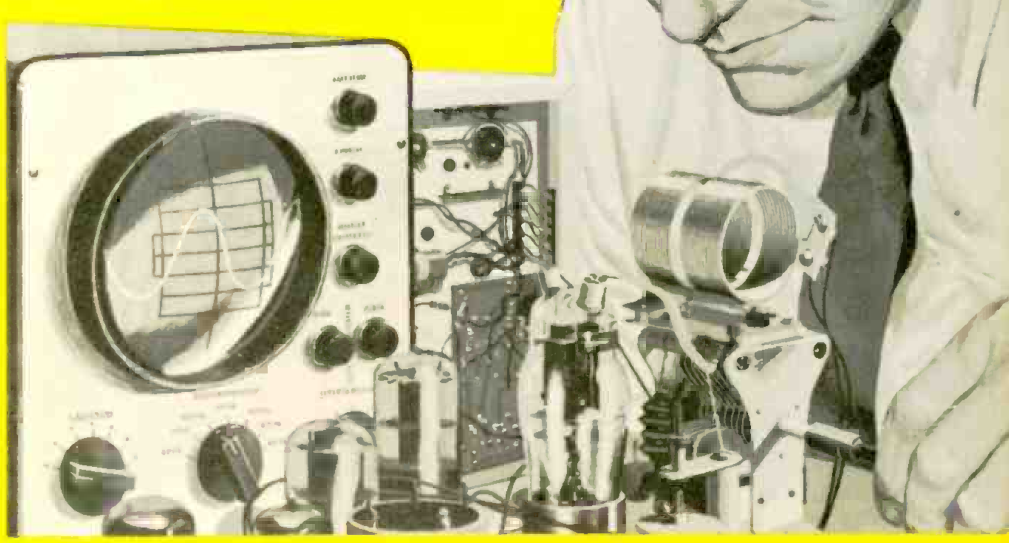
Net Paid Circulation 251,895

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

SUBSCRIPTION SERVICE: Forms 3579 and all subscription correspondence should be addressed to Electronics World, 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.

Learn RADIO, TELEVISION AND ELECTRONICS by Practicing at Home in Your Spare Time



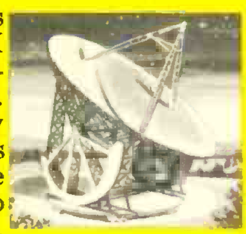
At No Extra Cost you get specially developed Electronic Training Kits for practical experience. Shop and laboratory practice at home make learning easier, interesting, faster. You do not need a high school diploma or previous experience.

Increasing Demand for Trained Men

This is the Electronics age. Men with Electronic know-how are in demand. They enjoy high pay and growing opportunities for advancement. Satellites, Radar, Automation in Industry, Missiles, Rockets, Planes, Stereo, TV, Radio, Two Way Communications for transportation are a few of the fantastic developments in the fast growing Electronics industry. If you are not completely satisfied with your work; if you are doubtful about your future, investigate Electronics.

High Pay, Prestige, Bright Future

What branch of Electronics interests you? Thousands of successful NRI graduates prove that NRI's learn-by-practice method is the way to success. You start in your chosen career 'way ahead of the man who only learns from books. You do not need to give up your job. You do not need to go away to school. You learn at home, get practical knowledge from training kits NRI provides.



Train With the Leader

NRI is the world's oldest and largest home study Electronics school. You benefit from the experience NRI has gained from training men for 45 years. NRI offers you proven courses of home study in Electronics; Principles, Practices and Maintenance—Radio Television Communications—Radio Television Servicing.

Start Soon to Earn More

Soon after enrolling NRI shows you how to apply your knowledge to earn extra money doing Electronics repairs or servicing Radio and Television sets for friends and neighbors. Take the first step toward success now. Find out what NRI offers you. Mail the postage-free card. No obligation. Cost of NRI training is low. Monthly payment plan available. NATIONAL RADIO INSTITUTE, Washington 16, D.C.

NRI Has Trained Thousands for Success

"I get over twice the salary I made before enrolling. NRI training gave me a thorough understanding." H. ATKINSON, Austin, Tex.

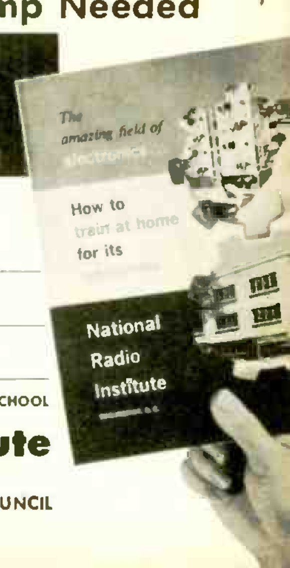
"I started with station CJIC, now in charge of sound effects for CBC. NRI opened doors to greater opportunity for me." F. TUDOR, Toronto, Ontario

"Averaged $150 a month spare time before I graduated. Now have my own full time business and employ 2 men." F. W. COX, Hollywood, Cal.

NEW COURSE IN ELECTRONICS TURN PAGE

Cut Out and Mail—No Stamp Needed

64-PAGE CATALOG FREE



No Salesman will call. (Please PRINT) YZ

Name ______________________ Age ____

Address ______________________

City ____________ Zone ____ State ____________

OLDEST & LARGEST HOME STUDY RADIO-TV SCHOOL

National Radio Institute

WASHINGTON 16, D. C.

ACCREDITED MEMBER NATIONAL HOME STUDY COUNCIL

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 to regulate all wire and 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 should prepare for his *second class* radiotelephone license after from 200 to 250 hours of study. This same student should then prepare for his *first class* license in approximately 75 additional hours of study.

In the Grantham *resident course*, the time normally required to complete the course and get your license 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 (3 nights a week) you should get your *second class* license at the end of the 15th week of classes and your *first class* license at the end of 5 additional weeks of classes. This makes a total of less than 5 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 pre-examination 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	Weeks
Neil W. Michel, 402 E. Jefferson, Owensville, Mo.	1st	12
L. Gordon Combs, RR#3, Box 279A, Hemet, Calif.	1st	11
Daniel A. Ruch, Station KVOZ, Box 1498, Laredo, Texas	1st	12
George H. Sanderson, 128½ W. 4th Street, Marysville, Ohio	1st	8
Donald F. Teneyck, 58 Brighton Road, Worcester, N. Y.	1st	12
Richard Scherzer, Apt. 5, 1175 S. Franklin Ave., Los Angeles, Calif.	1st	13
Jerry Miller, P. O. Box 1253, Charleston, West Virginia	1st	11
David M. Tarter, 1174 Hilltop Road, Kansas City 4, Kansas	1st	12
Verne S. Melton, Jr., 1014 Canyon Road, Santa Fe, New Mexico	1st	8
Gerald T. Bullock, 613 Keefer Place, NW, Washington, D. C.	1st	12

Resident Classes Offered at Four Locations

To better serve our many students throughout the nation, Grantham School of Electronics maintains four separate schools—located in Hollywood, Seattle, Kansas City, and Washington, D.C.—all offering the same resident courses in F.C.C. license preparation. (Correspondence courses are conducted from Hollywood.)

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

1505 N. Western Ave. Hollywood 27, Calif. (Phone: HO 7-7727)	408 Marion Street Seattle 4, Wash. (Phone: MA 2-7227)	3123 Gillham Road Kansas City 9, Mo. (Phone: JE 1-6320)	821 - 19th Street, N.W. Washington 6, D.C. (Phone: ST 3-3614)

MAIL COUPON NOW—NO SALESMAN WILL CALL →

MAIL COUPON TO SCHOOL NEAREST YOU

(Mail in envelope or paste on postal card)

To: GRANTHAM SCHOOL OF ELECTRONICS

1505 N. Western **Hollywood** • 408 Marion **Seattle** • 3123 Gillham Rd **Kansas City** • 821-19th, NW **Washington**

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 ______

I am interested in: ☐ Home Study, ☐ Seattle classes

☐ Hollywood classes, ☐ Kansas City classes, ☐ Washington classes

10B

. . . for the Record

By **W. A. STOCKLIN**
Editor

The Service Technician and Hi-Fi

WHEN something goes wrong with his treasured equipment, the owner of a hi-fi system, even today, faces a special problem. Is his dependable TV service dealer the man for the job? For their part, TV technicians are also in a peculiar position. Few seek hi-fi work actively. Some even shun it when they are asked. Surely they know that the plum they leave dangling on the branch is a ripe one. The music-system owner is not likely to be so price conscious about service as he or anyone else is when the TV set dies.

What makes dealers hold back? The circuits of amplifiers and tuners may be quite sophisticated, but they are no more complex than those in TV receivers and usually simpler. Also, they are not unfamiliar.

Many technicians are aware that a difference in troubleshooting approach, but not necessarily in technique, is involved. Others suspect that, to do conscientious work, they may have to invest heavily in special equipment whose cost they may not be able to justify by the results. Another great impediment is the dealer's feeling that he falls far short of the non-technical requirements for the job. He may not have the slightest notion of how a hi-fi system should sound. He may not consider himself a critical listener of any type of music. How then can he establish criteria, which he feels are largely subjective, for evaluating his work?

As to service approach, no one will question that a great difference exists. Completing a repair on a TV set means getting it to work. On a hi-fi amplifier, the requirement is to get it to work *right*. Of course, there are performance standards in TV too, but they are broad. The picture must be sufficiently clear and stable to be viewed without annoyance. The sound must be intelligible. But who ever checks the response of a video or TV sound amplifier? Hi-fi *is* different. In fact, performance level when the technician is called in may seem quite acceptable to him—better than that last TV set on which he "fixed the sound" by replacing a shorted tube. But now he hears strange complaints of muddiness, raspiness, lack of definition, poor frequency balance, or other bewildering, subjectively stated conditions.

Clearly, replacing a defective capacitor or resistor is not the end of a hi-fi repair. More refined performance checks are needed. As to the presumed "language" problem, this is neither new nor insurmountable. How often can a skilled TV technician translate the set owner's subjective account of his trouble, given over the phone, into something meaningful? The "moving lines," which sound just like interference, turn out to be lost horizontal sync. With a little experience, the strange vocabulary of the hi-fi fan can be related to such measurable phenomena as intermodulation distortion and limitations in frequency response.

Adequate equipment is less of a problem. The meters, generators, and oscilloscope already on hand are probably satisfactory. A distortion analyzer—and one such is important—is no longer an expensive laboratory rarity. Satisfactory ones are now available in the price range the service dealer is accustomed to paying for his instruments. Such necessary paraphernalia as stylus-pressure gauges and strobe discs do not involve enough money to merit a second thought.

Perhaps the greatest hurdle is the technician's assumption that he is not qualified to evaluate performance. If that is so, he is the victim of a common error. True, the determination of what constitutes good performance and relating it to objective standards is a formidable problem. It is of the utmost importance to the audio design engineer and the music lover. But it is not the requirement of service.

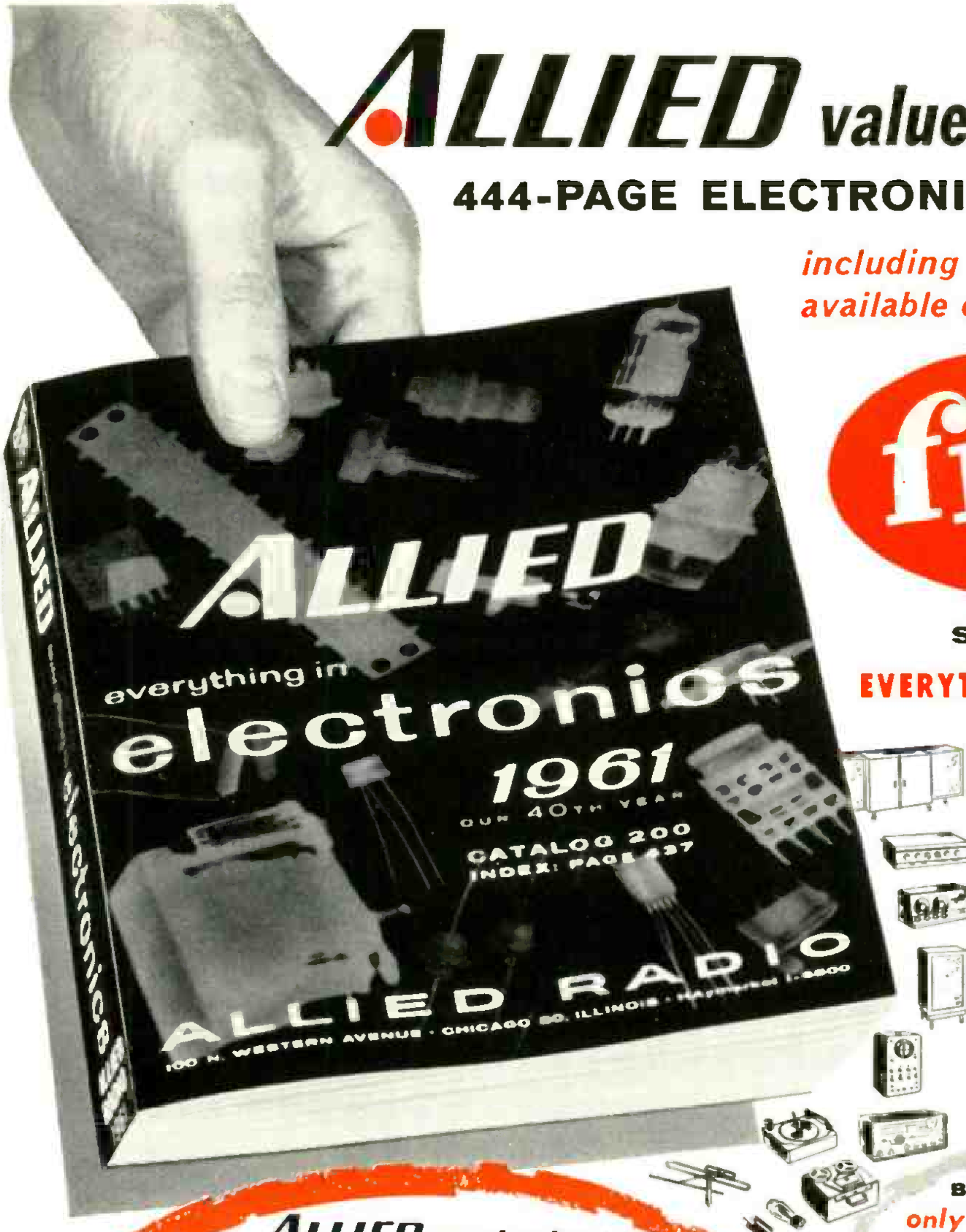
Hi-fi repair does indeed go beyond fixing obvious defects to include restoration of original capability. But this much can be done on the basis of specifications and measurement without becoming a master musician. Take a misaligned FM tuner as an example. It will not have a pleasant sound. If it is carefully aligned to its original condition, it will sound just as good—or bad—as it once did, whether the technician is a musician or stone deaf. Another example: A 50-watt amplifier sounds very muddy and weak in the bass. At least the owner says so! When you try to push a 30-cycle sine wave through it with your generator, you can see clipping (distortion) on the scope before you get to 20 watts. You find and replace a weak output tube. Beyond that, you re-set the bias and balance controls in the push-pull stage correctly. The sine wave goes through cleanly to 50 watts now. You have done your work. The owner will hear the difference, even if you don't.

We are not deriding the value of a little musical sophistication. It will certainly be helpful, if not downright necessary. However, the point we make is apart from this: the ability to repair hi-fi equipment is not a mystical quality possessed by the very few. A technician who is already skilled and conscientious needs only one more thing—a little experience. Perhaps the man who originally aligned that tuner at the factory can't even hum! So give it a try. —30—

ALLIED value-packed 1961

444-PAGE ELECTRONICS CATALOG

including special products available only from Allied



free

SAVE MOST ON

EVERYTHING IN ELECTRONICS

- New Stereo Hi-Fi Systems—Everything in Hi-Fi Components
- Money-Saving, Build-Your-Own KNIGHT-KITS® for Every Need
- Best Buys in Recorders & Supplies
- Newest Public Address Systems, Paging and Intercom Equipment
- Amateur Receivers, Transmitters and Station Gear
- Citizen's Band 2-Way Radio
- Test and Laboratory Instruments
- TV Tubes, Antennas, Accessories
- Huge Listings of Parts, Tubes, Transistors, Tools, Books

BUY ON EASIEST TERMS
only $2 down on orders up to $50;
only $5 down on orders up to $200;
only $10 down over $200.
Up to 24 months to pay.

ALLIED exclusives:

MONEY-SAVING KNIGHT-KITS®—truly the very best in build-your-own electronic equipment—lowest in cost, easiest to assemble, best for performance. Select from a complete line of Stereo hi-fi kits, Hobbyist kits, Test Instrument and Amateur kits. KNIGHT-KITS are an exclusive ALLIED product.

KNIGHT® STEREO HI-FI—Comparable to the best in quality, styling and performance, yet priced far lower. Select super-value KNIGHT components or complete systems and save most. Also see the largest selections of famous-name hi-fi components and money-saving ALLIED-recommended complete high-fidelity music systems.

Exclusive Allied products save you more

You get every buying advantage at ALLIED: Lowest, money-saving prices, fastest shipment, expert personal help, easiest-pay terms, satisfaction guaranteed or your money back.

send coupon today for 444-page catalog **free**

ALLIED RADIO, Dept. 1-B1
100 N. Western Ave., Chicago 80, Ill.

☐ Send FREE 1961 Allied Catalog No. 200

Name ______________________
PLEASE PRINT

Address ______________________

City ____________ *Zone* ____ *State* ____________

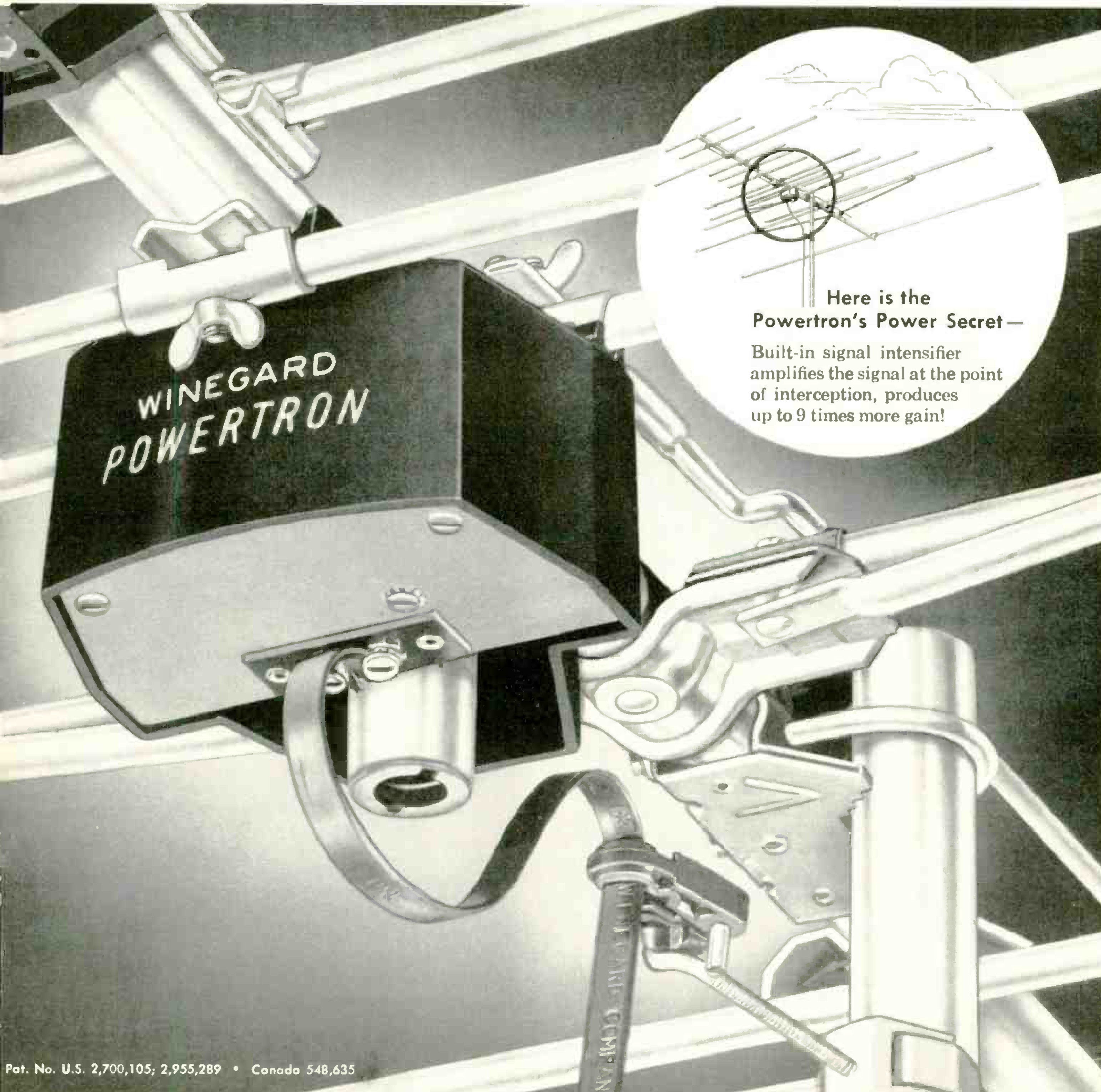
ALLIED RADIO

Satisfaction Guaranteed or Your Money Back

World's Largest Electronic Supply House

our 40th year

World's first Electronic TV Antenna



NOW AN ANTENNA WITH 5-9 TIMES MORE GAIN

THAN ANY TV ANTENNA EVER MADE!

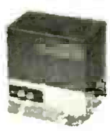
Here's the antenna that will obsolete tens of thousands of old-style antennas, will give new life to old TV sets, will build new profits for TV Service Technicians.

WINEGARD POWERTRON

POWERTRON AMPLIFIES TV SIGNALS AT THE POINT OF INTERCEPTION

Now Winegard engineers have designed a new high gain, all-channel yagi antenna incorporating a low noise, high gain RF amplifier in one integral unit! Because the input circuit of this amplifier *exactly matches* the characteristics of the *new "Tapered T" driven elements* to which it is *directly coupled*, every last particle of signal is amplified. The results are amazing.

We call this new electronic antenna the POWERTRON. The Powertron amplifier uses the frame grid 6DJ8 dual triode (12,500 MHOS) transconductance, in a radical new RF circuit, that allows this one tube to amplify all signals in the VHF TV band, 54 to 216 MC, with a gain of 5 times (14 DB). This gain is added to the gain of the antenna which is a high gain yagi design, quite superior to other all channel antennas.



The Powertron power supply lowers 117 VAC to a safe 24 volts which is fed up the lead-in to the Powertron antenna. Completely fused, the power supply is made shock-proof by an AC isolation transformer.

Imagine what this super-powerful electronic antenna can do! Weak signals become strong and clear—dim pictures bright and contrasty. Old-style tuners pull in snow-free pictures better than 1961 models on ordinary antennas.

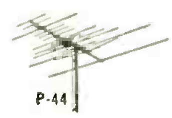
You can do many things with this new antenna that are impossible with any other. You can drive up to 6 TV sets in deep fringe, 10 TV sets in normal areas without an additional amplifier. You can put TV outlets in every room of the house and all sets will have better pictures than any single set with a regular antenna.

Because of its extreme sensitivity, Powertron can be installed lower than other antennas. For instance, where 40-ft. masts are normally used, a Powertron can usually be installed at 25 ft., yet give better results!

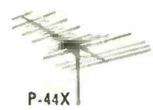
Where desirable, the Powertron can be remoted up to ¼ of a mile and still deliver a perfect signal.

In large distribution systems (motels, apartments, etc.), Powertron makes the perfect antenna to use in conjunction with Winegard's 4-tube A-400 or 7-tube A-700 distribution amplifiers.

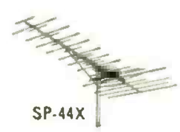
For critical color, Powertron's extremely linear frequency response makes it the ideal antenna for your "color" installations.



P-44



P-44X



SP-44X

To sum it up, Powertron makes weak TV pictures good, and good TV pictures even better. It *works equally well* for *color or black and white* reception. It is the world's first all channel (VHF) *electronic* TV antenna, and is a tremendous step forward in the search for improved TV reception.

3 Gold Anodized Powertron Models —

Powertron Model P-44, 14 elements **$74.95 list.**

Powertron with Power Pack Model P-44X, 21 elements, **$91.90 list.**

Super Powertron Model SP-44X, 30 elements, **$104.95 list.**

NEW TELETRONS, TOO! NON-ELECTRONIC, BUT 26% TO 484% MORE POWER INCREASE THAN COLOR'CEPTOR

Similar to the Powertron, but without the RF amplifier, Teletron embodies the same new WINEGARD "TAPERED T" DRIVEN ELEMENTS for proven performance superior to any other non-electronic TV antenna. Teletron is gold anodized, has the same fine quality construction and mechanical features as the Powertron.

3 Gold Anodized Teletron Models —

Teletron Model T4, 14 elements, **$34.95 list.**
Teletron Model T-4X, 21 elements, **$51.90 list.**
Super Teletron Model ST-4X, 30 elements, **$64.95 list.**

COMPARISON OF POWERTRON AND TELETRON MODELS TO WINEGARD COLOR'CEPTOR

Chart shows Gain and Power Increase over Color'Ceptor (CL-4) Antenna

Model		DB Gain Over CL-4	Power Increase Over CL-4	Voltage Gain Over CL-4
P-44	Powertron	14 DB	25.1 Times (2500%)	5.01 Times
P-44X	Powertron with Pack	15.8 DB	38.4 Times (3800%)	6.20 Times
SP-44X	Super Powertron	19.1 DB	81 Times (8100%)	9.0 Times
T-4	Teletron	1.0 DB	1.26 Times (26%)	1.12 Times
T-4X	Teletron with Pack	2.8 DB	1.9 Times (90%)	1.38 Times
ST-4X	Super Teletron	6.1 DB	4.84 Times (484%)	2.2 Times

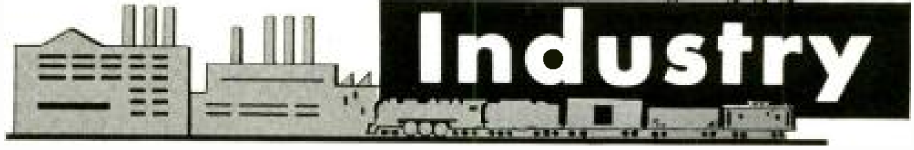
GET IN ON THE POWERTRON — TELETRON PROFIT BANDWAGON!

Be first in your area to offer the superb Powertron performance to your customers. Take advantage of many new sales aids now available through your Winegard distributor . . . and watch for sales-making consumer ads in LIFE

Winegard

Winegard Co., 3003-2 Scotten, Burlington, low

Within the Industry



OTTO H. SCHADE, SR., staff engineer at *Radio Corporation of America*, has been named recipient of this year's Society of Motion Picture and Television Engineers' "Progress Medal Award" for outstanding technical contributions to the progress of engineering phases of the motion picture and television industries.

Mr. Schade has been with *RCA* since 1931. He has been engaged in broad studies of electron tubes and their influence on the performance of audio and video systems. His development, during this time, of the sine-wave response technique for evaluating and specifying the several elements of a TV or motion picture system to determine its over-all performance is recognized as a particularly valuable contribution to the industry.

* * *

HARRY TURKINGTON has been named director of engineering, and **HAL MOORE** advanced to chief meter engineer of the meter and controls division of *Hickok Electrical Instrument Co.*, Cleveland.

Mr. Turkington was formerly chief engineer, product application, for *Simpson Electric Co.*, Chicago. Prior to that, he was assistant chief engineer, *Burlington Instrument Co.*, Iowa. He is a graduate of Iowa State College.

Mr. Moore has been a member of *Hickok's* meter engineering department since 1957. Before that, he was product sales manager of *Texas Instruments Co.*, Dallas, and was associated with *Burlington Instrument Co.* He is a graduate of Youngstown University.

* * *

STEVEN R. MIHALIC of *General Electric Co.* has been renamed chairman of the Electronic Industries Association Service Committee. E. W. Merriam of *Sylvania Electric Products Inc.* will continue as vice-chairman of the committee, which is responsible for developing a series of training aids for electronic service technicians.

Also serving on the committee are the following industry representatives: Andrew Adler, *Olympic Radio & Television;* Russell M. Alston, *Conrac, Inc.;* Vic Amador, *Glaser-Steers Corp.;* John Bennett, *Philco Corp.:* John R. Brocki, *Bendix;* Kenneth H. Brown, *Westinghouse;* George D. Butler, *International Resistance Co.;* Pat Calobrisi, *Motorola Inc.;* Al Coumont, *Sprague Products Co.:* Dan R. Creato, *RCA Service Co.:* William Curtis, *General Electric Co.;* Carl A. Duffy, *Packard Bell Electronics Corp.;* Herman Feldman, *Trav-Ler Radio Corp.;* Charles Golenpaul, *Aerovox Corp.;* Edward J. Greaney, *Hoffman Electronics Corp.;* T. R. Hayes, *Delco Radio Div.;* Charles N. Hoffman, *Warwick Mfg. Corp.;* O. H. Lange, *IBM;* Joseph Loiacono, *General Electric Co.;* William Marble, *Arvin Industries, Inc.;* F. B. Ostman, *Federal Electric Corp.;* Henry T. Paiste, *Philco Corp.;* William L. Parkinson, *General Electric Co.*, Kermit W. Pietenpol, *American Television & Radio Co.;* William D. Renner, *Howard W. Sams & Co., Inc.;* John F. Rider, *John F. Rider Publisher, Inc.;* Norman F. Schumacher, *Wells-Gardner Electronics Corp.;* Harold Schwalbe, *Columbia Phonographs;* Frank E. Smolek, *Zenith Radio Corp.;* and Ray J. Yeranko, *The Magnavox Co.*

* * *

MURRAY G. CROSBY, president of *Crosby-Teletronics Corp.*, and a leading authority in the communications field, has been appointed to the government's Patent Advisory Committee.

The committee, which advises the Secretary of Commerce on measures affecting the operation of the U.S. patent system, is composed of members of the legal profession as well as leading figures from industry and science.

Mr. Crosby holds more than 180 patents in the field of communications, and his system for transmitting stereophonic broadcasts by FM stations has been under consideration by the FCC for permanent broadcast licensing.

* * *

CLARENCE H. HOPPER has been appointed president of *CBS Electronics*, according to a recent announcement by Frank Stanton, president of *Columbia Broadcasting System, Inc. CBS Electronics*, located in Danvers, Mass., is the semiconductor, electronic tube, and phonograph instrument division of *CBS*. In his new post, Mr. Hopper will take over the operating responsibilities of the division. Mr. Hopper formerly served five years as vice president, facilities, for *CBS*.

* * *

DR. W. R. G. BAKER, internationally known as one of the leading pioneers in the field of electronics, died recently following an illness. He was 68. A retired vice president of the *General Electric Co.*, Dr. Baker was president of the *Syracuse University Research Corp.* at the time of his death. He also was a director and chairman of the finance committee of *Gulton Industries, Inc.*

It was under Dr. Baker that *General*

The TEC S-15 all transistor 40 watt stereo amplifier brings a space age concept to high fidelity. Never before has the audiophile been able to get so much high quality sound for so little. A neat package 10" long and seven pounds light puts out 40 watts of pure undistorted sound. And the price is as exciting as the package—only $129.50. Because of its all-transistor circuitry, the unique S-15 has no heat, no hum, no microphonics. Quite naturally, from Transis-Tronics. Write for your copy of complete specifications. Power Output 40 watts (20 watts per channel). Frequency Response ±0.5 db 20-20,000 cps. Response is 3 db down at 6 cps and 45,000 cps. Intermodulation Distortion less than 0.9% at rated output, 60 and 6000 cps. Harmonic Distortion less than 0.5% at rated levels. Inputs 5 pair: magnetic phono, tuner, tape, auxiliary 1, auxiliary 2. Front Panel Controls: volume, power; balance; bass channel A; bass channel B; treble channel A; treble channel B; function (phono, tuner, tape, auxiliary 1, auxiliary 2); mode (mono A, stereo, mono B); loudness; scratch filter, rumble filter. Balance Control for equalizing speaker outputs. At full rotation will completely cut off sound from either speaker. Circuitry, 2 germanium diodes, 3 silicon diodes. Power Requirements 105-120 volts AC, 50-60 cps; 12-28 volts DC for battery operation.

TEC S-15

TEC Transistor Engineered Components

TEC IS THE TRADEMARK OF TRANSIS-TRONICS, INC. Transis-Tronics, Inc., 1601 Olympic Boulevard, Santa Monica, California

Electric established Electronics Park on a 200-acre site in Syracuse, N.Y. as a research and manufacturing plant and as headquarters for its electronics business in 1947.

During his career of more than 40 years, Dr. Baker helped the advancement of electronics and telecommunications, and was honored for his contributions by the Army, the Navy and the nation's leading professional and business associations. Among his best known contributions were the organization and direction of two national television system committees which recommended engineering standards to the FCC, paving the way for commercial monochrome telecasting in 1941, and color TV in 1953. *G-E's* pioneer television station at Schenectady uses Dr. Baker's initials (WRGB) to identify itself. Dr. Baker was a former president of the IRE, and served two terms as president of the Electronics Industries Association, receiving medals of honor from both these groups.

* * *

DR. GEORGE M. ANDERSON has been appointed president of the Thomas A. Edison Research Laboratories of the *McGraw-Edison Co.* The laboratories at West Orange, N. J. serve as central research headquarters for the company's 43 divisions and subsidiaries here and abroad. Dr. Anderson, who succeeds Dr. Donald W. Collier who has resigned, joined the *McGraw-Edison Co.* seven years ago. He has been head of the laboratories' engineering department. A graduate of Carnegie Institute of Technology, where he also served as assistant professor, Dr. Anderson came to *McGraw-Edison* from *Westinghouse*.

Dr. Anderson is active in professional societies and has authored several scientific papers. He is chairman of the northern New Jersey section, Institute of Radio Engineers.

* * *

EMERSON RADIO & PHONOGRAPH CORP. has leased a newly constructed one-story plant in Woodbridge, N.J. to house the company's air-conditioner laboratory, engineering, and manufacturing operations. The plant comprises an area of 115,000 square feet . . . **SHURE BROTHERS, INC.** is adding 38,000 square feet of manufacturing space to its plant in Evanston, Ill. . . . **BENDIX-PACIFIC DIV., BENDIX CORP.** is planning a new multi-million dollar electronics center. Ground already has been broken on an 80-acre site in the northern San Fernando valley . . . **BURTON BROWNE ADVERTISING** of Chicago and New York recently opened a western office in Pasadena, Calif. under the general management of George Balsam . . . **CENTRAL ELECTRONICS, INC.,** wholly owned subsidiary of **ZENITH RADIO CORP.,** is building a new manufacturing plant in Paris. Ill. The new plant will occupy a 30-acre tract and provide 100,000 square feet of floor space . . . **R. V. WEATHERFORD CO.,** distributors, has

AT LAST!

RADIO-TV and ELECTRONICS TRAINING

.... AT A PRICE YOU CAN AFFORD!

*21 INCH
Receiver Kit included

Yes, this great course costs *far less* than *any* training of its kind given by other major schools! Radio-Television Training School will train you for a good job in Television or Industrial Electronics — **AT HOME IN YOUR SPARE TIME.**

Think of it—a complete training program including over 120 lessons, Fourteen Big Radio-Television Kits, Complete Color-TV Instruction, Unlimited Consultation Service . . . *ALL at a really big saving to you.* How can we do this? Write to us today . . . and find out!

And what's more — you can (if you wish)

OPEN YOUR OWN RTS-APPROVED AND FINANCED RADIO-TV SERVICE SHOP

We Want Many More Shops This Year

This 38 year old training organization — called RTS, that's Radio-Television Training School — wants to establish a string of Radio-TV Repair Shops in principal cities throughout the U. S. So far, a great many such shops are NOW IN BUSINESS AND PROSPERING. We are helping and training ambitious men to become future owners and operators of these shops in all areas.

FOR UNSKILLED INEXPERIENCED MEN ONLY – WE TRAIN YOU OUR WAY!

We must insist that the men we sign up be trained in Radio-TV Repair, Merchandising and Sales by our training methods—because WE KNOW the requirements of the industry. Therefore, we will TRAIN YOU . . . we will show you how to earn EXTRA CASH, during the first month or two of your training period. YOU KEEP YOUR PRESENT JOB. TRAINING TAKES PLACE IN YOUR OWN HOME, IN YOUR SPARE TIME!

RTS APPROVED SERVICE SHOP

COMPLETE COLOR TV INSTRUCTION INCLUDED

Get your free book on the

FAMOUS RTS BUSINESS PLAN

find out how you can open

A REPAIR SHOP OF YOUR OWN

We supply and finance your equipment

When you are ready and qualified to operate one of our RTS-Approved TV Repair Shops ***WE WILL SUPPLY AND FINANCE EVERY BIT OF EQUIPMENT YOU NEED TO GET STARTED*** plus an inventory of parts and supplies. In other words *we will stake you* . . . **AN OFFER NEVER MADE BEFORE BY ANY TRAINING ORGANIZATION.** Under the RTS Business Plan you receive:

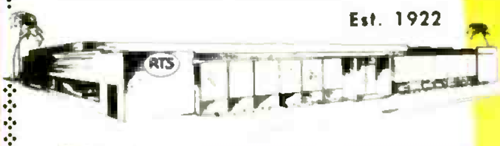
1. An electric sign for the shop front.
2. Complete laboratory of test equipment.
3. Letterheads, calling cards, repair tickets, etc.
4. Basic inventory of tubes, parts, supplies.
5. Complete advertising and promotional material.
6. Plans for shop arrangement.
7. Instructions on how to go into business.
8. Continuous consultation and help.
9. The right to use RTS Seal of Approval, and the RTS Credo.
10. The right to use the Famous Trade Mark

YOU BUILD THESE AND OTHER UNITS!

*tubes excluded

RADIO-TELEVISION TRAINING SCHOOL
815 E ROSECRANS AVENUE
LOS ANGELES 59, CALIFORNIA

Est. 1922



ACT NOW!

ACCREDITED MEMBER

RTS' Membership in The Association of Home Study Schools is your assurance of Reliability, Integrity, and Quality of Training.

ALL THESE FREE!

CUT OUT AND MAIL — *TODAY!*

RADIO-TELEVISION TRAINING SCHOOL
815 EAST ROSECRANS AVENUE Dept. EW-21
LOS ANGELES 59, CALIFORNIA

SEND ME FREE — all of these big opportunity books — "Good Jobs in TV-Electronics," "A Repair Shop of Your Own" and "Sample Lesson." I am interested in:

☐ Radio-Television ☐ Industrial Electronics (Automation)

Name ______________________ Age ______

Address ______________________

City & State ______________________

302

Mail This Coupon Now—No Salesman Will Call

opened a new 3000 square foot facility in Palo Alto to service the northern California and Bay area . . . **PENTRON SALES CO., INC.** has established a factory branch sales and merchandising facility to serve New England area dealers. Division headquarters will be located in Boston.

* * *

THEODORE ROSSMAN was elected chairman, and **IRVING ROSSMAN** president of *Pentron Electronics Corp.*, Chicago, at a recent board of directors meeting. Previously, Theodore Rossman was president, and Irving Rossman executive vice-president of *Pentron*. Irving Rossman remains president and chief executive officer of *Pentron Sales Co., Inc.*, wholly owned subsidiary of *Pentron Electronics Corp.*

Pentron, listed on the American stock exchange, recently expanded its product line to include the "Pentronaire Purifier" which uses the "Ionray" cold cathode electron tube, and the "Humi-Zon" humidifier.

* * *

JOHN H. RICHARDSON, *Hughes Aircraft Company* vice-president, has been elected third vice-president of the National Security Industrial Association, a group that serves as a link between industry and the armed forces . . . **RICHARD G. VANINWAGEN** has been appointed manager of engineering administration of *General Electric's* television receiver department . . . **ROBERT G. SWAIN** has been named to the new post of product planning manager, semiconductors, for *CBS Electronics*. He was formerly Eastern regional sales manager . . . **ROBERT W. JORGENSEN** has joined *The Hallicrafters Co.* as manager of marketing development. He has served as a management consultant and marketing vice-president with other organizations . . . **THOMAS C. PRIDMORE** has been appointed sales manager of *Bradley Semiconductor Corp.* He formerly was the company's chief engineer . . . **J. B. HOLTZ** has been named marketing manager, new products, for *Centralab*, the electronics division of *Globe-Union, Inc.* The position is a new one at *Centralab* . . . **ERWIN TOMASH** of *Telemeter Magnetics, Inc.*, and **DR. RICHARD BELLMAN** of the *Rand Corp.* have been elected to the board of directors of *Solid State Radiations, Inc.*, an organization which conducts research and development in nucleonics, semiconductors, electronics, and data handling . . . **DR. KENNETH M. MERZ** has joined *International Resistance Co.* as manager of ceramic research . . . **JAMES FOOSKAS** and **CHARLES C. WESTON** have been appointed director of acccounting and director of budgets respectively for the same organization . . . **LLOYD M. POWELL,** president of *Dictaphone Corporation*, has been elected by the board of directors to the post of chairman of the executive committee as well as the chief executive officer . . . *Acro Products Company*, Philadelphia manufacturer of high-fidelity amplifiers and transformers, has recently announced a change of its name to *Acro Electronics Products Co.* In addition, the Philadelphia organization an-

nounces new appointments as follows: **LEONARD KLINGSBERG** to executive vice president and member of the board of directors; **WILLIAM F. CARTER** to assistant to chief engineer and president Herbert I. Keroes; new representatives to include *Spivey-Cole Co.*; *Loren F. Green and Associates*; and William Ferguson . . . **NILES P. GOWELL**, veteran *Raytheon* tube engineer, has been named engineering manager for the company's industrial components division . . . **LEE J. GOODMAN** has been named vice president for industrial sales in California, and **HERBERT R. BAKER** is the new vice president for operations in that division of the *Newark Electronics Corp.* . . . **PETER N. DUDENEY** has been appointed director of engineering for *Vitro Electronics*, Silver Spring, Md. . . . **THOMAS ROY JONES** has been elected chairman of *Daystrom, Inc.*, while **JOHN B. MONTGOMERY** will become the organization's new president . . . **ROSS YEITER** has been named semiconductor sales manager for *CBS Electronics* . . . **SYDNEY W. NATKIN** has been appointed vice president and manager of sales of *National Radio Co.* He was with *RCA* for 19 years before joining *National* last year . . . **FRANK E. CERVENY** has joined *Anderson Controls, Inc.* as assistant chief engineer . . . **MARTIN SHERIDAN** has been elected vice president, public relations of *Admiral Corp* . . . **HUGH J. DALY** has been named vice president in charge of sales and marketing by *Globe Electronics*, a division of *Textron Electronics, Inc.* He was formerly a vice president for *Magnecord* . . . **LOUIS G. PACENT** has rejoined *Emerson Radio & Phonograph Corp.* as vice president, manufacturing subsidiaries . . . **EDSON D. STRONG** has been appointed senior applications engineer of the advanced devices laboratory of *Airtron*, a division of *Litton Industries* . . . **ELIASZ POSS** has been appointed chief circuit development engineer of *Electronic Energy Conversion Corp.*, N.Y. . . . **DR. VICTOR HICKS**, formerly chief physicist for the *Allen-Bradley Co.* has joined *Remington Rand Univac* military department as staff scientist . . . **ALAN ROBERTSON** has been promoted to the post of product line manager for *Heath Company*, where he will be in charge of development of amateur radio, test, and laboratory equipment products . . . **JOHN R. GRIGGS** has been named head of the new communications division of *Rutherford Electronics Co.*, Culver City manufacturer of pulse instrumentation and pulse technique equipment. Mr. Griggs was formerly president and chief engineer of *Transpace, Inc.* and was also associated with *Packard Bell Electronics Corp.*, *Enright Engineering Co.*, *Hoffman Laboratories*, and *Convair* . . . *CBS Laboratories* has named **JOHN MANNIELLO** to the new position of director of marketing . . . **DR. ROBERT W. HALL** is the new vice-president in charge of reliability for the semiconductor division of *General Instrument Corporation*. The post is a newly created one within the firm . . . **LOUIS KAHN** has been appointed manager of application engineering for *Aerovox Corporation*. He will be available as a consultant to

(*Continued on page* 125)

FREE!

LAFAYETTE'S 1961 CATALOG

324 GIANT SIZED PAGES

The Complete Catalog Featuring
"The Best Buys In The Business"

- ☑ Stereophonic Hi-Fi Equipment
- ☑ Public Address Systems
- ☑ Tape Recorders
- ☑ Radio and TV Tubes and Parts
- ☑ Citizen Band Equipment
- ☑ Amateur Equipment
- ☑ Industrial Supplies

Send for Lafayette's FREE Catalog—the most complete, up-to-the-minute electronic supply catalog crammed full of everything in electronics at our customary down-to-earth money-saving prices.

CONTAINS HUNDREDS OF EXCLUSIVE LAFAYETTE ITEMS NOT AVAILABLE IN ANY OTHER CATALOG OR FROM ANY OTHER SOURCE—SEND FOR YOUR COPY NOW!

A "must" for the economy-minded hi-fi enthusiast, experimenter, hobbyist, engineer, technician, student, serviceman and dealer.

Our 40th Year

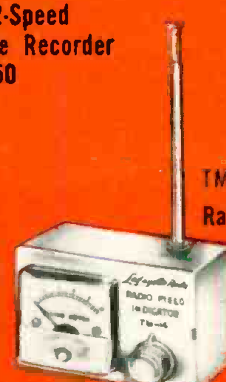
EASY PAY PLAN—the simplest, and quickest way to get what you want when you want it. As little as $2 down . . . up to 24 months to pay.

Communications Receiver
KT-200, Kit 64.50 — **HE-10, Wired** 79.95

RK-400 2-Speed Portable Tape Recorder
49.50

TE-15 Tube Checker
19.95

RW-60 20,000 Ohms Per Volt Multitester
13.50



TM-14 Radio Field Indicator
6.95

HE-800WX Citizen Band Mobile Antenna
6.95

LAFAYETTE RADIO

Mail the coupon today for your FREE copy of Lafayette Radio's 1961 catalog.

Lafayette Radio Electronics Corp.
Dept. RB1-1, P. O. Box 190
Jamaica 31, N. Y.

Send me the FREE Lafayette 324 page 1961 catalog 610

Name ____________________

Address ____________________

City __________ Zone ____ State ______

Spot News

Latest Information on the Electronic Industry

By ELECTRONICS WORLD'S WASHINGTON CORRESPONDENT

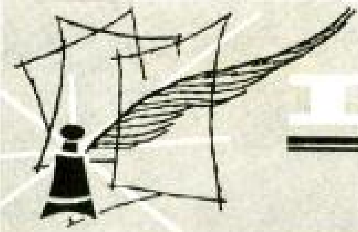
TV CHANNEL FREEZE LOOMS IN U.H.F. SHIFT PLAN PROPOSED BY FCC COMMISSIONER — In a bold program, outlined during a convention of the National Association of Educational Broadcasters, FCC Commissioner Robert E. Lee indicated that all TV stations, within the next 5 to 7 years, may have to move to the higher bands, and a short freeze period may have to be set up to permit a smooth transfer. Pointing out that the military services have twice turned down FCC pleas for more v.h.f. space, and since the Commission's long-range 50-channel plan has been considered impractical, Lee said we must go elsewhere for help and the u.h.f. bands are the only answer. He viewed the currently suggested channel splitting, which would crowd more stations into presently available frequencies, as an intolerable source of interference. It is entirely feasible, he added, to allocate the present 12 channels to the mobile radio communications services, who certainly are in need of these frequencies. The plan is to be brought to the attention of the Commission for official consideration.

AIRCRAFT GUIDANCE RADIO RANGE TESTED ON PITCHING OCEAN VESSEL — As part of an effort by the Federal Aviation Agency and the U.S. Coast Guard to develop acceptable guidance signals for aircraft from pitching, rolling ocean ships, tests were recently begun aboard Coast Guard cutter "Androscoggin." Equipment involved is a very-high frequency radio range (VOR) combined with a military tactical air navigation system (TACAN) to form a facility known as VORTAC. The range uses an antenna mounted on top of a 75-foot mast, and beneath is a counterpoise 15 feet in diameter.

HIGH-SPEED FACSIMILE PROCESS UNVEILED BY NAVY — A Navy-sponsored high-speed facsimile system, developed to transmit microfilmed engineering drawings or printed pages, and reproduce such copy enlarged on translucent paper at the receiving end at a rate of 26 feet-per-minute, was demonstrated recently in Washington. The new approach is expected to overcome serious distribution problems involving bulky construction diagrams and plans, which in some instances weigh nearly 300 tons. The speed of the equipment is such that a 480-page book can be transmitted in four minutes. In operation a scanner picks up images from microfilm, and a recorder receives the images from the scanner either by coaxial cable or over a microwave network. According to the Navy, if the units were produced in quantity, the cost of the scanner and recorder would be about $70,000.

BOOM U.H.F. MARKET OPENS IN WEST GERMANY — With the advent of a second television channel on the ultra-highs in the North-Rhine-Westphalia area of West Germany, 3-million TV sets now require u.h.f. dipoles and converters or tuners. In view of marked shortages of these items overseas, with a dim outlook for improvement because of backlogs, the American Consulate General at Dusseldorf has alerted Washington to the urgent need for these components. The required volume, it was reported, can only be supplied by manufacturers over here. A complete list of German firms who are interested in prices and delivery dates is available from the Bureau of Foreign Commerce, U.S. Department of Commerce, Washington 25, D.C.

DIMENSIONAL RADAR FOR GROUND TRAFFIC CONTROL IN WASHINGTON AIRPORT — A new radar, which provides a relief map picture, with runways and taxiways outlined by bright lines of light, was recently placed into operation at the Washington National Airport. Using Airport Surface Detection Equipment (ASDE), a radar antenna sweeps the field once every second, providing a detailed picture of ground traffic, moving or still. Visible light is not required to obtain a picture on the ASDE scope, and thus the system is fully effective during darkness or fog, when human vision is handicapped by limited visibility. According to experienced operators, the new technique not only makes it possible to see buildings and other objects, but even permits the operator to distinguish between two and four-engine aircraft on the ground. -30-



Letters from our Readers

CB TRAVEL SERVICE FREQUENCY

To the Editors:

Reference is made to an article in the September issue of your magazine suggesting a national travel service frequency for Citizens Banders. This is a very worthwhile idea and one that has proven invaluable in a number of cases. In one particular instance, this undoubtedly saved the life of at least one person who was buried in a snow bank when his car went off the road and came to rest with the motor running.

BOB FORMAN
The Forman Company
Monmouth, Illinois

To the Editors:

In your September, 1960 issue (top of page 55), there is an article concerning Channel 15.

In Southern California there are over 200 CB stations monitoring Channel 15 now, and more are added to this number daily. Your article was of great interest to me as I am one of the stations monitoring Channel 15. This is voluntary on my part to assist other Citizens Banders, marine or mobile, who may need help.

I have brought this article to the attention of many CB stations, and would like to point it out to all the others operating in the Citizens Band in Southern California.

GEORGE LOFTHOUSE
West Covina, California

We have received many letters supporting our stand on setting up a national travel service frequency. The item also has been widely reprinted by several organizations who are interested in getting the most useful operation from their CB equipment.—Editors.

* * *

AIRCRAFT RADIO AIDS

To the Editors:

I have followed with interest Mr. Francis A. Gicca's series of articles on aircraft navigation and, for the most part, they are informative and accurately written with the one exception of his description of an ILS Glide Slope in his most recent article on Instrument Landing Systems. (Refer to our September issue.)

In all equipment currently used by the Federal Aviation Agency, modulation is not accomplished by the use of coder-oscillators, as indicated by Mr. Gicca in his article and by block diagram 10B of the same article. Instead, modulation of the carrier is done by a mechanical means consisting of a rotor blade arrangement with the blades passing through a modulation trough that immediately follows the output of the transmitter proper. The modulation troughs are essentially shorted quarter-wave sections of transmission line with capacitor stators located near one end of the trough. When a blade is engaged between the stators, we have a condition of maximum pass of r.f. energy, and when the rotor is disengaged, we have a condition of minimum pass. As the 90-cycle side has three blades and the 150-cycle side has five blades all being driven on a common shaft by a 30-rps synchronous motor, we have the following situation: 3 blades @ 30 rps equals 90 cycles; 5 blades @ 30 rps equals 150 cycles.

Mr. Gicca also states that the upper dipole in a Glide Slope antenna beams the 90-cycle signal and the lower dipole beams the 150-cycle signal. The correct description of these two antennas is the top antenna being termed the sideband antenna while the lower is termed the carrier antenna. In the sideband antenna we find the following frequencies being radiated ±90 cycles and ±150 cycles, while in the carrier antenna we find current containing F_c, ±90 cycles and ±150 cycles. A composite radiation pattern is formed with a carrier lobe and two small sideband lobes. The first null of the vertical pattern is what actually determines the glide angle, hence the common usage of the name "Null Reference Glide Slope."

I in no way want to minimize the amount of work involved or the quality of Mr. Gicca's series, but did want to bring to light these inaccuracies for the benefit of your readers who may be interested in the technical aspects.

DONALD A. LITTLETON
Engineering Technician
Federal Aviation Agency
Casper, Wyoming

To the Editors:

The "Radio Aids to Aircraft Navigation" series just concluded contained one misstatement of fact which every air traveller no doubt will recognize. You have stated: "In general, these instrument landing minima are: ceiling 1000 feet, visibility 3 miles. If the weather causes airport conditions to be below these minima then a landing is not legally possible, even with radio aids, and an alternate airport with acceptable weather must be used."

Actually, the 1000-3 mentioned is for VFR (Visual Flight Rules), and IFR (Instrument Flight Rules) allow considerably lower minima. Each airport equipped for instrument landings has

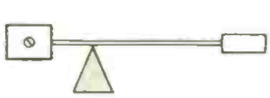
Never before . . . a record playing unit with so much to offer!

A step beyond the turntable . . . A step beyond the changer

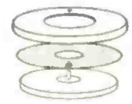
AN AUTOMATIC TURNTABLE

GARRARD'S LABORATORY SERIES TYPE A

Instantly acclaimed, because only the Type A offers you . . .

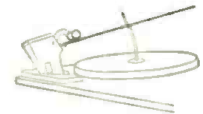


The only dynamically balanced tone arm on an automatic unit . . . with adjustable sliding counter-weight, and built-in calibrated scale to set and insure correct stylus tracking force. Once balanced, this arm will track stereo grooves perfectly even if player is intentionally tilted, or record is warped or not perfectly concentric.



Full-sized, heavily weighted (6 lb.) balanced, cast, polished turntable. Actually 2 turntables balanced together . . . a drive table inside, a non-ferrous heavy cast table outside; separated by a resilient foam barrier to damp out vibration.

New Laboratory Series Motor . . . a completely shielded 4-pole shaded motor developed by Garrard especially for the Type A turntable system. Insures true musical pitch, clear sustained passages without wow, flutter, or magnetic hum.



The great plus feature of automatic play – without compromise. Garrard's exclusive pusher platform changing mechanism, makes the Type A fully automatic, at your option. Affords the greatest convenience, reliability in operation, and protection to records available.

Only the Garrard Laboratories, with their unmatched facilities, could have developed this all-in-one unit . . . a superb instrument in which you will find the realization of everything you have ever wanted in a record-playing device. Only Garrard, with its 40 years of manufacturing experience and its highly developed production and critical quality control procedures, could offer the Type A, with its unique advantages, for this price. $69^50

Garrard
world's finest

For literature write to Garrard Sales Corporation, Dept. GB-1501, Port Washington, New York.

B.I.C. ENDORSED QUALITY

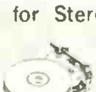
There's a Garrard for every high fidelity system . . . all engineered and wired for Stereo and Monaural records.

Type A Automatic Turntable **$69.50**

RC88 Deluxe Changer **$59.50**

Model 210 Deluxe Intermix Changer **$49.50**

301 Transcription Turntable **$89.00**



4HF Transcription Manual Player **$59.50**

Model T/II Manual Player **$32.50**

Canadian inquiries to Chas. W. Pointon, Ltd., 66 Racine Road, Rexdale, Ontario Territories other than U.S.A. and Canada to Garrard Engineering & Mfg. Co., Ltd., Swindon, Wilts., England its own published minima for each category aircraft. These minima may go as low as 200—½ for ILS straight-in approaches for certain planes at airports with good, clear approach areas.

PAUL HALMBACHER
Milwaukee, Wisconsin

We have received much favorable comment concerning the series of three articles referred to above, and they have been reprinted to be used in the training program of several aircraft manufacturers. We are glad to point out the discrepancies indicated. However, they do not detract from the overall good quality and useful information that is contained in the articles.—Editors.

* * *

SPEAKER CONE TREATMENT

To the Editors:

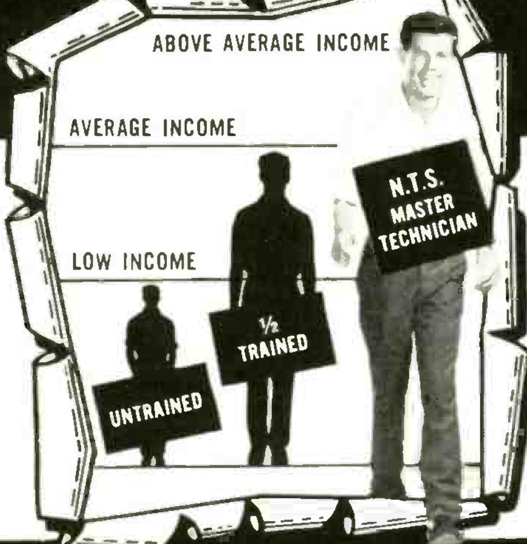
In an article in the September issue of ELECTRONICS WORLD the author, Mr. W. F. Hughes, suggests edge damping inexpensive speakers by applying "a saturated solution of silica gel (calcium chloride) in water." I believe some comments on this suggestion are in order.

First of all, silica gel is not calcium chloride and will not work at all for this purpose. The confusion of silica gel and calcium chloride is not new. In fact, the November, 1959 issue carried this same error and was corrected later in a letter to the editor. The source of this confusion is probably the widespread use of both substances as dessicants, for which they are usually interchangeable. However, silica gel is useful as a dessicant because of its being a spongy insoluble solid which can absorb large quantities of water on its tremendous surface while remaining a solid. (A small bag full inside electronic instruments can solve humidity problems.)

Calcium chloride, on the other hand, takes up water by chemical reaction, starting out as anhydrous $CaCl_2$ and ultimately becoming $CaCl_2 \cdot 6H_2O$. But calcium chloride is soluble in water and will continue to take water from the air to such an extent that the crystals will dissolve, giving the thick solution that *could* be used to soften the edge of a speaker cone. The solution will remain wet unless the humidity of the air reaches a value much lower than is normally encountered.

But secondly, as everyone living in the snowy part of the country, familiar with calcium chloride on automobile bodies, has learned, it is an extremely corrosive chemical and hence, is of doubtful merit when applied near metal parts. Other agents which attract water have been suggested for speaker damping and probably should be used in its place. Ordinary glycerine mixed with water in a ratio of about 1 to 1 would be quite suitable for this treatment. An even better method would be to use some fluid which is itself viscous and sticky, as are some silicones, instead of a wetting agent. Then the damping would not depend on the humidity and corrosion would be no problem. I suspect that these compounds are the ones em-

BREAK THROUGH TO HIGHER PAY *in* ELECTRONICS
TV-RADIO



START NOW! Break through the Earning Barrier that stops half-trained men. N.T.S. "All-Phase" training prepares you — at home in spare time — for a high-paying CAREER in Electronics — TV — Radio as a MASTER TECHNICIAN. One Master Course at One Low Tuition trains you for unlimited opportunities in All Phases: *Servicing, Communications, Preparation F.C.C. License, Broadcasting, Manufacturing, Automation, Radar and Micro-Waves, Missile and Rocket Projects.*

A more rewarding job . . . a secure future . . . a richer, fuller life can be yours! As an **N.T.S. MASTER TECHNICIAN** you can go straight to the top in industry . . . or in your own profitable business.

You work on actual job projects

SUCCEED IN MANY HIGH-PAYING JOBS LIKE THESE...

- TV-Radio Sales, Service and Repair
- Profitable Business of Your Own
- Communications Technician — F.C.C. License
- Hi-Fi, Stereo & Sound Recording Specialist
- TV-Radio Broadcasting Operator
- Technician in Computers & Missiles
- Electronics Field Engineer
- Specialist in Microwaves & Servomechanisms
- Expert Trouble Shooter
- All-Phase Master Technician

19 BIG KITS
YOURS TO KEEP

Free book gives you all the facts

NATIONAL TECHNICAL SCHOOLS
WORLD-WIDE TRAINING SINCE 1905
4000 SO. FIGUEROA ST., LOS ANGELES 37, CALIF., U. S. A.

Write Dept. RH-21

RESIDENT TRAINING AT LOS ANGELES
If you wish to take your training in our Resident School at Los Angeles, start NOW in our big, modern Shops and Labs. Work with the latest Auto and Diesel engines — all types — fuel injection, automatic transmissions, all power equipment — most complete facilities offered by any school. Expert, friendly instructors. Graduate Employment Service. Help in finding home near school — and part time job while you learn.

WRITE FOR SPECIAL RESIDENT SCHOOL CATALOG AND INFORMATION

ACCREDITED MEMBER
. . . the only nationally recognized accrediting agency for private home study schools.

N.T.S. Shop-Tested HOME TRAINING is **Better, More Complete, Lower Cost** . . . and it is your key to the most fascinating, opportunity-filled industry today!

YOU LEARN QUICKLY AND EASILY THE N.T.S. SHOP-TESTED WAY

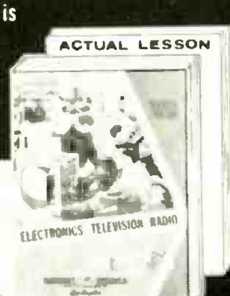
You get lessons, manuals, job projects, unlimited consultation, graduate advisory service.
You build a Short Wave-Long Wave Superhet Receiver, plus a large-screen TV set from the ground up, with parts we send you at no additional cost. You also get a Professional Multitester for your practical job projects.

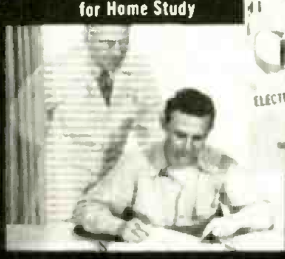
EARN AS YOU LEARN... WE SHOW YOU HOW!

Many students pay for entire tuition — and earn much more — with spare time work they perform while training. You can do the same . . . we show you how.

SEND FOR INFORMATION NOW... TODAY! IT COSTS YOU NOTHING TO INVESTIGATE.

N.T.S. HOME TRAINING is
- Classroom Developed
- Lab-Studio Planned
- Shop-Tested
- Industry-Approved
- Specifically Designed for Home Study





MAIL COUPON NOW for FREE BOOK and ACTUAL LESSON

NO OBLIGATION!
NO SALESMAN WILL CALL

NATIONAL TECHNICAL SCHOOLS
WORLD-WIDE TRAINING SINCE 1905

Mail Now To
National Technical Schools, Dept. RH-21
4000 S. Figueroa St., Los Angeles 37, Calif.

Please rush FREE Electronics-TV-Radio "Opportunity" Book and Actual Lesson. No Salesman will call.

Name______________________ Age____
Address______________________
City______________ Zone____ State______
☐ Check here if interested ONLY in Resident Training at Los Angeles.
VETERANS: Give date of discharge______________

ployed commercially for this purpose.

JOHN W. GREEN
University of Wisconsin
Dept. of Chemistry
Madison, Wisconsin

Several of our readers who are in the field of chemistry have taken Author Hughes to task for his recommendation.—Editors.

* * *

MUSIC VS SINE-WAVE POWER

To the Editors:

I agree completely with the editorial on music-power rating that appeared in one of your past issues, and I disagree most strongly with the views on the relative importance of music-power versus steady-state sine-wave ratings expressed by some members of our industry. Proponents of music-power ratings maintain that sine-wave power ratings are of secondary importance compared to music-power ratings. My own viewpoint is that sine-wave power is the more important rating, and music power of secondary importance.

Music waveforms are highly random in shape and the ratio of peak-to-average values is not always high. Sometimes as in organ music, for example, the waveforms closely approximate sine waves for considerable periods. Under those conditions, two amplifiers with the same music power, but different sine-wave ratings will *not* perform the same. The amplifier with the higher sine-wave rating will be the better one.

Music-power rating of an amplifier, which depends mainly on the designer's choice of tube types, electrode voltages, and output transformer, is actually a measure of its "electrical size" for "easy-to-reproduce signals." When the amplifier is called upon to reproduce signals of adverse waveform, the "size" will shrink by an amount which depends on the change in electrode voltages with change in signal input. An amplifier rating in terms of music power only, does not give any indication of the amount of "shrinkage" to be expected. It is therefore, an incomplete rating, and does not merit the importance ascribed to it. Music-power ratings are useful chiefly as a means for indicating the electrical "size" of amplifiers for purposes of comparison.

On the other hand, an amplifier rated in terms of sine-wave power only is conservatively rated. For easy-to-reproduce waveforms it will deliver more than its rated power. An amplifier rating which gives both the music power, and the sine-wave power for rated distortion is much more meaningful than either rating alone.

R. SHOTTENFELD
Chief Engineer
Pilot Radio Corporation
Long Island City, N. Y.

Mr. Shottenfeld is chairman of the Institute of High Fidelity Manufacturers Committee on Amplifiers. The views expressed above are his personal views and not necessarily those of the IHFM.—Editors.

—30—

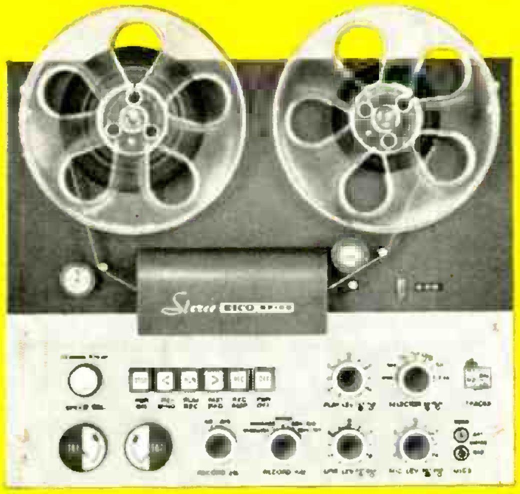
4-TRACK STEREO TAPE DECK

MODEL RP-100W
Completely assembled, wired and tested. $395.00

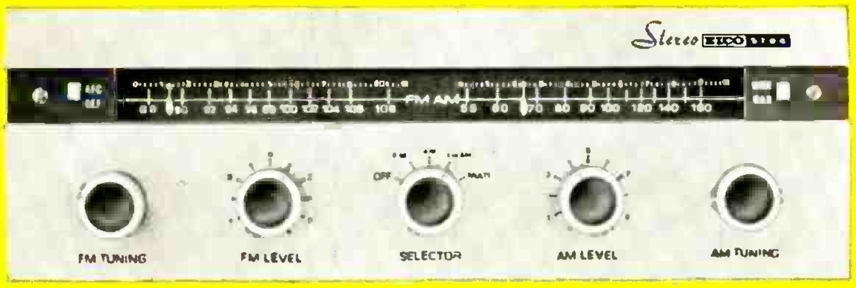
MODEL RP-100K
Semi-kit includes a completely assembled and tested transport, electronics in kit form. $289.95

Perfected 4-track stereo/mono recording, 4 & 2 track playback. True high fidelity transistor electronics, individual for record & playback, plus separate record & playback heads permitting off-the-tape monitor. 2 recording level meters, mixing, mic & level controls, switched sound-on-sound recording. Electrodynamically braked supply & take-up reel motors; hysteresis synchronous capstan motor. Individual solenoids for pinch-roller & tape lifters. All-electric, interlocked push-button transport control & interlocked safety "record" pushbutton. Precision tape guidance & sweep loading — no pressure pads. No slurring or tape bounce problems. Digital turns counter. Vertical or horizontal mounting. Modular plug-in construction. An original, exclusive EICO product designed & manufactured in U. S. A. (patents pending).

dedicated to perfection



NEW MEDALIST LINE



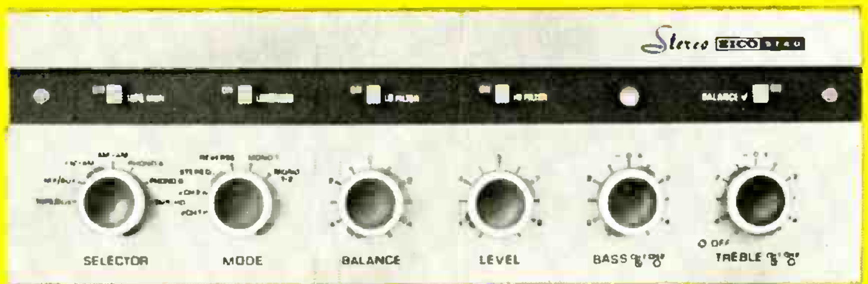
FM-AM STEREO TUNER ST96
Kit $89.95 Includes Metal Cover and FET Wired $129.95

FM and AM stereo tuners on one compact chassis. Easy-to-assemble: prewired, prealigned RF and IF stages for AM and FM. Exclusive precision prewired EYETRONIC® tuning on both AM and FM.

FM TUNER
Switched AFC (Automatic Frequency Control). Sensitivity: 1.5uv for 20db quieting. Frequency Response: 20-15,000 cps±1db.

AM TUNER
Switched "wide" and "narrow" bandpass. High Q filter eliminates 10 kc whistle. Sensitivity: 3uv for 1.0V output at 20db S/N ratio. Frequency Response: 20-9,000 cps ("wide"); 20-4,500 cps ("narrow").

OF EICO STEREO



70-WATT INTEGRATED STEREO AMPLIFIER ST70
Kit $94.95 Includes Metal Cover Wired $144.95

40-WATT INTEGRATED STEREO AMPLIFIER ST40
Kit $79.95 Includes Metal Cover Wired $124.95

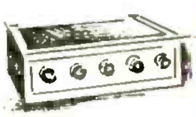
BOTH AMPLIFIERS: Complete stereo centers plus two excellent power amplifiers. Accept, control, and amplify signals from any stereo or mono source.

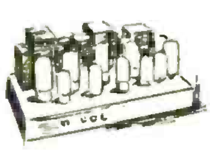
ST70: Cathode-coupled phase inverter circuitry preceded by a direct-coupled voltage amplifier. Harmonic Distortion: less than 1% from 25-20,000 cps within 1db of 70 watts. Frequency Response: ±½db 10-50,000 cps.

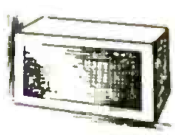
ST40: Highly stable Williamson-type power amplifiers. Harmonic Distortion: less than 1% from 40-20,000 cps within 1 db of 40 watts. Frequency Response: ±½db 12-25,000 cps.

Over 2 MILLION EICO instruments in use.
Most EICO Dealers offer budget terms.

There's an EICO for your every stereo/mono need. Send for FREE catalog.







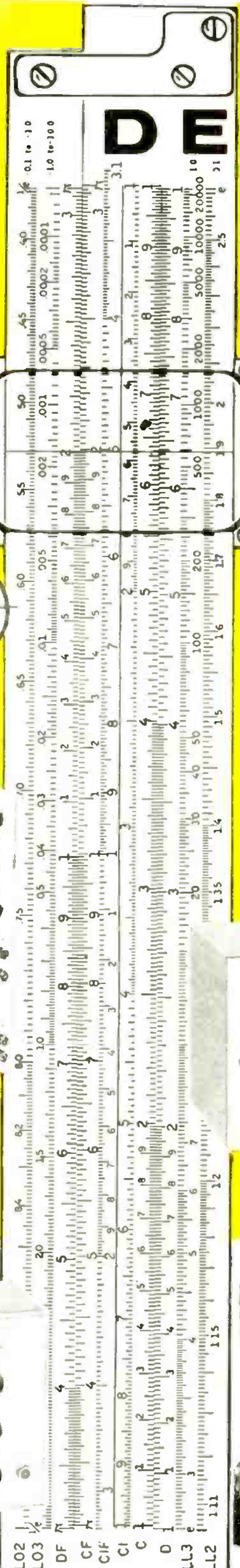
EICO

EICO, 3300 N. Blvd., L.I.C. 1, N. Y. EW-2
☐ Send free 32-page catalog & dealer's name
☐ Send new 36-page Guidebook to HI-FI for which I enclose 25¢ for postage & handling.
Name ....
Address ....
City .... Zone .... State ....

Add 5% in West. Turn Page For More EICO Values.

INSTITUTE OF HIGH FIDELITY MANUFACTURERS INC.

Listen to the EICO Hour, WABC-FM, N. Y. 95.5 MC, Mon.-Fri., 7:15-8 P.M. © 1961 by EICO, 33-00 N. Blvd., L. I. C. 1, N. Y.



DESIGNED

AS YOU WOULD DESIGN IF YOU WERE AN ELECTRONICS ENGINEER...

Praised by the experts as Best Buys... **EICO**®

Ⓐ By far the best professional VTVM value in electronics; nobody but EICO brings you such outstanding instrument performance for so low a price! Calibration without removing from cabinet. Measure directly p-p 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 volts with HVP probe, & 250 mc with PRF probe). Ohms: 0.2 ohms to 1000 megs. 4½" meter, can't-burn-out circuit. 7 non-skip ranges on every function. Zero center. Features EICO's exclusive **UNI-PROBE**: your terrific time-saver, performs all functions: a half turn of probe-tip selects DC or AC-Ohms!

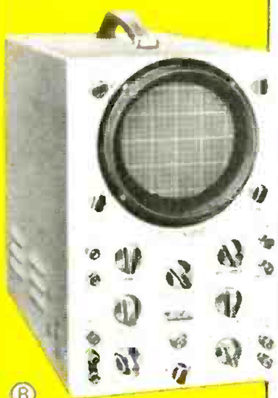
Ⓑ An engineering achievement unmatched in the industry! EICO-designed for laboratory precision and EICO-priced for lowest cost. Features **DC amplifiers**. Flat from DC to 4.5 mc, usable to 10 mc. Vert. Sens.: 25 mv/in.; input Z 3 megs; direct-coupled & push-pull throughout. 4-step frequency-compensated attenuator up to 1000:1. Sweep: perfectly linear 10 cps - 100 kc (ext. cap. for range to 1 cps). Pre-set TV V & H positions. Auto sync limiter & amplifier. Direct or C coupling; balanced or unbalanced inputs; edge-lit engraved lucite screen with dimmer control.

Ⓒ More features and versatility, more range and accuracy than in generators costing three to four times as much. **150 kc to 435 mc with ONE generator** in 6 fundamental bands and 1 harmonic band! ±1.5% frequency accuracy. Colpitts RF oscillator directly plate-modulated by K-follower for improved modulation. Variable depth of internal modulation 0-50% by 400 cps Colpitts oscillator. Variable gain external modulation amplifier: only 3 volts needed for 30% mod. Turret-mounted, slug-tuned coils for max. accuracy. Fine & Coarse (3-step) RF attenuators. RF output 100,000 uv, AF output to 10 v.

Ⓓ Provides more ranges, greater ease and accuracy, and better performance than any competitive unit. Entirely electronic sweep circuit with accurately-biased incre-ductor for excellent linearity. Extremely flat RF output. Exceptional tuning accuracy. Hum & leakage eliminated. 5 fundamental sweep ranges: 3-216 mc. Variable marker range: 2-75 mc in 3 fund. bands, 60-225 mc on harmonic band. 4.5 mc crystal marker osc., crystal supplied. Ext. marker provision. Attenuators: Marker Size, RF Fine, RF Coarse (4-step decade). Narrow range phasing control for accurate alignment.

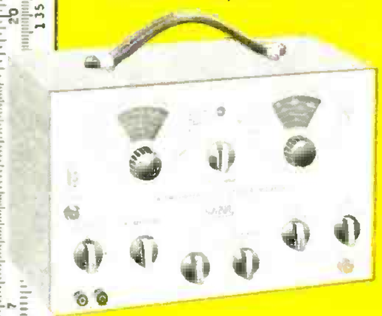
Ⓔ Speedy, simple operation, unexcelled sensitivity and accuracy; superb electrical and mechanical design. **Tests all receiving tubes** (picture tubes with adapter), n-p-n and p-n-p transistors. Composite indication of Gm, Gp & peak emission. Simultaneous selection of any one of 4 combinations of 3 plate voltages, 3 screen voltages, 3 ranges of continuously variable grid voltage (with 5% accurate pot.). Sensitive 200 ua meter. 10 six-position lever switches: freepoint connection of each tube pin. 10 push-buttons: rapid insert of any tube element in leakage test circuit. Direct reading of inter-element leakage in ohms. New gear-driven rollchart. **CRA Adapter $4.50.**

Ⓐ
PEAK-TO-PEAK VTVM #232 & †UNI-PROBE® KIT $29.95 WIRED $49.95
†U. S. Pat. No. 2,790,051

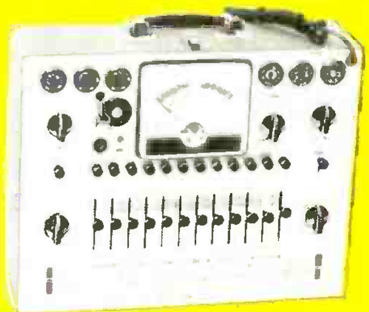


Ⓑ
COLOR & MONOCHROME DC TO 5 MC LAB & TV 5" OSCILLOSCOPE #460 KIT $79.95 WIRED $129.50

Also available:
5" Push-Pull Oscilloscope #425 Kit $44.95 Wired $79.95



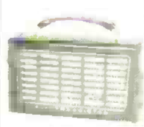
Ⓓ
TV-FM SWEEP GENERATOR & MARKER #368 KIT $69.95 WIRED $119.95



Ⓔ
DYNAMIC CONDUCTANCE TUBE & TRANSISTOR TESTER #666 KIT $69.95 WIRED $109.95 Complete with steel cover and handle

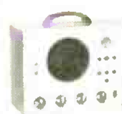
Ⓒ
RF SIGNAL GENERATOR #324 KIT $26.95 WIRED $39.95

Turn Page For More EICO Values



All Transistor Portable RA-6 Kit $29.95 Wired $49.95 less battery

Power & Bias Supply for Transistorized Eqpt. #1020 Kit $19.95 Wired $27.95

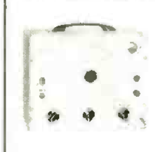


DeLuxe Multi-Signal Tracer #147 Kit $24.95 Wired $39.95

Tube Tester #625 Kit $34.95 Wired $49.95 Pix Tube Test Adapter $4.50

6 & 12V Battery Eliminator & Charger #1050 Kit $29.95 Wired $38.95 #1060 Kit $38.95 Wired $47.95

V-O-M #565 Kit $24.95 Wired $29.95
V-O-M #536 Kit $12.90 Wired $14.90



R-C Bridge & R-C-L Comparator #950B Kit $19.95 Wired $29.95

Most EICO distributors offer budget terms.

EICO 33-00 Northern Blvd., L. I. C. 1, N. Y. EW-2
Show me HOW TO SAVE 50% on ☐ Test Instruments ☐ Hi-Fi ☐ Ham Gear. Send me FREE Catalog, name of neighborhood dealer. ☐ Send free Short Course for Novice License.

Name ....
Address ....
City .... Zone ...... State ....

EXPORT: Roburn Agencies, Inc., 431 Greenwich St., New York 13, N.Y.

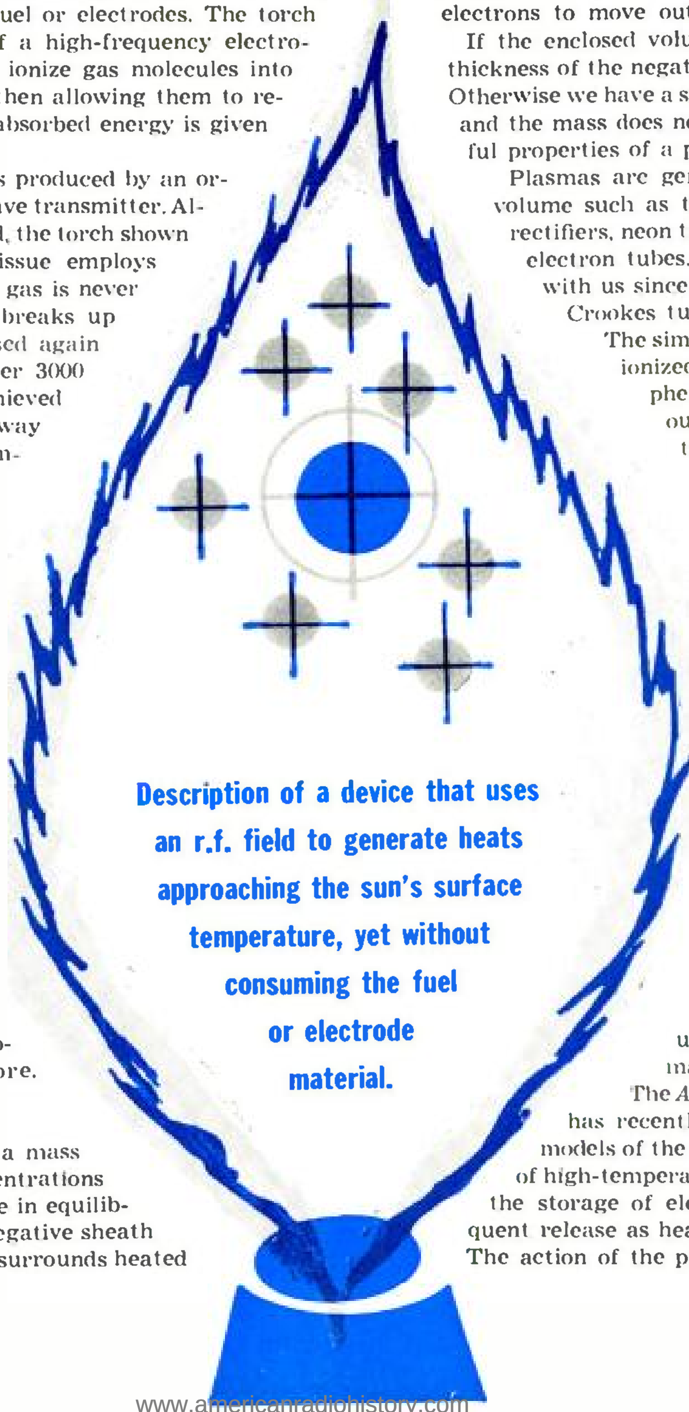
© 1961 EICO 33-00 N. Blvd., L. I. C. 1, N. Y. Add 5% in the West

SEE OUR OTHER ADVERTISEMENT ON PAGE 129

The Radio-Frequency Plasma Torch

By **CHARLES RODDY, Product Manager**
& BERT GREEN, Applications Engineer
Amperex Electronic Corporation

COVER STORY



Description of a device that uses an r.f. field to generate heats approaching the sun's surface temperature, yet without consuming the fuel or electrode material.

THE "PLASMA TORCH" is a device that uses an r.f. field to generate heats approaching the temperature of the sun, yet without consuming any fuel or electrodes. The torch operates by using the energy of a high-frequency electromagnetic field to dissociate and ionize gas molecules into electrons and positive ions, and then allowing them to recombine. When this occurs, the absorbed energy is given off in the form of heat.

The field that does the work is produced by an ordinary high-frequency or microwave transmitter. Although many gases can be utilized, the torch shown on the cover of this month's issue employs ordinary nitrogen gas. Since the gas is never actually consumed, but simply breaks up and is recombined, it can be used again and again. Temperatures of over 3000 degrees C have already been achieved and experiments are now under way to reach the 5700-degree C temperature of the sun's surface.

Another unique characteristic of the plasma torch is that none of its parts ever heat. As a matter of fact, when the small piece of metal that produced the shower of sparks shown on the cover was removed from the torch, the nozzle was found to be cold to the touch. The whole unit should then be long-lasting with only the tubes used in the r.f. portion requiring replacement. The torch is small enough to be mobile, simple in design, and not difficult to construct. The high-frequency prototype was not expensive to build, though microwave versions would cost more.

What Is Plasma?

A plasma may be defined as a mass of ionized gas in which the concentrations of electrons and positive ions are in equilibrium. A plasma has an outside negative sheath similar to the space charge that surrounds heated cathodes in electron tubes. The greater mobility of electrons compared to the heavier ions causes the electrons to move outward and produce a sheath.

If the enclosed volume is large compared to the thickness of the negative sheath, we have a plasma. Otherwise we have a simple accumulation of charges and the mass does not, in general, exhibit the useful properties of a plasma.

Plasmas are generally confined to a specific volume such as those found in mercury-vapor rectifiers, neon tubes, or other types of gaseous electron tubes. In this form they have been with us since the early Geissler tube or the Crookes tube.

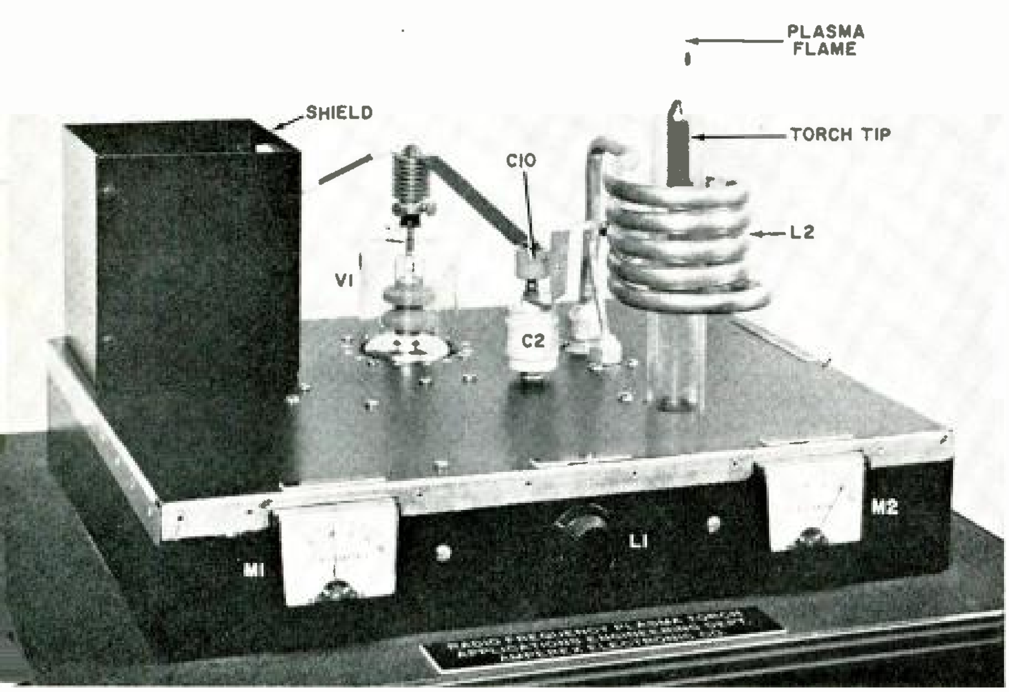
The similarity in behavior of the upper ionized layers of the Earth's atmosphere to what takes place in gaseous electrical discharges led to the study of plasma physics. Directions followed by this research have been diverse.

Research is being done in many centers on the use of plasma discharges to guide or drive projectiles by means of a plasma engine. These applications use the "pinch effect," in which the plasma is actually compressed by intense surrounding magnetic fields.

Another line of investigation concerns the production of the very high temperatures needed for thermonuclear reactions. In the electronic field, investigations are being made in the possible production of ultra-microwaves in an efficient manner by means of a plasma.

The *Amperex Electronic Corporation* has recently produced two experimental models of the plasma torch. These new types of high-temperature generators are based upon the storage of electrical energy and its subsequent release as heat from a gas plasma.

The action of the plasma torch depends upon the



Construction of the 27-mc. r.f. plasma torch generator. The plasma flame may be seen within the plastic tubing inside the tank coil. Separate power supply is used.

generation of a heat producing plasma in free space where it may be used to heat or melt materials. The temperature of the flame is determined by the energy exchanges in the particular molecular composition of the gas passed through the radio-frequency field as well as the field intensity supplied by the r.f. generator used.

The heat is not, as in conventional combustion, a result of oxidation or other chemical reactions. The gas used is virtually unchanged chemically. The operation of the torch takes place at relatively low pressures and low gas velocities. By proper choice of the heating gas one can control the chemical composition of the material being processed. The system may prove to be more versatile than the oxyhydrogen or oxy-acetylene flame for this reason. Solid materials introduced into the flame promote recombination at the surface exposed to the flame. The temperatures resulting are extremely high.

Oxidation or reduction reactions may be accomplished by means of the plasma flame or it is theoretically possible to accomplish useful work in a closed chamber using any gas which, by its chemical nature, provides a protective atmosphere.

A typical gas reaction which is useable is the dissociation of nitrogen from N^2 into $N + N + 24.3$ electron volts. Each molecule of nitrogen dissociated stores energy equal to 24.3 electron volts as the gas enters the radio-frequency field and liberates this energy as heat as it leaves the field recombining in the plasma flame.

It becomes possible to melt such materials as zirconium oxide (melting point 2720°), molybdenum (2600°), or tungsten (3380) in the center of the plasma flame.

The two experimental approaches followed in the construction of this device involve a 27-mc., 500-watt generator and a 2450-mc., 2000-watt generator. These experimental designs are similar to the generators originally built and tested at *Valvo G.M.B.H.* in Hamburg, and described by Ole Scholz (Sonderdruck aus "Umschau fur Wissenschaft und Technik" '59.23 S716-717).

The 27.5-mc. Oscillator

The oscillator tube chosen for the 500-watt (plate-input power) generator was the *Amperex* 5866 triode. This tube combines small size, ruggedness, and good high-frequency characteristics. A heavy graphite anode insures good performance and long life under widely varying load and plate dissipation conditions. The generator delivers about 250 watts into the load at 27.5 mc.

The schematic diagram and parts list are given in Fig. 1. This will be recognized as a conventional tuned-plate untuned-grid oscillator. Although the grid circuit appears to be tuned, the function of C_1 is merely to vary the feedback by controlling the effective inductance of the grid tank circuit. An alternative method would be to vary the inductance of L_1. Parallel feed is used for the plate circuit through the radio frequency choke RFC_1.

The plate is capacitively coupled to a tap on the output tank circuit and the bulk of the circuit capacity (C_2) is connected to the same tap on the coil. Actually the capacitance of the flame to ground is in parallel with the entire coil. This arrangement allows a voltage step-up and provides approximately 5 kv. of r.f. at the tip of the torch.

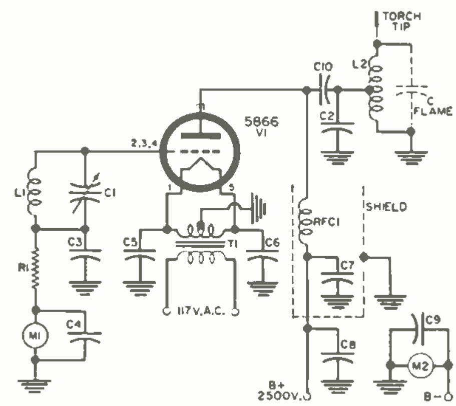
Water cooling is used for the tank coil and tip in the following manner. The tank coil is formed from ⅜-inch tubing with 3/16-inch tubing inserted. It becomes possible to cool this assembly by passing water at ground potential into the ⅜-inch tube and using a return path through the 3/16-inch tube. Isolation hoses are thus dispensed with.

The torch tip (Fig. 2) is constructed of ½-inch (inside diameter) tubing with an internal divider. This is connected so that it permits the cooling water to go up one side of the torch from the ⅜-inch tubing and return from the other side of the torch via the 3/16-inch tubing. The tip is internally countersunk to allow the water to pass the tip and return down the other side of the torch. The material used for the tip itself is molybdenum. A Lucite or polystyrene tube serves to contain and direct the gas flow.

Oscillator Adjustment

The plate circuit tap point on the tank coil and the degree of feedback are adjusted to obtain matched operation with an ignited flame. This tap point is approximately two turns from the grounded side of the tank coil.

Typical values found when operating under full load (flame ignited) and no load conditions (no flame) are as follows. In this case low-pressure air was used as fuel.



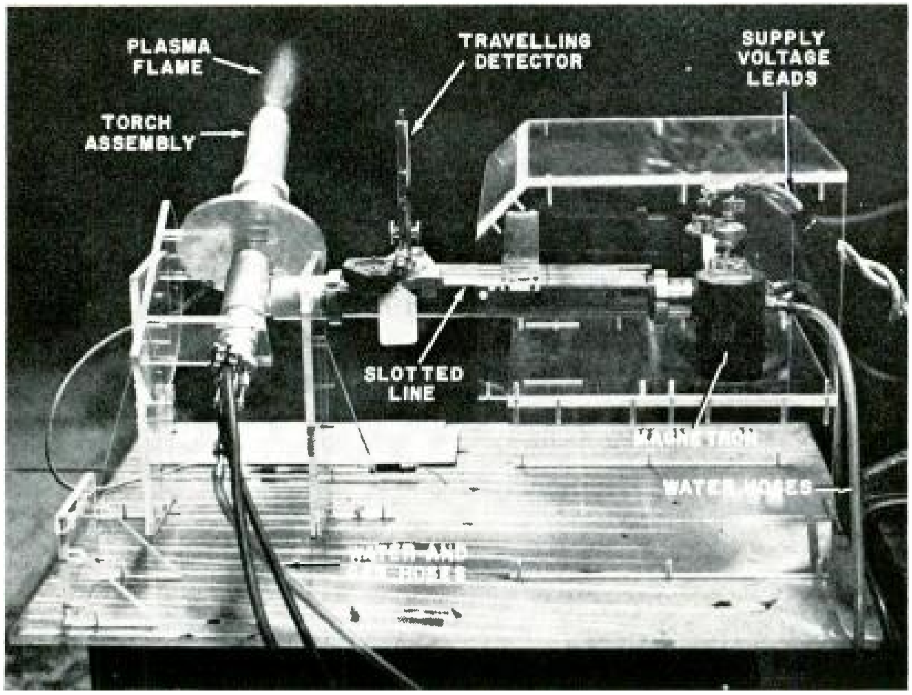
R — 5000 ohm, 50 w. res.
C_1 — 10.5 μμf. per sect. butterfly cap. (Johnson 167-21 Type L. or equiv.)
C_2 — 25 μμf., 15 kv. cap. (Centralab 857-252, or equiv.)
C_4, C_{10} — 500 μμf., 5 kv. cap. (Centralab 858S-500, or equiv.)
C_3, C_5, C_6, C_9 — .005 μf., 1 kv. disc ceramic cap.
C_7, C_8 — .001 μf., 5 kv. cap. (Centralab 858S-1000, or equiv.)
L_1 — 4 turns #16 wire, 1" diameter, 2" long
L_2 — 4¾ turns ⅜" copper tubing, 3" diameter, 3⅜" long (with 3/16" tubing inside)
RFC_1 — ½" x 2⅛" ceramic form, closewound with #22 d.s.c. wire
T_1 — 6.3 v., 5.4 amp. fil. transformer
M_1 — 100 ma. d.c. milliammeter
M_2 — 250 ma. d.c. milliammeter
V_1 — 5866 tube

Fig. 1. Schematic of the 27-mc. torch.

	FULL LOAD	NO LOAD
Plate volts	2500 v.	2500 v.
Plate ma.	210 ma.	72 ma.
Grid ma.	60 ma.	80 ma.

To ignite the flame the generator-tube filament is first energized and allowed to warm up for a few minutes. Water is fed to the cooling system, and the gas flow started through the Lucite tube which encloses the torch tip.

It is necessary to temporarily provide a source of free electrons in order to start the ionization process which results in the plasma flame. A simple means of accomplishing this is by



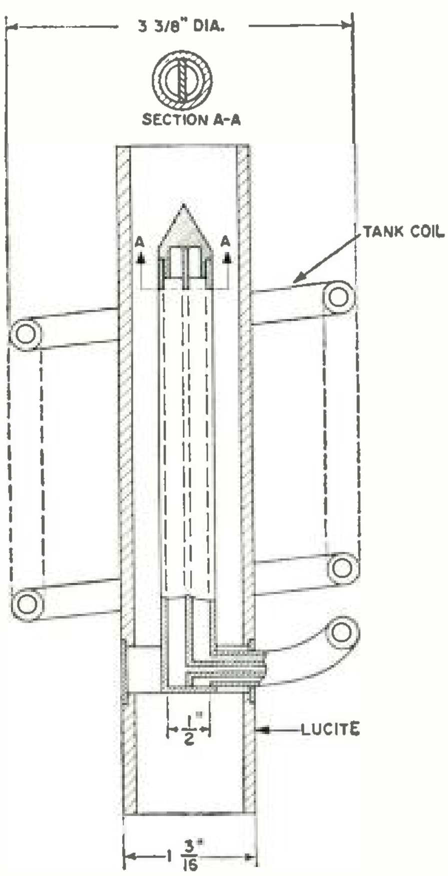
View from the rear of the microwave torch. The slotted line and travelling detector are used to keep a check on the standing-wave ratio between magnetron and tip.

"sparking" the torch tip by means of an auxiliary electrode which is grounded through a 10-megohm resistor. Free electrons liberated by this discharge are accelerated in the r.f. field until they acquire enough kinetic energy to cause dissociation of the gas molecules in the field.

This process is cumulative because of multiple collisions, creating in turn more electrons until considerable energy is extracted in this manner from the r.f. field. Recombination occurs when the dissociated gas leaves the intense r.f. field and the energy released causes the gas to glow as in a normal flame. While this flame has the normal appearance of a coal gas flame, there is no actual combustion present. The gas, in general, is virtually unchanged as it leaves the torch (unless a chemically reactive mixture of gases is used).

It will be found that there is a rather critical balance between power output of the generator and the gas velocity provided, if a steady flame is to be sustained. This will require some adjustment.

Fig. 2. Details of 27-mc. tank coil and tip.



Microwave Torch

The microwave torch illustrated on the cover and in Fig. 3 is a much more elaborate and powerful design. Using *Amperex* tube type 7292, a water-cooled c.w. magnetron originally designed for microwave oven applications, this torch provides a plasma flame from a power input of 2 kw.

Temperatures in the 3000 to 4000 degree Kelvin range are easily achieved and many high melting point materials have been satisfactorily fused. The torch tip uses a special coaxial construction matched for operation at 2450 mc. An air dielectric coaxial line links the magnetron directly to the torch tip. Suitable matching devices have been provided. These are plunger-type shorting collars which are adjusted during operation to present a lower standing-wave ratio to the magnetron. The torch tip is water cooled through two concentric tubes which terminate at the tip in such a manner that the water cools the tip and returns via the outside tube. Little water is required since the tip does not heat up greatly during operation of the torch.

An advantage of the microwave version is that the geometry of the torch in useful applications lends itself better to a coaxial system than in the case of the low-frequency design. This is due to the higher frequencies used, and for the same power output the microwave arrangement would be much more compact.

Suitable precautions must be observed as far as interference is concerned because both of these torches radiate some radio-frequency energy. Also the eyes should be protected from intense ultraviolet radiation generated by both instruments.

In the case of the microwave torch, dangerous levels of microwave energy were not measured at reasonable distances from the torch tip. However, as in all high-powered microwave devices it is necessary and advisable to monitor

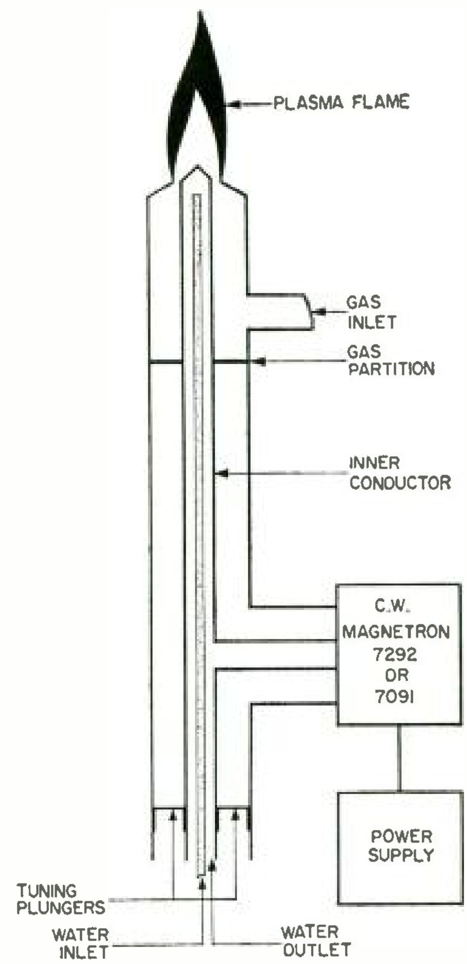


Fig. 3. Block diagram of microwave torch.

microwave radiation levels and make sure that the accepted safe levels of such radiation are not exceeded at the body. In addition, the eyes may be protected by microwave absorbent materials that are incorporated in goggles.

Possible Fields of Use

In speculating on future uses of the principles of the plasma torch, one might first consider the following:

(*Continued on page* 117)

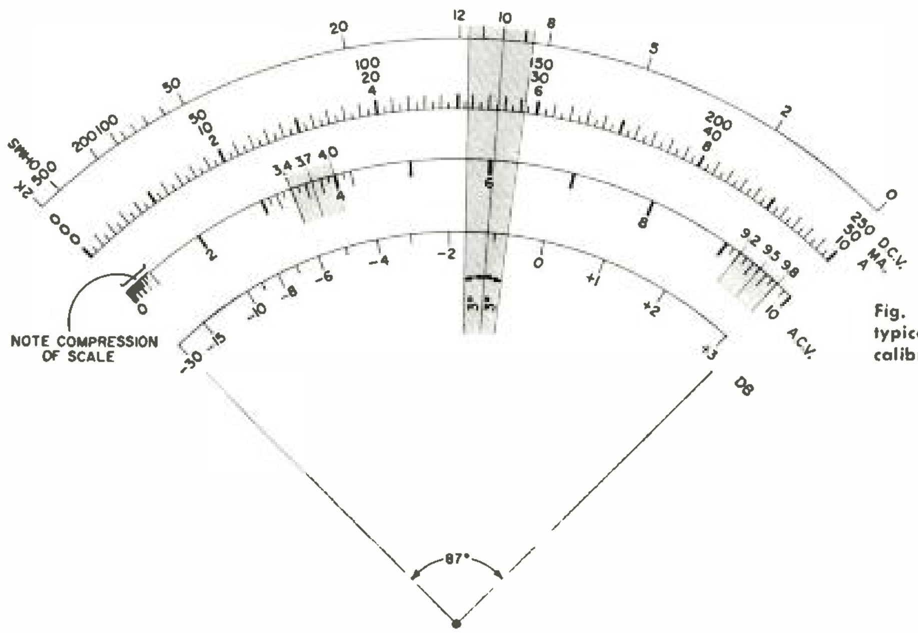


Fig. 1. Partial scales on a typical instrument emphasize calibrations analyzed in text.

Is Your Multimeter Accurate?

By TOM JASKI

Guarantees permit great deviation, actual precision is better, but proper use insures most reliability.

IF YOU have worked with a multimeter, you have doubtless come across the situation where an off-value reading has made you hesitate to pass judgment.

The reading you get is quite a bit off the one expected, but not entirely out of range. If your instrument is reasonably correct, it is worthwhile to investigate the portion of the circuit involved further. However, it may be that, although the circuit is somewhat off, there is no cause for actual concern because this deviation is simply adding to and being exaggerated by some error in the instrument. You then take a critical glance at the specifications of the instrument manufacturer and your doubts are increased rather than resolved.

For example, you may read that the voltage scales are guaranteed accurate to 3 per-cent of full scale and that the resistance scales, with a fresh battery, are accurate to 1½ per-cent of the "length of scale used." Accuracy of the resistance scales may be phrased somewhat differently. For example, this figure may be given as being "within 3 degrees of arc of the absolute resistance measured." What do these specifications mean? How do they affect your use of the instrument? What causes these inaccuracies?

To begin with, remember that the meter movement itself is a mechanical device. It has bearings, springs, and balancing weights. If all of these are in perfect condition, the meter will at least give exactly the same reading, accurate or not, each time the same amount of current passes through the coil in the movement. Even here, minute flaws in pivots or bearings may introduce differences when the same reading is repeated with no other factors being changed.

Another mechanical consideration: when the meter movement is lying flat, perfectly horizontal, readings are independent of gravity. Tilt the meter or use it in the vertical position and gravity begins to pull the pointer. If the latter happens to be precisely straight up, this force is balanced out. With the pointer off-center, its own weight pulls it down, tending to make readings too far up-scale on one side and too far down-scale on the other.

To offset this effect, balancing weights are built into the pointer system. Fig. 2A presents a simplified idea of the arrangement. Nevertheless, they seldom cancel out gravity altogether, and minute differences in the weights themselves may introduce some error, shown exaggerated in Fig. 2B.

Aside from the movement, the multimeter circuit also includes resistors. These could be made with great precision, but at prohibitive cost. The accuracy of those used is 1 per-cent or, at best, ½ per-cent. Here is another source of slight error which, however, may be cumulatively added to other factors.

What do all of these add up to, in terms of the limits of guaranteed accuracy? Look at some of the scales of a typical instrument, shown in Fig. 1. Suppose you wish to take a reading on the 10-volt scale, which is accurate to within "3 per-cent of full scale." Actually, this would probably be specified for d.c. readings, with the a.c. scales guaranteed at somewhat less accuracy. However, for convenience, we will plot 3 per-cent error on the 10-volt a.c. scale.

Now 3 per-cent of 10 volts is .3 volt. This amount of error, in terms of the rating, may occur anywhere on the 10-volt scale. If you are measuring 9.5 volts, the multimeter could indicate anywhere from 9.2 to 9.8 volts, which is not bad. However, if the actual voltage measured is 3.7 volts (Fig. 1), you could read anywhere from 3.4 to 4 volts. In terms of the absolute voltage measured, possible error has increased to about 8 per-cent!

Consider resistance readings. On the scale shown, 10 ohms is close to the center. Suppose you had a resistor whose actual value was precisely 10 ohms. Your reading may be "within 3 degrees of arc" of this value. How far off is one degree? Since the resistance scale is non-linear, the actual amount will depend on the portion of the scale used, but we can conveniently use the linear d.c. scale to determine the amount of error and then project this up to the resistance scale. The entire scale arc for this typical instrument, on any function or range, is 87 degrees, as shown at the bottom of Fig. 1. The d.c. scale conveniently has exactly 100 fine, linear divisions. Thus each d.c. scale division represents .87 degree of arc, and 3.45 of these divisions come to 3 degrees.

Projecting 3.45 d.c. divisions up to and on either side of the 10-ohm point, as shown, we see that the resistance reading might be anywhere from 8.6 to about 11.8 ohms. The higher reading is 18 per-cent off—but it could be worse. Consider the same 3-degree difference on the left-hand side of the scale. A 100-ohm resistor, for example, might give a reading anywhere from 72 to 200 ohms. The maximum error possible would be 100 per-cent off!

Before you throw your meter away in disgust, read on. The situation is not really as bad as it sounds. Good practice in use and a bit of know-how can improve matters a great deal. For one thing, it is obviously a good idea to read as high up on the scale as possible for voltage and current, and on the right-hand portion of the scale for resistance. For another thing, console yourself with this fact: when a manufacturer guarantees certain specifications, these are the limits beyond which he is willing to take the instrument back without a murmur and give you a new one.

Actually, the meter is most likely to be far more accurate than claimed, being particularly more accurate at the left-hand portion of the scales than the broad deviation permitted here by the guarantee. Many multimeters, when checked against calibrating standards, are extremely close all through the d.c. scales and not much more off on a.c.

The additional error in a.c. readings is introduced by the fact that the instrument contains a rectifying system using one semiconductor or more to convert the a.c. into a d.c. that may be applied to the movement. The action of this system is non-linear, particularly when lower voltages are impressed across it. This accounts for the fact that, by way of compensation, the a.c. scales are compressed at the left, as shown in Fig. 1. However, rectifier behavior is somewhat subject to aging, so the a.c. scales are somewhat less reliable over time. Even less reliable over a period of time are the resistance scales. In fact, they will not usually read the same on a single instrument for an extended period. Why is this so?

The basic resistance-measuring circuit used in most multimeters is shown in Fig. 3. It is a voltage divider. First, the voltage drop is measured across a standard, internal resistance (with the external prods shorted, for zero setting). Then the prods are put across the unknown resistance and a reading is taken, effectively across the standard resistance again, with some of the applied voltage now being dropped across the unknown resistor in series.

Suppose the battery voltage is initially 1.5 volts, the standard resistance 1500 ohms on the scale being used, and the meter is, for convenience in calculating, a 1-ma. movement with 1000 ohms internal resistance. With the prods shorted, the zero-set control is adjusted to make the meter read full scale, or zero. To make the meter read full scale, there must be 1 ma. of current through the movement. Since the voltage applied across the meter itself and the series potentiometer is 1.5 volts, a calculation based on Ohm's law *($R=E/I$)* shows that there must be 1500 ohms in this branch of the circuit. With the meter resistance known to be 1000 ohms, there must be 500 ohms of potentiometer resistance in the circuit.

This 1500 ohms is in parallel with the 1500 ohms of R_s, presenting a resistance of 750 ohms across the battery. Let us say that the inserted unknown resistor is 1500 ohms. In series with the 750 ohms of the shunted meter circuit, this comes to 2250 ohms. Current drawn from the battery by this resistance is approximately .667 ma., or two-thirds of a milliampere. All of it goes through the unknown resistor, but it divides equally in the 1500-ohm standard resistance and the 1500-ohm parallel combination that includes the movement. Thus the latter carries one-third of a milliampere and (being a 1-ma., linear movement) deflects one-third of the way. This would be the 1500-ohm calibration on the resistance scale.

To illustrate one reason for inaccuracy (on the left-hand side of the resistance scales), suppose the unknown were 3000 ohms instead of 1500. This would place a total of 3750 ohms across the 1.5-volt battery and total current

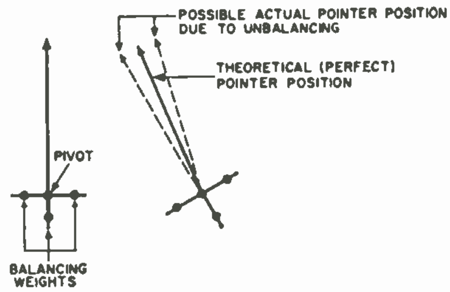


Fig. 2. Pointer balancing system counters pull of gravity in vertical use, but may introduce some error of its own.

would be .4 ma. Half of this, or .2 ma., would go through the movement. Since the resistance now being measured is twice that of the preceding example, we might expect that current through the meter would drop to half. However, it has dropped to only about two-thirds of that in the last example and one-fifth of full-scale current, so the pointer still deflects quite a bit. This explains the compression of calibrations to the left.

However, we have yet to account for increasing error with time. Suppose that the battery has aged and its output, with the meter adjusted to zero, is only 1 volt. To get the 1 ma. of current that would deflect the meter full-scale during zero adjustment, we need 1000 ohms in the meter's branch of the parallel circuit that is across the battery. Since this is the resistance of the movement itself, the zero-adjust control is entirely out of the circuit. Now the parallel combination of the meter and R_s comes to 600 ohms.

With the circuit in this condition, let us once more measure the 1500-ohm "unknown" resistor that was used three paragraphs back. The entire resistance across the 1-volt battery is 2100 ohms, and total current is .4761 ma. To determine how much of this passes through the meter movement, we can no longer simply divide by two, since the resistances of the two parallel paths are no longer equal. Actually, 60 per-cent of this current goes through the meter, or .2857 ma. Comparing this with the .333 ma. of current when the same resistor was measured with 1.5 volts from the battery, we find that current, and therefore the amount of deflection, has dropped more than 14 per-cent.

The resistance reading will be too high, but the degree of error can be much more than 14 per-cent. Remember that an error in pointer deflection is generally reflected in greater calibration percentage error with respect to the absolute value being measured. Also remember that mechanical and other accumulated inaccuracies must be considered. Thus, in time, resistance readings can become surprisingly unreliable.

When your internal battery is fresh, *and* you are careful to set the zero adjustment accurately, *and* you read as high up on the scale as possible, your resistance measurements will be far from perfect, although error will be tolerable. If you are careless in meeting these conditions, you may be wasting time by taking readings at all.

What does all this mean in terms of use? In service work and most other applications, it means little. For one thing, voltage measurements, usually d.c., are the main duty of the meter. As far as resistance checks are concerned, it is seldom that the instrument serves as much more than a continuity checker. The most frequent resistance defects, such as shorts or open conditions, are gross in nature and will show up despite inaccuracy. The allowable tolerance for most resistors used in radios and TV sets is quite broad, so that a meter of only reasonable accuracy will generally suffice.

In certain types of laboratory work or in designing circuits for publication that might contain critical values, the ordinary, uncalibrated ohmmeter is clearly not the instrument to use to de-

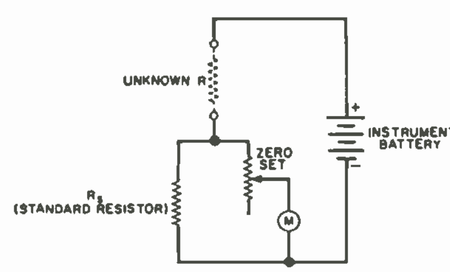


Fig. 3. In ohmmeter circuit, unknown R is made part of a voltage divider.

termine resistances. However, much can be done in the way of using the multimeter itself to provide far greater accuracy than is customary for this type of instrument.

The instrument's calibration can be checked so that constant, inherent error is known and compensation can be made for it. Output voltage of the internal battery can also be checked, so that the latter can be replaced when this value begins to fall off. As to accurate resistance measurements, there are various indirect methods for taking readings, using the multimeter, that are far more accurate than the technique of using the ohmmeter section directly. However, these measures are another matter, which can take the form of other articles. The important thing, at this point, is that the user should know of the possible hazards. From just the information already covered here, he can minimize the chance of error considerably. –30–

NEW TV DESIGNS FOR 1961

By **WALTER H. BUCHSBAUM,** Industrial Consultant, ELECTRONICS WORLD

The year has seen no revolutions, but the trend of change is heartening. There is greater emphasis on serviceability and quality, less on troublesome gadgets of doubtful value.

IN RECENT years, TV design has settled into a pattern of gradual change and improvement rather than one of revolutionary or radical innovation. Take such developments as the use of transistors or the wide-angle, short-necked picture tubes that are returning closer to the truly rectangular shape, some with integral safety glass. These were all with us last year, but there has been no avalanche this year of transistorized TV sets, and many new receivers continue to use earlier CRT's.

Color television is another case in point. Receivers continue to be produced at a steady, even increasing, pace; but there are no signs that an avalanche will develop in 1961. *RCA* no longer stands alone as a color-set manufacturer; one or two makers not yet in the picture report themselves ready to get into color during the year; but *RCA* will continue to carry the major portion of the output and moderate gains in color-set ownership will be made.

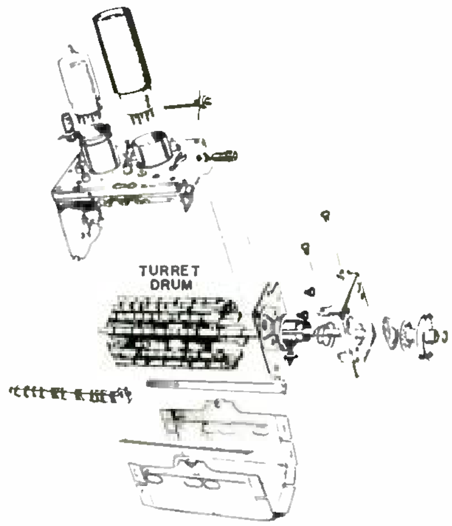
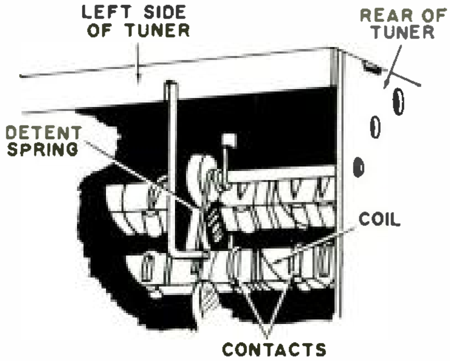


Fig. 1. Exploded view of the newer and smaller turret tuner adapted by Admiral.

It is interesting and perhaps gratifying to note that many novelty features of recent years seem to have been abandoned. Clock timers with or without programming facilities and pneumatic controls are no longer in evidence, for example. TV manufacturers may be realizing something that even the automobile industry shows signs of accepting: the consumer buying a television set (or auto) is interested in just that, and is not necessarily trembling with eagerness for fancy gadgets that sometimes seem to have no other purpose than to confound the service problem.

Fig. 2. This detail of the compact tuner shows coils wound directly on plug-in strips and novel detent-contact system.



Those who service sets, as well as those who own them, should be happy to learn that engineering departments are growing increasingly concerned with the problems of service. A few stalwart manufacturers have championed this cause all along; but, during the past year, practically all of them have taken some worthwhile steps to ease the lot of the service technician.

For example, printed boards are now almost universally marked with component values, test points, and other such helpful data. In addition, the techniques for making these boards seem to have improved to the point that they are, in themselves, quite reliable. As in any receiver, component failures are always possible; but now it is easier for the technician to locate and repair these defects.

In the view of anyone who has ever repaired a TV set, accessibility is the watchword that should be engraved on the drawing table of every chassis designer. Many of the new 1961 models are examples of the type of mechanical layout that could and should have been incorporated in TV sets for the last decade. If the trend continues, one may seriously hope that, in another few years, it will be possible to work on most TV sets without having to skin knuckles or remove a dozen screws.

Two electrical features show signs of gaining in popularity. One is the use of a thermistor in the vertical-output circuit; the other is a power transformer followed by a voltage doubler. The latter arrangement uses a 1:1 transformer for isolation without step-up, followed by two semiconductor rectifiers in a doubler circuit to provide about 250 volts of "B+." Apparently a configuration of this type is now less expensive than a step-up transformer. The thermistor, a resistor whose ohmic value decreases with increasing temperature, cancels the effects of warm-up in the vertical deflection-yoke windings and in the output transformer. Without it, picture height would tend to be greater immediately after the set is turned on than it would be a few minutes later.

Admiral

At first glance, it would appear that most of this manufacturer's 1961 models are the same as those in last year's line. Closer scrutiny reveals some new and interesting features. *Admiral* now marks parts numbers, conductor identification, and other pertinent data right on top of the printed-wiring boards. Accessibility and ease of tube replacement have also been given consideration.

Another feature that can aid in many troubleshooting situations is the thermal-overload circuit breaker, which is connected in the "B−" lead. In most models, it is wired through the yoke connector plug, so that "B+" is interrupted when the yoke is disconnected. There has also been some innovation in receivers designed to operate by remote control. The receiving portion of the remote-control circuit is a 7-transistor, ultrasonic unit.

Another interesting item is a new, miniaturized v.h.f. tuner. An exploded view of this turret tuner is shown in Fig. 1. The greatest point of difference between it and earlier front ends using turret drums is in the design of the

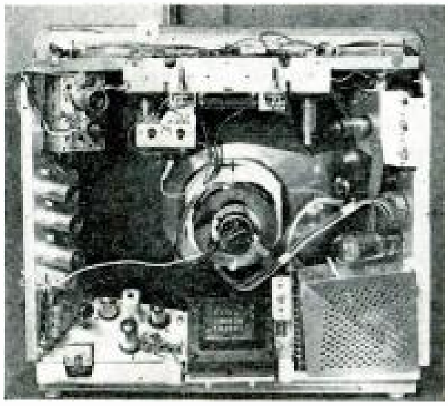


Fig. 3. This Hoffman chassis comprises 4 accessible assemblies framing the CRT.

channel plug-in segments, one of which is shown to the extreme left in Fig. 1. Instead of having separately wound coils mounted on each segment, the coils are wound directly on the plug-in strips. This is shown more clearly in Fig. 2. The design of the contacts and detents is also novel.

The small size and lowered cost are probably the greatest attractions of this front end, but it does have many excellent electrical characteristics. However, certain precautions are worth noting when it must be handled. For one thing, when it becomes necessary to remove plug-in strips, care should be taken to avoid disturbing the position of the coils on this "form." Also, when it becomes necessary to clean tuner contacts, the cleaning compound used should not be permitted to run onto the coils.

Andrea, ATR

Following previous practice, *Andrea* continues to concentrate on hand-wired chassis of conservative design. Greater attention is evidently being given to the export market. A model is available in which the power transformer and the "B+" filter system have been redesigned for operation on 50-cps a.c.

American Television & Radio continues its policy of gradual product improvement rather than the rigid introduction of new models every year. This year's hand-wired, conservatively designed sets use essentially the same circuits that appeared in last year's line.

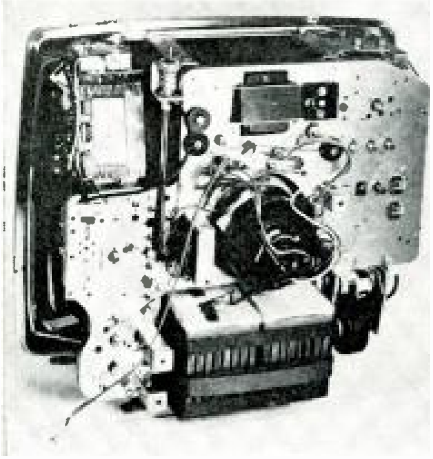


Fig. 4. Transistors and other parts are all on rear deck of Motorola's "Astronaut."

There appears to be a major effort on quality control.

Emerson, DuMont

Since obtaining rights to the use of the *DuMont* name, *Emerson* has begun to offer two lines of TV sets available through separate dealerships. The *DuMont* line is a deluxe series. It features transformers in the power supply, hand-wired chassis, and various combination units that include high-fidelity facilities, phonographs, and stereo. Power tuning and ultrasonic remote controls are available on many models.

The *Emerson* line of TV receivers consists of two main chassis models. One, the even-numbered series from 1524 to 1538, uses no power transformer and is actually an a.c.-d.c. model. A single silicon rectifier provides about +130 volts, which powers all circuits. The second is the 1600 series, which uses the conventional 5U4 circuit. A large, single, printed-wiring board contains most of the receiver circuitry. For easier troubleshooting the tube pin numbers, functions, and many voltages are printed on the underside of the board, in addition to the new, conventional, top markings.

General Electric

Practically all of the basic receiver circuitry used in last year's receivers is found again in the 1961 models. This company has joined others in offering a TV-stereo combination model and has also introduced a new ultrasonic, transistor remote-control unit. To keep the service technician reasonably happy, the marking of printed-wired boards has been made more legible and some additional information is now included.

G-E apparently has branched out into a field previously pursued mostly by small companies in offering special TV receiver models for motel installation. Custom features found among the various models include a volume-limiter control, which is adjustable only with a long screwdriver. The guest who carries such a tool and knows how to use it presumably is too considerate to blast his neighbors. On certain models, an extra speaker is added at the rear of the set and connected to the central paging system. This, of course, reaches even the non-TV viewer. For installations catering to a really sophisticated clientele, a TV set with a 7-position selector switch is available. This gives the guest a choice of either TV, one of 4 radio programs, recorded music or, in the "off" position, silence and rest.

Hoffman Electronics Corp.

This company offers a wide variety of TV sets this year, with models ranging from a 19-inch portable to deluxe receivers which include such features as automatic brightness-level control geared to ambient light levels, remote control, including a "zoom" control for

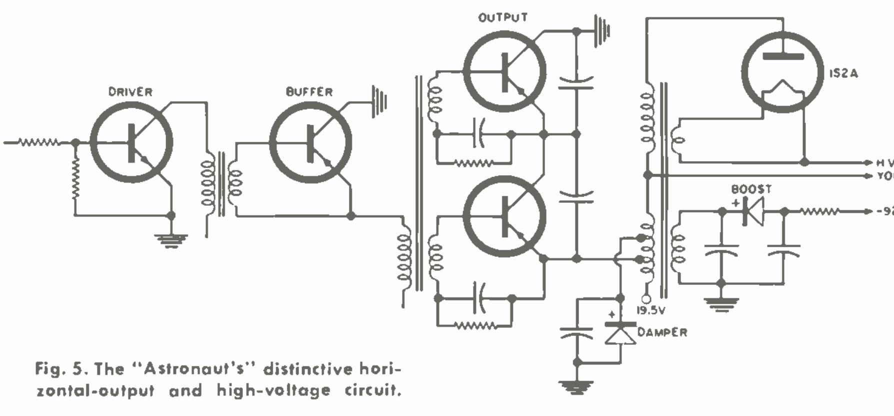


Fig. 5. The "Astronaut's" distinctive horizontal-output and high-voltage circuit.

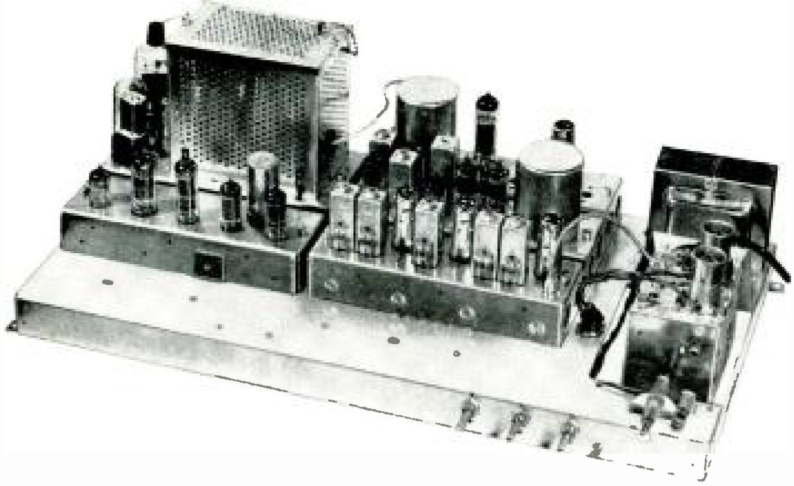


Fig. 6. Six plug-in sub-chassis on main deck are used in this Setchell-Carlson receiver. They simplify many service chores.

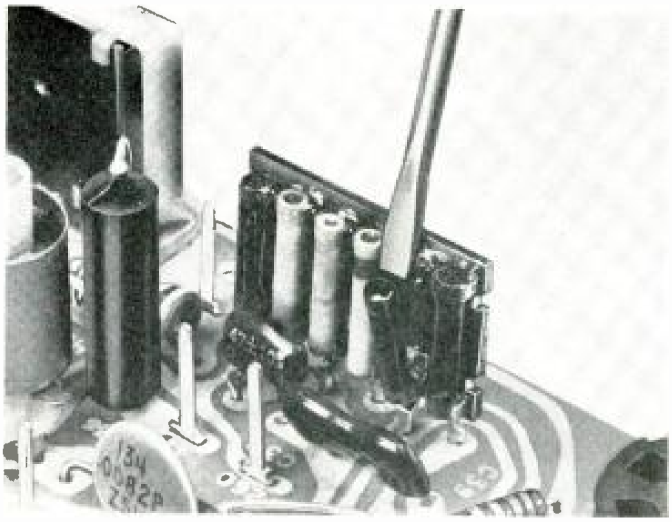


Fig. 7. This Philco "component pack" connects to the printed board. Note ease with which individual parts can be removed.

increasing picture size by as much as 25%. This latter feature uses a simple relay which switches a resistor in the height circuit and a capacitor in the flyback section. The brightness-level control consists of a light-sensitive resistor which is part of the brightness resistance network. As special feature for the service technician, some *Hoffman* sets have a unique arrangement of four sub-assemblies which are mounted on a frame around the picture tube. This construction is shown in Fig. 3 and permits access to every tube with the back cover removed. When the wrap-around cabinet is removed, the bottom of each sub-chassis becomes completely accessible.

Motorola

This manufacturer's TV line includes at least one outstanding innovation that deserves somewhat more comment than simple honorable mention. It is the first transistorized TV receiver, for battery-portable or line-cord operation, that uses a CRT of reasonably large size—19 inches, diagonal measurement. Space permits neither a detailed circuit description nor a full enumeration of all features that are novel or technically interesting. Some coverage has already appeared in this publication ("19-inch Transistor TV," July 1960, page 70). Nevertheless, some highlights are worth comment.

As shown in Fig. 4, the rear of the set consists of one deck which contains all of the transistors, mounted in individual sockets, together with a power transformer, flyback transformer, and batteries. The power transformer is a step-down affair for operating the receiver directly from the a.c. line (approximately 22 volts of d.c. needed) or for re-energizing the rechargeable battery. Using 23 transistors and 12 diodes, the set consumes only 40 watts. Design philosophy goes beyond that of a portable receiver. It anticipates the possibility that future sets intended for use in the home may also be transistorized.

One of the more unusual circuits involves the horizontal-output system, which provides deflection power and high voltage for the CRT from a "B+" source of only 19.5 volts. A simplified version of this circuit is shown in Fig. 5. Note the h-v rectifier, the miniature 1S2A, which is the only vacuum tube in the design. The damper tube, however, is replaced by a semiconductor diode, but a separate diode is used to develop the boosted voltage, which is 92 volts below ground. This voltage is used in series with the positive 22 volts available from the battery to provide 114 volts d.c. to bias the picture tube and to be applied to its first anode.

To obtain sufficient horizontal drive, a driver amplifier follows the oscillator, and in turn feeds into an emitter-follower buffer stage. The actual horizontal-output amplifier, which then follows, employs two transistors in a variation of push-pull circuitry that is not encountered too often. Inputs to the two power transistors are in parallel through separate transformer secondaries in the same phase. However d.c. voltage (the equivalent of "B+") is applied across the two transistors in a stacked or series arrangement. While this arrangement has been sometimes used in audio-amplifier output stages, its appearance in a flyback circuit, whether tubes or transistors are used, is quite novel.

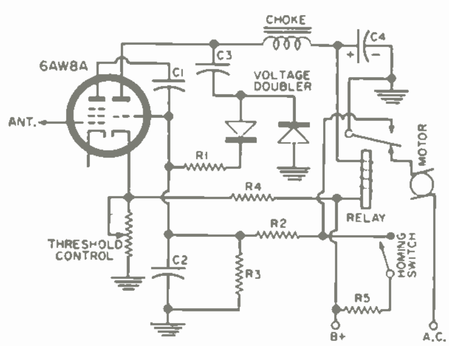


Fig. 8. This Sylvania remote-control receiver uses one tube for several jobs.

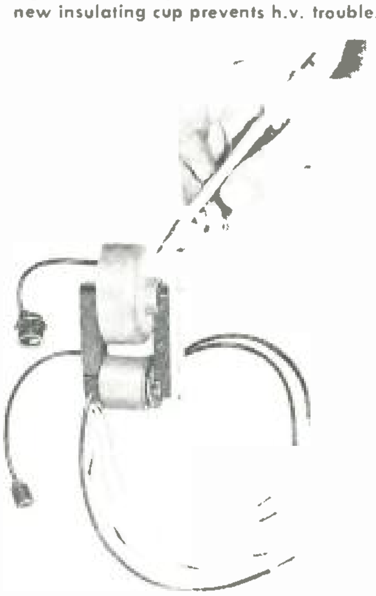


Fig. 9. Zenith flyback transformer with new insulating cup prevents h.v. trouble.

Olympic, Packard Bell

Continuing last year's trend, *Olympic* adheres to established circuitry and emphasizes other aspects as new-model features. Cabinet design from the standpoint of furniture use is stressed. High-fidelity and stereo models are available. Most of the receivers offered are combinations of TV with other units, such as phonographs, to make complete "home-entertainment units."

Packard Bell offers something unusual this year in that it is providing a series of color receivers, including combination units. For example, one model is being offered as a color set and complete stereo system.

This manufacturer's monochrome line includes one set without a power transformer and two models that use the transformer in conjunction with a conventional 5U4 rectifier system. Carried over from the 1960 line is the remote-control system and also the "computer-dial" channel-indicating panel, which was described last year. An innovation on the model 19T-1 is the teacart on which this receiver is mounted. The metal cart is designed to act as the antenna for the set, so that it can be moved about to any place where a.c. is available without having to worry about

(*Continued on page* 114)

COMMERCIAL SOUND SYSTEM FUNDAMENTALS

PART 1 Requirements, Equipment, Speaker Connections

By RUSS PAVLAT
Communications Engineer, State of Wisconsin

Practical working knowledge of sound-system design and servicing—a field that will allow the technician to supply an additional profitable service as well as to gain entry into the field of industrial electronics.

SOUND systems are performing many services in our modern world. The design and servicing of sound systems for schools, offices, stores, factories, shopping centers, hospitals, homes for the aged, and institutions can be a profitable business or a money-making adjunct to an existing radio, TV, and electronics service establishment. These sound systems may be installed to provide music for entertainment or background, paging, as an aid to locating personnel, or as office, school, and plant intercommunication systems. Special systems are being installed to aid plant security and to provide entertainment for invalids and hospital patients. The use of sound systems to aid business efficiency and to help in the operation of institutions of various sorts will undoubtedly increase. A practical background in the fundamentals and operational principles of sound systems is essential for anyone who wishes to realize the potential profits of this growing business. The purpose of this series is to provide a practical working knowledge of sound-system design and servicing.

Requirements

With the advent of much activity in the high-fidelity field, we have been exposed to many "requirements" as far as frequency response, distortion, and noise are concerned. It is claimed that the frequency response range must be very wide (some claim as low as 5 cps and as high as 100,000 cps), distortion must be practically at the vanishing point, perhaps even less than one-tenth of 1%, and noise must be virtually non-existent in a good hi-fi setup. A considerably narrowed frequency response, more distortion, and some noise are entirely acceptable in most sound-system work. Microphones, amplifiers, lines, line-matching transformers, and speakers should all be chosen for the performance, reliability, and economy factors peculiar to a job. Components matched to the specific job usually produce the most satisfactory installation.

For the installation of a system where the interest is only in the intelligibility of voice—for example, a high-level paging system in a noisy factory area—a frequency response of 200 to 3000 cps is preferred and adequate, a distortion level of up to 15% can be tolerated, and the amplifier noise level could be 1% of the average voice power produced by the sound system (20 db below average voice power). Trumpet-type horns with limited frequency response and high power handling capacity and an amplifier designed for high power and long life, rather than low distortion, broad frequency response, and low noise would be preferred. Operating machinery in a factory area will generate a high level of sound below 200 cycles, and any addition of frequencies of 200 cycles or lower from the paging system could reduce the intelligibility and the effectiveness of the system.

In ordinary one-way or two-way voice systems an over-all frequency response of 80 to 5000 cps, a total distortion of 10% or less, and a noise level of approximately 1/10 of 1% of the average sound power of the voice (30 db below average voice power) will provide good voice communication and allow identification of voices. For such systems, cone-type speakers and ordinary amplifiers ranging in power from 2 to 100 watts would be used. If fans or room air conditioners contribute a background noise level of 200 cps and below, it may be desirable to limit the low-frequency response of the system.

The requirements of a system for the distribution of music vary widely depending upon use and individual preference. An "ideal" music distribution system might have an over-all frequency response of 20 to 20,000 cycles, a total distortion of 1% or less, and a noise level of .001 of 1% of the average music level of the music system (50 db below average music power).

Objection from "golden ears" considered, a good practical music distribution system suitable for background or entertainment use would require an over-all frequency response of 50 to 8000 cps, an over-all distortion of 5% or less, and

a noise level of 1/100 of 1% of the average sound level of the music (40 db below average music power). In shopping centers, noisy offices, and any locations where the background noise level is high, a top frequency response of 5000 cps is sufficient. An important consideration in music systems is the selection of equipment designed for continuous usage.

Selecting Equipment

In selecting equipment, attention to some of the detailed equipment specifications and the environment under which the equipment will operate, will save time and money initially, and provide the reliability of service intended. Amplifiers should be located to provide good component ventilation; tube ageing should be considered in sensitivity and noise requirements (normal tube ageing can reduce sensitivity and/or increase noise from 10 to 20%). A visual inspection of components and workmanship can be a great help in determining quality. A heavy frame, a strong magnetic field, a spider or diaphragm-mounted voice coil, and cone treatment if the speaker is to be used in a moist environment, will contribute much to the efficiency and the service life of a speaker. The distribution line should be flexible and smooth for easy conduit pulling, and designed to operate at the ambient temperature encountered. Any shielding should be at least 90% effective and an over-all covering should be provided. The wire size should be large enough to transmit the required power without excessive loss. Any matching transformers should be of good quality. A narrowing of frequency response, excessive power loss, and the introduction of distortion into the system are the penalties for using poor matching transformers.

Distortion introduced by poor matching transformers appears not only in the speaker connected to the faulty output transformer but also in the primaries of other matching transformers connected to the same line and, if sufficiently severe, this distortion may affect any other speakers connected to different output taps of the amplifier driving the line. A good matching transformer will transmit the frequency band required, will have an insertion loss of not more than ½ db (a loss of approximately 10% of the power being transmitted), and will introduce 1% or less distortion over the band of frequencies being transmitted.

In designing and installing a sound system, the use of components with the best "laboratory-type" specifications is neither desirable nor good business in most cases. An example in point would be the general use of the new "low efficiency" speakers and baffles, designed for broad frequency response. A realistic appraisal of the performance of available components coupled with the requirements of the particular system being designed will increase both buyer and contractor satisfaction. Since the contractor many times assumes the responsibility for installation and service, one of his primary interests will be costs

Amplifier Output Impedance In Ohms	Impedance of Voice Coil or Transformer Primary in Ohms									
	4	8	16	45	78	156	200	312	400	500
4	100	50	25	8.9	5.1	2.6	2	1.3	1	.8
8	X	100	50	17.8	10.3	5.1	4	2.6	2	1.6
16	X	X	100	35.6	20.5	10.3	8	5.1	4	3.2
125	X	X	X	X	X	80	62.5	40	31.2	25
250	X	X	X	X	X	X	X	80	62.5	50
500	X	X	X	X	X	X	X	X	X	100
	Impedance of Voice Coil or Transformer Primary In Ohms									
	625	800	1000	1250	2000	2500	4000	8000	16,000	32,000
4	.64	.5	.4	.32	.2	.16	.1	.05	.025	.012
8	1.28	1	.8	.64	.4	.32	.2	.1	.05	.025
16	2.56	2	1.6	1.28	.8	.64	.4	.2	.1	.05
125	20	15.6	12.5	10	6.25	5	3.12	1.56	.78	.39
250	40	31.2	25	20	12.5	10	6.25	3.12	1.56	.78
500	80	62.5	50	40	25	20	12.5	6.25	3.12	1.56

Table 1. Per-cent of rated amplifier output that is delivered to a voice coil of a loudspeaker or that is delivered to a matching transformer primary winding.

both during and after installation. Selection of quality components which can be easily installed results in real economy of installation and operation.

In addition to frequency, distortion, and noise considerations, the "regulation" of an amplifier should be considered. The output voltage of an amplifier with good regulation should not drop more than about 25% from no-load to full-load. A drop of 25% in output voltage represents a reduction of just 2.5 decibels.

In a system of multiple speakers, speakers may be switched "on" and "off" without providing compensating loads, if the power amplifier has good regulation. There will be no objectionable change in volume as speakers are switched if the voltage regulation of the power amplifier is 3 db (a voltage drop of about 30%) or better from no-load to full-load.

An amplifier with poor regulation will require the use of compensating resistors to eliminate objectionable volume changes as speakers are switched, will require more complicated switching to insert and remove compensation, and may result in annoying scratches and pops in all speakers on the system whenever switching takes place. The output regulation of an amplifier can be improved considerably by connecting a permanent "idling" resistive load to the output of the amplifier. This resistor should dissipate from 3 to 5% of the rated amplifier output continuously as heat. Thus the amplifier will not be required to operate from no-load to full-load but from a 3 to 5% load to full load. The amplifier regulates poorest at very light loads and component-damaging electrical transients are greatest at light loads. The use of this idler resistor results in improved regulation characteristics and some increase in amplifier parts life. If part of the speaker load can be permanently attached, it will, of course, provide the same help as the "idler" resistor in providing a load.

Speaker Connections

The proper connection of a speaker load (whether a single speaker or a number of speakers) to a power amplifier is a major factor in good sound distribution. The output transformer of a power amplifier has a secondary winding which usually has several impedance "taps" which are expressed in ohms (audio impedance), and the most common are 4, 8, 16, 125, 250, and 500 ohms. Ordinary speaker impedances are 4, 8, and 16 ohms. Maximum power transfer occurs when the load is matched to the output impedance, and a common way to connect a speaker to an amplifier is to an output tap of like impedance, *e.g.*, connecting a 16-ohm speaker to a 16-ohm output tap. The impedance of the speaker would be "matched" to the output impedance of the amplifier and any adjustment in sound level would be made by using a volume control on the amplifier. When using this method of impedance matching, a speaker with less power handling capacity than the output capability of the power amplifier can be damaged or "burned out" by high volume control settings. A speaker should never be connected to an impedance tap of higher value than the speaker impedance, since under these conditions the system generates frequency and harmonic distortion due to overloading and "impedance mismatch."

Parallel Speakers

If the load consists of more than one speaker, they would normally be connected in parallel. Connecting a number of speakers in series may present problems. Individual speaker variations and varying acoustic speaker loading make it difficult to calculate sound levels in a series speaker circuit. Further, since the sound power being radiated by each speaker requires a definite voltage drop across each speaker (the voltage drop across a 16-ohm speaker drawing 10 watts of audio power would be nearly 13 volts), the voltage required on the series line would vary with the number of speakers and might become excessively high in elaborate installations. Connecting speakers in series would therefore require a power amplifier with essentially constant current output and varying voltage output.

Parallel speaker connections require a power amplifier with essentially constant voltage output and varying output currents. It is presently more practical and economical to build a quality amplifier with good output voltage regulation, *i.e.*, essentially constant voltage output and varying output current. Parallel speaker connections also avoid the problem of having one speaker in a series circuit "open," causing all other speakers to be inoperative. The design of matching transformers for a constant-current series circuit would be difficult, *e.g.*, there would be mechanical problems with movable cores and electrical problems because of core saturation varying with frequency.

If all speakers connected in parallel are of the same impedance, the impedance of the group is found by dividing the impedance of one speaker by the number of speakers, and the group should be connected to an output tap which is the same or slightly lower than the group impedance.

If the speakers connected in parallel are of different impedance, the group impedance can be calculated by a formula similar to the formula for parallel resistances. If Z_G = group impedance, Z_1 = first speaker impedance, Z_2 = second speaker impedance, Z_3 = third speaker impedance, etc., then

$$\frac{1}{Z_G} = \frac{1}{Z_1} + \frac{1}{Z_2} + \frac{1}{Z_3} + \ldots\ldots\ \text{etc.}$$

As an example, the group impedance of two 16-ohm speakers and one 8-ohm speaker in parallel would be:

$$\frac{1}{Z_G} = \frac{1}{16} + \frac{1}{16} + \frac{1}{8}$$

$$\frac{1}{Z_G} = \frac{1}{16} + \frac{1}{16} + \frac{2}{16} = \frac{4}{16} = \frac{1}{4}$$

and $Z_G = 4$.

This group of speakers connected in parallel would be connected to the 4-ohm tap of the power amplifier. The power which each speaker will draw when the amplifier is operating at rated output may be calculated by using the following formula:

$$\textit{Per-cent rated output} = \frac{\textit{output tap (ohms)} \times 100}{\textit{speaker impedance (ohms)}}$$

E.g., if we wished to find the power fed to one of the 16-ohm speakers

$$\textit{Per-cent rated output} = \frac{4 \times 100}{16} = 25\%,$$

and 25% of the amplifier output would go to the 16-ohm speaker. If the amplifier were a 10-watt unit, 2.5 watts would be drawn by each of the 16-ohm speakers and calculation will show that 50% or 5 watts would be drawn by the 8-ohm speaker.

This method of distribution at voice-coil impedances is used for relatively short distances only. Since audio currents are high at voice-coil impedances, line losses are high because, for practical lines, line resistance rapidly approaches and may exceed voice-coil impedance as line length increases.

In general, distribution at voice-coil impedance is used unless total power loss in the lines is greater than 1 db, or about a 20% loss. If this loss is greater than 1 db, an advantage is gained by using good matching transformers and distributing at higher impedances. In a case where high-frequency response is important, distribution at voice-coil impedance may be used and high resistive losses tolerated to gain response at high audio frequencies. The method and the reason for this procedure will be covered later.

Series-Parallel Speakers

The foregoing calculations show that it is impractical to connect very many parallel speakers at voice-coil impedance to an amplifier output tap. Remembering that the output tap must be equal to or less than the group impedance to avoid distortion, four 16-ohm speakers connected to a 4-ohm tap represent a practical limit of this type of distribution. Five 16-ohm speakers in parallel will have a group impedance of 3.2 ohms and would overload a 4-ohm tap, causing the amplifier to be unable to deliver its rated power output with the minimum distortion inherent in its design.

A series-parallel connection of identical speakers is useful for impedance matching where distribution at low impedance is adequate and multiple low-power speakers are required. If two 8-ohm speakers are connected in series to form a 16-ohm group, two of these groups could be wired in parallel and the resulting impedance would be 8 ohms. Four of these groups could be wired in parallel to match a 4-ohm amplifier output tap. Under these conditions all speakers would distribute the same sound level and the total available amplifier output would be divided equally among all the speakers. The proper selection of series-parallel connections therefore provides a method of matching multiple low-impedance speakers to an amplifier. Adjustment of individual speaker volume levels using the series-parallel method of connection is best accomplished by using fixed or adjustable "constant impedance pads" (at voice-coil impedance) in the voice-coil circuit of each speaker. Volume adjustment of each speaker can be made while maintaining the impedance match to the amplifier. Any speaker switching will require compensating resistors and the switching problems would include noise and volume level changes during switching.

Matching Transformers

The formula for "per-cent rated output" is valid as long as the speaker impedance is greater or equal to the amplifier output impedance. This method of calculation is a form of the "constant-impedance method." The impedance of the line is considered to be the impedance of the amplifier output tap and the load each speaker draws from the line is calculated by the formula. Thus a single 16-ohm speaker connected to 4-ohm tap would draw (4 × 100)/16 or 25% of the amplifier rated output. If the speaker impedance could be 400 ohms then the speaker would draw (4 × 100)/400 or 1% of the amplifier rated output. To adjust the speaker imped-

Constant Line Voltage	Impedance of Voice Coil or Transformer Primary In Ohms									
	4	8	16	45	78	156	200	312	400	500
25	156	78	39	13.9	8.02	4.01	3.12	2	1.56	1.25
70	1250	625	312	111	64.1	32.1	25	16	12.5	10
141	5000	2500	1250	445	257	128	100	64	50	40
	Impedance of Voice Coil or Transformer Primary In Ohms									
	625	800	1000	1250	2000	2500	4000	8000	16K	32K
25	1	.78	.63	.5	.31	.25	.16	.08	.04	.02
70	8	6.25	5	4	2.5	2	1.25	.63	.31	.16
141	32	25	20	16	10	8	5	2.5	1.25	.63

Table 2. Power in watts delivered by constant-voltage lines to a voice coil of a loudspeaker or that is delivered to a matching transformer primary winding.

Table 3. Impedance in ohms of constant-voltage output taps on typical amplifiers.

Constant Line Voltage	Amplifier Rated Output In Watts							
	4	8	10	15	25	50	70	100
25	156	78.2	62.5	41.6	25	12.5	8.93	6.25
70	1250	625	500	333	200	100	70	50
141	5000	2500	2000	1333	800	400	280	200

Amplifier Rated Output In Watts	Constant Line Voltage and Constant Line Voltage Squared	Amplifier Output Impedance In Ohms						
		4	8	16	62.5	125	250	500
4	E	4	5.6	8	15.8	22.3	31.7	44.7
4	E^2	16	32	64	250	500	1000	2000
8	E	5.6	8	10.4	22.4	31.7	44.7	63.2
8	E^2	32	64	108	500	1000	2000	4000
10	E	6.3	8.9	12.6	25	35.3	50	70
10	E^2	40	80	160	625	1250	2500	5000
15	E	7.7	10.1	15.5	30.6	43.3	59.1	86.6
15	E^2	60	120	240	937.5	1875	3750	7500
25	E	10	14.1	20	39.5	55.9	79	112
25	E^2	100	200	400	1563	3125	6250	12,500
50	E	14.1	20	28.3	55.9	79	112	158
50	E^2	200	400	800	3125	6250	12,500	25,000
70	E	16.7	23.7	33.5	66.1	93.5	132	187
70	E^2	280	560	1120	4375	8750	17,500	35,000
100	E	20	28.3	40	79	112	158	223
100	E^2	400	800	1600	6250	12,500	25,000	50,000

Table 4. Constant line voltage of impedance taps on commonly encountered amplifiers.

ance to the value giving the desired power level for that particular speaker, a matching transformer is used. A matching transformer normally consists of an iron core with a tapped primary winding and an isolated tapped secondary winding. The primary winding may have impedance taps varying from 78 to 32,000 ohms and the secondary winding will normally be designed to match 4-, 8-, or 16-ohm speakers. By connecting the speaker to the proper secondary tap and connecting the proper primary tap to the line, the desired power can be drawn from the line. Some characteristics necessary for a good matching transformer were mentioned earlier in this article.

One precaution should be taken when using matching transformers. Distortion and excessive power losses will result if a matching transformer is overloaded. The power and/or voltage rating should not be exceeded. Power and/or voltage lower than rated will cause no distortion or loss problems. Table 1 is a chart showing the "per-cent rated output" for voice coils (or transformer taps) connected to the common amplifier impedance taps. The portions of Table 1 filled in with an "x" show conditions of overload and distortion. At first glance, the parts of Table 1 showing very low percentages may seem relatively useless. However, the power input to an ordinary portable radio speaker is on the order of 50 milliwatts. In hospital and institutional sound systems an input level of about 50 milliwatts is sufficient and desirable for many applications. A 2000-ohm transformer tap connected to a 4-ohm output tap, a 4000-ohm transformer tap connected to an 8-ohm output tap, or an 8000-ohm transformer tap connected to a 16-ohm output tap all show .2 of 1% rated amplifier output or 50 milliwatts from a 25-watt amplifier. Assuming a good matching transformer of about ½-db insertion loss (10% loss), a total of 45 milliwatts would be delivered to the speaker.

Full output for a good ordinary magnetic headset is developed with a 1-milliwatt input. The audio impedance of a headset with 2000 ohms d.c. resistance is about 8000 ohms. If this headset is connected to the 8-ohm output of an amplifier, it will receive 1 milliwatt if the amplifier is adjusted for a 1-watt output. Simultaneous headset and speaker operation from the same amplifier is possible by using various taps and connecting methods. Power levels should be established for each unit or groups of units and proper matching transformers and output taps should be selected. Simultaneous connection to more than one amplifier output tap, for impedance matching reasons, is permissible if the total power load does not exceed the rated power output of the amplifier.

Constant-Voltage Method

Good modern amplifiers have an essentially constant-voltage output. When a distribution line is considered to operate at constant voltage, the "constant-voltage method" of power calculation is used to determine the power driving a speaker or a combination speaker and matching transformer. The formula for power is $P=E^2/Z$ where E is the constant line voltage and Z is the impedance of the speaker voice coil or the matching transformer tap.

The total power drawn by all the speakers must not exceed the rated power output of the amplifier. If more than rated power is drawn, overloading and distortion will result. Power overloading produces the same result as, and actually is, the connection of a load of definite impedance to an amplifier output tap of higher impedance.

Table 2 is a chart showing power, in watts, for combinations of impedances and the most commonly used constant-voltage lines. Some of the higher power levels shown are, of course, impractical. They show the power which is theoretically available at an amplifier tap and although ordinary power amplifiers do not have these capacities, they give some idea of the speaker damage which could result if these connections are made inadvertently.

From Table 2 and the formulas for constant-voltage distribution the following characteristics will help in selecting the line voltage which best suits the distribution system being designed:

1. For a given impedance, the 70-volt line transfers eight times the power transferred by a 25-volt line, and a 141-volt line transfers thirty-two times the power transferred by a 25-volt line and four times the power transferred by a 70-volt line.

2. For a given power, a 70-volt line impedance is eight times the impedance of a 25-volt line, and a 141-volt line impedance is thirty-two times the impedance of a 25-volt line and four times the impedance of a 70-volt line.

3. For a given line length, the resistive losses (I^2R) in a 70-volt line are 12.5% of the resistive losses in a 25-volt line, and the resistive losses in a 141-volt line are 3.1% of the resistive losses in a 25-volt line and 25% of the resistive losses in a 70-volt line.

4. For a given acceptable resistive loss, a 70-volt line can be eight times the length of a 25-volt line, and a 141-volt line can be thirty-two times the length of a 25-volt line and four times the length of a 70-volt line.

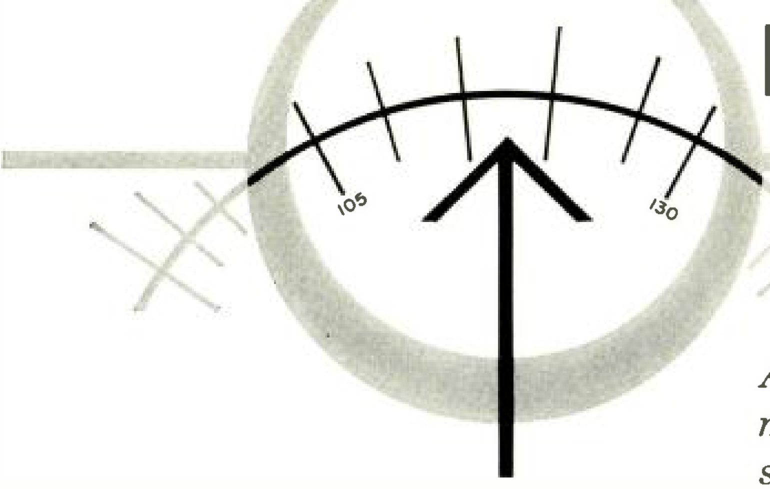
Matching transformers are sometimes rated according to the constant line voltage for which they are designed, with wattage ratings stamped on the primary windings. Table 2 may also be used to convert these wattage ratings to impedances, if desired.

Where close attention must be paid to the loss characteristic and/or the frequency characteristics of a distribution line, the constant impedance method of calculation is advantageous since resistive losses are due to impedances in series with the line and capacitive losses are due to impedances approximately in parallel with the line. Table 3 is provided as a conversion table from constant-voltage taps to amplifier output impedances for eight commonly encountered amplifier power ratings.

Table 4 gives the opposite type of conversion—from amplifier output impedance taps to constant-line voltage and constant-line voltage squared—for ease of calculation in using the constant-voltage formula where power (P) in watts is equal to E^2/Z where E is the constant-line voltage and Z is the load

(*Continued on page* 67)

Expanded-Range Voltmeter Reads R.M.S.



By
PAUL S. LEDERER

Accurate line-voltage readings can be made with this instrument even where sinusoidal output has been distorted.

THERE IS nothing new in the notion of a suppressed-zero, expanded-range a.c. voltmeter designed to read around the normal value of line voltage; nor is there a lack of descriptions of such units that can be built conveniently by the user himself. In fact, the author has described one such ("Expanded-Range A.C. Voltmeter," ELECTRONICS WORLD, July 1959). However, instruments of this kind are peak-reading devices that are calibrated to read r.m.s. voltage. The one presented here is different in that it responds to true r.m.s. values.

Why should this type of action be important? A consideration of the applications of such voltmeters in general gives the reason.

Most pieces of electronic equipment that operate from a.c. power are designed to operate at a nominal line voltage, usually 117 volts r.m.s. The use of the word "nominal" indicates that the voltage may actually vary within certain permissible limits, usually ±10 per-cent. The complete range of permissible variation will then be approximately 105 to 129 volts.

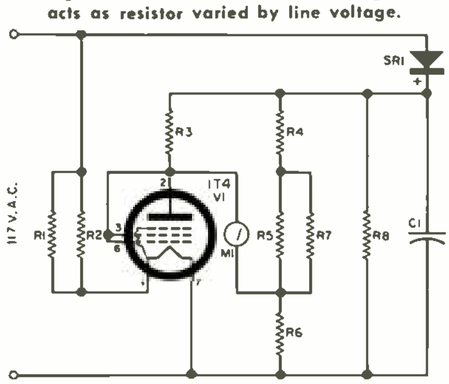
There are many reasons why one would, at times, wish to keep the actual voltage as close to the rated value as possible. This would be the case if it is desired to make certain standard tests and measurements. Close regulation would also be a consideration when optimum efficiency and life of equipment are factors.

When equipment is operated at a voltage that is too low, the life of such components as tubes may be prolonged considerably, but performance will suffer. In the case of a TV receiver, for example, there may be insufficient brightness, degraded focus, decreased deflection amplitudes, loss of sensitivity, and other undesirable effects. On the other hand, if line voltage is too high, the life of components, particularly tubes, can be shortened out of all proportion to the increase in performance.

Take the case of a single item, the tube's heater. This is comparable to the filament of a light bulb. Published tables on the effects of voltage variation on both life and efficiency of such lamps reveal some interesting facts. When they are operated exactly at rated voltage (100 per-cent), light output and life expectancy are said to be normal, or at 100 per-cent. When operated at 95 per-cent of rated voltage, a drop of only 5 per-cent, light output drops to 82 per-cent but life expectancy nearly doubles, increasing to 195 per-cent. At 90 per-cent of rated voltage, light output drops to 69 per-cent of normal, but life nearly quadruples (390 per-cent).

If voltage is increased only to 105 per-cent, light output increases to 119 per-cent—but expected life falls to 53 per-cent of normal, or nearly half. With voltage up to 110 per-cent, light output goes up to 139 per-cent and life drops to 29 per-cent.

Fig. 1. The tube, one arm of a bridge, acts as resistor varied by line voltage.



R_1—4000 ohms, 5 w. wirewound res. (see text)
R_2—33,000 ohm, 1 w. composition res.
R_3, R_4, R_5, R_8—10,000 ohm, 1 w. composition res.
R_6—220,000 ohm, ½ w. composition res.
R_7—47,000 ohm, ½ w. composition res. (see text)
C_1—.5 μf. paper capacitor
M_1—0-1 ma. meter
SR_1—Selenium rectifier, 35 ma. (or higher) @ 130 v.
V_1—1T4 tube

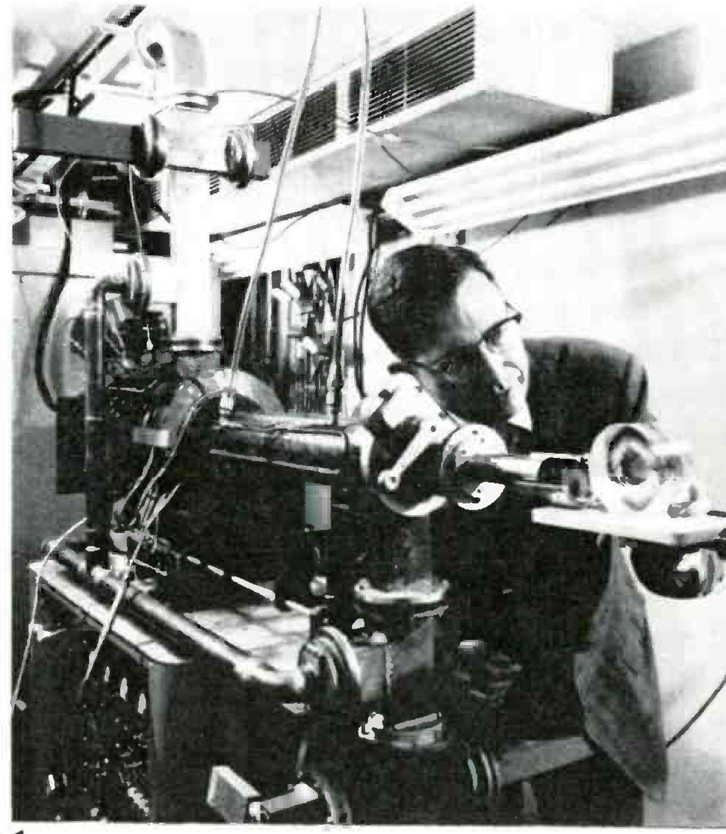
The desirability of keeping line voltage close to the rated value is obvious and, to do this, there must be a fairly precise way of reading this voltage. Since normal variations are small percentage-wise, they cannot be read with sufficient accuracy on a conventional voltmeter. For this purpose, many commercially available meters have been designed to read between about 90 and 130 volts, suppressing everything below the lower value. While they are excellent, they are also rather expensive for most service shops, experimenters, or individual users. Simple, inexpensive units that may be constructed usually rectify and filter the a.c., then respond to the resultant d.c. Thus they are essentially peak-reading devices.

As long as the line voltage is a true sine wave, there is nothing wrong with this method. However, some distortion is quite likely to exist. In industrial applications, or others where inductive regulators are in use, this distortion may be considerable. Various types of loads may introduce distortion in any location. When this happens, there is no simple way of determining r.m.s. value from the peak value of the line voltage. Thus a peak-reading device cannot be relied on to give the desired accuracy, even with calculation. Yet it is the r.m.s. value that must be known, because this is the value that determines how much heat is developed or how much other work is done.

The unit shown in Fig. 1 will indicate the desired value independently of waveshape. Basically it is a bridge circuit with three arms made up of true resistance and the fourth arm consisting of a vacuum tube. Resistor R_3 is in one arm; R_4, R_5, and R_7 make up the resistance for another; and R_8 is in the third. In the fourth arm, a 1T4 pentode

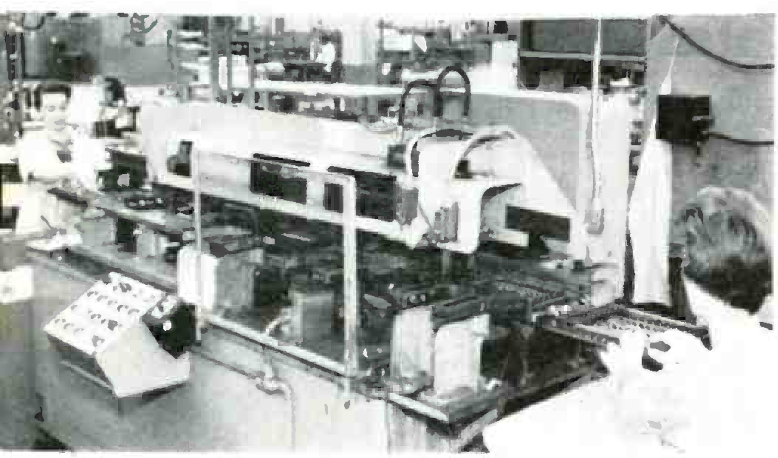
(Continued on page 97)

Recent Developments in Electronics



10-megavolt Linear Accelerator ▶

A linear accelerator capable of bombarding objects with a *gamma* radiation pulse similar to that produced by an atomic explosion has been built for the U. S. Army by *Hughes Aircraft Co.* to "flash test" missile electronics systems at White Sands Missile Range, New Mexico. At the right, Dr. John W. Clark, manager of the firm's nuclear electronics laboratory, examines the flower-like pattern in a Lucite disc caused by the linear accelerator's single high-intensity burst of about 10,000,000 volts of electrons.

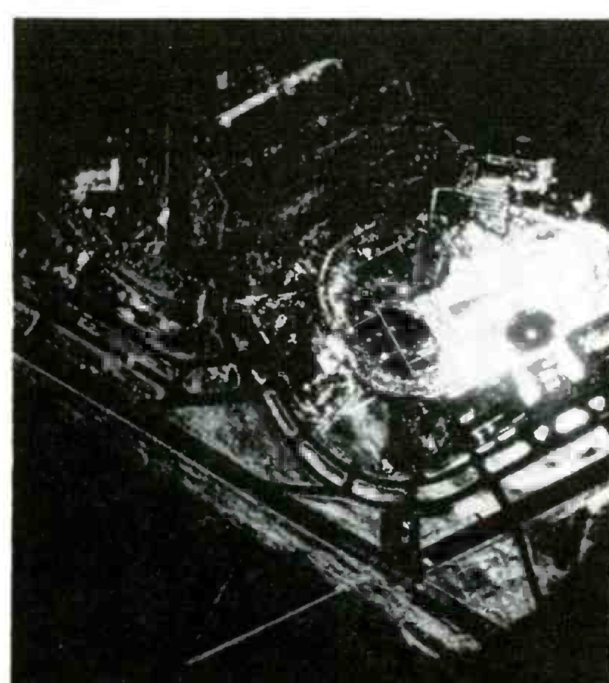


◀ Automatic Soldering for Missile Parts

This is the final soldering operation in a new, automated technique developed at *Convair* for electronic gear in "Terrier" and "Tartar" missiles. Operator at left is loading a rack containing etched circuit boards into the automatic dip-solder machine. Operator at right is unloading the soldered boards.

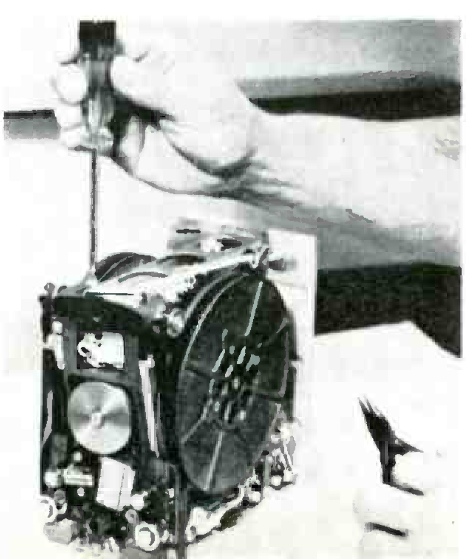
Airport Surface Detection Radar

Activity on the surface of N. Y. International Airport shows up clearly on this radar photo taken from the scope of the newly installed Airport Surface Detection Equipment developed by *Airborne Instruments Laboratory*. The extreme resolution is the result of using a .02-μsec. pulse, a .25° beam width, and a frequency of 24,000 mc. ▼



Orbiting Tape Recorder

Five tape recorders like this are orbiting the earth in "Courier 1B," the communications satellite which is recording and playing back teletypewriter messages sent to it from the ground. A special *Minnesota Mining* instrumentation tape is used. ▼



▲ Electronic Telephone Central

The voices of telephone customers in Morris, Illinois are carried through neon gas tubes that make up the switching network shown above. Part of an electronic central office, the tubes are used to interconnect telephones, a task that until now has been performed by relays. An installer of the *Western Electric Co.* removes a tray of the tubes while a *Bell Laboratories* engineer observes. Dots of light at the right are tubes being used at the moment to set up telephone connections.

▲ "Tunneling" with Thin Films

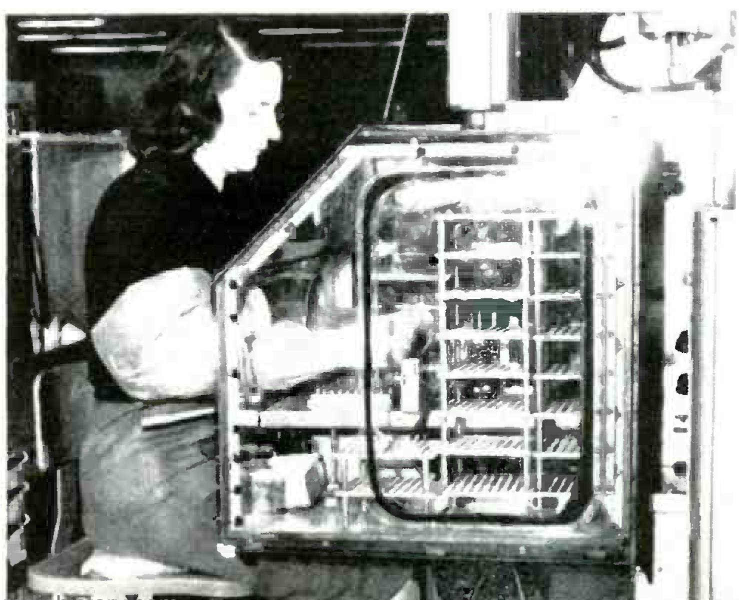
The useful effect of "tunneling," previously observed only in carefully prepared semiconductors, has now been observed in thin metal films in the superconducting state at temperatures close to that of liquid helium. Ivar Giaever of the *G-E Research Laboratory* discovered the effect. He is shown here adjusting the voltage applied to a thin-film experimental device.

◀ Portable Heart Pacer

Westinghouse plans to make and market a portable, transistorized heart pacer and other medical instruments for the heart. Designed for use in the operating room or for out-of-hospital emergency service, the cardiac pacer is a source of periodic electrical stimuli with adjustable rate and amplitude to keep the heart beating properly. A companion unit will respond to indications of a failing heart by switching the pacer into operation automatically.

High-Reliability Transistors ▶

Germanium transistors are being welded here in a moisture-free, temperature-controlled atmosphere at the Semiconductor Division headquarters of *Sylvania Electric Products Inc.* The company recently received the U. S. Army Signal Corps RIQAP (Reduced Inspection Quality Assurance Plan) Award for "consistent production of high-quality germanium transistors" for military applications.



By JOHN T. FRYE

MAC'S service shop

Ladies' Man

IT was a foul day. Since early morning a cold rain from a leaden sky had been pelting the dirty, rotting snow and cutting crooked channels through the ice frozen in the gutters.

But all was snug and warm inside Mac's Service Shop. In the front office Matilda's typewriter beat out a clicking accompaniment to her contented humming. Back in the service department Mac and Barney were working side by side at the service bench. Both completed their current jobs at the same time and, by unspoken agreement, stopped for a breather.

"You know, Mac," Barney remarked thoughtfully as he perched himself on a high stool and entwined his long legs through its rounds, "this wouldn't be a bad racket if it weren't for the women customers."

Mac glanced up quizzically from the pipe he was lighting and said with an exaggerated sigh, "OK, let's get it out of your system. What have the nasty. mean old women been doing to poor little Barney? Tell papa."

"They haven't been doing anything to me," Barney retorted as a flush dimmed his freckles. "I don't give 'em a chance. But they're so doggone unreasonable. They don't know any more about electronics than a hog does about Sunday; yet they always want you to tell them exactly what was wrong with their set. And when you try to explain, they don't listen."

"They listen enough to get a phrase or so they can relay to their husband when *he* asks what was wrong," Mac explained. "That's all they want, and that's all you should give. You may know a short developed in the mixer tube that caused a resistor to char in the tuner, that all the oscillator slugs needed re-setting, and that the vertical linearity was away off: but for gosh sakes don't recite all this. Simply say a tube shorted and burned out some other parts and that some of the circuits needed re-aligning. She can remember that and relay it without too much distortion. If he wants more information, he can get it from your itemized bill."

"OK, but women don't recognize nor appreciate good service when they get it, either. They're always looking for little things to gripe about. Take that call I made this morning, for instance. The set was in a third-floor walk-up apartment. A filament of an i.f. tube had burned out, and then the owner had twisted every screw and knob he could reach on the back of the set in an effort to make the picture come back. When he failed, he told his wife to call us. It took me nearly an hour to straighten everything out, but I took a lot of care and ended up with as good a picture as I have ever seen.

"After I had gone down those three flights of stairs and was putting the caddy in the truck, the woman hoisted a window and yelled down to me to 'come back and finish fixing the set.' I climbed back up those three flights with the tube caddy and the tool box, and do you know what she was yelling about? Some time before they had lost the spring out of the volume control knob and had wedged it on the shaft with a sliver of wood. Naturally I didn't notice this because I didn't have the knob off, and she never said a mumbling word about it. But after I left she pulled the knob off to see if I had put in a new spring and then started screaming bloody murder. When I asked, very politely, how I was supposed to know the knob needed a spring, she tartly reminded me it was my business to check her set over *completely!*"

Mac was chuckling as he replied, "*Now* it comes out! I was just waiting to see what had triggered your sudden jaundiced attitude toward the fair sex. That woman was a little unreasonable, I'll grant; but let's not be too hard on women in general because of her. To do so would make us unreasonable. Remember women are not ordinarily required to work with and on mechanical gadgets as are men; so they naturally know less about these things and have less interest in them. They are ignorant about electronics for the same reason you couldn't bake a cake or sew a straight hem in a skirt if you were required to.

"All most women know about a TV set is what they can see and touch on the front of the cabinet. That loose volume control knob was something your customer could understand, and it loomed larger in her mind than many of the more serious picture defects your trained eye noticed. She is not peculiar in this. I've always harped on the necessity of seeing to it that all radio and TV and record player controls work smoothly and well. A slipping dial cord or a noisy volume control is of little consequence to a technician because he understands how easily these things can be corrected; but they are a constant source of annoyance to set owners as stark reminders that something is wrong with their pride and joy."

"I still don't like to work for women," Barney insisted stubbornly. "For one thing, they're tight-fisted and suspicious. You hand a bill to a man and he will take a quick look at the total and reach for his billfold; but you give the same bill to a woman, and she will go over it item by item, check on the addition, and then, likely as not, make some nasty crack about its being 'plenty' as she pays it."

"If what you say is true," Mac observed with a grin, "I'm not sure but that it's more of an indictment of men's business sense than it is of women's niggardliness."

He paused, got out his billfold, took a dollar bill at random from it, and handed it to Barney. "Sniff that and tell me what it smells like," he said.

Obediently Barney raised the bill to his nose. "In addition to the usual smell of tanned leather, there's a faint scent of perfume or face powder; I can't be sure which," he finally decided.

"The 'which' doesn't matter. In either case, where do you suppose it picked up that sweet scent?"

"In a woman's pocketbook, I suppose."

"Right, and a good nose can pick up that same tell-tale odor on a very high percentage of bills. It's a subtle reminder that women handle most of the money in this country. Buying the groceries and paying the bills as they do, they've developed a very healthy respect for money—especially their own —and they don't part with any of it without being convinced they're getting equal value in return. That's not being tight; that's just being smart and business-like. A man's more afraid of being thought a pinch-penny than he is of being cheated. That's why he seldom adds up a grocery list or counts change. A woman operates under no such foolish self-imposed handicap. To keep *her* self-respect, she wants everything that's coming to her, and she does her best to get it. I think you'll find most sales people agree that women are much smarter shoppers than men."

Mac paused to knock the dottle from his pipe and then went on:

"Keep in mind the significance of

(*Continued on page* 114)


Audio Empire "Troubador"


Bogen-Presto Model T68AH


Channel Master Model 6652

MANUAL & SEMI-AUTOMATIC Hi-Fi Turntables

By WARREN DeMOTTE

How to select a hi-fi turntable. Features to look for along with a complete directory of what is now available.

THE QUEST FOR QUALITY in high-fidelity reproduction of phonograph records usually leads to a professional-type manual (non-automatic) record player or turntable. The record changer has certain operational advantages that have made it very popular, but the manual turntable has limitless quality possibilities, and these endear it to the earnest seeker after audio perfection. Some of these units have a semi-automatic feature in that the turntable motor is switched on when the tone arm is moved into playing position and the motor is turned off at the end of a record. These may be called semi-automatic players or semi-automatic turntables, and they are included in our discussion.

Some turntables are true professional units that meet National Association of Broadcasters (NAB) standards of quality for broadcast use. However, there are others that are used as manual record players that employ the same drive motor and turntable platter used in a record changer. These units may or may not meet professional broadcast standards.

The basic function of the turntable is a simple one. It merely has to rotate the record at a specific, constant speed. The speed most commonly used today is, of course, 33⅓ rpm, and hence there are turntables which operate at this single speed or a combination of speeds, depending on the individual requirements of the audiophile.

Whatever the speed, 33⅓, 45, or 78 rpm, the NAB standards require that there be no average speed deviation from it exceeding 0.3 per-cent and that the maximum instantaneous peak deviation from the average speed not exceed 0.2 per-cent. If the average speed is inaccurate, the exact musical pitch will not be reproduced. If there are rapid speed changes, then "wow" at low frequencies or "flutter" at higher frequencies will be heard. This standard is based on the inability of the ear to aurally detect variations in pitch when the speed deviation is kept at or below the latter figure.

Motors and Platters

Naturally, constancy of speed demands the use of high quality motors. The types of motors commonly used in high fidelity turntables are 4-pole induction motors and hysteresis-synchronous motors. Either type, when well made, will function effectively. However, fluctuations in line voltage will usually affect the speed of induction motors, whereas the speed of hysteresis-synchronous motors is determined by the frequency of the alternating current. As the constancy of a.c. frequency is more easily kept under control than the constancy of line voltage, this gives the hysteresis-synchronous motor a slight edge over its rival. Yet, it is possible to design excellent induction motors, and some of the best turntables use them. In these, it is not uncommon to use an induction motor designed so that its stator is magnetically saturated. Under these conditions, changes in line voltage have little effect on speed, which now depends mainly on frequency.

The rotation of a motor does not progress with steady smoothness like a stream of water. Actually, it moves in a rapid series of pulls and tugs, chugging along so rapidly that the effect is one of seeming steadiness. However, the minute hesitations between the "chugs" do exist and they manifest themselves as vibrations or ripples ("flutter" in the reproduced sound) unless they are smoothed out. An effective way of doing this is by using a turntable platter too heavy to respond to these tiny hesitations. The weight of the platter also creates a flywheel effect that helps to keep the speed of rotation constant when there are quick line voltage fluctuations.

From this, it would seem that the heavier the turntable platter, the better. This probably would be so, except that the heavier the platter, the more powerful the motor needed to rotate it, and increasing the power of the motor creates additional vibration and adds to the problem of its isolation. Fortunately, there is a point at which platter weight and motor power meet, and good engineering design matches the one with the other for maximum efficiency.

Rumble

Regardless of the nicety with which the motor and the platter are matched, there is a residual vibration in the motor and drive system that must be kept isolated from the platter. If this vibration is transmitted to the platter, it will be picked up by the cartridge stylus and heard through the loudspeakers as "rumble," a low-pitched growl. This low-frequency noise signal is usually heard directly, but even if it is not audible, it may distort and modify the sound of all of the music or other material on the phonograph record.

(*Continued on page 48*)

Collaro Model 4TR200

Components Mark I

Connoisseur Type B

DIRECTORY OF

Name	Model	Price	Size (inches—minimum mounting area)	Clearance (inches—below mounting board)	Weight of Platter (pounds)	Type of Motor	Drive	Speeds[13]	Built-in Level Indicator	Built-in Strobe	Built-in 45 rpm Adapter	Speed Adjustment Control	Integral Tone Arm	Automatic Arm Setdown	Automatic Stop
Audio Empire	208	92.50[1]	14 11/16x16 11/16	3½	6	HS	Belt	3	No	No	Yes	Yes	No	No	No
Audio Empire	Troubador[3]	145.50	14 11/16x16 11/16	7¼[6]	6	HS	Belt	3	No	No	Yes	Yes	Yes	No	No
Bogen-Presto	TT3	59.95[1]	12x16	4½	5	HS	Belt	33⅓	No	Yes	No	Yes	No	No	No
Bogen-Presto	TT4	99.50[1]	12x14½	3¼	5	HS	Idler	3	No	Yes	Yes	No	No	No	No
Bogen-Presto	TT5	129.50[1]	12x14½	4¾	5	HS	Idler	3	No	Yes	Yes	No	No	No	No
Bogen-Presto	T68AH	170.00[1]	14¼x15¾	4¾	6¾[7]	HS	Idler	3	No	No	No	No	No	No	No
Bogen-Presto	B50	40.40[1]	12½x14½	2¼	3¼	4 pole	Idler	X[10]	No	No	No	Yes	Yes	No	No
Bogen-Presto	B60	49.95[1]	13¼x15¼	2¼	3¾	4 pole	Idler	X[10]	No	No	No	Yes	Yes	No	No
Bogen-Presto	B61	59.95[1]	13¼x15¼	2¼	7¾	4 pole	Idler	X[10]	No	No	No	Yes	Yes	No	No
Channel Master	6652	64.95[1]	13x17	3⅞	2½	4 pole	Idler	4	No	Yes	No	Yes	Yes	No	No[13]
Collaro	4TR200	49.50[1]	12½x12½	3¼	7½	4 pole	Idler	4	No	No	No	No	No	No	No
Collaro	TP59	29.95[1]	12x13½	3¼	2	4 pole	Idler	4	No	No	No	No	Yes	No	Yes
Components	Mark I	44.50[1]	13½x14½	3½	5	4 pole	Belt	33⅓	Yes	No	No	No	No	No	No
Components	Mark II	54.50[1]	13½x14½	3½	5	4 pole	Belt	33⅓-45	Yes	No	Yes	No	No	No	No
Components	Mark III	99.00[1]	13⅝x14⅝	5¼	8	4 pole	Belt	3	Yes	Yes	Yes	Yes	No	No	No
Components	TT[2]	29.50[1]	12x12	3½	4	4 pole	Belt	33⅓	No	No	No	No	No	No	No
Connoisseur	Type B	119.50[1]	13½x15¼	3¾	4	HS	Idler	3	No	Yes	No	Yes	No	No	No
Connoisseur	F2S	59.50[1]	12x16	3¾	4	HS	Idler	33⅓-45	No	No	No	No	No	No	No
Fairchild	412-1A	87.50[1]	14¾x17⅜	5½	8	HS	Belt[5]	33⅓	No	No	No	Yes	No	No	No
Fairchild	440	69.95[1]	15x17⅞	3½	4½	4 pole	Belt	33⅓-45	No	No	No	Yes	No	No	No
Garrard	301	89.00[1]	13¾x16	3½	6	4 pole	Idler	3	No	No	No	Yes	No	No	No
Garrard	4HF	59.50[1]	13½x17¼	3⅜	3	4 pole	Idler	4	No	No	No	Yes	Yes	No	Yes
Garrard	T/II	32.50[1]	12½x14¾	2 1/16	2	4 pole	Idler	4	No	No	No	No	Yes	No	Yes
Gray	ST33	89.50[1]	14⅜x16	3½	4	HS	Belt	33⅓	No	No	No	No	No	No	No
Gray	PK33[2]	49.50[1]	12¼x12¼	3½	4	HS	Belt	33⅓	No	No	No	No	No	No	No
Heath	AD-10[4]	33.95	9¾x12¾	5¾[6]	2	4 pole	Idler	4	No	No	No	No	Yes	No	Yes
Knight	KN1000	49.95[1]	13¾x16¾	4	6	HS	Idler	33⅓-45	No	No	No	No	No	No	No
Lafayette	PK240W	37.50[1]	11x14½	4	3	4 pole	Idler	4	No	No	No	Yes	No	No	No
Lafayette	PK449WX	49.50[1]	12½x16¼	4	3	4 pole	Idler	4	No	No	No	Yes	Yes	No	No[14]
Lafayette	PK160SW	26.95[1]	10⅞x12 15/16	2¾	2	4 pole	Idler	4	No	No	No	Yes	Yes	No	No

Footnotes: HS—Hysteresis Synchronous, S—Synchronous

1. Base available at additional cost
2. Kit
3. Includes base
4. Includes base and cartridge
5. Two belts
6. Over-all height
7. Two motors

HI-FI TURNTABLES

Name	Model	Price	Size (Inches—minimum mounting area)	Clearance (Inches—below mounting board)	Weight of Platter (pounds)	Type of Motor	Drive	Speeds[13]	Built-in Level Indicator	Built-in Strobe	Built-in 45 rpm Adapter	Speed Adjustment Control	Integral Tone Arm	Automatic Arm Setdown	Automatic Stop
Lesa	4V3/11	23.25[1]	7¾x12	3½	1½	4 pole	Idler	4	No	No	No	No	Yes	No	Yes
Lesa	SM5/DU2[8]	29.95[1]	8x10½	2½	1½	2 pole	Idler	4	No	No	Yes	No	Yes	No	Yes
Pickering	Gyropoise 800	66.00[1]	13½x13½	3	3½	S	Idler	33⅓	Yes	No	No	No	No	No	No
Realistic	Mark VIIIa	59.95[1]	17x22	4¾	5¼	HS	Idler	4	No	No	No	No	Yes	No	No
Realistic	Mark IX	24.95[1]	12½x14¾	2 1/16	1¾	4 pole	Idler	4	No	No	No	No	Yes	No	Yes
Rek-O-Kut	B12H	139.95[1]	14x15 23/32	6¼	4	HS	Idler	3	No	Yes	Yes	Yes	No	No	No
Rek-O-Kut	B12GH	99.95[1]	14x15 23/32	4¾	4	HS	Idler	3	No	Yes	Yes	Yes	No	No	No
Rek-O-Kut	CVS 12	89.95[1]	16¼x16½	4½	4¼	4 pole	Idler	X[10]	No	No	No	Yes	No	No	No
Rek-O-Kut	NL33H	69.95[1]	12½x19	4¼	5¼	HS	Belt	33⅓	No	No	No	No	No	No	No
Rek-O-Kut	N34H	79.95[1]	12⅝x19	4¼	5¾	HS	Belt	33⅓-45	No	No	Yes	Yes	No	No	No
Rek-O-Kut	L34	59.95[1]	16¼x16½	4½	4	4 pole	Idler	33⅓-45	No	Yes	Yes	Yes	No	No	No
Rek-O-Kut	L37	59.95[1]	16¼x16½	4½	4	4 pole	Idler	33⅓-78	No	Yes	No	Yes	No	No	No
Rek-O-Kut	L34H	69.95[1]	16¼x16½	4½	4	HS	Idler	33⅓-45	No	Yes	Yes	Yes	No	No	No
Rek-O-Kut	L37H	69.95[1]	16¼x16½	4½	4	HS	Idler	33⅓-78	No	Yes	No	Yes	No	No	No
Rek-O-Kut	K33H[2]	49.95[1]	17⅜x17¾	4	5¼	HS	Belt	33⅓	No	Yes	No	Yes	No	No	No
Rek-O-Kut	K33[2]	39.95[1]	17⅜x17¾	5	5¼	4 pole	Belt	33⅓	No	Yes	No	Yes	No	No	No
Rek-O-Kut	K34H[2]	59.95[1]	17⅜x17¾	4¼	5¾	HS	Belt	33⅓-45	No	No	Yes	Yes	No	No	No
Stromberg-Carlson	PR500	69.95[1]	14¾x14¾	2 3/16	X[11]	S[7]	Belt	33⅓	No	No	No	No	Yes	No	No
Stromberg-Carlson	PR499	99.95[1]	14⅝x15¾	5½	6	4 pole	Belt	X[10]	No	Yes	Yes	Yes	No	No	No
Stromberg-Carlson	PR499B	149.95[1]	14⅝x15¾	5½	6	HS	Belt	X[10]	No	Yes	Yes	Yes	Yes	No	No
Thorens	TD124	99.75[1]	12⅞x15½	2¾	11½	4 pole	Belt, Idler	4	Yes	Yes	Yes	Yes	No	No	No
Thorens	TDK101[2]	47.50[1]	12x14	3	3	4 pole	Belt, Idler	33⅓	No	No	No	Yes	No	No	No
Thorens	TD134	59.95[1]	12x15	2½	3	4 pole	Belt, Idler	4	No	No	Yes	Yes	Yes	No	Yes
Thorens	TD184	75.00[1]	12x15	2½	3	4 pole	Belt, Idler	4	No	No	Yes	Yes	Yes	Yes	Yes
Weathers	ML-1LB	49.95[1]	14⅛x15⅛	1¾	X[11]	S	Idler	33⅓[12]	No	No	No	No	No	No	No
Weathers	K601D[4]	119.50	15⅜x16⅜	6[6]	X[11]	S	Idler	33⅓[12]	No	No	No	No	Yes	No	No
Weathers	ML234LB	64.50[1]	14⅛x15⅛	1¾	X[11]	S[7]	Idler	33⅓-45	No	No	No	No	No	No	No
Weathers	K834[4]	204.00	15⅜x16⅜	6[6]	X[11]	S[7]	Idler	33⅓-45	No	No	No	No	Yes	No	No
Weathers	KL-1[2]	46.50[1]	14⅛x15⅛	1¾	X[11]	S	Idler	33⅓	No	No	No	No	No	No	No
Weathers	KL-2[2]	59.95[1]	14⅛x15⅛	1¾	X[11]	S[7]	Idler	33⅓-45	No	No	No	No	No	No	No

8. Includes cartridge
9. 15¾" diameter
10. Continuously variable
11. Lightweight
12. SC-1 Electronic Speed Control optional for 4 speeds
13. The 3 speeds are: 33⅓, 45, 78 rpm; the 4 speeds are 16⅔, 45, 33⅓, 78 rpm
14. Motor stops with arm placed in rest.

Fairchild Model 440

Garrard Model 301

Gray Model ST-33

Heath Model AD-10

Knight Model KN1000

Lafayette Model PK449WX

The NAB standards state that when playing a silent groove test record, rumble should be at least 35 db below the reference level of 1.4 cm. per sec. peak velocity at 100 cps. This reference level is equal to 7 cm. per sec. at 500 cps and roughly 7 cm. per sec. at 1000 cps.

While this style of rumble measurement has been adopted by most manufacturers, there are a few whose specifications read "35 (or more) db below average recording level." Unfortunately, this "average recording level" is not specified, so for all practical purposes, the rumble specification thus stated has little exact meaning. It may be mentioned here that one manufacturer of quality turntables has suggested that a more meaningful rumble statistic than that set forth by the NAB would be the amplitude of rumble vibration as measured in millionths of an inch. However, this is a matter for the engineers to argue.

It is much harder for a record changer to meet this rumble standard, because of its added mechanism needed for automatic operation, than it is for a good manual or semi-automatic turntable. If this standard is not met, and good loudspeakers are employed in the audio system, the rumble filter will probably have to be switched on when records are played, with a concomitant loss of desirable bass tones. It is axiomatic that the better the speakers and the more capable they are of producing clean, deep bass, the more prominent will be the rumble—if it exists. Hence, the better the related audio equipment, the more necessary a high-grade, rumble-free turntable.

Rumble is fought in many ways and on many fronts. The way the motor is mounted and motion transmitted to the platter is of prime importance. Springs or rubber are used to isolate the motor mounting board from the rotating platter. Motion is transmitted from the shaft of the motor to the platter by means of pulleys, idler wheels, and drive belts, carefully calculated and fabricated. Each method can be made effective and each has its adherents. Whichever is used, important consideration is given to its ability to filter out vibration rather than transmit it.

The motor must not be held solely responsible for all of the rumble that may enter the system. The manner in which the turntable platter is mounted can also contribute a substantial amount. It is imperative that the platter turn freely, with little friction. The turntable shaft must fit in its bearing snugly, without any play, yet with perfect freedom of rotational movement. To minimize friction, the shaft may be supported by a ball and the ball may sit in a nylon seat. Again, there must be no looseness in the fit or the ball will wobble, with the result that there will be an eventual increase in friction and a loss in the trueness of rotation.

The platter itself must be well machined so that the rim is concentric with the shaft. It must be well balanced so that when it rotates, it remains level and there is no wobble and a minimum of up and down movement on the tonearm. Some platters are machined with exceptional care, with the ultimate balancing individually accomplished by means of holes drilled underneath the rim in order to distribute weight evenly. Such a refinement of construction may well result in smoother rotation.

Another method of minimizing rumble is to bring its tonal frequency down below normal hearing ability. Most rumble is at the 30-cps frequency. This is the result of using the very common motor

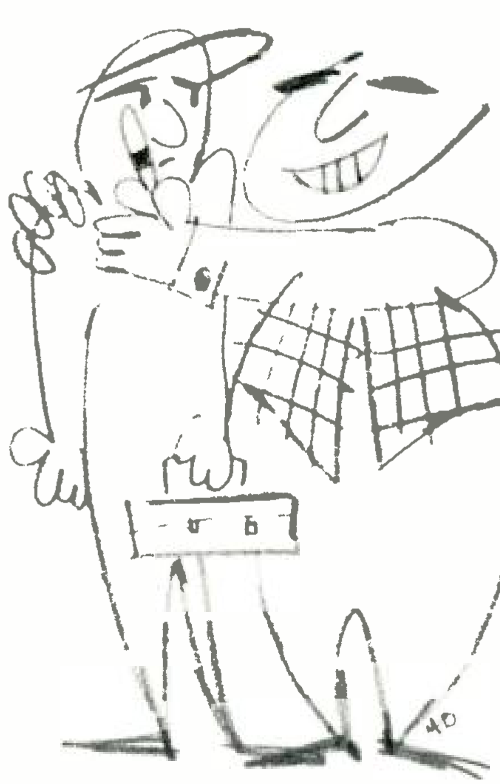
(Continued on page 110)

Pickering "Gyropoise 800"

Lesa Model SM5/DU2

Realistic Mark VIIIa

Tricky Service Customers



By **GEORGE PHILLIPS & DAVID VAN IHINGER**

You can be hurt by the few set owners who deliberately set out to cheat. How they work and what you can do about it.

EDITOR'S NOTE: *Like the majority of service dealers, most customers are honest people. Either minority, however, can create trouble out of proportion to its size. The fast-buck dealer is a well-publicized phenomenon. The service customer with larceny in his heart, who seldom makes the newspapers, can do a fairly good job of turning a service shop upside down. Here are the ways in which he works and how he can be outmaneuvered.*

ARE YOU finding yourself with a low bank balance, a large Accounts Payable, and a dubious Accounts Receivable made up of customers who insisted on charging their bills after their TV sets had been repaired and re-installed? Do you worry because you think your prices may be pegged a little high? Have you found yourself throwing in all kinds of extras for nothing just because you don't want to lose a customer?

If you do have these problems, you are certainly not alone; but if you can't overcome them, you may be among the number of TV technicians who will go bankrupt this year.

There are many ways in which you can let customers take advantage of you. One of the most common is when you give credit—or are manipulated into giving it foolishly. Let's take one example of how a customer can maneuver this.

A Mrs. Harris phones your shop to ask for a home call. When you arrive, she is not in, but her 10-year-old boy is waiting for you. "Mommy said she'll be home in a little while," Junior dutifully informs you, "and for you to go ahead and fix it." Half an hour later the set is repaired and you have already wasted a little time waiting for Mrs. Harris. The phone rings again. This time Mommy informs Junior that she has been held up at Auntie's house and won't be back for some time, but has the television man been there yet?

After Junior informs her that you are there right now and are still waiting after having fixed the set, she instructs him, "Well, you tell him to leave the bill. Tell him Daddy will be over to pay him tonight."

How do you handle this one? You can leave a bill but it won't be signed by a responsible person, which means you have no legal proof that the work was done. You can take back the parts and leave the set in the condition in which you found it—but you have already put in your time and this would only antagonize a customer who might turn out to have honorable intentions. So you leave a bill and hope that everything works out. The best way to handle a situation like this is to prevent it. If you didn't telephone before coming over to make sure that someone responsible would be on hand, you could have told Junior that you would drop by again later and beat a hasty retreat.

Now this is an isolated case and the loss of $8 or $10 on a single call isn't going to put a lock on your door, but consider the case of one E. Dowling, independent service technician, who went bankrupt a few months ago. Included among his assets were accounts receivable of $6847, accumulated over a 3-year period. They were all small accounts, the highest being $34 and the lowest $4. Practically none of these was collectable.

Any way you look at it, extending credit on service performed is a risky business. The technician should make up his mind early in his career whether he is going to operate on a strictly cash basis or extend credit. If he feels he must do the latter, he must base it on sound practice and policy.

To set up a credit department takes considerable equipment and trained help. Take the word of successful finance companies. They figure it costs between $7 and $10 to set up an account—and that doesn't include the cost of carrying it. So remember, if you extend credit on a bill that comes only to $10 altogether, you may be giving yourself another $5 to $10 worth of work trying to collect it. A losing game, don't you think?

The best policy is obviously not to extend credit at all. If it must be done, however, it shouldn't be extended indiscriminately to anyone who wants it. The cash basis on which the shop customarily transacts its business should be spelled out clearly. Something should be known about the customer who wants credit and his reputation. Finally, there is no excuse for credit unless the bill is higher than would ordinarily be expected. A responsible customer who calls for service knows that he is expected to pay for it and will not call unless he is prepared with a certain reasonable amount. In fact, in the case of a higher-than-average bill, there is no reason why a reasonable amount should not be paid down at once.

The use of checks is such a common way of doing business that it is often difficult for a TV technician to refuse one. Nevertheless, lack of discrimination in this direction can also be a risky way of doing business. According to the Better Business Bureaus, there are thousands of people in the United States and Canada who do a thriving business in bad checks for small amounts. They gamble on the fact that a business man would rather forget the $5 or $10 involved than go to court to prosecute.

When you are tendered a check in

(*Continued on page* 92)

Knowing and Using the Signal Tracer

This is the instrument to use for speedy radio service. It also does other jobs.

By LOU DEZETTEL
Allied Radio Corporation

THE REPAIR of common, household radio receivers is still a very large business. However, since the initial cost for such sets is low, the repair fee cannot be high. For this reason, work of this type is not actively sought by some technicians.

Doing the work profitably depends on the speed with which each job can be handled. Even with the relatively low fees involved, money can be made on radio work if repairs can be handled quickly. And there are few ways of speeding up this work that are better than by use of a signal tracer. The instrument takes cognizance of the fact that there is a convenient, reliable, and steady source of test signals available: the thousands of broadcasting stations that fill the AM band from approximately 540 to 1600 kilocycles. With this vast energy available free for the taking, a signal tracer will, in the majority of instances, localize a receiver defect to a small portion of the circuit very quickly. After this, determination of the specific, defective component with simple checking is possible. Sometimes the exact defect can be determined directly with the tracer alone. In addition, modern tracers offer other refinements.

One of the things that makes the signal tracer such a joy to use is its utter simplicity. Examination of Fig. 6, the schematic of a representative unit, available in kit form from *Allied Radio*, reveals that it is basically a high-gain audio amplifier. Tubes V_1 and V_2 are conventional voltage amplifiers with resistance-capacitance coupling. They feed V_3, which is a power amplifier. V_4 is that old favorite, the magic-eye tuning indicator, also sometimes known as the poor man's cathode-ray tube. Plate voltage is furnished by a full-wave supply comprising power transformer T_1, rectifier V_5, and a filter consisting of the sections of C in conjunction with R_{23} and other resistors.

The sensitivity of the amplifier is controlled by a four-step voltage divider in the input of V_1, consisting of fixed resistors R_1, R_2, R_3, and R_4, and also by continuously variable potentiometer R_{10} in the input circuit of V_2. Sensitivity selector switch S_1 taps the signal off at various points along this divider. The switch also has a fifth position, which will be discussed later.

With the switch in the "× 1" position, shown in the schematic, maximum attenuation of the incoming signal occurs. Trace out the path from the input jack, J_1, through S_{1A} and you'll see that it goes through all resistors in the divider to ground. However, at the junction of R_3 and R_4, signal is tapped off to be fed through S_{1B} and then through C_1 to the grid of V_1. Since the chosen resistor values are in steps of 10, we have roughly a decade divider. When the switch is in the "× 1000" position, maximum amplification is obtained because the entire signal across the divider is fed to the amplifier. Since the variable gain control is also externally calibrated in ten steps, the settings of these two controls can be used to make measurements of stage gain, where this is useful in troubleshooting.

Connection between the tracer itself and the equipment under test is made by means of a dual-purpose probe, shown schematically in the lower left corner of Fig. 6, through a shielded lead. In this tracer, the shielded lead can be plugged into the main body of the probe in either of two ways. The two parts of the probe, ready to be plugged into each other, are shown in Fig. 1. If these two sections are aligned in one way, connection within the probe is made to the upper contact shown in the schematic. In this position, the path from the probe tip is directly into input jack J_1. This position is used when the tracer will be employed to investigate audio signals.

If the probe head is rotated before the two sections are connected, the lower contact is used. The path from the tip is now through crystal diode CR_1, which serves as a rectifier to recover the audio modulation of amplitude-modulated r.f. signals, and its associated filter network. In this position, detected signal is

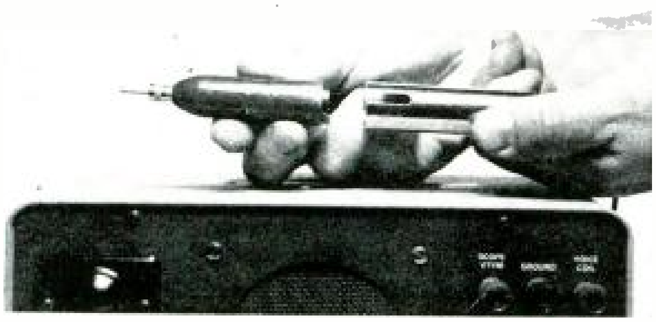


Fig. 1. Dual-purpose probe connects in either of two ways.

Fig. 2. Detector probe near antenna yields audible signals.

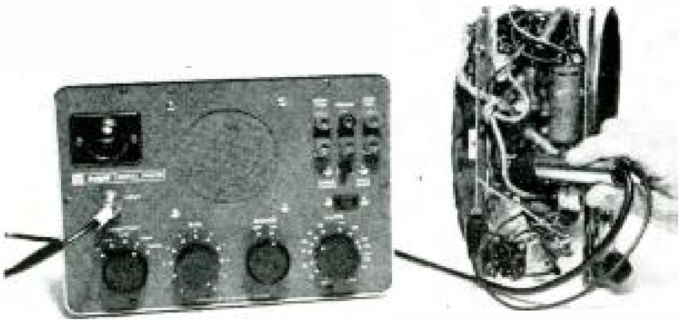


Fig. 3. Tip is touched to circuit points along signal path.

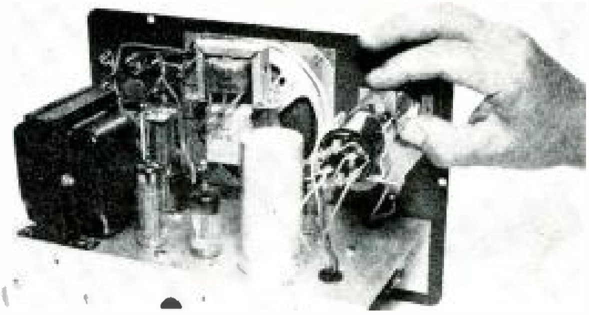


Fig. 4. Simple layout and construction shown in chassis view.

Fig. 5. Checking radio's power drain.

fed to the tracer. In either case, the net result is audible sound from the loudspeaker in the output circuit of V_2. While this general technique is widely used, the method of cutting the detector in or out of the circuit may be different in other tracers. In some cases, a simple switch on the probe housing is used instead of rotation of the tip with respect to the portion of the probe connected to the shielded lead.

In V_2 we find two diode plates tied together to form a rectifier with the tube's cathode. Some signal from the triode's plate load is tapped off, from the junction of R_{17} and R_{18}, by the rectifier. The resultant d.c. voltage is applied to the eye tube. Since this d.c. ultimately depends on the magnitude of input signal, the eye provides a visual indication of signal strength. Since the ear is insensitive to relatively small differences in volume, the eye will be a more reliable index.

A little experimenting with a receiver in normal operating condition will teach anyone how to use a signal tracer in short order. A ground lead from the probe housing, which terminates in an alligator clip, is connected to chassis ground or "B−" of the equipment to be checked. The probe tip is free to be placed in various portions of the circuit. With the probe set for r.f. detection and sensitivity controls set to maximum, place the tip against the loop antenna with the receiver turned on, as shown in Fig. 2. Actual, metallic contact is not necessary: capacitive coupling will be sufficient to pick up energy. Keep the receiver's volume control down so that there will be no audible signal to conflict with that coming out of the tracer's speaker.

Next touch the probe to the grid of the r.f. amplifier tube, if the receiver has an r.f. stage. When the probe is advanced to the plate of the r.f. amplifier, an increase in loudness of the signal (or closing of the eye) should be noted. It is safe to touch the probe to this and other hot "B+" points because C_1 in the grid of V_1 acts to block d.c., although it will freely pass r.f. (or a.f.) signals. This use of the tracer is shown in Fig. 3. If signal at the r.f. grid was noted but is no longer existent at the plate, a defect obviously exists in this stage.

If the radio has no r.f. stage, the next step after the antenna is the mixer. (This will also be the step after the r.f. stage, if one is present.) If signal disappears at the mixer's input grid, a defect in the coupling network to the mixer is indicated. While tracing in the circuits already mentioned, you should be able to tune in different stations with the tuning knob of the receiver.

The next test point is the output plate of the mixer. If the signal disappears at this point, there is indication that the oscillator is not working. Advance the probe through the grids and plates of the i.f. stages and note how, in the normally operating receiver, volume builds up. It will be necessary to reduce the sensitivity of the tracer, using the sensitivity swich and/or the variable gain control, to prevent blasting the speaker.

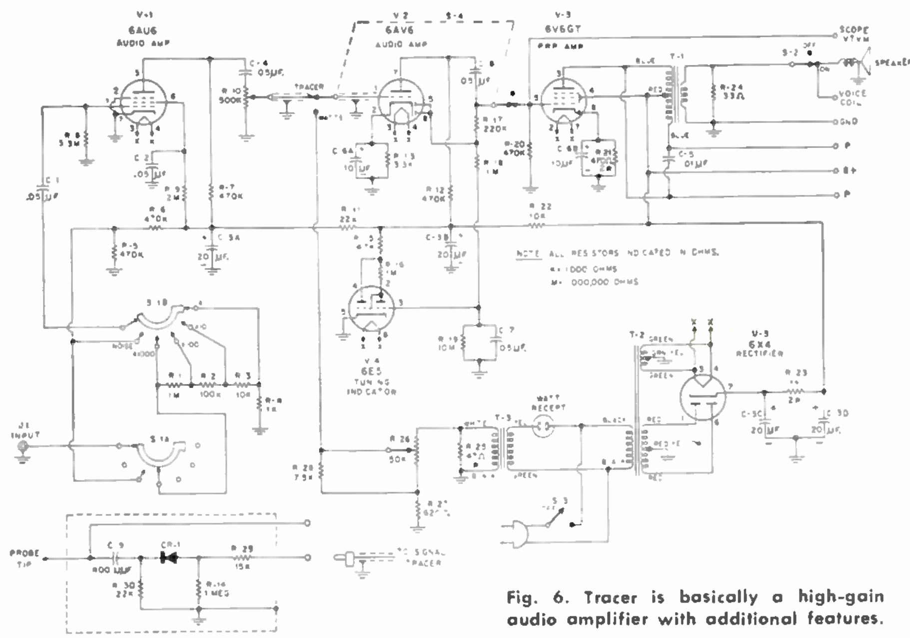


Fig. 6. Tracer is basically a high-gain audio amplifier with additional features.

Before going from the i.f. system into the audio stages of the radio, it will be necessary to turn the probe to the direct position, since detection of r.f. is no longer needed. The volume control of the receiver will also have to be turned up so that it will permit the audio signal to enter this portion of the radio's circuit.

To see how quickly the tracer localizes the area of a defect by going silent at one point, put a fault into the circuit. For example, you can hook a shorting wire across the primary of an i.f. transformer. Touched to the plate of the tube that feeds this primary, the probe will produce a signal because the d.c. path is still complete and the tube is operating. However, when the secondary lead to the grid of the next stage is touched, there will be no signal, because there is no transfer of energy from primary to secondary. In practice, this would usually indicate that the transformer is defective or perhaps that some associated component is faulty. In this limited area, few additional continuity and voltage checks are needed to pinpoint the exact trouble.

The tracer is an especially valuable time saver in pointing the finger of suspician at a tube whose heater is intact, and therefore keeps a series string lit up, but which has some other defect. Simple tube testing would seem to be a more logical procedure, but it is not necessarily faster. The business of pulling tubes one at a time and setting them up in a tube checker may be more time-consuming than the routine of going through the receiver with a few, quick passes of an operating tracer. When the faulty stage is located, substitution of the single tube involved can be made prior to other checks. In fact, a tube with a defect that might be overlooked by a checker would be pinpointed more readily in this way.

In addition to its basic function, the tracer can be used for several other, useful tasks. It can locate noisy components, measure the power consumption of receivers and other electrical appliances, provide a source of substitute "B+" voltage, and also provide a loudspeaker for substitution and other tests.

With switch S_1 rotated to its fifth ("Noise") position and the probe plugged for "direct" use, d.c. at about 100 volts is available at the probe tip for application to other circuits or for component checking. When this voltage is applied across a resistor, for example, a clean, sharp click in the speaker shows that the path has been completed, indicating continuity. A crackling or intermittent sound would indicate that the resistor is defective in such a way as to generate noise when it is used in a circuit.

Of course, a component that is to be checked in this way must be isolated from its original circuit, by the removal of one or both connections to it. In circuit wiring, the noise test can often reveal such elusive faults as cold soldered joints. To become familiar with this technique, it is a good idea to try the

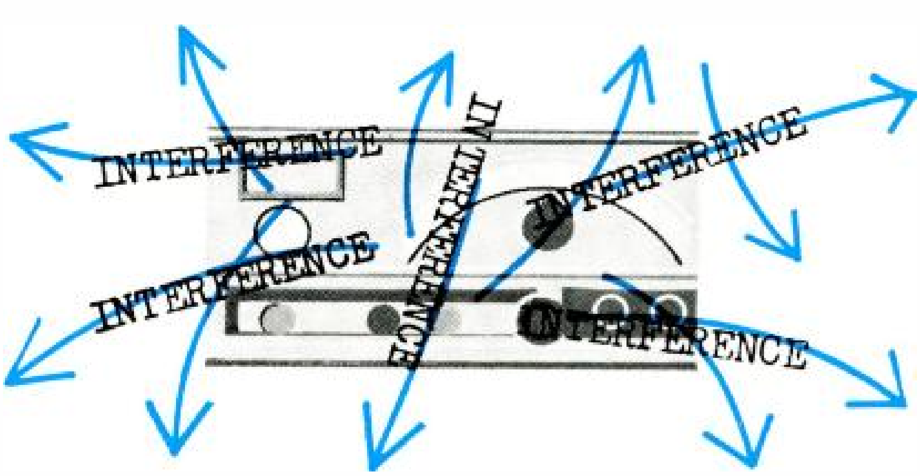
(*Continued on page 77*)

Reducing Transmitter Interference

By JAMES G. ARNOLD

Surface Communications, Defense Electronic Products, Radio Corporation of America

Practical methods for reducing interference produced by mobile, amateur, CB, and industrial transmitters.



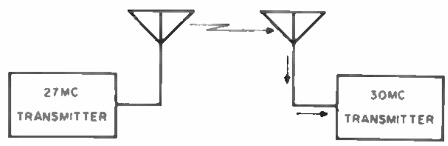


Fig. 9. How r.f. intermodulation occurs.

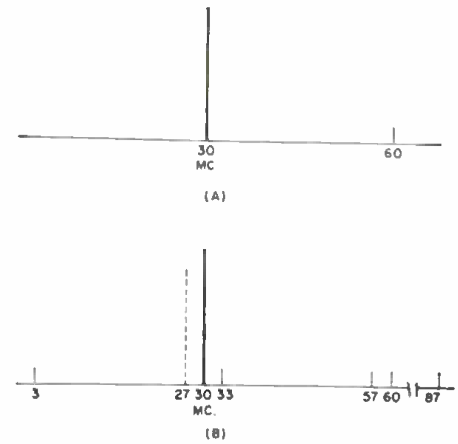


Fig. 10. (A) Normal frequency spectrum of a 30-mc. transmitter. (B) Spectrum of same transmitter with 27-mc. intermodulation.

IN THE previous article we discussed two important causes of transmitter interference: harmonics and other spurious signals. Now, let us consider the important aspects of shielding and r.f. intermodulation effects.

Shielding

Since the purpose of a transmitter is to supply r.f. power to radiate into space, one might wonder why it is necessary to do any shielding. In Part 1 we pointed out the various undesirable signals which are generated in a transmitter. We have also discussed methods used to reduce the radiation of these signals from the antenna, but these techniques have only reduced these signals in the transmitter output and they are therefore still being generated in the transmitter. It is therefore necessary to shield the r.f. circuitry of the transmitter otherwise the undesirable signals will be radiated from the cabinet.

In general, conventional cabinets provide very poor shielding. The louvers for air circulation, lids, doors, and holes for wires, meters, and controls all leak r.f. signals into space. Wires passing through r.f. stages become both antennas and pickup loops.

Shielding properly is not difficult if a few basic factors are kept in mind. All r.f. stages of the transmitter should be totally enclosed. This does not mean air-tight enclosures. A good copper screen is essentially as good as a solid sheet of metal except at extremely high frequencies where the openings in the screen are a large portion of a wavelength. When enclosing r.f. stages, special attention must be given to metal-to-metal bonds, such as the corner of a box. Where metal sides are joined, they should have at least one-half inch of overlap. The surfaces should be clean and should be firmly joined with screws at least every inch along the joint. The oxides of both copper and aluminum are fair insulators. If joints are made with corroded surfaces, or with poor pressure, the joint itself becomes an excellent antenna.

Shielding should not be placed too close to the r.f. components. The greater the power in the r.f. circuit, the greater should be the clearance. In general, an inch of clearance is satisfactory for power of a few watts or less. Shielding is, for this reason, less of a problem if all the spurious generating stages are operated at low power output. All the high-power-level stages should be operating at the output frequency.

Finally, it must be recognized that a fine job of shielding components becomes completely worthless if the leads passing in and out of the r.f. enclosures are not adequately bypassed. In bypassing leads, the greater the capacity the better the bypass. This is true only, however, if the capacitor is not physically large or if the leads are not long. If the leads become too long, the capacitor does not look like a capacitor to the r.f. In general, up to 200 megacycles, .001-μf. ceramic disc capacitors are good r.f. bypasses. For higher frequencies, capacity must be lower or the capacitor itself becomes too large to be an effective bypass. A number of feedthrough-type ca-

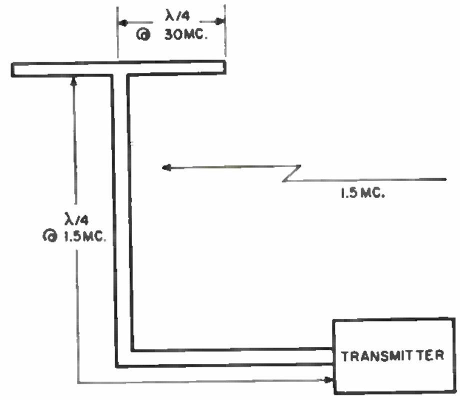


Fig. 11. Intermodulation effects produced by means of two widely separated frequencies.

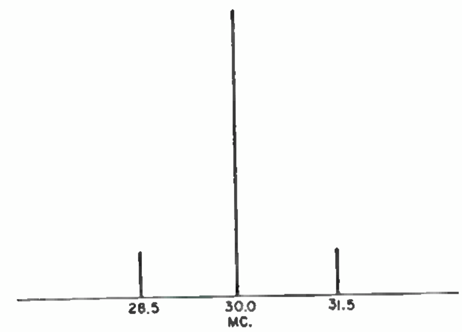


Fig. 12. Shown above is the r.f. signal spectrum that is produced by means of the intermodulation effects shown in Fig. 11.

pacitors are available which provide minimum lead length and good ground contact.

Thus far, we have described means of reducing all undesirable signals usually generated in a transmitter. These methods have provided for reduction in both the antenna and the transmitter cabinet. After such precautions, it would seem that the transmitter could not be a party to creating an interference problem. Unfortunately, this is not always true. A situation of this type will now be described.

Radio-Frequency Intermodulation

It might be felt that a transmitter which is well shielded, has its power feedlines filtered, and has all harmonics and spurious emission well attenuated in its transmission line cannot be suspected of causing interference. This, however, is not the case.

The problem of transmitter-to-transmitter intermodulation arises when two transmitters are located close enough to each other to deliver significant power to each other's antennas. Consider the case of two transmitters operating on 27 megacycles and 30 megacycles, as shown in Fig. 9. The power delivered to the 30-megacycle transmitter's antenna by the 27-megacycle transmitter will flow down the transmission line and into the plate tank circuit of the 30-megacycle transmitter. This signal will appear on the plate of the power amplifier in the same manner as if it were an audio voltage being used to modulate the power amplifier. The sidebands, however, will be 30 plus 27 or 57 megacycles and 30 minus 27 or 3 megacycles, as shown in Fig. 10B. Since both of these sidebands are well separated from the frequency of the power amplifier tank circuit, practically none of this sideband energy is retransmitted back to the antenna. However, as pointed out in last month's article, the plate current of the power amplifier contains harmonics of the carrier frequency as well as the carrier. The interfering 27-megacycle signal will therefore modulate the second-harmonic component of the plate current as well. The sidebands of this modulation will be 60 plus 27 or 87 megacycles and 60 minus 27 or 33 megacycles. Now the 87-megacycle sideband will also be rejected by the plate tank circuit but the 33-megacycle sideband is close enough to the frequency to which the plate circuit is tuned so that it is passed back to the antenna with very little attenuation and radiated by the antenna. This type of interference is most elusive when first experienced. If either the 27-megacycle transmitter or the 30-megacycle transmitter goes off the air, the interference at 33 megacycles disappears. The question would seem to be "who is causing the interference?" Actually, of course, the two transmitters are mutually causing the trouble but the process of modulation is taking place in the 30-megacycle transmitter, and this is the place where it can be eliminated.

The most important single point in the reduction of intermodulation of this type is, as in most of the previously described types of interference, the use of high-"*Q*" circuits. If the selectivity of the power amplifier output tank is sufficient to reject the signal from the neighboring transmitter before it reaches the plate of the amplifier, intermodulation cannot occur. It should be noted in the case of the 27-megacycle and 30-megacycle transmitters, the signal producing the intermodulation in the 30-megacycle transmitter is 3 megacycles below the frequency of the tank circuit and the intermodulation sideband produced is 3 megacycles above the frequency of the tank circuit. Therefore, if the tank circuit provides 10 db of rejection at 3 megacycles off resonance, the intermodulation sideband in the output will have been reduced by 20 db.

While this particular pattern of r.f. intermodulation seldom occurs except where the two transmitters are close together in both frequency and geography, other patterns can occur. Any time that two transmitters are located relatively close together, there is a possibility of some type of intermodulation. As an example, consider a transmitter operating at 30 mc. and located very close to the antenna of a high-power broadcasting station which is operating at 1.5 mc. The 1.5 mc. signal is, of course, rejected by the 30-mc. tank circuit and the 30-mc. dipole. But if the open-wire transmission line of the 30-mc. transmitter is about a quarter-wavelength long at 1.5 mc., as shown in Fig. 11, the plate tank is coupled to an antenna which is resonant at the 1.5-mc. signal. Under such a condition, considerable signal from the 1.5-mc. transmitter will be delivered to the plate of the 30-mc. amplifier despite the 30-mc. tank selectivity. In this case, side tones are produced which are above and below 30 mc. by 1.5 mc., as shown in Fig. 12. The obvious solution in a case like this is to use coaxial rather than open-wire line. This is not always a desirable solution, however, and is not necessary. A simple 1.5-mc. trap across the open-wire line would be quite effective. Such a trap should be located as close to the transmitter as possible.

The use of a tetrode as a final power amplifier provides excellent insurance against this sort of interference. It is commonly realized that to amplitude-modulate a tetrode, both the screen grid and the plate must be modulated. The screen grid, however, will be bypassed to ground for r.f. and hence the interfering signal can modulate the plate only. The modulation losses are therefore quite large and the resulting output sideband is quite low. A triode, of course, is easily modulated by the plate and provides little protection against intermodulation.

Summary

In this, and the preceeding article, several types of interference have been discussed and several characteristics in a transmitter have been shown to be helpful in all these cases of interference. The general procedures for reducing interference in a transmitter can thus be very simply summarized:

1. Interference is best reduced at its point of generation. High selectivity *("Q")* in all tuned stages is extremely important.

2. Couple no more power from any stage than is necessary. Where efficiency and power are important (as in the power amplifier), couple to the optimum point. Coupling with a loop is to be preferred.

3. Stages where spurious signals are generated (mixers, multipliers, and oscillators) should be operated at low power levels and the outputs of these stages should be very lightly coupled.

4. All r.f. stages should be completely shielded.

If these points are observed and care is taken to modulate properly with an undistorted audio signal, a transmitter need not be a spectrum waster. —30—

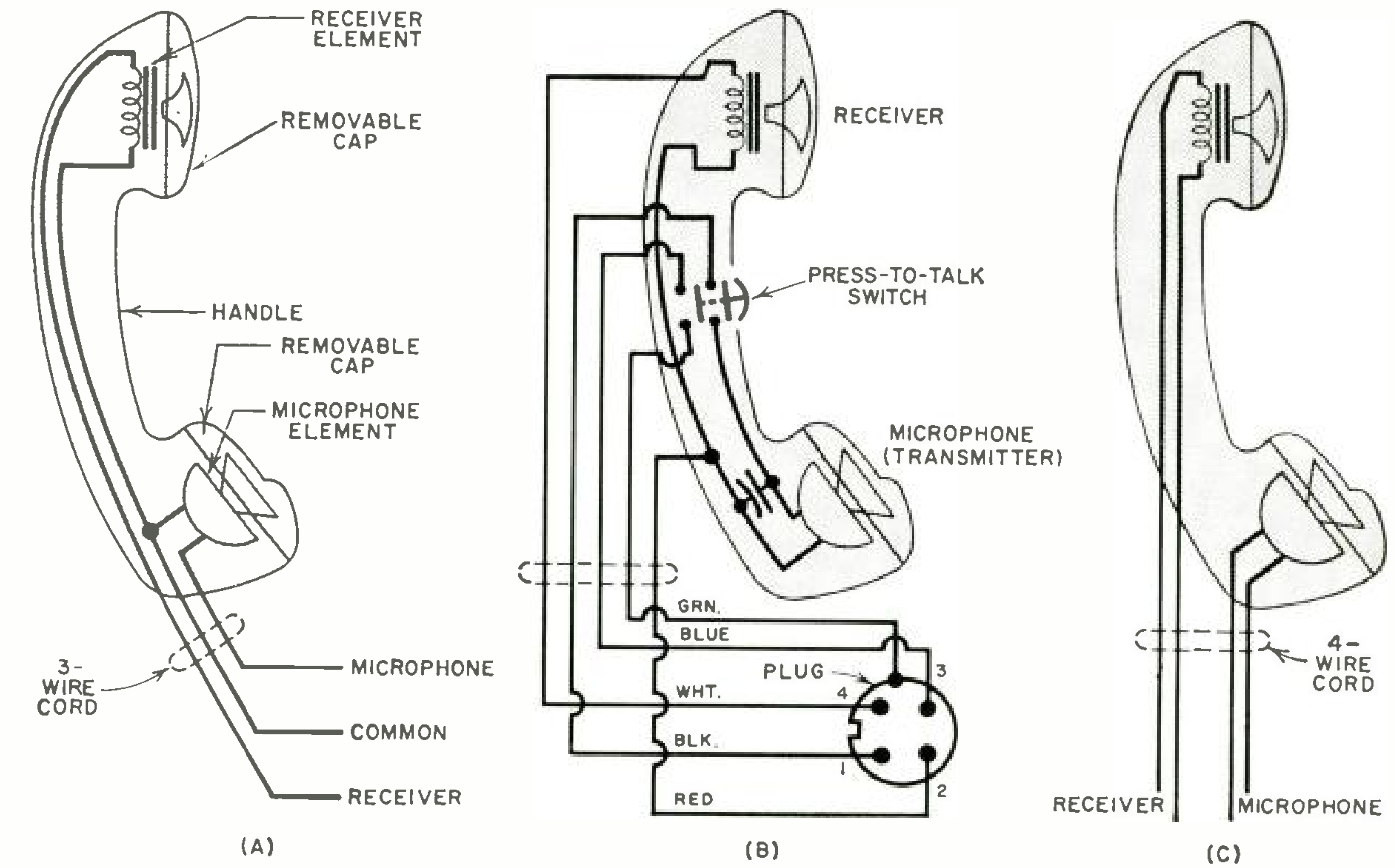


Fig. 1. (A) Standard telephone handset. (B) Radio handset with plug. (C) Handset with 4-wire cord, and (D) with 6-wire cord.

Add A Handset To Your Citizens Radio

By **LEO G. SANDS** / Author, "Class D Citizens Radio"

You can talk-out farther and hear better in noisy areas with a handset. Here are circuit details that show how you can add a handset to a CB transceiver.

WHEN YOU use a handset with your Citizens Radio, you can hear better in areas where acoustical noise is high. You can also talk out better, achieving a higher percentage of modulation, because the microphone is automatically positioned at the correct distance from the lips.

If you also add a switch to cut off the loudspeaker when using the handset, you can have more privacy. Others in the same room or car may hear you transmitting, but they won't overhear the other side of the conversation.

When railroads first started equipping cabooses and locomotives with two-way radio, hand microphones were used. They were quickly replaced, however, by handsets, overcoming varying microphone techniques and permitting better reception on noisy trains.

A handset can be added to any Citizens Radio. A handset consists of a single earphone, known as the *telephone receiver*, and a single-button carbon microphone, known as a *telephone transmitter*, one at each end of a handle.

If we look at the microphone and receiver elements of a handset individually, it is easier to determine how they should be connected to a specific make and model Citizens Radio.

Connecting the Receiver

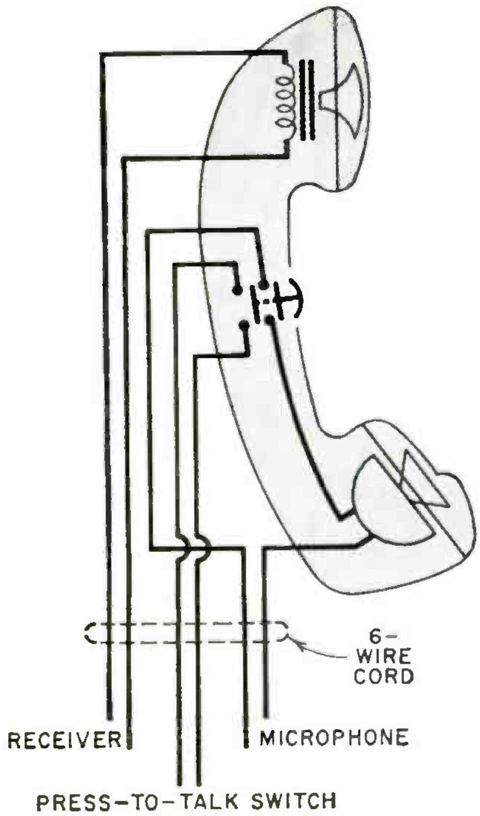
Connecting the receiver is easy. The speaker circuit of most CB sets is shown in Fig. 2. The secondary of the output transformer is connected to the speaker voice coil through the contacts of the "transmit-receive" switch or relay, indicated on the diagram as S_1. When receiving, the contacts are closed and the speaker is operative.

When transmitting, the contacts are open—for two reasons: to silence the speaker and to avoid loading down the secondary of the output transformer. This is an important consideration because the output transformer is used as the modulation choke when transmitting. If it were loaded by the speaker voice coil during transmission, its impedance as a modulation choke would be reduced and not enough audio power would be available for modulating the transmitter.

The handset receiver may be connected to points *A-B* or *X-Y*. When connected to *A-B*, you can hear all incoming calls through the handset. When connected to *X-Y*, you will be able to hear all incoming calls plus your own voice, when transmitting. This is called *sidetone* and gives the same effect as a regular telephone.

The impedance of a typical telephone handset receiver is around 140 ohms at 800 cycles. Because of this relatively high impedance, the handset receiver may be connected to *X-Y* without significantly loading down the secondary of the output transformer when it functions as a modulation choke during transmission.

When the CB receiver volume control is set for room level (about 100 milliwatts into the speaker), the handset receiver will be driven at a level of



(D)

about 5 milliwatts, which is more than ample. If lower sound level is required, but without reducing the speaker sound level, a 1000-ohm potentiometer may be connected in series with the handset receiver, as shown in Fig. 3A. When the potentiometer is set so that its full resistance is in the circuit, the handset receiver level is reduced 20 db. Or, the potentiometer may be connected as a voltage divider as shown in Fig. 3B.

When a handset is used, it may be desirable to be able to shut off the speaker after a call has been intercepted so that other persons in the same room or car won't overhear both sides of the radio conversation. A s.p.d.t. toggle switch (S_2) may be connected as shown in Fig. 4A. When the switch is in the position shown in the diagram, the speaker is connected. In the other switch position, the audio output (when receiving only) is soaked up by the dummy load resistors R_1 and R_2.

Or, as shown in Fig. 4B, a fader may be added which permits use of the speaker and handset individually or simultaneously. By adjustment of R_1 it is possible to raise the speaker volume while reducing the handset volume and *vice versa*. R_2 is needed in the circuit to act as a dummy load when the handset is set to a relatively higher level than the speaker. This circuit, however, does not provide sidetone.

A telephone handset may be placed in a hanger when not in use. This hanger may be one that has no switch, or it may be of the type that includes a hook

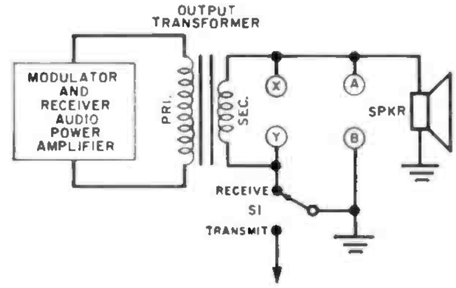


Fig. 2. Speaker circuit of typical CB set.

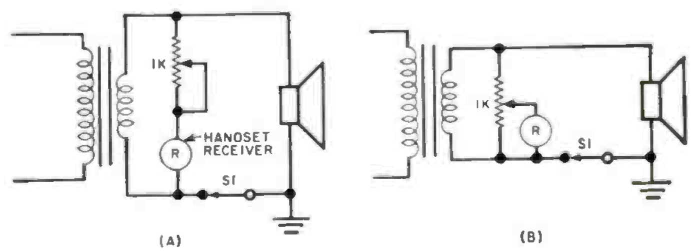


Fig. 3. (A) Series volume control. (B) Voltage divider control.

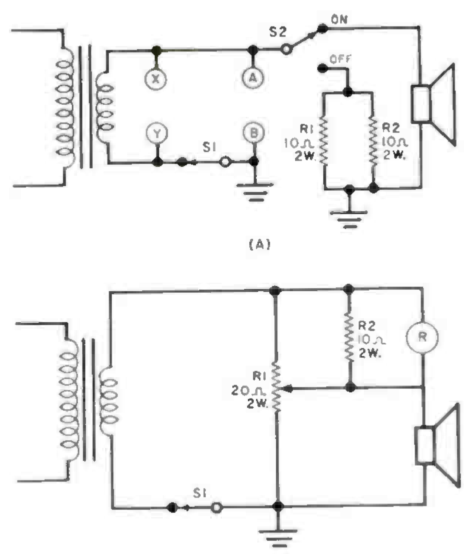


Fig. 4. (A) Switch may be added for cutting off speaker. (B) Use of fader permits variation of speaker and headset output levels.

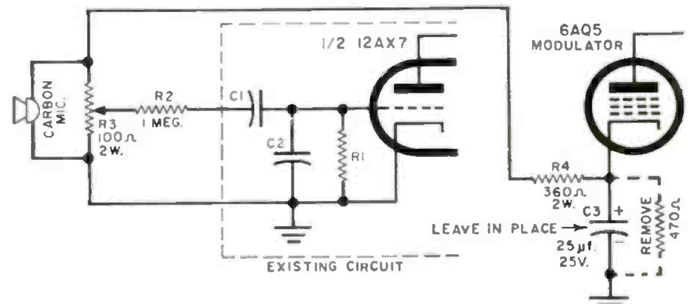


Fig. 5. Modification of high-impedance input for carbon mike.

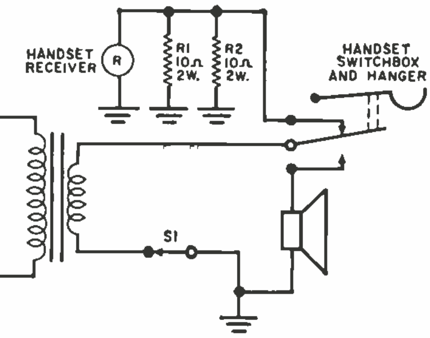


Fig. 6. Handset switch cuts off the speaker.

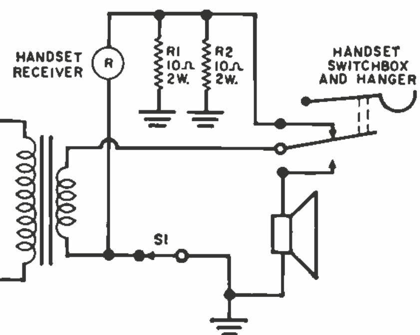


Fig. 7. Sidetone circuit for handset switch.

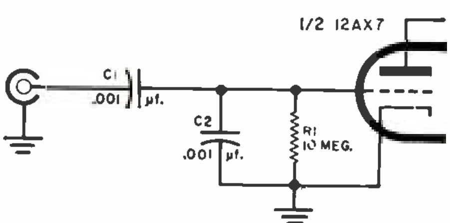


Fig. 8. A typical microphone input circuit.

switch. When a hook switch is provided, it may be used to automatically mute the speaker and to connect the handset when the handset is removed from the hanger. This is called the *off-hook* condition; when the handset is on its hanger, the *on-hook* condition exists.

A simple circuit for this purpose is shown in Fig. 6. The handset switchbox and hanger are shown in the off-hook position. The switch contacts connect the handset receiver to the output transformer secondary. The handset becomes operative only when the "transmit-receive" switch (S_1) of the CB set is in the *receive* position (no sidetone). When the handset is hung up, the speaker is connected and the handset receiver is disconnected.

If sidetone is desired, the circuit shown in Fig. 7 is required. In Fig. 6, the handset receiver is connected across *A-B;* in Fig. 7 it is connected across *X-Y*.

Connecting the Transmitter

The microphone of a telephone handset is known as the *transmitter*. In most handsets a single-button carbon transmitter is used. It has a resistance of from 20 to 50 ohms, not 200 ohms as many assume. It delivers a much stronger audio signal than a crystal, ceramic, or dynamic microphone. When a handset is used with a CB set intended for use with any one of these types of low-output, high-impedance microphones, means must be provided for reducing the output of the carbon microphone.

First, let us look at typical CB microphone input circuits so we can evaluate the requirements. Fig. 8 shows the microphone input circuit of the *Heathkit* CB-1. The ceramic microphone output is fed through C_1 to the grid of the microphone preamplifier stage. Capacitors C_1 and C_2 tend to limit frequency response to the voice band. When a carbon microphone is used in lieu of a high-impedance mike, care must be taken not to upset the frequency response materially and to avoid overdriving the speech amplifier.

The input circuit is modified as shown in Fig. 5. The microphone is connected across R_3, a 100-ohm, 2-watt potentiometer which has been added to the set. This potentiometer acts as the microphone load and also as a modulation level control. R_2 has been added to the circuit to prevent loading down the preamplifier input circuit.

A d.c. excitation voltage is required for a carbon microphone. This can be obtained as shown in Fig. 5. The cathode bias resistors of the modulator tube (a 6AQ5 in the *Heathkit* CB-1) is removed, but the cathode bypass capacitor, C_3, is left in the circuit. The cathode resistor is replaced by R_1 and R_3 in series. The d.c. bias voltage is developed across these resistors, and the portion of it developed across R_3 is the microphone excitation voltage. Since C_3 removes the audio fluctuations across these resistors, there is no audio feedback from the modulator to the preamplifier.

In the *Heathkit* CB-1, the modulator bias resistor has a value of 470 ohms. In Fig. 5, this resistor has been replaced by a 360-ohm fixed resistor and a 100-ohm potentiometer. In other makes of sets where other values of modulator bias resistors are used, R_3 and R_1 in series should equal the value of the original resistor. The resistance of R_1 and R_3 should be about 3 to 1 or 4 to 1. This is not critical.

So far, we have been concerned with the use of a handset with a typical CB set which has a front-panel "transmit-receive" switch. A handset can also be used with sets equipped with a "transmit-receive" relay actuated by a press-to-talk button on the microphone.

Press-to-Talk Operation

Handsets are available with or without a press-to-talk switch in the handle. Fig. 1A shows the circuit of a standard handset without a press-to-talk switch, and Fig. 1B shows the circuit of a handset with this feature. In both cases, one terminal of the receiver element and one terminal of the microphone element are connected together. This is satisfactory when sidetone is not desired.

To obtain sidetone, the handset should be provided with a cord that permits

(*Continued on page* 90)

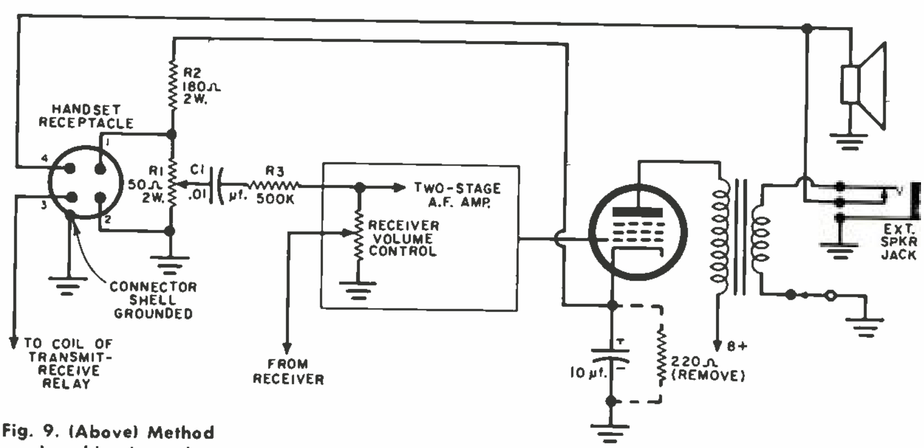


Fig. 9. (Above) Method employed by the author to connect a telephone handset to a Globe CB-100 Citizens Band unit.

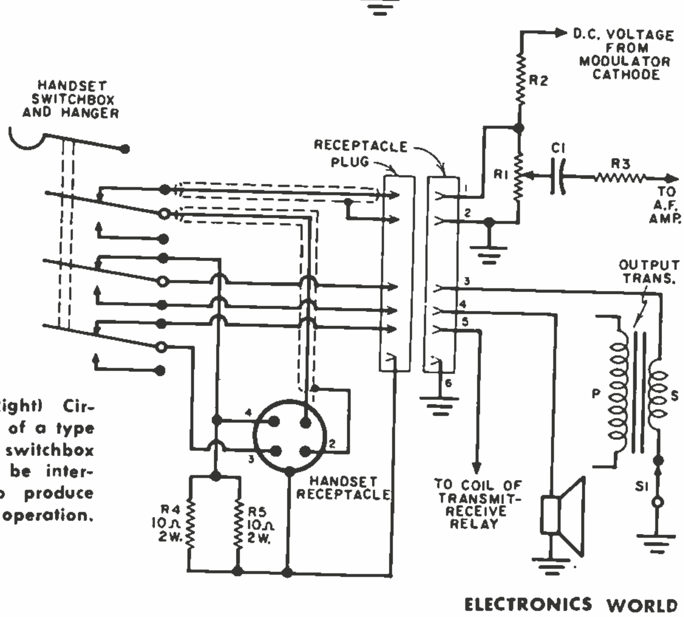


Fig. 10. (Right) Circuit diagram of a type of handset switchbox that has to be interconnected to produce press-to-talk operation.

The Resistance Substitutor

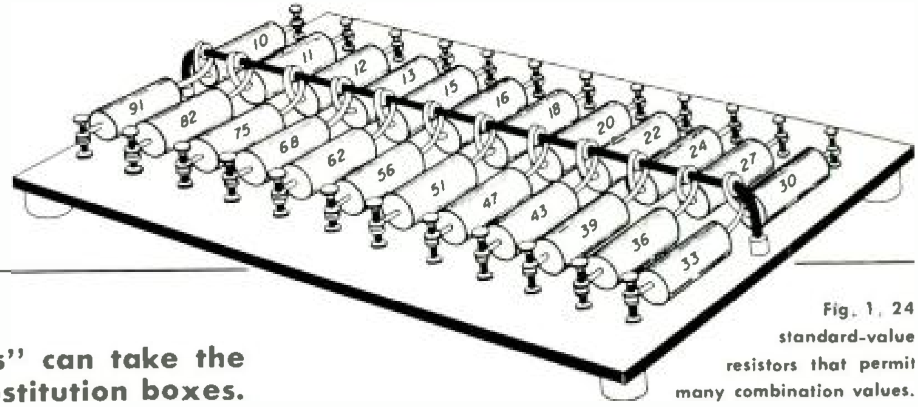


Fig. 1. 24 standard-value resistors that permit many combination values.

By SERGIO BERNSTEIN-BERVERY

Resistor or capacitor "boards" can take the place of both decade and substitution boxes.

RESISTANCE or capacitance substitution boxes have always been useful items in the service shop or on the experimenter's bench. In the laboratory, few items of equipment are more useful or more frequently used. These are marketed in various forms, including kits with a variety of commonly used, standard values and accurate decade boxes for precision work.

In the usual form, these items have certain disadvantages. Barring the use of a precise decade box or series of decades, not all resistance values can be obtained. Also, if resistors in the box are accidentally overloaded and damaged, this will go unnoticed because the components are not visible. The switches used can wear out, reducing reliability. The expense of having a full range of values may be prohibitive for ordinary, "everyday" use.

A simple, practical, and far more economical solution is to wire up several terminal boards, instead of several boxes, in the manner shown in Fig. 1, each board having 24 terminals, 12 along each side. Two-watt resistors should be used. Depending on the desired accuracy and the amount to be invested, units of five per-cent tolerance (or better) will be required. One board is used for each range of values. Thus one board, like the one shown, will use 24 resistors ranging from 10 to 91 ohms. The next board could use resistors from 100 to 910 ohms, and so on.

One end of each resistor is connected to the common bus shown down the center. Thus, to use any two resistors in series, external connections need be made only to the free end of each resistor. The values for all resistors in the set illustrated are marked in Fig. 1. These markings could be transferred to the board, beside the resistors. Choosing desired values, as will be shown later, is relatively simple. For the basic group of 24 components, only standard EIA values are used.

The advantages in this arrangement are considerable. For example, to determine the optimum value of a plate-load or cathode resistor in a circuit, the common bus may be used for the "B+" or ground connection. Changing a single connection makes it possible to choose from a wide range of experimental values. Power dissipation larger than two watts can be accommodated by using various series or parallel combinations. Simple voltage dividers can be made up—something not possible with conventional boxes. For example, a reasonably precise 10:1 divider can be made by using 10 and 91 ohms, or 100,000 and 910,000 ohms on a higher-value board. When a component is damaged in use, this is relatively easy to spot. Also ease and economy of replacement are advantages.

If component values have been checked on a bridge before use, or if they are otherwise known to be sufficiently precise, a remarkable collection of closely spaced values, including decade steps, is available from each board. Actually one board presents the possibility of several hundreds of different combinations, although there would be much duplication of values. Table 1 illustrates the variety of unduplicated values (more than 120) available from just the single board of Fig. 1 by using either individual resistors or series combinations.

Decade steps from 10 to 100, shown in bolder face, are available. Total range is from 10 to 173 ohms. From 23 to 109 ohms, one-ohm steps are continuously available, if the constructor cares to use that much precision in the original choice of components. The chart shown will be convenient for the user in any case, since it enables him to pick off quickly the two resistors to whose free ends he must connect for any series-pair value without stopping for calculations. Once it has been drawn up, to simplify the matter of determining the possible combinations, an even simpler list can be made from it, if desired.

The possible values available can be listed in one column in numerical sequence, from 10 to 173, and the two values required, where a series pair is used, can be placed in the adjacent column. For example, part of this list could read, "23=11+12, 24=24, 25=12+13, 26=11+15," and so on. Furthermore, a single such chart may be used for all the resistance boards drawn up in the same way, simply by multiplying by 10, 100, 1000, or more. In this way, the substitution board is no more difficult to use than a conventional box with a selector switch on which values are marked.

The particular board of Fig. 1 has been used for illustration, but many variations are possible. A reduced but nevertheless wide range of values would be possible by using fewer resistors on a board. It is also possible to make up similar capacitor boards with parts of suitable values and ratings. A chart like Table 1 would apply to parallel-connected pairs, but a list for series pairings could also be made up.

Many more values can be obtained with boards of this type by combining two or more of different ranges. —30—

Table 1. Over 120 unduplicated values from board of Fig. 1, including decade steps.

	11	12	13	15	16	18	**20**	22	24	27	**30**	33	36	39	43	47	51	56	62	68	75	82	91
10	21																				85		
11		23		26							41												
12			25				32																
13				28	29												64						
15					31		35	37														97	
16						34																	
18							38	**40**		45	48										93	**100**	
20								42	44		**50**	53		59		67				88			
22									46	49	52	55	58	61	65								
24																						106	
27											57	**60**			**70**	74	78				102		
30												63	66		73	77	81	96					
33													69	72	76	**80**	84	89			108		
36															79	83	87	92		104			127
39																86		95	101		114	121	
43																**90**	94	99	105	111		125	134
47																	98	103	109	115	122	129	
51																		107	113	119	126	133	142
56																			118	124	131	138	147
62																				130	137	144	153
68																					143	150	159
75																						157	166
82																							173

The Listening Center Technician

By
LOREN D. CRANE and
REZIN C. WHITE
Ohio State University

Increasing use of electronic aids in learning institutions is creating jobs for a new kind of technician.

EDITOR'S NOTE: The use of audio learning aids, individually as well as on a group basis, is widespread in colleges and growing in secondary schools. The full-time services of an audio technician whose chief asset is his electronics background has become increasingly necessary. His role and the organization of equipment under his control is described here. Mr. White is the audio technician at Ohio State.

TODAY'S schools, with already bulging enrollments rapidly growing, search frantically for more teachers despite their awareness that there are not enough qualified people available and will not be in the future. Thus the search turns, more and more, to more efficient teaching procedures and mechanical aids that will extend the influence of each teacher to a greater number of students or that will relieve him of part of the instructional burden.

Radio, TV, and motion pictures are being relied on more heavily to bring the best instruction available to the greatest number of students. Recorded materials, for use in classroom groups as well as self-instruction by individual students, have never before been available in such quantity or used so heavily.

As part of this trend, there has been a marked increase in the number of so-called "language laboratories." This term is a misnomer. It is true that one important use of such an installation is to enable students of foreign languages to benefit from hearing native instructors speaking their tongues properly. However, there are many other types of subject matter in which recorded and recording aids play important roles. Also, the type of laboratory in question is only one of the varieties of possible installations. The one of greatest interest to an electronics technician would be the audio or listening center.

What Is an Audio Center?

Three general types of installations are found in colleges at the present time. A room for experimental study containing many various electronic devices for use by relatively few teachers or advanced students is usually referred to as an audio laboratory. It is so named because its specialized use is developing new techniques. A room for instructional purposes containing many identical pieces of electronic equipment for use by a large number of students—but simultaneously under the direction of a teacher—is an audio classroom.

Fig. 1. Individual student booth with tape deck and master-program inputs.

The last type is not a classroom, but a place for out-of-class practice, self-instruction, or the completion of classroom assignments. It contains many identical pieces of equipment for use by a large number of students—but they work individually and at their own convenience. This is an audio center. Of the three types, this is the most likely to require a supervisory technician. The one at the Ohio State University, named the "Listening Center," is the basis for this article. It is also true that a center of this kind generally costs less than the other two types of installations. For this reason, too, it is likely to be the most popular installation in the future.

The Technician's Role

The technician will not only be a key man in the operation and maintenance of the center, but will also play an important role in its development. His advice will generally be sought in four areas. He will be called on to advise architects and others involved with the design of the installation. He will largely be responsible for the choice of particular units of equipment to be purchased. Supervision and systematic maintenance will be his continuing task. And finally he will be expected to educate the educators in the proper use of facilities.

In planning, he should remember that the room ought to be attractive and well-lighted. Time spent in it should be a pleasant experience. An important problem encountered here is the arrangement of booths to give a degree of privacy to individual students. Some knowledge of acoustics and familiarity with the use of sound-proofing materials is essential here.

The arrangement of equipment in each individual booth is also important. One point a technician may easily overlook (especially if he is right-handed) is that left-handed students will be using the facility The lay-out should not handicap them. Nor is convenient use the only consideration. Ease of installation, accessibility of equipment for maintenance and repair, and sufficient flexibility to allow for future additions or other changes are also of extreme importance.

Looking at the room as a whole, there should be a master switch that will turn off all equipment at the end of the day. This eliminates the need for a detailed check of each individual piece of equipment. The storage space for discs and tapes should be convenient to the area where master programs are played. For the technician's own sake, as well as for the convenience of other users, the controls in each booth available to the student should be few and simple. For example, it is advisable to pre-set the level of the recording amplifiers in tape recorders available to individual students.

Choosing Equipment

The Listening Center at Ohio State has 40 booths equipped with dual-channel tape decks and record-playback amplifiers. One such is shown in Fig. 1. The particular decks used here are the *Viking* 75 series. Twin-channel units provide an important function. Many taped aids are recorded on one channel only, called the master channel. If the erase head for this channel is removed from the tape deck, the user may record on the other (student) channel as he listens without erasing the former. Of course, separate amplification for each channel is necessary. Since the erase head for the second channel is left in place, a later student using the same tape can replace the first student's voice with his own without affecting the master recording.

Installed in 35 booths are 4-speed, manual turntables with dual-stylus playback cartridges and playback amplifiers with microphone inputs. *Bogen* B50-16 tables are used in conjunction with *Magneticon* amplifiers. In any of these booths, when the student speaks into a microphone, he can hear his own voice through the earphones along with the material on the disc, so that he may compare his voice with that on the recording as in language practice.

In 50 separate booths, as well as in the booths containing the tape decks, 11-position selector switches have been installed. This permits each student to choose among as many as 11 master programs that originate in an adjoining control room, which is part of the center. A block diagram of the lay-out for each of the 50 master-program booths appears in Fig. 2A. No microphones are used here. The arrangement for the 35 turntable-only installations is shown in Fig. 2B. The 40 combined master-program tapedeck installations are set up as shown in Fig. 3.

In the control room, master programs originate from 10 tape decks (erase heads removed) and one turntable. A portion of this room, showing four of the decks, appears in Fig. 4. Continuous playing loops are sometimes used for the master tapes.

In choosing equipment, the utmost fidelity will often be less of a consideration than reliability and durability. For example, the headphones are of two basic types. For speech materials, a response of 100 to 5000 cps is very satisfactory. For music, some headphones with response from 60 to 8000 cps serve the purpose. The microphones are sturdy, relatively inexpensive ceramic types, also with response from 60 to 8000 cps. These also have relatively directional pick-up patterns. There are many specific models of equipment from which choices can be made. In the center under discussion, *Clevite-Brush* BA-200 headphones are used for speech materials, the same manufacturer's model BA-206 is used for music, and the microphones are *Electro-Voice* model 729 ceramics, which have a cardioid pattern.

Maintenance Problems

The technician will obviously have to repair any equipment that breaks down or begins to malfunction. He can also expect such chores as splicing tapes that break, dubbing and editing tapes, and supervising the recording of tapes of local origin. However, this is only the beginning of his duties. If he is wise enough to want to "stay ahead of trouble," he will set up a time-table for periodically checking all equipment in his charge.

An important check will be for loss of gain, which will often warn that trouble is developing somewhere. This can be done with test signals, recorded or "live," of known amplitude. Control settings and normal readings for these checks should be set up early as a matter of record. He should also check for the development of vibration, noise, and the loss of fidelity or intelligibility. In addition, it will be wise to clean tape heads and demagnetize them regularly after given periods of use, whether there are any indications for this necessity or not.

The best way to set up a time-table is to work with the attendant who is responsible for scheduling students and assigning them to booths. With little extra trouble, the latter can simultaneously keep a record of hours of use for each booth. This can be developed into a reliable guide for maintenance and replacement. For example, if sapphire playback styli are used in cartridges adjusted to track at 4 to 6 grams, they should be replaced after 65 hours of use. Record-playback heads on the tape decks used at Ohio State are re-

(*Continued on page* 106)

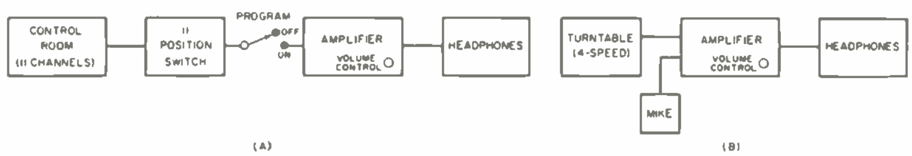


Fig. 2. Block diagrams of layout in (A) master-program and (B) turntable booths.

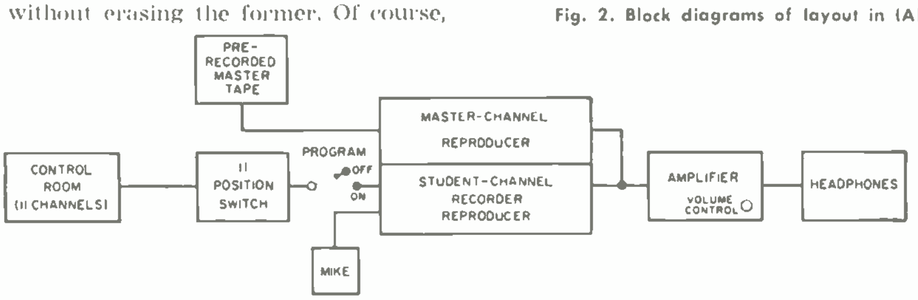


Fig. 3. Layout for booth with both master-program and individual-tape facilities.

Fig. 4. This corner of the control room shows four of ten tape players that feed master programs to individual booths. A turntable provides an eleventh channel.

Fuses and Fuseholders:
The New Look

By **ROY E. PAFENBERG**

Circuit protection today is a sophisticated matter, with many devices available for varied applications.

THE DAY when the fuseholder was just a simple, mechanical clip and the fuse a mere strip of metal that would melt at a given temperature are gone forever. These prosaic parts, often added as afterthoughts in circuit design, have moved from the dark recesses of equipment out to the front panel. This is now being accomplished without compromising safety or appearance.

So much change has occurred that many are unaware of all the possibilities. Yet these components are of considerable interest and importance. The technician, particularly if he is concerned with industrial equipment, should understand the special features of all types, as he will encounter them in variety. The experimenter or constructor now has many opportunities to incorporate improved protection and failure indication in his efforts. Electrical ratings, including blowing characteristics, have been discussed in an earlier article in this publication ("Fuses Are Not for Confusion," October 1960, page 140). Accordingly the main emphasis here will be on mechanical considerations and applications.

In an earlier day, when equipment was simple and fuses were few, placement in the easily accessible, uncrowded interior of a chassis presented no real inconvenience. Failure of the fuse was adequately indicated by failure of the equipment to perform. In today's complex devices, with a multiplicity of circuits requiring protection, the picture is different. There is a definite need to localize a malfunctioning circuit quickly so that correction can be undertaken with the least possible wasted effort.

One solution, the use of panel-mounted fuseholders, was a definite improvement. However, as the fuse population per unit of equipment increased, it again became difficult to determine the particular, defective fuse. To solve this problem, separate blown-fuse indicator lamps were used, particularly in critical applications. This worked well but increased assembly and component costs; it also used increasingly valuable panel space.

Modern, lamp-indicating fuseholders have been developed which provide positive identification of the blown fuse, but occupy no more space than conventional fuse posts. While originally engineered for military requirements, they are now widely available to all potential users at reasonable cost.

The *Buss* HKL fuseholder is representative of one type of available component. This unit, designed for applications in the range from 100 to 250 volts, accepts the common 3AG fuses and similar types of this size (1¼ in. by ¼ in.). As shown schematically in Fig. 1, it consists of the fuse itself shunted by a series combination. The latter consists of the neon lamp and its current-limiting resistor. Even if the abnormal condition that caused the fuse failure is self-removing, the lamp will continue to glow in most applications. In the rare case where high resistance in the protected circuit will not permit continued ignition of the neon lamp, a "keep-alive" resistor of suitable value may be added as shown.

Fig. 6 shows the compact HKL fuseholder in assembled and exploded views, and also highlights the separate components that would otherwise be required to perform the same function. The three components of the assembly—the holder body, the fuse, and the indicator—appear from left to right at the top. They are shown assembled in the center with the limiting resistor flat against one side of the holder. At the bottom are the holder, separate resistor, lamp, and lamp housing that would otherwise be used.

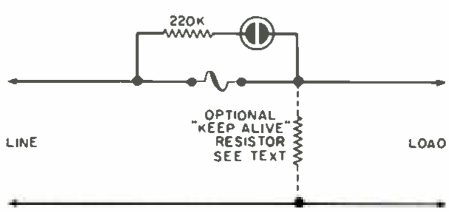


Fig. 1. Indicating circuit, including the fuse, for the HKL type fuseholder.

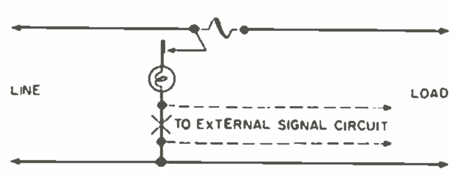


Fig. 2. Circuit for the HKA fuseholder shows lamp used for local indication and the insertion point for remote indicator.

Fig. 3. HPC holder (top) permits safe, panel-mounted fusing for high currents. Open holder with fuse is at the bottom.

A simple calculation of costs for the separate components also shows that, at a net price of not much more than a dollar for the HKL holder assembly with a fuse in it, it is a bargain even for non-critical applications. Fig. 4 illustrates the advantages in space-saving, ease of use, and appearance provided by such modern units. This is a bank of indicator-type fuseholders on the control panel of a teletypewriter loop.

For comparison, a panel using the older "grasshopper" type of fuse is shown in Fig. 5. This assembly is also from commercial teletypewriter gear similar to the kind shown in Fig. 4. However, note the housing for the "grasshopper" panel, which is made necessary by the fuse type. These fuses cannot be enclosed or hidden if they are to provide visual indication. The requirement involves exposed live terminals. Compare this arrangement with the narrow strip of panel space occupied by the array in Fig. 4. In addition, while the "grasshopper" fuses have been used successfully for years, they are mechanically fragile and require the use of a screwdriver when they must be changed. All in all, the newer component effects substantial improvement in reliability, ease of maintenance, and appearance.

The already described HKL assembly was designed for use with relatively high voltages. The ignition characteristics of the neon lamp, for example, will not provide indication much below 100 volts. For use with lower voltages type HKR, similar in appearance except that it uses an incandescent lamp instead of a neon type, is rated at 32 volts. For more general low-voltage use, or when it is desirable to have both a local and a remote indication of fuse failure, the type HKA holder is available. In addition to incorporating an incandescent lamp, it accepts special fuses, type GLD, which rely on built-in electro-mechanical switching action to indicate failure.

In Fig. 7, an assembled HKA holder is shown to the left. At the right, it is shown open to accept a fuse. Two examples of the GLD fuse used, each in a different condition, are shown in the center. The cartridge has a spring-loaded metal pin that is released when the element fuses and extends from one end. When this pin is sprung, it completes the circuit for the indicating lamp in the upper (knob) portion of the holder, and also through the optional external-indicator circuit to the other leg of the supply source.

The circuit arrangement for the HKA appears in Fig 2. The remote-signalling feature is shown as an option, which may be used by breaking the link between the lamp and the unfused side of the line, where shown, to insert the indicating device. The latter may be another lamp, an audible alarm, a relay, or other suitable unit.

While this configuration was specifically designed for use with a 24-volt supply, it has considerable flexibility above and below this value. It will give reliable indication of fuse failure from a potential as low as 12 volts. Where potentials higher than 24 volts are involved, a resistor may be inserted in series with the indicator lamp. A reasonable value may be determined by using 30 ohms for each volt in excess of the 24-volt rating. If the external-alarm circuit is used, the resistance of the inserted device should be computed as part of this total series dropping resistance. As to the GLD fuses themselves, they are rated at 125 volts and available in current ratings from $^3/_4$ ampere to 5 amperes.

The unit just described has many commercial applications but is not likely to be used frequently by the amateur constructor. The latter individual, however, will certainly be interested in another device that solves a problem he has doubtless encountered in the past. This has been the lack of a conservatively rated, panel-mounted, post-type holder that would enable fusing of line a.c. up to 15 amperes or even higher. Part of the problem has been the limited availability of cartridge fuses rated at over 5 amperes and 120 volts in sizes small enough to fit the preferred type of fuse post. As a result, many experimenters and manufacturers, as well, have used high-current fuses rated at 32 volts in a.c. line-voltage applications. Many cases of "unexplained" fuse failure may be traced back to this practice.

It is seldom the voltage rating that is responsible for erratic failure. In most applications, fuses may be used safely at voltages well above rated value. The cause is rather the fact that, at higher currents, adequately low contact resistance between fuse and holder is essential. If this resistance is appreciable, excessive voltage drop at the contact area and consequent heating are inevitable. Heating of a fuse, whether developed externally or internally, is what makes it blow. With this additional heat, the component may give way before its current rating is exceeded or reached.

The obvious solution is a holder that will accommodate larger fuses and provide greater contact area. The HPC panel-mounting post will accept cartridge fuses $1^1/_2$ in. long and $^{13}/_{32}$ in. in diameter. Such high-current fuses as the 5AG, KTK, and FNM types are available in this size at ratings beyond 15 amperes.

An integral HPC holder is shown at the top of Fig. 3. Below it is an open unit with a fuse ready for insertion. It will provide reliable fusing at a low net price, less than half a dollar, that is in line with the cost of older, less manageable, exposed mountings.

Use of such fusing concepts and associated hardware as those described here make possible easier maintenance, increased reliability, and greater safety in all types of equipment, whether commercial or individually built. Where an increase in cost is involved, it is nominal in most cases, and the benefits of doing the job in the best way more than compensate for the difference. —30—

Fig. 4. A bank of modern, indicating fuseholders on a teletypewriter control panel occupies little space above controls.

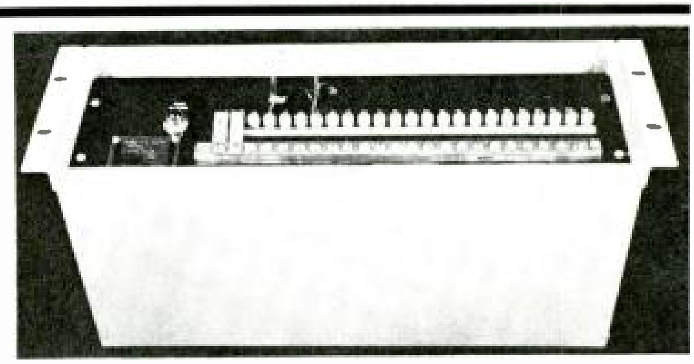


Fig. 5. A bank of older "grasshopper" indicating fuses as used in commercial teletypewriter gear. Compared to the array of Fig. 4, it uses more space, needs separate housing. ▶

Fig. 6. HKL holder with fuse (top) and assembled (center). Separate components (bottom) that would otherwise be needed.

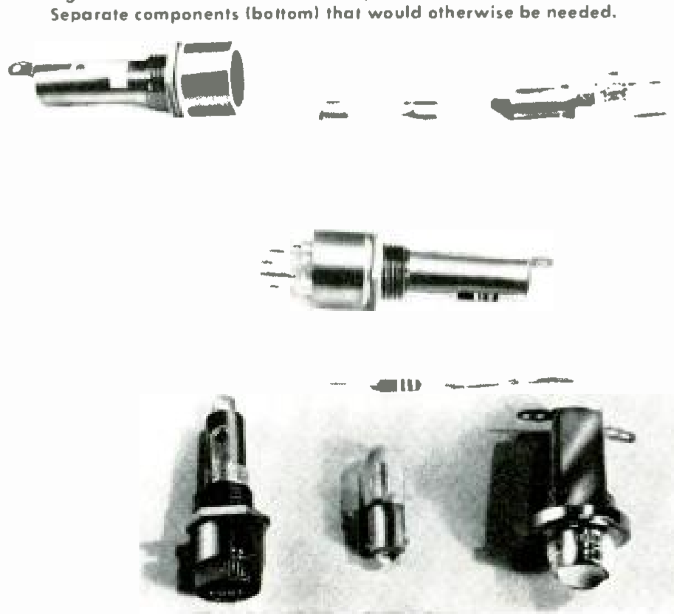
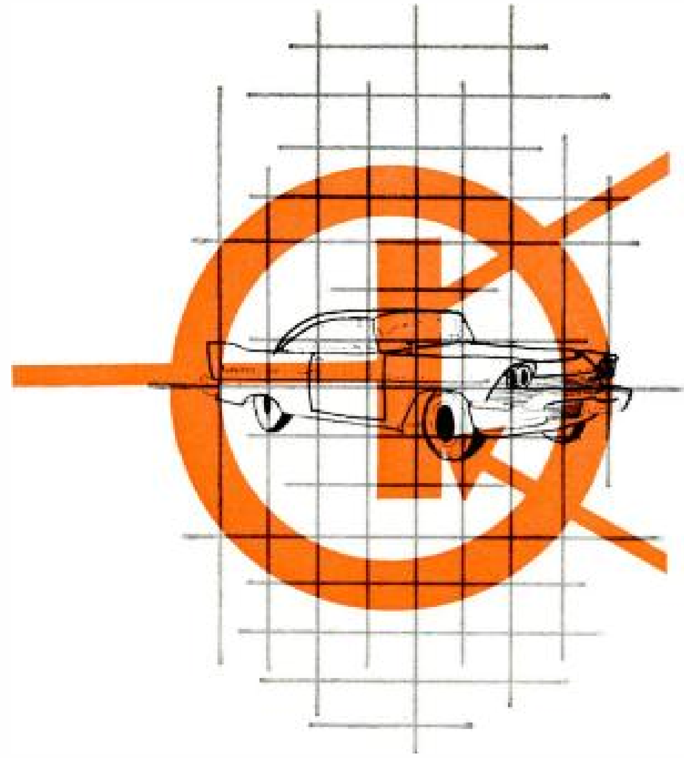
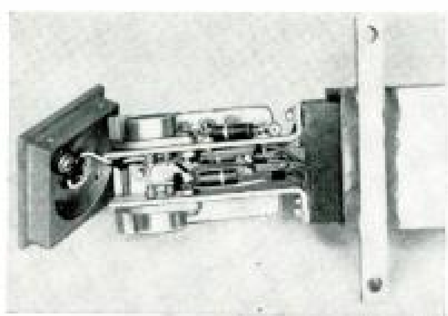


Fig. 7. The HKA holder (assembled, left) accepts a special type of fuse, two examples of which (center) are shown in different conditions. The pin shown protruding from one springs out when the fuse blows, to complete the circuit for local and remote indicators. An open holder, with the lamp in the top, is at right. ▼



DESIGNING A TRANSISTOR POWER CONVERTER



Inside view of the converter described by author. Unit has been removed from case.

Useful and basic information on how these transistorized mobile power supplies work along with an example of just how they are designed.

By **WILLIAM L. BLAIR**
Cubic Corporation

MUCH has appeared in the literature during the past few years describing the use of transistors as switching devices for power converters. In an effort to understand how these converters operate and also to describe the application of their theory to the design of a particular converter, it is simplest to begin with some of the fundamentals of transformer action.

Transformer Action

Take, for example, the transformer shown in Fig. 1. Here is a toroidal iron core around which has been wound a few turns of primary winding and a few turns of secondary winding. To understand what happens within this transformer, consider that a voltage E is applied across the primary. The resulting current does not reach its maximum value instantaneously, since the winding around the iron core is an inductance and constitutes an impedance to the build-up of current.

The current builds up gradually at a rate determined by the cross-sectional area and material of the iron core, the number of turns, and the applied voltage. At the same time the flux within the core increases directly proportional to the build-up of current through the winding. The build-up of flux continues until the core saturates. At this point, the transformer primary no longer acts as an inductance and the current increases very rapidly, limited only by the capabilities of the power supply and the resistance of the primary winding. Losses beyond saturation are excessive and transformers are normally operated considerably below this point.

By way of definition, the amount of flux existing within the core at any instant is designated by the Greek letter *phi* (ϕ) and the maximum value which the iron can support (saturation flux) by ϕm. The magnetic induction density is measured in lines-per-square-inch or per-square-centimeter. The latter unit is commonly called "gauss" and is symbolized by the letter B. The relationship between these two units is such that a flux density of one gauss is equal to 6.45 lines-per-square-inch. The total flux is equal to the product of the flux density times the core cross section area, $\phi = BA$.

It is a change in the number of lines of flux within the core which produces a voltage in the secondary winding. The more rapidly the number of lines change per second, the larger is the voltage which is induced in the secondary winding. Once the core saturates, the number of lines of flux in the core does not change and, therefore, no voltage is induced in the secondary.

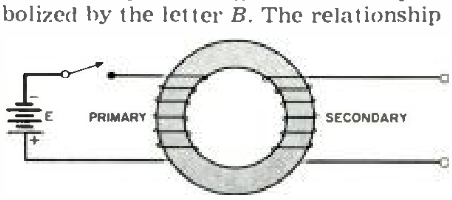
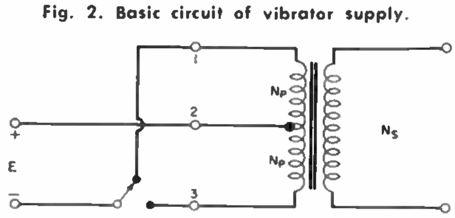


Fig. 1. The toroidal transformer setup.

Fig. 2. Basic circuit of vibrator supply.



Basic Vibrator Circuit

Look now at Fig. 2. This shows a standard vibrator-type power supply found in many car radios. A d.c. battery voltage, E, is applied to the two input terminals. The positive terminal goes to the center tap of the primary winding on the transformer. The negative terminal is connected alternately, by means of a single-pole, double-throw switch, to one end of the winding and then the other. The circuitry which causes the vibrator to switch this pole back and forth is not shown.

Assume that the switch has just been thrown to its present position. The entire battery voltage is now applied across terminals 1 and 2 of the transformer. The current begins to build up from zero and, as it does, the total flux within the core also begins to rise. Depending on the effective inductance presented by the transformer between terminals 1 and 2, this current, and therefore total flux, may increase rapidly or relatively slowly. We shall now assume that the switch remains in its present position only long enough for the flux to rise to a level somewhat below saturation. At this time the vibrator throws the switch to the opposite position and the battery is connected between terminals 2 and 3.

It can be seen that the current now flows in the opposite direction through the primary, and the flux must change from its maximum value in one direction to an equal maximum value in the opposite direction. Thus, the primary sees from one battery source a square-wave voltage applied to it, and the expanding and contracting lines of flux induce into the secondary winding a square-wave voltage proportional to the ratio of the number of turns in the secondary winding to the number of turns in the primary winding.

Fig. 3 shows the various waveforms. The top waveform is the voltage applied to the primary winding. Assume that at time T_o the pole has been in such a position as to produce a flux of ϕ in the negative direction. At this point, the switch is moved to its other position so that the full battery is applied across terminals 1 and 2 of the primary. The flux density

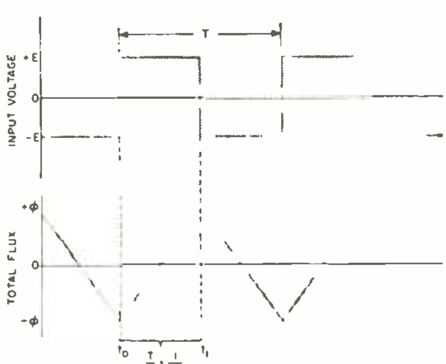


Fig. 3. Idealized transformer waveforms.

changes linearly from $-\phi$ to $-\phi$, at which time the switch is again thrown and the cycle is repeated.

It can be seen that if the frequency at which the switch changes position is F cycles-per-second, the total time for one complete cycle is one second divided by F. This time, or period, is symbolized by the letter T; and it may be seen in Fig. 3 that the time required for the flux to change from $-\phi$ to $+\phi$ is $T/2$, or $1/2F$.

The magnitude of voltage induced is equal to the number of turns times the rate of change of flux. Eq. 1 expresses this in algebraic form. The minus sign simply implies that the induced voltage is always of opposite polarity to the applied voltage. The factor "x 10^{-8}" permits one to use the more practical units of "volts" instead of electromagnetic units in this equation. N is the number of turns across which the voltage is applied.

MAKER	BRAND NAME	SATURATION FLUX DENSITY
Arnold Eng.	Silectron	16 kilogauss
	Deltamax	14 kilogauss
	Supermendur	21 kilogauss
Magnetics, Inc.	Orthonol	14 kilogauss
G-L Electronics	Orthonik	15 kilogauss
Thomas & Skinner	OrthoSil	16 kilogauss
Westinghouse	Hipernik V	14 kilogauss

Table 1. Typical flux saturation densities.

$$e = -N \times \frac{\text{total change of flux}}{\text{time for change to occur}} \times 10^{-8} \quad \text{.......... (1)}$$

Since the total change of flux is 2ϕ and the time for this change to occur is $1/2F$, the equation for the induced voltage is simply $e = -4\phi FN \times 10^{-8}$.

As shown previously, the total flux may be expressed as the flux density, B, times the cross sectional area of the core, A, so that this equation becomes $e = -4BAFN \times 10^{-8}$.

Since we are interested in determining the number of turns required, the equation is finally re-arranged to:

$$N = -\frac{e \times 10^{8}}{4BAF} \quad \text{.......... (2)}$$

If the transformer were to be driven with a sine-wave voltage, this same equation would hold with the exception that the constant 4 would become 4.44.

Using Power Transistors

Now it can be shown that two power transistors can be used to replace the vibrator switch. In Fig. 4, terminals 1 and 3 of the transformer have been connected to the emitters of transistors V_1 and V_2 while their collectors have been connected to the negative battery terminal, which is assumed to be grounded. Since the collectors of most power transistors are normally connected internally to the case of the transistor, this emitter-follower configuration makes it possible to mount the cases in direct contact with the chassis for best transfer of heat away from the transistors.

With the bases of the transistors either open or connected to their emitters, the transistors are cut off with only a very small amount of leakage current flowing. This condition corresponds to the open condition of the switch in Fig. 2. If a potential is applied to the base of one of the transistors, which is negative with respect to its emitter, a small positive current will flow from the emitter to the base (or electrons will flow from base to emitter) which turns on the transistor and causes a very low resistance to exist between the emitter and the collector. If the bases of both transistors are driven with a square-wave voltage in push-pull, the action of the s.p.d.t. switch is exactly duplicated and the waveforms in Fig. 3 are again obtained. This drive signal may be supplied externally from a square-wave oscillator or from the transformer itself by means of a feedback winding.

In this latter case, as shown in Fig. 4, assume that when the voltage is first applied, the leakage current through V_1 is slightly greater than that through V_2. The larger current through the primary from terminal 2 to 1 induces a small voltage in the feedback winding such that terminal 4 is positive with respect to terminal 6. This polarity applied to the bases of V_1 and V_2 increases the current through V_1 while at the same time decreasing it through V_2. It can be seen that this amounts to positive feedback so that V_1 rapidly goes to full "turn on" condition while V_2 is cut off.

Current continues to increase through the primary winding from terminal 2 to 1 until the core is saturated. At this point, the induced voltage in the feedback winding drops to zero and V_1 is turned off. The rapidly collapsing field in the core induces a large voltage in the feedback winding of the opposite polarity which further turns off V_1 and turns on V_2. Current now flows from terminal 2 to 3 in the primary winding until core saturation is again reached in the negative direction. It is apparent from this discussion that the conditions for oscillation exist, and the switching cycle continues to be repeated with the core being driven alternately from a flux level of $+\phi m$ to $-\phi m$. Each transition occurs very rapidly and closely ap-

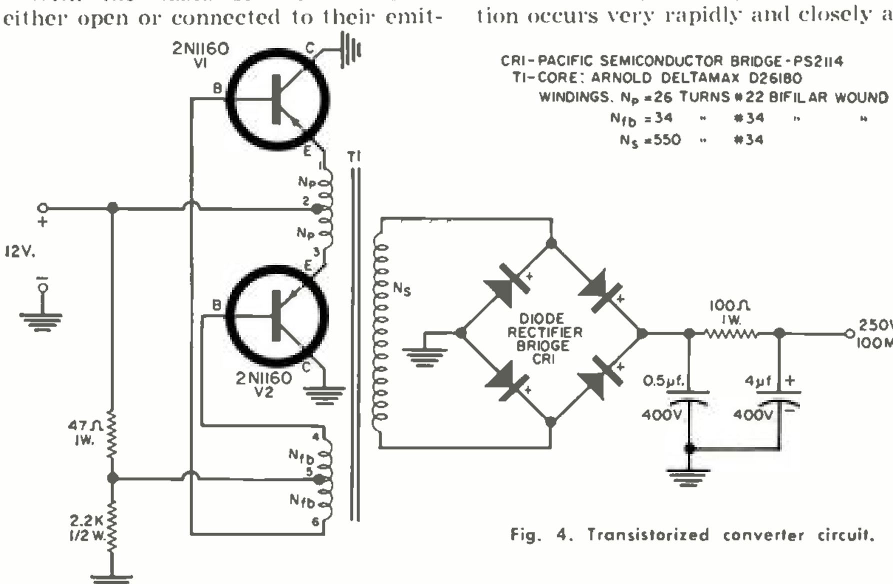


Fig. 4. Transistorized converter circuit.

proximates the mechanical switch in Fig. 2.

The Transformer Design

We may now use Eq. 2 to calculate the number of turns required in the primary to produce the particular switching action desired. Since the core is being operated to saturation, the flux density B in Eq. 2 becomes the saturation value, Bm. We must now consider separately the factors which affect the choice of each of the quantities in this equation.

The applied voltage is usually fixed according to the intended application. For use in an automobile, either 6 or 12 volts would be substituted for e. In aircraft, it could also include 24 or 28 volts and, for marine applications, 36 volts might be desired.

The maximum flux density obtainable in a core is largely a function of the core material and may range from 6000 to better than 22,000 gauss. It is obviously desirable to select an iron which has a very pronounced saturation so that the switching point is precisely defined. Iron with this type of saturation characteristic has what is known as a "square" hysteresis loop. In this type of iron, the core losses are a minimum, however other silicon irons may be used which are less costly, at the expense of a little efficiency. Values which should be used for Bm in calculating the number of turns required are shown in Table 1 for various types of transformer iron.

Within certain limits, the frequency of oscillation at which the converter should operate may be chosen for the particular purpose desired. For example, if it is intended to operate standard a.c. equipment, such as an electric razor, from an automobile battery, it is desirable that the operating frequency be as near to 60 cps as possible. However, if it is intended to transform the output to a higher voltage and then rectify it for application to the plates of mobile receiving and transmitting tubes, it is much more desirable to choose a higher operating frequency so that minimum sized filter components may be used. If the frequency is too high, the losses in the transformer iron become too great. As a rule of thumb, frequencies between 1000 and 2000 cps have been found to constitute a good compromise between excessive losses and bulky filter components.

It was desired to design a d.c.-to-d.c. converter which would operate with an input of 12 volts and deliver an output of 250 volts at 100 ma. For this output power of 25 watts, Fig. 5 shows that the area of the core should be about 0.17 square inch. However, in the interest of minimum size and weight, and a consideration of the fact that continuous duty was not required, a core having a cross-sectional area of only about half this value (0.08 in.^{2}) was used. A frequency of 1600 cps was chosen in order to permit the use of a minimum amount of filtering. It was also determined that a "Deltamax" core having a saturation flux density of 14 kilogauss would be used.

Fig. 6 provides a convenient means of finding the number of turns required for the primary winding in order to obtain the desired operating conditions. First, follow down the dashed line corresponding to the input voltage to be used to the slanting solid line corresponding to the desired operating frequency. It will be noted that each solid line represents a different frequency, depending upon the operating voltage to be applied. From this line, the required number of turns between the center tap and each transistor may be found as a function of the product of flux density in kilogauss times the core area in square inches. It must be remembered that the total number of turns to be used in the primary winding is twice the value obtained from the graph.

In our specific design problem, the dashed line labeled "12 volts" indicates by the arrow head the particular solid line marked 1600 cps which should be used. Finally, the BA product of 1.12 (14 kilogauss times 0.08 in.^{2}) determines that 26 turns for half the winding will produce the desired operating conditions. In order to obtain a good electrical balance between the two halves of the primary winding, it is common to wind the two halves at the same time with two parallel wires (bifilar wound winding). After the required number of turns have been wound, the start of one wire is connected to the end of the other parallel wire, to become the center tap of the winding, and the two remaining ends are then connected to the emitters of the transistors. If care is not exercised in making this interconnection, the two halves of the winding may be connected so as to oppose each other. In this event, the circuit will not be able to operate.

If one assumes that the efficiency of the supply will be 90%, an input power of 28 watts is required in order to realize an output of 25 watts. This corresponds to an input current of about 2.3 amperes at 12 volts. It is customary to allow anywhere from 250 to 1000 circular-mils-per-ampere in cross-sectional wire area. The area of various wire gauges in circular mils (cm) is given in

(*Continued on page* 98)

Fig. 5. Graph showing the power output versus core area used.

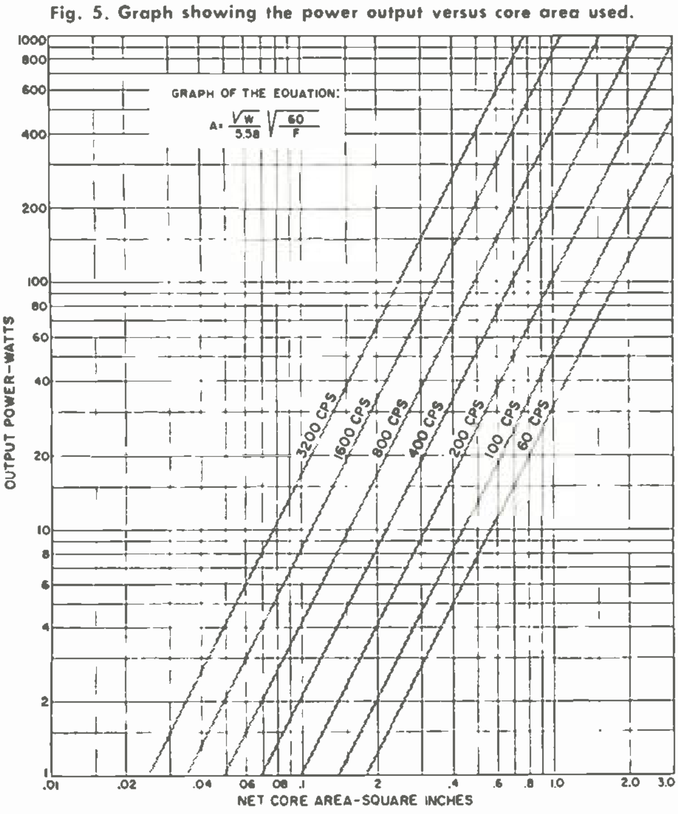
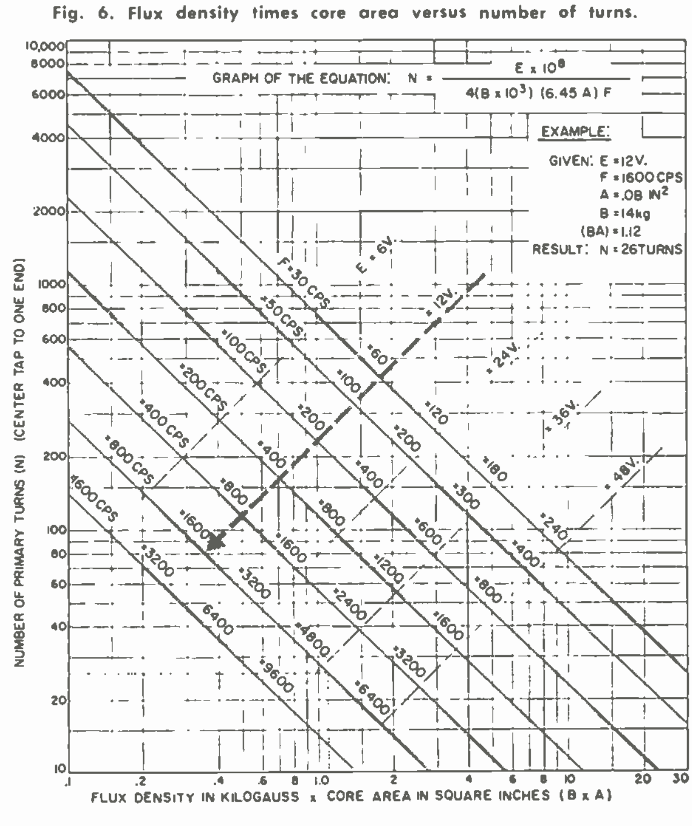


Fig. 6. Flux density times core area versus number of turns.



Tips On Tuning-Eye V.T.V.M.'s

By **JOHN POTTER SHIELDS**

A simple circuit change which permits voltages to be measured positive with respect to ground, increasing the shadow angle on the eye tube, improving accuracy. A.c. signal can also be measured with this set-up.

THERE have been a number of articles describing simple vacuum-tube voltmeter circuits using such popular tuning-eye tubes as the 6E5, 6U5, 6AF6, etc. whose shadow angle varies in proportion to the amount of applied grid voltage.

While most of these circuits are quite novel and, to some extent, useful, they all suffer from one major drawback—they can only measure voltages negative with respect to ground. The reason for this is shown in the simplified circuit of Fig. 1A. In operation, with zero volts applied to the grid of V_1, the unlighted portion or shadow of its target will be at maximum. As the grid is made progressively more negative with respect to ground, the shadow angle will decrease until it completely disappears at a given negative voltage; dependent upon the type of tube used. If a positive voltage is applied to the grid of V_1, the shadow will merely increase slightly from its original size when zero grid voltage is applied, irrespective of the magnitude of the positive voltage.

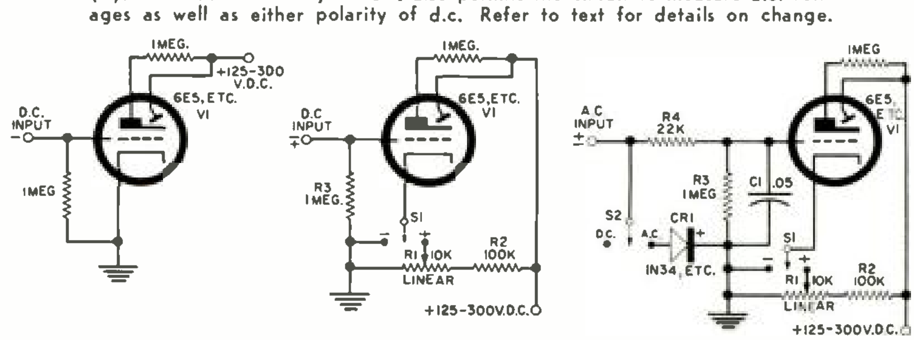
To overcome this difficulty, the circuit shown in Fig. 1B is suggested. Instead of returning the cathode of V_1 direct to the ground, it is connected to the arm of S_1. In the "−volts" position, the cathode is grounded just as in Fig. 1A. With the switch in the "+ volts" position, V_1's cathode is connected to the arm of the pot, R_1, which is connected between ground and "B+" through R_2.

In operation, with no d.c. signal applied to the grid of V_1, the arm of R_1 is adjusted to the point where the positive voltage applied to V_1's cathode is sufficient to cause the shadow to *just* disappear. Since the cathode is now positive with respect to the grid, which is at ground potential through R_3, it is the same as if the cathode were grounded and the grid negative the end result is the same as far as the tube is concerned. We can now apply a *positive* voltage to the grid of V_1; decreasing the positive voltage difference between grid and cathode, thereby causing the shadow angle to increase.

Fig. 1C shows the same circuit with a few added refinements. With switch S_2 in the "D.C." position, the operation is the same as in Fig. 1B except that R_4 and C_1 have been added to remove any a.c. hum signal picked up from the "hot" test lead—which could cause fuzziness and blurring of the shadow. They also act as a simple *RC* filter for the rectified a.c. signal when the unit is measuring a.c. With S_2 in the "A.C." position, the crystal diode, CR_1, is connected so as to clip the positive half cycles of an applied a.c.-voltage input signal; allowing only the negative half cycles to be applied to the input of the *RC* filter and thence to the grid of V_1.

—30—

Fig. 1. (A) Schematic diagram of a typical v.t.v.m. circuit which uses one of the popular tuning-eye tubes. (B) A circuit variation which permits measurement of positive voltage. (C) A more sophisticated version of the circuit shown in (B). The addition of crystal CR_1 also permits the circuit to measure a.c. voltages as well as either polarity of d.c. Refer to text for details on change.



Sound System Fundamentals

(Continued from page 40)

impedance. Table 4 is also useful for determining line voltages when considering cable voltage requirements.

Low-Level Line Distribution

When a large amount of audio power is required at a point quite distant from the program source, line losses can prevent the use of power amplifiers at the program source and low-level line distribution becomes necessary. This system consists essentially of a line amplifier at the program source, a constant-impedance line, and a power amplifier at the sound location. In such cases, 500- or 600-ohm constant-impedance lines are commonly used, although lower impedance may be used if high audio frequency response is required. From 1 to 10 milliwatts of audio power is fed into the line at the selected impedance. A 1-milliwatt level is the common "zero level," a term derived from the use of decibels. A discussion of decibels with conversion tables will follow later. At 600 ohms, a 10-milliwatt level means a line voltage of 2.46 volts and an audio line current of 4.1 milliamperes. The resistive loss in 3000 feet of stranded, twisted #18 copper cable would be about 7½%. If this same line were used in an attempt to transfer power at a load impedance of 8 ohms, the resistive loss would be about 87% and if an 8-ohm output tap were connected to the line, it would be difficult to get power into the line because the line resistance would seriously affect impedance matching. If this line were used as a 70-volt line, the resistive loss would depend on the amount of power transferred. At 25 watts the resistive loss would be about 19%, at 100 watts it would be about 51%. Again, mismatch because of line resistance would cause additional losses and proper impedance matching becomes quite involved.

The additional equipment required to operate a low-level line consists of a line amplifier at the program source and an impedance-matching transformer at the power amplifier location. These are relatively inexpensive items and in many applications the use of low-level distribution saves the additional cost of a power amplifier of sufficient wattage to overcome the resistive line losses. This saving can be considerably higher than the cost of the line amplifier and the matching transformer. Because of the relatively low voltage levels in this type of distribution, precautions must be taken to prevent noise and/or crosstalk from entering the system. With the present availability of good shielded cable this is not a major problem. Ordinary good shielding techniques and proper grounding methods will usually suffice.

Next month's concluding article will cover some of the practical problems involved in actually wiring up the sound system.

(Concluded next month)

THERE'S A NEW HEATH KIT FOR EVERYONE IN THE FAMILY!

fits both space and dollar budgets!

COMPLETE STEREO-PHONO CONSOLE WIRED OR KIT

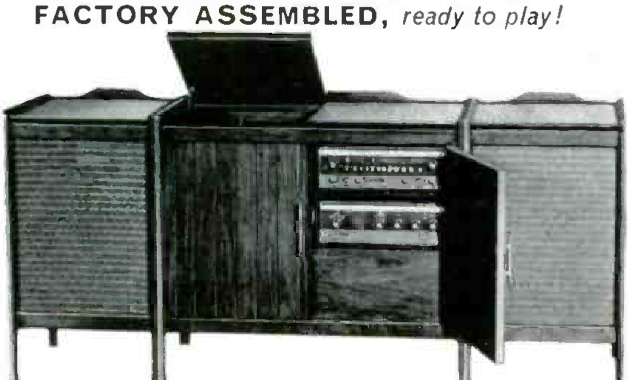
Less than 3′ long and end-table height, yet its *six* speakers assure rich, room-filling stereo! Smooth "lows" are delivered by two 12″ woofers, "mid-range" and "highs" are sparklingly reproduced by two 8″ speakers and two 5″ cone-type tweeters mounted at wide dispersal angles in the cabinet. The "anti-skate" 4-speed automatic stereo/mono record changer has diamond and sapphire styli. Concentric volume and separate dual bass and treble tone controls are within easy reach. Superbly styled with solid genuine walnut frame, walnut veneer front panel, and matching "wood-grained" sliding top, the cabinet measures just 31¾″ L x 17⅝″ W x 26¾″ H. Whether you buy the ready-to-play or kit form, the cabinet is factory assembled and finished; to build the kit, just wire the amplifier and install the changer and speakers. 70 lbs.

Model GD-31 (kit)...$13 dn., $11 mo.............................. **$129.95**
Model GDW-31 (wired)...$15 dn., $13 mo...................... **$149.95**

INTRODUCING

... a superb new line of Stereo Hi-Fi Consoles ...

FACTORY ASSEMBLED, *ready to play!*



COMPLETE 28-WATT AND 50-WATT STEREO CONSOLES

Now you can buy Heath stereo components factory-wired and tested with beautiful preassembled, prefinished cabinets . . . ready to plug in and enjoy. The consoles are available in both 28 and 50 watt models, with money-saving optional kit plans. The 28-watt model (HFS-26) contains the Heathkit AJ-10 stereo AM/FM tuner, SA-2 stereo amplifier, AD-50A stereo record changer and two US-3 12″ coaxial hi-fi speakers. The 50-watt model (HFS-28) contains the Heathkit AJ-30 Deluxe stereo AM/FM tuner; AA-100 Deluxe stereo amplifier; AD-60B Deluxe stereo record changer and two Jensen H-223F coaxial 2-way 12″ hi-fi speakers. Specify walnut or mahogany.

Model HFS-26 (wired)...215 lbs....$47.50 dn......... **$475.00**
Model HFS-27 (kit)...$37.00 dn...................... **$370.00**
Model HFS-28 (wired)...264 lbs....$75.00 dn......... **$675.00**
Model HFS-29 (kit)...$55.00 dn...................... **$550.00**

Cabinets available separately, write for information.

HEATHKIT® by DAYSTROM

HEATH COMPANY / Benton Harbor, Michigan

NOW ONLY

HEATH

BRINGS YOU

ALL 3!

1. HEATHKIT for do-it-yourself hobbyists.

2. HEATHKIT factory-built, ready to use.

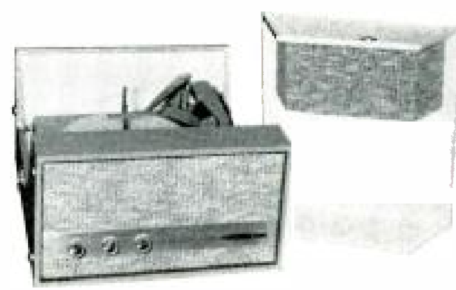
3. HEATHKIT learn-by-doing Science Series for youngsters.

PORTABLE 4-TRACK STEREO TAPE RECORDER KIT

Delight to the vast treasures available to you in popular 4-track pre-recorded stereo tapes . . . make your own 4-track stereo home recordings . . . (you can even use it as a hi-fi center to amplify and control hi-fi tuners, record players, etc.) Has "record," "play," "fast-forward" and "rewind" functions, 2 speeds (3¾" and 7½" per second). Controls include: individual tone balance controls for each channel; level controls; monitoring switch for each channel to let you hear programs as they are being recorded; and a pause button for tape editing. Two "eye-tube" indicators provide control of recording levels. Speaker wings may be detached. Cabinet and tape mechanism are completely preassembled. A storage compartment is provided for tape and accessories. 49 lbs.

Model AD-40...$18 dn., $16 mo. **$179.95**

STEREO/MONO PORTABLE PHONO KIT



From jazz to classics, the younger set will have stereo wherever they go! Plays either stereo or mono records on its top quality 4-speed automatic changer with diamond and sapphire styli. Has detachable stereo speaker wing and complete tone and stereo balance controls. Record changer and cabinet are factory-assembled, the kit is a "snap" to build. 15½" x 18" x 8⅝". 28 lbs.

Model GD-10...$7 dn..... **$69.95**

ACOUSTIC SUSPENSION SPEAKER SYSTEM KIT

Using the revolutionary "acoustic suspension principle" licensed to Heath by Acoustic Research, Incorporated, the AS-10 meets and surpasses performance of speaker systems three to four times its size. The 10" bass speaker and two 3½" hi-frequency speakers cover 30 to 15,000 cps with fantastic brilliance and fidelity! Use in upright or horizontal position. Cabinets preassembled and prefinished. 32 lbs.

Model AS-10U (unfinished)...$6 dn., $6 mo. **$59.95**
Model AS-10M (mahogany) ..$6.50 dn., $6 mo. **$64.95**
Model AS-10W (walnut)...$6.50 dn., $6 mo............ **$64.95**

DELUXE AM/FM STEREO TUNER

Exciting new styling and advance-design features rocket this new Heathkit to the top of the stereo hi-fi value list! Featured are: complete AM, FM and simultaneous stereo AM/FM reception, plus a multiplex adapter output; individual flywheel tuning; individual tuning meters on each band; FM automatic frequency control (AFC); and AM bandwidth switch. 24 lbs.

Model AJ-30 (kit)...$9.75 dn., $9 mo. **$97.50**
Model AJW-30 (wired) ..$15.30 dn., $13 mo............ **$152.95**

DELUXE 50-WATT STEREO AMPLIFIER

Look-alike companion to the tuner above, here's two 25-watt channels hi-fi-rated and loaded with extras! Mixed-channel center speaker output; "function selector" for any mode of operation; stereo reverse, balance and separation controls; ganged volume and separate concentric bass and treble tone controls. 5½" H, 15¾" W, 13½" D. 31 lbs.

Model AA-100 (kit)...$8.50 dn., $8.00 mo............... **$84.95**
Model AAW-100 (wired)...$14.50 dn., $13.00 mo...... **$144.95**

8 new, exciting Heathkit® products on following pages

HEATHKIT®... pioneer in do-it-yourself

NOW . . . BUY YOUR HEATHKIT FOR as low as $2.50 DOWN! Yes, under the new, easy Heath Time Payment Plan, orders of $25.00 or more can be purchased for just 10% down . . . and up to 18 FULL MONTHS ON BALANCE for orders of $300 to $600.

So, don't wait . . . enjoy that Heathkit you've wanted so long NOW . . . for just a small amount down, and pay the balance in easy monthly installments!

ANNOUNCING THE ALL-NEW HEATHKIT "WARRIOR" GROUNDED-GRID KILOWATT LINEAR ....ONLY $229.95

Here's news to rock the entire Amateur Radio world! The new desk-top Heathkit "Warrior" matches any unit on the market feature for feature with no quality short cuts and slashes the price in half! *Completely Self-Contained*—amplifier *and* HV, filament, and bias supplies are built in. *Versatile*—drives with 50 to 75 watts, no matching or swamping network required. *Efficient*—stable g-g circuit puts part of drive in output for up to 70% efficiency. *Inexpensive Tubes*—four paralleled 811A's and two 866A's. *Dynamic Regulation*—big oil-filled capacitor and 5-50 henry swinging choke for high peak power output with low distortion. *Design*—special low-capacity filament transformer requires less driving power and eliminates broad-band filament RF choke. *Monitoring*—gives constant output to scope regardless of frequency. *Easily Assembled*—average time 8 hours. *Bands*—80 through 10. *Max. Power Input*—SSB-1000 watts PEP; CW-1000 watts; AM-400 watts (500 using controlled carrier mod.); RTTY-650 watts. *Write for Complete Information.*

Model HA-10...100 lbs....$23.00 dn., $20.00 mo........ **$229.95**

DELUXE SERVICE BENCH VTVM KIT

Greater accuracy and convenience for precision testing. Big 6", 200 ua meter has longer scales plus separate 1.5v and 5v AC scales. Wider frequency coverage with greater precision is made possible through use of 1% resistors and husky capacitors. Other deluxe features include high-visibility meter and controls; recessed thumb-wheel "zero" and "ohms adjust" controls. Measures AC and DC volts to 1500 in 7 ranges; resistance from .1 ohm to 1,000 megohms in 7 ranges. Db calibrations for relative voltage measurements selected to give 10 db steps between ranges. Test leads included. 9½" H x 6½" W x 5" D. 7 lbs.

Model IM-10...$3.30 dn., $5.00 mo....... **$32.95**

NEW ISOLATION TRANSFORMER KIT

The IP-10 presents a significant improvement in isolation transformers. Provides output voltage from 90-130v in 0.75v steps at 300 watts continuous duty, 500 watts intermittent duty, with 117v input—ample power for even color TV servicing. Built-in meter continuously monitors output voltage with ± 1 volt accuracy (linear scale is electronically expanded to cover 90-140v). Power line input voltage can also be measured by operating spring-return slide switch on front panel. Fused primary. Measures 6½" W x 9½" H x 5" D. 22 lbs.

Model IP-10...$5.50 dn., $5 mo......... **$54.95**

NEW FOR THE SIX & TWO METER VHF NOMADS . . .

The new "Shawnee" 6-meter and "Pawnee" 2-meter Heathkit transceiver kits bring a new definition to *superior performance*. And each offers complete AM and CW facilities with the greatest array of features anywhere! *Single Knob Tuning*—tracked VFO and exciter stages. 10 *Watt Output*—6360 dual tetrode. *Built-In Low Pass Filter. Three-way Power Supply*—built-in for 117vac. 6vdc or 12vdc with separate DC and AC plugs and cables included. *Dual-Purpose Modulator*—10 watts for high level plate modulation or 15 watts for PA operation. *Double Conversion Receiver*—crystal controlled first oscillator. *Voltage Regulation*—on all oscillators. *Complete Controls*—up front on the panel for transmitter and receiver. *Tuning Meter*—auto-switched for signal strength or relative power output. *Slide Rule Dial*—seven inches of spread for receiver and VFO, edge lighted. *VFO or Crystals*—front panel switch of vfo or four crystals for novice, CAP, MARS or net operation. *Spot Switch*—zero in signals with transmitter off. *Complete Shielding*—power supply, final and receiver front end. *Ceramic Microphone*—push-to-talk with coiled cord. *And many more—Write for Information.* 34 lbs.

Model HW-10...6 meter, or **HW-20**...2 meter
$20 dn., $17 mo.................. **$199.95**

HEATH COMPANY / Benton Harbor, Michigan

electronics—always the leader!

now a new improved 6 meter model joins this famous transceiver series

2, 6 & 10 METER TRANSCEIVER KITS

The new 6 meter HW-29A joins "Tener" and "Twoer" to bring you top transceiver values. Like "Twoer," the new HW-29A multiplies its output frequency from an 8 mc crystal for greater stability. All models have crystal-controlled, 5 watt input transmitters and tunable super-regen receivers that pull in sigs as low as 1 uv . . . FB for emergency work and "local" nets. Each includes transmit-receive switch, metering jack, ceramic mike and two power cables. Less crystal. 10 lbs.

Model HW-19...10 meter...$4 dn., $5 mo.............**$39.95**
Model HW-29A...6 meter...$4.50 dn., $5 mo..........**$44.95**
Model HW-30...2 meter...$4.50 dn., $5 mo...........**$44.95**
Model HWM-29-1...Converts early "Sixer" to "A" model. 1 lb.........................**$4.95**

HEATHKIT BASIC RADIO COURSE

Here's a new 2-part series in basic radio for youngsters and adults. "Basic Radio—Part I," available now, teaches radio theory in everyday language, common analogies, and no difficult mathematics. Experiments performed with radio parts supplied result in a regenerative radio receiver. "Part II" of the series, which will be ready March 1, advances your knowledge of radio theory and supplies additional parts to extend your Part I receiver to a 2-band superheterodyne circuit.

Model EK-2A..."Part 1"...8 lbs...................**$19.95**

ATTENTION MARINERS!
Keep a "weather-eye" peeled for announcement of a new Heathkit SHIP-TO-SHORE RADIOTELEPHONE . . . COMING SOON!

be your own "tune-up" specialist!

NEW ELECTRONIC IGNITION ANALYZER KIT

Checks ignition faults quickly and accurately. One simple hook-up to ignition wiring, and the IO-20 does the rest! No removing plugs, wiring or other engine parts. Checks engine in operation. Switch selection of primary, secondary, parade or superimposed patterns without changing leads to the engine. Detects shorted plugs, defective distributor points, defective wiring, coil and condenser problems, incorrect dwell time, worn distributor parts, etc. Features improved trigger circuit for locked-in patterns without trigger level adjustment; 2-1 vertical and 10-1 horizontal expansion. 8" H x 9½" W x 16" D. 22 lbs.

Model IO-20...$8.95 dn., $9.00 mo..................**$89.95**

MONEY BACK GUARANTEE

Heath Company unconditionally guarantees that each Heathkit product, whether assembled by our factory or assembled by the purchaser in accordance with our easy-to-understand instruction manual, must meet our published specifications for performance or your purchase price will be cheerfully refunded.

FREE CATALOG

Send today for your Free Copy of the latest Heathkit Catalog showing over 200 Heathkit items for hi-fi fans, amateur radio operators, students, technicians, marine enthusiasts, sports car owners and hobbyists. Many Heathkit products are now available in both kit and wired form!

ORDER DIRECT BY MAIL OR SEE YOUR HEATHKIT DEALER

HEATHKIT® DAYSTROM

HEATH COMPANY
Benton Harbor 15, Michigan

ORDERING INSTRUCTIONS
Fill out the order blank below. Include charges for parcel post according to weights shown. Express orders shipped delivery charges collect. All prices F.O.B. Benton Harbor, Mich. A 20% deposit is required on all C.O.D. orders. Prices subject to change without notice.

Please send the following HEATHKITS:

ITEM	MODEL NO.	PRICE

Ship via ( ) Parcel Post ( ) Express ( ) COD ( ) Best Way

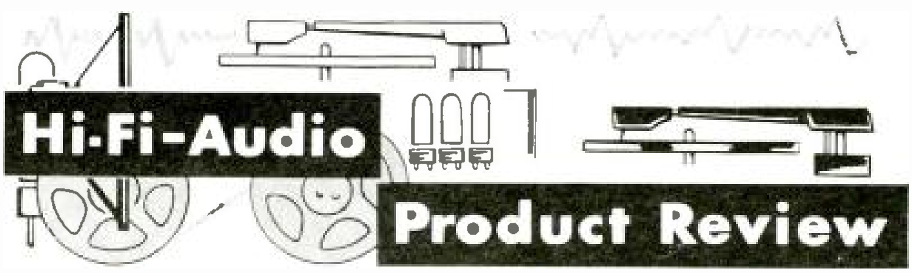
( ) SEND MY FREE COPY OF YOUR COMPLETE CATALOG

Name ____________________

Address ____________________

City ____________ Zone ___ State ____________

Dealer and export prices slightly higher.



Hi-Fi-Audio Product Review

STEREO AMPLIFIER

H. H. Scott, Inc., Dept. P, 111 Powdermill Rd., Maynard, Mass. has brought out a new 100-watt stereo power amplifier.

Listed as Model 290, it is rated at 50 watts per channel, IHFM standard. At maximum output, harmonic distortion is 0.5 per-cent, and first order IM is given as .01 per-cent.

Output circuits are meter-monitored. Thus, as tubes age, changes of output tube bias can be made to maintain the peak performance and balance between channels.

NEW RECORD CHANGER

BSR (USA) Limited, College Point, Long Island, N.Y., has announced that the letters "BSR" will become the new brand-name for the record changers manufactured in England by *Birmingham Sound Reproducers, Ltd.*, producers of the "Monarch" line.

The *BSR* changers are styled by a leading British designer, Douglas Scott. The line includes four-speed, fully automatic units with an intermix feature that permits playing different diameter records of the same speed.

Details on the line are available from the American firm.

NEW STEREO AMPLIFIER

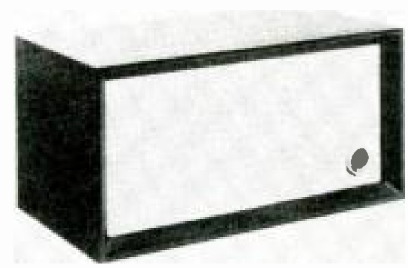
H. H. Scott, Inc., 111 Powdermill Road, Maynard, Mass., has announced a new version of its Model 299 integrated stereo amplifier. The new model, designated as 299B, features tape monitoring facilities, an extra high-level input for connection of an electronic organ, and an increase in power to 50 watts (25 watts per channel), measured by IHFM standards.

A complete technical bulletin describing the 299B is available from Dept. P of the manufacturer.

"ADD-ON" REVERB UNIT

Utah Radio & Electronic Corp., 1124 E. Franklin St., Huntington, Ind. has introduced an "add-on" reverberation unit for connecting to a speaker line.

Designated as Model RVB-1, it is self-contained with its own amplifier and speaker, and may be used with consoles, portables, or component systems. It features a control that adds any proportion



of reverberation to the original program source being played over the system.

NEW STYLUS IN SHURE CARTRIDGE

Shure Brothers, Inc., 222 Hartrey Ave., Evanston, Ill. announces that new models of the M7D and M3D stereo cartridges will use the N21D stylus and will be designated, respectively, as the M7-N21D and the M3-N21D. Intended for use in independent tone arms at a tracking force of 2 grams, the new models are said to provide greater compliance and cleaner high-end frequency response.

The company also announced that it is marketing its model M232 and M236 tone arms with either of the new cartridges installed, and with the arm balanced and set at proper tracking force.

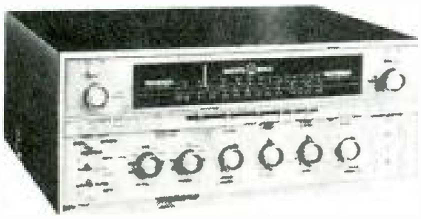
Although the N21D stylus originally was made only for use in the integrated *Shure* studio stereo "Dynetic" arm, the company reports that recent laboratory tests reveal that the N21D stylus also will give "superior performance in the M7D and M3D cartridges . . . where the tracking force does not exceed 2½ grams."

TWIN HI-FI SYSTEMS

Bogen-Presto Division, The Siegler Corp., Paramus, N.J. has introduced its "SoundSpan" PR-40, a twin high-fidelity receiver that may be used as a complete stereo instrument, or as two completely independent hi-fi systems.

The PR-40 is described as a 40-watt FM/AM, mono-stereo sound center with all the features and controls of conventional receivers, plus new ones "reflecting its unique functions."

Among these, for example, are two program selector knobs (one for each



amplifier channel) which are indicated by rows of illuminated tabs. A speaker-selector panel permits the user to run various combinations of local and remote speakers, also indicated by labelling. Completely independent controls for each channel are carried through for all functions, including filters and loudness compensation.

STEREO TUNER-AMPLIFIER

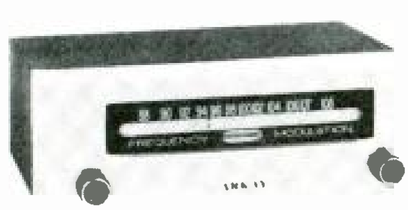
Lafayette Radio Corp., 165-08 Liberty Ave., Jamaica 33, N.Y. has announced a new all-in-one stereo "music center" containing individual FM and AM tuner sections, plus dual 20-watt amplifiers and preamplifiers on a single chassis.

Designated as Model LA-225, the instrument is designed for the control and reproduction of all stereo and monophonic sources, including an output for FM multiplex. The twin amplifier sections, which feature complete preamp control facilities and dual 20-watt out-

puts, furnish a frequency response listed as 15 to 30,000 cps, within 1 db at normal listening levels.

FM TUNER KIT

Arkay International, 88-06 Van Wyck Exp'way, Jamaica, N.Y. announces its Model FM-7 FM tuner, in kit or factory-wired form. The unit features a pre-wired and pre-aligned front end. Coils and i.f. transformers are pre-adjusted, and the unit is said to be ready



to operate as soon as construction is completed. A slight touch-up on alignment can be accomplished by following instructions in the manual.

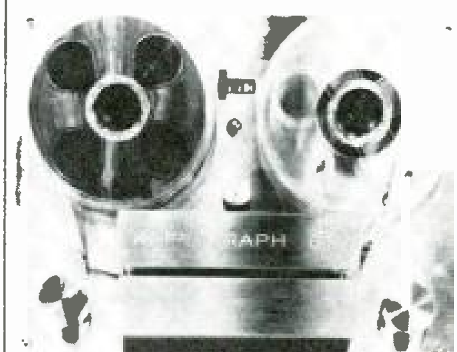
The tuner features a.f.c. and provides a multiplex output. Six tubes are used.

plus a tuning indicator tube and a selenium rectifier. Sensitivity is stated as 1.9 μv. for 20-db quieting, 30 μv. for full limiting. Distortion is said to be less than 1 per-cent.

STEREO TAPE DECK

Ampligraph Corporation, Box 103, Sudbury, Mass. has introduced its Model 66 stereo tape deck, claimed to offer "professional quality in the medium price range." It is available as a quarter-track playback machine or with a full combination of record and reproduce services. Two-speed operation (7½ and 3¾ ips) is provided. Editing is facilitated by the ability to control tape speed continuously between zero and the full fast forward or reverse positions.

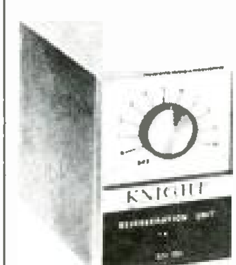
Wow and flutter are said to measure less than 0.15 per-cent. A stereo record-



ing preamplifier on a single chassis is available separately. Also available as accessories are a wooden base and a portable carrying case.

REVERB UNIT

Allied Radio Corp., 100 N. Western Ave., Chicago 80, Ill. has brought out an electronic reverberation unit, claimed to give acoustically "dead" rooms and older recordings a sensation of "live" reverberance experienced in "spacious cathedrals and indoor stadiums." Heart of the new device, designated as "Knight" Model KN-701, is the *Hammond* Type 4 reverberator unit. This produces a short time delay in the audio signal for a fraction of a second. According to *Allied*, the 3-tube mixer-amplifier control unit varies reverberation from zero to louder than source volume without affecting the signal in any other way. The KN-701 may be plugged into any hi-fi system using a separate preamp and power amp, or an amplifier with a "tape-monitor" switch.



For complete details, including price, on the model KN-701, write to the company direct at the above address.

SONY TAPE RECORDERS

Superscope, Inc., Audio-Electronics Div., Sun Valley, Calif. has announced its *Sony* Model 262-D, a low-cost stereo tape transport. The 262-D provides a 4-track stereo erase head and a 4-track stereo record/playback head. These

heads are wired to six output and input facilities for connection of external electronics to play or record.

Also available from this company are other models of tape recorders incorporating varying degrees of electronics and different configurations of heads for various stereo and mono facilities. For full information, write to the manufacturer.

AUDIO CATALOGUES

JENSEN SPEAKERS

Jensen Manufacturing Co., 6601 S. Laramie Ave., Chicago 38, Ill. is offering without cost a new 24-page loudspeaker catalogue. Designated as catalogue 165-F, it contains a guide to system planning as well as descriptions of units in the *Jensen* line.

SOUND EFFECTS

MP-TV Services, Inc., 7000 Santa Monica Blvd., Hollywood 38, Calif. has published a 56-page catalogue of its recordings of various sound effects. The catalogue will be sent upon receipt of 25 cents.

H. H. SCOTT GUIDE

H. H. Scott, Inc., Dept. P, 111 Powdermill Rd., Maynard, Mass. has published a "Guide to Custom Stereo." The booklet, which will be sent free upon request, includes a guide to stereo, ideas for room decor, and a listing of the company's components.

STEREO TUNER-AMPLIFIER

Altec Lansing Corp., 1515 S. Manchester Ave., Anaheim, Calif. has introduced a stereo tuner-amplifier combination unit. Designated as Model 707, the "all-in-one" features a connection for a center speaker as well as the flexibility to perform in either mono or stereo systems. The amplifiers provide an output of 48 watts, or 24 watts per channel, IHFM music-power rating.

RECORDS AND TAPES

Allied Radio Corp., 100 N. Western Ave., Chicago 80, Ill. has issued its Stereo Record and Tape Catalogue No. 104. Free on request, the booklet lists over 1000 stereo discs and 400 stereo tapes.

EICO PUBLISHES GUIDE

EICO (Electronic Instrument Co., Inc.), 33-00 Northern Blvd., Long Island

City 1, N.Y. has published a 36-page booklet explaining in simple language the fundamentals of mono and stereo high fidelity. Among topics discussed are the nature of sound, problems in reproduction, distortion, how components function, stereo conversion, and others. The booklet is available for 25 cents from the manufacturer.

SONOTONE CARTRIDGES

Sonotone Corp., Elmsford, N.Y. has issued an 8-page reference chart and service guide listing its line of stereo and mono ceramic cartridges, as well as its new crystal stereo cartridge. Seventy-three manufacturers of phonographs are listed, with a total of 1321 player models. Of these models, 1006 use *Sonotone* cartridges as original equipment. On the balance of 315, the guide shows the *Sonotone* cartridges that may be used as replacements.

THREE FROM HARMAN-KARDON

Harman-Kardon, Plainview, Long Island, N.Y. has issued a folder describing the company's line of stereo components in all price ranges; a booklet on "How to Decorate for Stereo Hi Fi," and a catalogue describing the "Citation" line of kits. All three are free for the asking. Requests for the last should be addressed to the "Citation" Division at the manufacturer's address.

DECOR BROCHURE

Rek-O-Kut Co., Inc., 38-19 108th Street, Corona 68, N.Y. has issued a brochure suggesting room settings and decorating ideas for five styles of rooms in which hi-fi components may be installed. —30—

A scissors tripped by pulses bounced off the moon gives Sam Harris a beard trim. The signal, a 2½-sec. pulse, came from a 1000-watt, 1296-mc. rig at Harris' home in Medfield, Mass. The pulses were picked up in Dorset, Ohio by another ham, Jack D. Rodebaugh, who relayed the pulses to New York City on the 40-meter ham band. In New York, the receiver shown picked up the signals and operated a relay that cut a tape opening the Hudson Amateur Radio Council's recent convention and social.

MOVING?

Make sure you notify our subscription department about any change of address. Be sure to include your postal zone number as well as both old and new addresses. Please allow four weeks' time for processing.

ELECTRONICS WORLD
434 South Wabash Avenue
Chicago 5, Illinois

Using the Signal Tracer
(*Continued from page* 51)

noise test on several new resistors and new capacitors in several types (paper, mica, and others) and values, to get an idea of what reaction can be expected from good parts. This will aid in recognizing deviations produced by defects. Incidentally, because of their normally high leakage, electrolytic capacitors do not lend themselves to this check.

To measure power consumption on an appliance, the latter is plugged into the standard a.c. receptacle on the front panel of the tracer, as is shown in the case of a radio in Fig. 5. A two-position function switch (marked "Signal Tracer—Wattmeter" in this instrument) is moved to the "Wattmeter" position. Shown as S_1 in the schematic, this disconnects the audio-output stage and connects the grid of the second voltage amplifier to the wattmeter circuit shown at the bottom and center of the schematic.

Note at the bottom of Fig. 6 that external a.c. is applied across the series combination of the appliance, through the receptacle, and the primary of transformer T_1. This transformer's secondary feeds the grid of V_2 through potentiometer R_{25}. An appliance whose power consumption is relatively low has a high impedance to line voltage, so the drop across the transformer will be relatively low. An appliance with high power consumption has a relatively low impedance, so the drop across the series transformer will be relatively high.

Potentiometer R_{25}, available on the front panel as the "Watts" control, is adjusted until the eye of the indicator tube just closes. The control is calibrated in watts, with usable readings from 25 to 1000, so that power consumption by the device under test may be read directly in this range.

The tracer has other facilities. The leads to the loudspeaker voice coil, and also the primary leads of the output transformer, are brought out to binding posts on the front panel so that these components can be used independently of the tracer itself when the latter is turned off. In the particular instrument used for illustration, a lead is also brought out to a binding post from the grid of the power-amplifier tube. A signal can be injected here or this point can be used for the additional connection of a v.t.v.m. or oscilloscope during certain tests.

Despite its versatility, the tracer remains an embellished audio amplifier and, as such, it requires no critical alignment or adjustment. For this reason, it is a particularly easy project for the user who elects to build one from a kit. An inside view of the unit, Fig. 4, shows the simplicity of layout.

The unit is not limited to radio work even when used strictly as a tracer. It can check signal paths in audio systems or act as detector and aural indicator of non-audio signals, as in TV video or sync circuits. —30—

LAFAYETTE 9-TRANSISTOR CITIZENS BAND "WALKIE TALKIE"

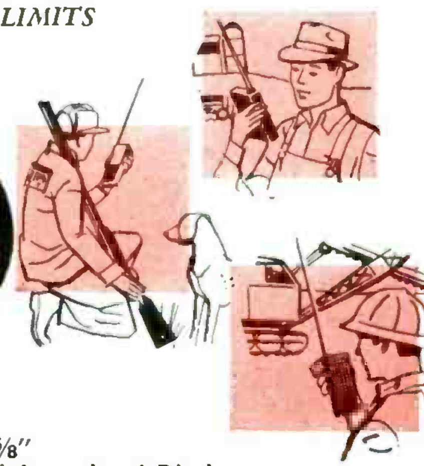
Complete Portable Two-Way Communications For Everyone

NO LICENSES, TESTS OR AGE LIMITS

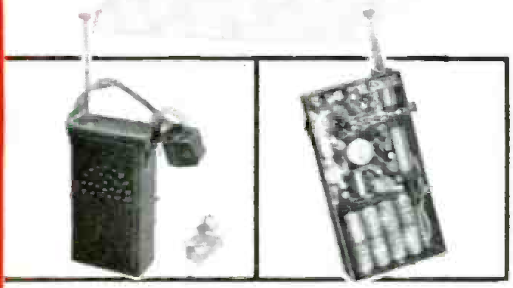
HE-29

ONLY 49.95 2.00 DOWN

2 for 96.50



- Pocket Size — 6⅜" x 3¼" x 1⅝"
- Fully Transistorized — 9 Transistors plus 1 Diode
- Transmits & Receives From 1.5 to 7 Miles (Depending Upon Conditions)
- Crystal Controlled with Superheterodyne Receiver
- Push-To-Talk Operation
- Uses 8 Inexpensive Penlight Batteries
- Up to 70 Hours Battery Life
- 46 Inch Telescoping Antenna
- Earphone For Personal Listening
- Weatherproof Leather Carrying Case with Shoulder Strap.



As simple and easy to use as your telephone and twice as handy—weighs only 18 ounces and slips easily into your pocket. Just two controls ensure fast, efficient operation—on/off volume and push-to-talk. Low input power of 100MW permits operation without FCC license or permit. Perfect for hunting, fishing, boating, virtually all sports. Use at work—construction, warehouse, office, farm or for in-plant communications. Supplied with 8 penlight batteries, earphone, leather carrying case with shoulder strap and matched crystals for channel 10.

LAFAYETTE HE-15A CITIZEN'S BAND TRANSCEIVER

Not Superregenerative but SUPERHET!

Completely Wired

HE-15A

57.50 5.00 Down

MADE IN U.S.A.

The Greatest Value In The Citizens Band Field—economical, efficient 2-way radio communications from your home, office, auto, truck, or boat. 4 dual function tubes, 2 single function tubes plus 2 rectifiers provide 12 tube performance. Has 5 crystal-controlled transmitting positions while the superheterodyne receiver is tuneable over the full 23 channels. Controls include a three position function switch (transmit, receive, and transmit with spring return), planetary vernier tuning plus an extremely effective full wave variable noise limiter. Supplied with high output crystal microphone and transmitting crystals for channel 9.

HE-15A	Wired & Tested (less antenna)	Net 57.50
HE-19	Whip Antenna	Net 3.95
HE-16	Power Supply for 12 Volts	Net 10.95
HE-18	Power Supply for 6 Volts	Net 10.95

LAFAYETTE HE-20 DELUXE CITIZEN'S BAND TRANSCEIVER

HE-20

99.50 5.00 Down

MADE IN U.S.A.

COMPLETELY WIRED! NOT A KIT

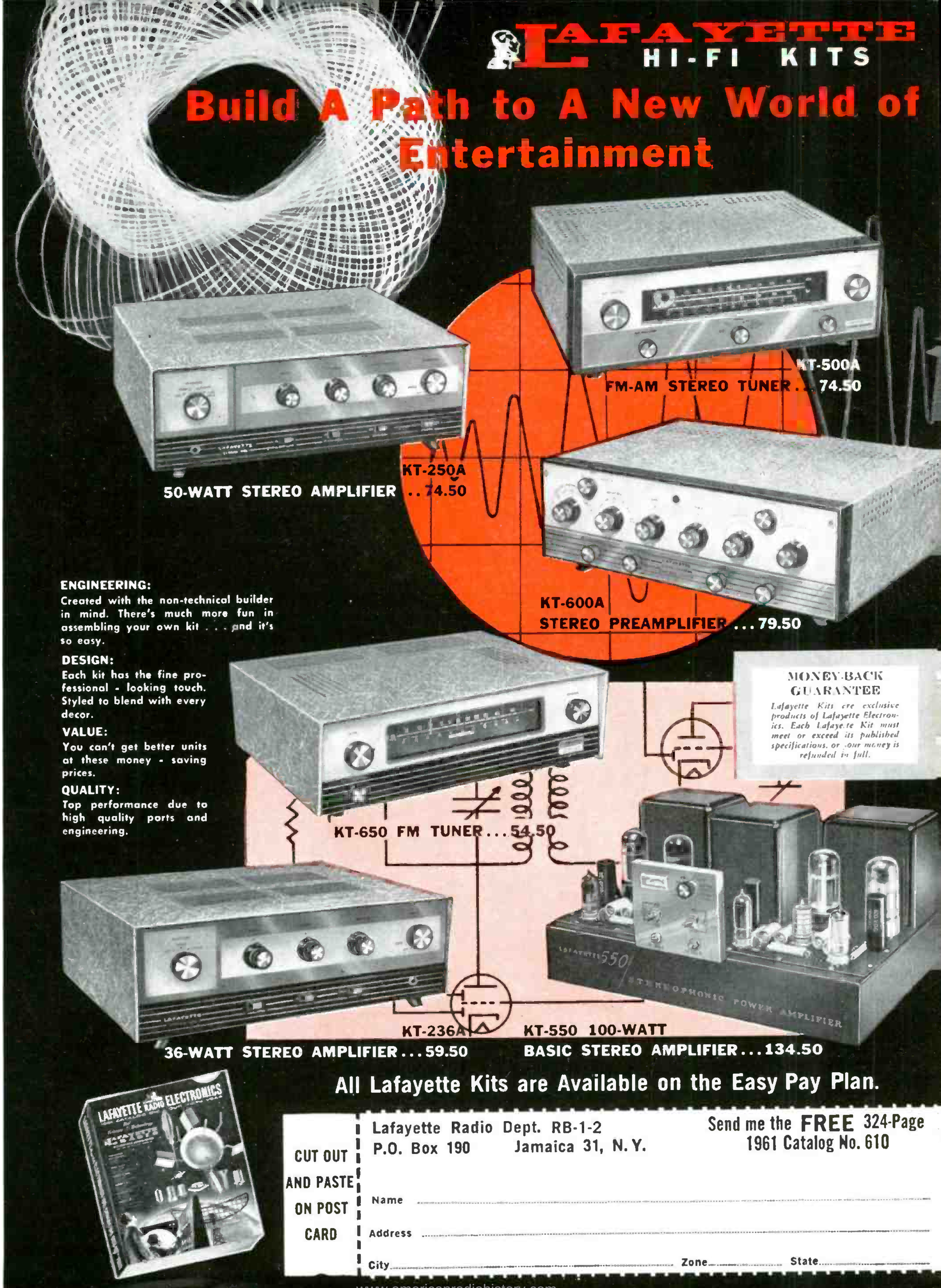
Sensitivity and selectivity that equals and surpasses that of the finest units available. Two will provide an effective communication system up to a distance of 20 miles, depending upon terrain and antenna height. Tuneable Superheterodyne Receiver section covers all 23 assigned channels with a sensitivity of 1 microvolt and provides for 4 crystal controlled receiving channels. 5 watt crystal-controlled transmitter operates on any 4 of 23 channels. Features include an adjustable squelch control, a highly effective series gate noise limiter, foolproof dependable relay switching plus a built-in "S" meter with switch to measure signal strength and to check on wattage input to final. Complete with rugged push-to-talk ceramic microphone, built-in 12V DC/115V AC power supply for mobile and fixed use plus matched crystals for channel 9.

LAFAYETTE RADIO

PLEASE INCLUDE SHIPPING CHARGES WITH ORDER

165-08 LIBERTY AVENUE, JAMAICA 33, N. Y. • OTHER LOCATIONS

NEW YORK, N. Y.	NEWARK, N. J.	BRONX, N. Y.	PARAMUS, N. J.	BOSTON, MASS.	PLAINFIELD, N. J.
100 6th Avenue	24 Central Avenue	542 E. Fordham Rd.	182 Route 17	110 Federal Street	139 W. 2nd Street


LAFAYETTE
HI-FI KITS
Build A Path to A New World of Entertainment
KT-500A
FM-AM STEREO TUNER... 74.50
KT-250A
50-WATT STEREO AMPLIFIER ..74.50
KT-600A
STEREO PREAMPLIFIER ... 79.50
ENGINEERING:
Created with the non-technical builder in mind. There's much more fun in assembling your own kit . . . and it's so easy.
DESIGN:
Each kit has the fine professional - looking touch. Styled to blend with every decor.
VALUE:
You can't get better units at these money - saving prices.
QUALITY:
Top performance due to high quality parts and engineering.
MONEY-BACK GUARANTEE
Lafayette Kits are exclusive products of Lafayette Electronics. Each Lafayette Kit must meet or exceed its published specifications, or your money is refunded in full.
KT-650 FM TUNER ... 54.50
STEREOPHONIC POWER AMPLIFIER
KT-236A
36-WATT STEREO AMPLIFIER ... 59.50
KT-550 100-WATT
BASIC STEREO AMPLIFIER ... 134.50
All Lafayette Kits are Available on the Easy Pay Plan.
LAFAYETTE RADIO ELECTRONICS
CUT OUT AND PASTE ON POST CARD
Lafayette Radio Dept. RB-1-2
P.O. Box 190 Jamaica 31, N.Y.
Send me the FREE 324-Page 1961 Catalog No. 610
Name
Address
City
Zone
State

Standard For Speaker Phasing

Uniform methods set up by new EIA speaker standard.

When setting up a stereo system, it is important to properly phase the loudspeakers that are used. If this is not done, then the resultant sound appears thin and there is a noticeable loss of bass. As an aid to proper speaker phasing, the Electronic Industries Association (EIA) has recently issued a new standard "Phasing of Receiver Loudspeakers (RS-233)." This standard indicates just how the phasing of the speakers is to be determined and how it is to be marked. Thus, when such speakers are placed in receivers or hi-fi enclosures, the phasing designation will show the proper way of making the connections to the speakers.

When the speaker is viewed from the back, with the voice-coil terminals at the bottom, the right-hand terminal is to be coded. This coding is to be either a "+" sign, a green color dot, or a combination of both. The voice-coil winding is to be such that when a positive voltage is applied to the coded terminal, the diaphragm will move forward (that is, toward the face of the speaker, away from the magnet and supporting housing). If the terminals are spaced vertically or in any other way so that they cannot be identified as right and left, the same coding shall be used. In other words, a positive voltage applied to the coded terminal is to cause forward motion of the diaphragm.

The standard goes on to suggest a simple method of determining phasing if the motion is not clearly discernible when a reasonable voltage is applied. Simply connect a galvanometer, a d.c. millivoltmeter, or microammeter across the voice-coil terminals and push the diaphragm slightly by hand in the forward direction. If the meter polarity matches the speaker polarity (plus lead of the meter to positive terminal of the speaker), then the meter reading will be in a positive direction. In cases where it is not practical to move the diaphragm forward, then the meter leads are simply reversed and the diaphragm is pushed backward (toward the magnet). Because of the reversed meter connection and reversed direction of motion, the meter will again read positive when the diaphragm is pushed backward.

A convenient source of low voltage for checking cone movement is a standard flashlight cell. In the case of a 3.2-ohm speaker, the 1.5 volts delivered by the cell should produce an easily discernible movement of the cone. For higher impedance speakers, two flashlight cells in series may have to be used.

The complete standard is available for 25 cents from EIA, Engineering Department, 11 West 42nd Street, New York 36, N. Y. —30—

ELECTRONICS WORLD SUBSCRIPTION CODE
W90R98083

"When does my subscription expire?"

This question is often asked of us by subscribers to ELECTRONICS WORLD. You can check the expiration date of your own subscription by reading the code line on the mailing label of ELECTRONICS WORLD as follows:

W = ELECTRONICS WORLD (Some older stencils bear RN—an outdated designation)

90 = The month and year in which your subscription started—in this case, September 1960.

R980 = (Filing instructions for our use only)

83 = The month and year in which your subscription will expire—in this case, August, 1963.

Emergency Power Supply

An inexpensive and handy unit to be built from junk-box parts.

By

CHARLES E. DIEHL

BEING in need of an additional d.c. supply of about 100 volts at less than 10 milliamperes for testing, a vibrator-type unit was assembled from parts on hand in the shop.

A heavy-duty buzzer was wired in series with the speaker winding of a 10-watt universal audio output transformer. With 8 volts from four small storage batteries, the load was 0.5 ampere through the buzzer and the 8-ohm portion of the speaker side of the transformer. The a.c. output was 150 volts r.m.s. at no load, across the total high-voltage side.

To filter out the high pulse formed at the time of contact break of the buzzer, a 0.1-µf. capacitor, rated at 600 volts d.c., was connected across the high-voltage winding. A very good no-load sine wave resulted.

With a small selenium rectifier and a 16-µf. capacitor for the output filter, a 120-volt at 8-ma. output was obtained through a 15,000-ohm load. Best output was obtained with the buzzer adjusted for 250-cycle output. The output a.c. wave is clipped and distorted with the rectifier in service.

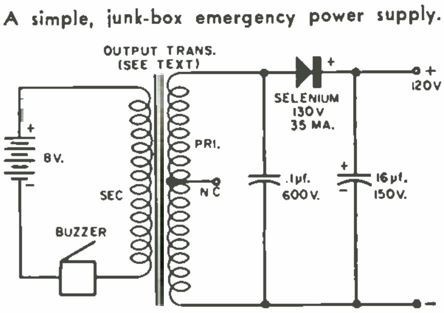
For the record, various audio output transformers and two filament transformers were tried in the same circuit with the following results:

TRANS. TYPE	OUTPUT VOLTS (15k Load)
50L6 to 4 ohms	30 d.c.
6V6 to 4 ohms	50 d.c.
6L6 P.P. to 8 ohms	110 d.c.
10-watt universal (optimum connection)	120 d.c.
115 to 5 v. @ 2 amps.	90 d.c.
115 to 6.3 v. @ 3 amps.	90 d.c.

This circuit will work very well on six flashlight cells in series although the battery life will be somewhat limited.

Correct connections are shown in the accompanying diagram. —30—

A simple, junk-box emergency power supply.



A PROPHECY

For men and women with a sincere desire to succeed

"In the years that have passed since my days on the faculty of RCA Institutes, I have become even more firmly convinced that the individual who continues his education . . . particularly his technical education . . . is the individual who profits both as a thinking man and as a working man. Science and industry will reward you for your talents and energy. Out of your efforts may come inventions, new products, processes and services. There is everything good yet to be accomplished in our lives and in our work. What man has done, man can do better."

David Sarnoff

Chairman of the Board,
Radio Corporation of America

RCA Institutes Offers the Finest of Home Study and Resident Training for Your Career in the Rapidly Expanding World of Electronics

RCA Institutes, founded in 1909, is one of the largest technical institutes in the United States devoted exclusively to electronics. A service of Radio Corporation of America, RCA Institutes offers unparalleled facilities for technical instruction . . . tailored to *your* needs. The very name "RCA" means dependability, integrity, and scientific advance.

RCA Institutes Home Study School, licensed by the New York State Department of Education, offers a complete program of integrated courses for beginners and advanced students ranging from electronic fundamentals to automation. All courses are designed to prepare you for a rewarding career in the rapidly expanding world of electronics. *The caliber of the training your receive is the finest!* And you get top recognition as an RCA Institutes graduate!

Technical BOOKS

"S. Z. MITCHELL AND THE ELECTRICAL INDUSTRY" by Sidney Alexander Mitchell. Published by *Farrar, Straus & Cudahy*, N.Y. 178 pages. Price $5.00.

This book is a biography of a man prominent in the electrical power industry from 1885 until his retirement in 1933. Politics and personalities, rather than technical information, occupy the text. A brief introduction has been contributed by Herbert Hoover.

* * *

"GETTING THE MOST OUT OF YOUR TAPE RECORDER" by Herman Burstein. Published by *John F. Rider Publisher, Inc.*, N.Y. 176 pages. Price $4.25. Soft cover.

This volume is written for the user of tape recorders in generally non-technical language. It begins with a discussion of the kinds of recorders available today, with suggestions for relating their functions to individual needs. Various aspects of tape recorders, different kinds of tape, useful accessories, and some advice on checking and maintenance are also included.

* * *

"ELECTRONIC ORGAN HANDBOOK" by H. Emerson Anderson. Published by *Howard W. Sams & Co., Inc.*, Indianapolis. 272 pages. Price $4.95. Soft cover.

Written for technicians as well as owners or potential owners of electronic organs who want to know more about these instruments, this book covers fundamentals and provides descriptions of organ models made by eight manufacturers. Over 140 illustrations, schematics, and diagrams complement the comprehensive text.

* * *

"PRACTICAL RADIO AND ELECTRONICS COURSE" compiled by M. N. Beitman. Published by *Supreme Publications*, Highland Park, Ill. 216 pages. Price $3.95. Soft cover.

This is a new, revised edition of a popular manual that is intended to serve as a self-study course. The beginner is introduced to radio parts and equipment first, theory following later in the text.

* * *

"TELEVISION ANALYZING SIMPLIFIED" by Milton S. Kiver. Published by *B & K Manufacturing Co.*, Chicago. 128 pages. Price $1.00. Soft cover.

This is a second edition of a work by Mr. Kiver of the same title. The revised version includes previously published important material as well as new information to help expand the knowledge and simplify the work of the service technician. The emphasis is on how to use test equipment and symptoms of TV set troubles to diagnose and locate defects. The treatment is generalized rather than dealing with specific models of TV receivers. As such, it should prove an important asset for the working service technician.

* * *

"AUTO RADIO MANUAL" by Sams Engineering Staff. Published by *Howard W. Sams & Co., Inc.*, Indianapolis. 160 pages. Price $2.95. Soft cover.

This is volume 11 in the Sams auto radio manual series. It extends the series coverage to include 47 models produced in the last two years. Like other volumes in the series, the present one includes "Photofact" schematics, chassis photos, parts lists, alignment information, resistance charts, and so on.

* * *

"REPAIRING TRANSISTOR RADIOS" by S. Libes. Published by John F. Rider Publisher, Inc., New York. 168 pages. Price $3.50. Soft cover.

The new and special techniques involved in servicing transistor receivers are explained in this volume which also provides a simple and systematic explanation of basic transistor theory. Written for the technician, the book should prove of value to all seriously interested in transistor work.

* * *

"MOST-OFTEN-NEEDED 1961 TELEVISION SERVICING INFORMATION" compiled by M. N. Beitman. Published by Supreme Publications, Highland Park, Ill. 192 pages. Price $3.00. Soft cover.

This is volume 18 in a popular series of TV service manuals. It covers sets of practically all makes. As in previous volumes, the servicing material provided includes double-page diagrams, alignment instructions, printed-panel views, waveforms, voltage values, production changes, and other data.

* * *

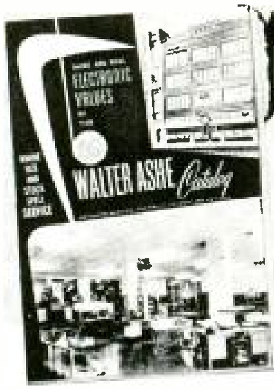
"ALL ABOUT CROSSOVER NETWORKS" by Howard M. Tremaine. Published by *Howard W. Sams & Co., Inc.*, Indianapolis. 80 pages. Price $1.50. Soft cover.

Information on basic principles, design, and construction of audio frequency dividing networks, for use in multiple speaker systems, is contained in this compact volume. The text is supplemented with numerous illustrations and useful charts.

* * *

"SERVICING TV TUNERS" by Jesse E. Dines. Published by *Howard W. Sams & Co., Inc.*, Indianapolis. 272 pages. Price $4.95. Soft cover.

This is an intensive study, from the servicing standpoint, of the mechanical and electrical characteristics of practically every type of TV tuner built. The author classifies tuners by type and provides complete data for trouble-shooting and alignment. —30—



FREE NEW 1961 WALTER ASHE CATALOG!

Exclusively Amateur Equipment, Parts and Supplies—144 Pages!

Here is the ham's own catalog . . . packed with all the latest gear you'll like to see in your shack . . . plus the latest in C-B and Hi-Fi! Here, too, is everything you need from solder lugs to tubes . . . all at Walter Ashe's money-saving prices!

MAIL COUPON FOR YOUR COPY—TODAY!

3 Big Reasons Why Walter Ashe is

hallicrafters HEADQUARTERS!

1 YOU GET THE HAM'S BEST TERMS . . .

If cash is short you can still get your new ham equipment at once, thanks to Walter Ashe's easier terms. You can use your trade as a down payment!

2 SERVING THE AMATEUR FOR OVER 38 YEARS

The Walter Ashe brand of service to the amateur has built our firm into America's leading supply source for the old timer and novice alike!

3 GUARANTEED SAME DAY SHIPMENT OF YOUR EQUIPMENT

Why wait for promised delivery on equipment that may take months to hit the market. We have everything Hallicrafters builds . . . in stock NOW!

Hallicrafters SX-111 Receiver

This new dual-conversion, selectable sideband receiver covers 80, 40, 20, 15 and 10 meters in five individual bands, with a sixth band tunable to 10 mc. crystal calibrator calibration with WWV.

Shipping Weight 40 lbs.

Amateur net $249.50

Walter Ashe— Where Size and Stock Spell Service

Hallicrafters' HT-37 Transmitter

The HT-37 is a complete table top, high efficiency amateur band transmitter providing S. S. B.—AM—or CW output on 80, 40, 20, 15 and 10 meters.

Shipping Weight 80 lbs.

Amateur net $450.00

YOUR PRESENT XMITTER or RECEIVER IS WORTH BIG MONEY

Get Our "Surprise" Allowance

Tell us what you have to trade . . . any name brand equipment made since 1946 . . . and we'll rush our biggest-ever "Surprise" allowance that is sure to make you wonder how Walter Ashe can do it. Incidentally, all used equipment we sell is checked thoroughly and guaranteed to work the same as new. Whether you're trading up to new or purchasing used equipment . . . you're always money and satisfaction ahead at Walter Ashe!

ALL HALLICRAFTERS EQUIPMENT IN STOCK READY FOR IMMEDIATE DELIVERY

SX 101A	7 band receiver	$399.50
SX 100	4 band receiver	295.00
SX 62A	6 band SW receiver	375.00
S-107	5 band receiver	94.95
S-108	4 band receiver	129.95
HT 32A	Transmitter	695.00
HT 33A	KW amplifier	795.00
HA-1	Automatic Keyer	79.95
SX 110	4 band receiver	159.95

All prices f.o.b. St. Louis

Walter Ashe RADIO CO.
Dept. R-2-61 1125 PINE STREET
ST. LOUIS 1, MISSOURI

"SURPRISE TRADE-IN" COUPON

WALTER ASHE RADIO CO.
YOUR ONE-STOP SUPERMARKET
Dept. R-2-61 • St. Louis 1, Mo. In Our 38th Year

☐ Rush New Catalog
☐ Send latest lists of guaranteed Used Equipment
☐ Rush "Surprise Trade-in" offer on my__________

For__________
(Show make and model of equipment desired)
Name__________
Address__________
City______ Zone____ State______

EXAMINE ANY OF THESE TESTERS *BEFORE* YOU BUY!!

Yes, we offer to ship at our risk one or more of the testers described on these pages.

SUPERIOR'S NEW MODEL 770-A

VOLT-OHM MILLIAMMETER

FEATURES:

- Compact—measures 3⅛" x 5⅞" x 2¼".
- Uses "Full View" 2% accurate 850 Microampere D'Arsonval type meter
- Housed in round-cornered, molded case.

SPECIFICATIONS:

6 **A.C. VOLTAGE RANGES:** 0-15/30/150/300/1500/3000 Volts.

6 **D.C. VOLTAGE RANGES:** 0-7.5/15/75/150/750/1500 Volts.

2 **RESISTANCE RANGES:** 0-10,000 Ohms, 0-1 Megohm.

3 **D.C. CURRENT RANGES:** 0-15/150 Ma., 0-1.5 Amps.

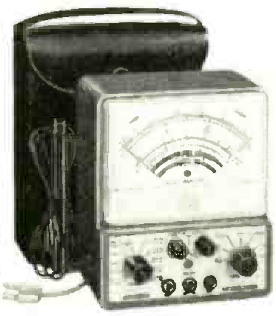
3 **DECIBEL RANGES:** —6 db to + 18 db, + 14 db to + 38 db, + 34 db to + 58 db.

The Model 770-A comes complete with test leads and operating instructions. **Price is $15.85. Terms: $3.85 after 10 day trial then $4.00 monthly for 3 months.**

SUPERIOR'S NEW MODEL 79

SUPER-METER

WITH NEW 6" FULL VIEW 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.

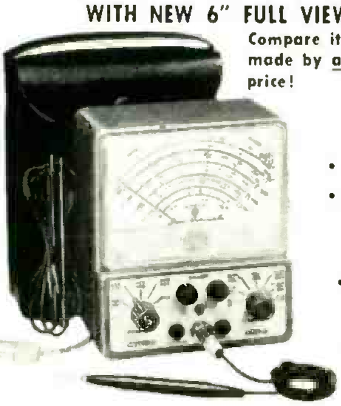
Model 79 comes complete with operating instructions, test leads and carrying case. **Price is $38.50. Terms: $8.50 after 10 day trial then $6.00 monthly for 5 months.**

SUPERIOR'S NEW MODEL 77

VACUUM TUBE VOLTMETER

WITH NEW 6" FULL VIEW METER

Compare it to any peak-to-peak V.T.V.M. made by any other manufacturer at any price!



SPECIFICATIONS:

- **DC VOLTS**—0 to 3/15/75/150/300/750/1500 volts at 11 megohms input resistance.
- **AC VOLTS (RMS)**—0 to 3/15/75/150/300/750/1500 volts.
- **AC VOLTS (Peak to Peak)**—0 to 8/40/200/400/800/2000 volts.
- **ELECTRONIC OHMMETER**—0 to 1000 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 and carrying case. **Price is $42.50. Terms: $12.50 after 10 day trial then $6.00 monthly for 5 months.**

SUPERIOR'S NEW MODEL 80

20,000 OHMS PER VOLT ALLMETER

6 INCH FULL-VIEW METER provides large easy-to-read calibrations. No squinting or guessing when you use Model 80.

MIRRORED SCALE permits fine accurate measurements where fractional readings are important.

SPECIFICATIONS:

7 **D.C. VOLTAGE RANGES:** (At a sensitivity of 20,000 Ohms per Volt) 0 to 15/75/150/300/750/1500/7500 Volts.
6 **A.C. VOLTAGE RANGES:** (At a sensitivity of 5,000 Ohms per Volt) 0 to 15/75/150/300/750/1500 Volts.
3 **RESISTANCE RANGES:** 0 to 2,000/200,000 Ohms. 0-20 Megohms.
2 **CAPACITY RANGES:** .00025 Mfd. to .3 Mfd., .05 Mfd. to 30 Mfd.
5 **D.C. CURRENT RANGES:** 0-75 Microamperes. 0 to 7.5/75/750 Milliamperes, 0 to 15 Amperes.
3 **DECIBEL RANGES:** —6 db to +18 db, +14 db to +38 db, +34 db to +58 db.

NOTE: The line cord is used only for capacity measurements. Resistance ranges operate on self-contained batteries.

Model 80 Allmeter comes complete with operating instructions, test leads and portable carrying case. **Price is $42.50. Terms: $12.50 after 10 day trial then $6.00 monthly for 5 months.**

SUPERIOR'S NEW MODEL 70 UTILITY TESTER

FOR REPAIRING ALL ELECTRICAL APPLIANCES MOTORS ★ AUTOMOBILES

INCLUDED FREE

64 page condensed course in electricity. Profusely illustrated. Written in simple, easy-to-understand style.

As an electrical trouble shooter the Model 70:
• Will test Toasters, Irons, Broilers, Heating Pads, Clocks, Fans, Vacuum Cleaners, Refrigerators, Lamps, Fluorescents, Switches, Thermostats, etc. • Measures A.C. and D.C. Voltages, A.C. and D.C. Current, Resistances, Leakage, etc. • Incorporates a sensitive direct-reading resistance range which will measure all resistances commonly used in electrical appliances, motors, etc. • Leakage detecting circuit will indicate continuity from zero ohms to 5 megohms (5,000,000 ohms).

As an Automotive Tester the Model 70 will test:
• Both 6 Volt and 12 Volt Storage Batteries • Generators • Starters • Distributors • Ignition Coils • Regulators • Relays • Circuit Breakers • Cigarette Lighters • Stop Lights • Condensers • Directional Signal Systems • All Lamps and Bulbs • Fuses • Heating Systems • Horns • Also will locate poor grounds, breaks in wiring, poor connections, etc.

Model 70 comes complete with 64 page book and test leads. **Price is $15.85. Terms: $3.85 after 10 day trial then $4.00 monthly for 3 months.**

DID YOU EVER?

- ▶ Order merchandise by mail, including deposit or payment in full, then wait and write...wait and write?
- ▶ Purchase anything on time and sign a lengthy complex contract written in small difficult-to-read type?
- ▶ Purchase an item by mail or in a retail store then experience frustrating delay and red tape when you applied for a refund?

Obviously prompt shipment and attention to orders is an essential requirement in our business...We ship at our risk!

NO

CONTRACT TO SIGN
CO-MAKERS
EMPLOYER NOTIFICATION

The simple order authorization included in this offer is *all* you sign. We ask only that you promise to pay for or return the goods we ship in good faith.

EXAMINE ANY ITEM YOU SELECT IN THE PRIVACY OF YOUR OWN HOME

Then if completely satisfied pay on the interest-free terms plainly specified. When we say interest-free we mean not one penny added for "interest" for "finance" for "credit-checking" or for "carrying charges." The net price of each tester is plainly marked in our ads—that is all you pay except for parcel post or other transportation charges we may prepay.

SUPERIOR'S NEW MODEL 82A

MULTI-SOCKET TYPE

TUBE TESTER

SPECIFICATIONS:

- Tests over 1000 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 low 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 82A comes housed in handsome, portable, saddle-stitched Texon case. **Price is $36.50. Terms: $6.50 after 10 day trial then $6.00 monthly for 5 months.**

SUPERIOR'S NEW MODEL TW-11

STANDARD PROFESSIONAL

TUBE TESTER

- 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.
- 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.
- **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 comes housed in a handsome, portable, saddle-stitched Texon case. **Price is $47.50. Terms: $11.50 after 10 day trial then $6.00 monthly for 6 months.**

SUPERIOR'S NEW MODEL 83A

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 83A provides separate filament operating voltages for the older 6.3 types and the newer 8.4 types.

Model 83A 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 83A 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.

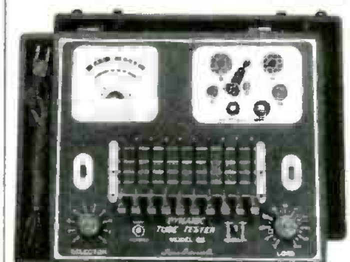
Rejuvenation of picture tubes is not simply a matter of applying a high voltage to the filament. Such voltages improperly applied can strip the cathode of the oxide coating essential for proper emission. The Model 83A applies a *selective* low voltage *uniformly* to assure increased life with no danger of cathode damage.

Model 83-A comes housed in handsome portable Saddle-stitched Texon case—complete with socket for all black and white tubes and all color tubes. **Price is $38.50. Terms: $8.50 after 10 day trial then $6.00 monthly for 5 months.**

SUPERIOR'S NEW MODEL 85

TRANS-CONDUCTANCE TYPE

TUBE TESTER



- Employs latest improved **TRANS-CONDUCTANCE** circuit. Test tubes under "dynamic" (simulated) operating conditions. An in-phase signal is impressed on the input section of a tube and the resultant plate current change is measured as a function of tube quality. 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.
- **SYMBOL REFERENCES**: Model 85 employs time-saving symbols (°, +, ●, ▲, ■;) in place of difficult-to-remember letters previously used. Repeated time-studies proved to us that use of these scientifically selected symbols speeded up the element switching step. As the tube manufacturers increase the release of new tube types, this time-saving feature becomes necessary and advantageous.
- **"FREE-POINT" LEVER TYPE ELEMENT SWITCH ASSEMBLY** marked according to RETMA basing, permits application of test voltages to any of the elements of a tube.
- **FREE FIVE (5) YEAR CHART DATA SERVICE.** Revised up-to-date subsequent charts will be mailed to all Model 85 purchasers *at no charge* for a period of five years after date of purchase.

Model 85 comes complete, housed in a handsome portable cabinet with slip-on cover. **Price is $52.50. Terms: $12.50 after 10 day trial then $8.00 monthly for 5 months.**

SUPERIOR'S NEW MODEL TV-50A

GENOMETER
7 Signal Generators in One!

- ✔ **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

The Model TV-50A comes absolutely complete with shielded leads and operating instructions. **Price is $47.50. Terms: $11.50 after 10 day trial then $6.00 monthly for 6 months.**

SUPERIOR'S NEW MODEL 88

TESTS ALL TRANSISTORS AND TRANSISTOR RADIOS

AS A TRANSISTOR RADIO TESTER
An R.F. Signal source, modulated by an audio tone is injected into the transistor receiver from the antenna through the R.F. stage, past the mixer into the I.F. Amplifier and detector stages and on to the audio amplifier. This injected signal is then followed and traced through the receiver by means of a built-in High Gain Transistorized Signal Tracer until the cause of trouble is located and pinpointed.

AS A TRANSISTOR TESTER
The Model 88 will test all transistors including **NPN** and **PNP**, silicon, germanium and the new gallium arsinide types, without referring to characteristic data sheets. The time-saving advantage of this technique is self-evident. A further benefit of this service is that it will enable you to test new transistors *as they are released!*

Model 88 comes housed in a handsome portable case. Complete with a set of Clip-on Cables for Transistor Testing; an R.F. Diode Probe for R.F. & I.F. Tracing; an Audio Probe for Amplifier Tracing and a Signal Injector Cable. Complete—nothing else to buy! **Price is $38.50. Terms: $8.50 after 10 day trial then $6.00 monthly for 5 months.**

Try any of the instruments on this or the facing page for 10 days before you buy. If completely satisfied then send down payment and pay balance as indicated on coupon. **No Interest or Finance Charges Added!** If not completely satisfied return unit to us, no explanation necessary.

MOSS ELECTRONIC, INC., Dept. D-857, 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 obligations.

- ☐ **Model 770-A Total Price $15.85** $3.85 within 10 days. Balance $4.00 monthly for 3 months.
- ☐ **Model 79 . . . Total Price $38.50** $8.50 within 10 days. Balance $6.00 monthly for 5 months.
- ☐ **Model 77 . . . Total Price $42.50** $12.50 within 10 days. Balance $6.00 monthly for 5 months.
- ☐ **Model 80 . . . . Total Price $42.50** $12.50 within 10 days. Balance $6.00 monthly for 5 months.
- ☐ **Model TW-11 Total Price $47.50** $11.50 within 10 days. Balance $6.00 monthly for 6 months.
- ☐ **Model 83-A . . Total Price $38.50** $8.50 within 10 days. Balance $6.00 monthly for 5 months.
- ☐ **Model 70 . . . Total Price $15.85** $3.85 within 10 days. Balance $4.00 monthly for 3 months.
- ☐ **Model 82-A . . Total Price $36.50** $6.50 within 10 days. Balance $6.00 monthly for 5 months.
- ☐ **Model 85 . . . . Total Price $52.50** $12.50 within 10 days. Balance $8.00 monthly for 5 months.
- ☐ **Model TV-50A Total Price $47.50** $11.50 within 10 days. Balance $6.00 monthly for 6 months.
- ☐ **Model 88 . . . . Total Price $38.50** $8.50 within 10 days. Balance $6.00 monthly for 5 months.

Name ....
Address ....
City .... Zone .... State ....

All prices net, F.O.B. N.Y.C.

Export Division: Rocke International Corp., 13 East 40th St., New York 16, N. Y.

Add Handset to Citizens Radio

(*Continued from page 56*)

separation of the receiver and microphone circuits, as shown in Figs. 1C and 1D. The handset may be ordered with the appropriate cord installed, or an existing cord may be replaced with one of the appropriate type.

The handset circuit shown in Fig. 1B is the standard circuit used by most mobile radio equipment manufacturers. Note that there is a small capacitor across the microphone element to provide frequency equalization. The handset cord is terminated in an *Amphenol* 91-MC4M plug. A mating 91-PC4F receptacle may be installed in the hole through which the existing microphone cord is run. The receptacle is wired within the set, as shown in Fig. 9. The only parts added are R_1, R_2, R_3, and C_1. The modulator cathode bias resistor (220 ohms) is removed and replaced by R_1 and R_2.

Some CB sets are designed for use with a carbon hand microphone. No modifications are needed when connecting a handset to the *Kaar* "D-Phone," except for the addition of an *Amphenol* 91-PC4F receptacle. The circuit of Fig. 11 shows how the receptacle is connected to the existing circuit. In this set, the speaker circuit differs in that the ground side of the speaker, not the output transformer, is opened when switching from receive to transmit. Therefore, when connected as shown, sidetone is obtained.

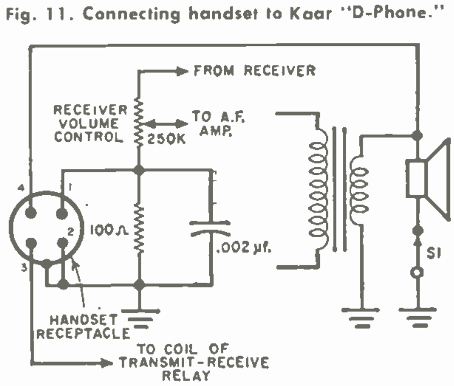
In both cases the handset is used with a switchless hanger. A switchbox and hanger can be used, however, which will cut off the speaker whenever the handset is lifted off its hook.

The handset may be wired directly to the switchbox or, preferably, through an *Amphenol* 91-PC4F connector added to the switchbox, as shown in Fig. 10. The handset cord plugs into the switchbox. Another cable is run from the switchbox to the CB set, directly or through a *Cinch-Jones* or similar 6-prong plug, as shown in Fig. 10.

The hook switch controls the speaker-handset circuit in the same manner as in Fig. 6. It also opens the microphone circuit and the press-to-talk circuit when the handset is hung up.

When the CB set is designed for use with a carbon microphone (see Fig. 11),

Fig. 11. Connecting handset to Kaar "D-Phone."



R_1, R_2, R_3, and C_1, shown in Fig. 10, are not needed. Instead, terminal 1 of the receptacle is connected directly to the microphone input circuit.

As can be seen in Fig. 10, it is necessary to break the circuit from the ungrounded side of the output transformer secondary to the ungrounded side of the speaker so that the handset switchbox can cut off the speaker and connect the handset receiver and dummy load, R_4-R_5, into the circuit in the off-hook condition.

When connecting a handset to a CB set designed for use with a high-impedance, low-output microphone, care must be exercised to avoid overmodulation of the transmitter or distortion due to overdriving the speech amplifier. In the circuits shown in Figs. 5, 9, and 10, the potentiometer which serves as both microphone load and the modulation level control should not be set so high that the signal is excessively distorted when monitored with a receiver. If the transmitted voice is distorted, overmodulation or overdriving of the speech amplifier may be the cause.

As shown in Fig. 11, a .002 μf. capacitor is connected across the microphone element. Try various size capacitors across the microphone circuit until you get the most pleasing sound quality. One specific value does not hold for all cases because of differences in the characteristics of the microphone elements and the associated circuitry.

Cost & Availability

Handsets are available from a number of telephone equipment manufacturers and supply houses. A standard telephone handset without a press-to-talk switch costs about $20. With a switch, retractile cord, and *Amphenol* plug, the cost is about $35. A switchless handset hanger costs about $4 and a switchbox hanger costs about $5. These are available in various switching configurations up to four-pole, double-throw.

Information about handsets and handset switchboxes and hangers may be obtained from one of the telephone equipment suppliers and manufacturers listed in Table 1.

It is a fairly safe bet that the added convenience of the handset will more than repay the expense and effort involved in installing it and in wiring it up. —30—

Automatic Electric Sales Corp., Northlake, Ill.
Buckeye Telephone & Supply Co., 1250 Kinnear Rd., Columbus 21, Ohio
DuMont, Allen B. Laboratories, Inc., Clifton, N.J.
Graybar Electric Co., 420 Lexington Ave., New York 17, N.Y.
Kellogg Switchboard & Supply Co., 6650 S. Cicero Ave., Chicago 38, Ill.
North Electric Co., Galion, Ohio
Roanwell Corp., 180 Varick St., New York, N.Y.
Stromberg-Carlson, Rochester 3, N.Y.
Suttle Equipment Corp., 135 S. LaSalle St., Chicago 3, Ill.

Table 1. Information about handsets and handset switchboxes and hangers may be obtained from telephone equipment suppliers and manufacturers, including those companies that are listed here.

NEW

for the first time, a

B & K QUALITY TUBE TESTER

at this amazing low cost!

TESTS All TV and Radio Tubes —both old and new

TESTS the Nuvistors

TESTS the new 10-pin tubes

TESTS the new 12-pin Compactrons

TESTS voltage regulators, thyratrons, auto radio hybrid tubes, European hi-fi tubes, and most industrial types.

Checks for all shorts, grid emission, leakage, and gas

Checks each section of multi-section tubes separately

Checks tube capability under simulated load conditions

Rejects bad tubes —not good tubes

Model 600
DYNA-QUIK

only $69.95 NET

8½" x 11" x 4½"
Handsome, sturdy leatherette-covered carrying case

For the man who wants the performance and reliability of a B&K professional-quality tester at minimum cost . . . there's nothing like the new "600". No other tube tester in this price range is so complete and up-to-date. Tests the newest tube types, as well as the old. It's fast . . . it's accurate . . . it's easy to use. Quickly reveals tube condition. Saves customers. Sells more tube replacements. Stops call-backs. Steps up servicing profit . . . day after day. Pays for itself over and over again.

Exclusive adjustable grid emission test. Sensitivity to over 100 megohms. Phosphor bronze socket contacts. Complete tube listing in handy reference index. Extremely compact.

NEW TUBE INFORMATION SERVICE
available every 3 months for all B&K Dyna-Quik Tube Testers

B&K

B & K MANUFACTURING CO.
1801 W. BELLE PLAINE AVE • CHICAGO 13, ILL.
Canada: Atlas Radio Corp., 50 Wingold, Toronto 19, Ont.
Export: Empire Exporters, 277 Broadway, New York 7, U.S.A.

Tricky Service Customers

(Continued from page 49)

payment, make sure you know exactly whom you're dealing with. If you don't know about the reliability of the party, it may be safer to use some sort of "line," for a change, instead of falling for one. You can always have some reason or other ready for needing cash right away. Or else the "boss" (even if you are he) has given you strict instructions about not taking checks and you can't do anything about it.

Also, if a check does bounce, take immediate and positive legal action no matter how small the amount may be. In the long run, this is cheaper. It is the opinion of field investigators that, if tougher action were taken against these operators in general, this would do a great deal to eliminate the problem.

Another check technique used by those who intend to chisel is the stop-payment gambit. After you fix a set for Mr. Jones, he pays by check. A few days later this check comes back from the bank marked "payment stopped." When you phone him, he reports, "The set isn't right." And the haggling begins.

One method for handling this problem, fair to customer and service dealer both, is to get a rubber stamp for the back of checks you take. It's wording could go something like this: "The amount of this check covers service and parts on my television receiver. I acknowledge that repairs have been done to my satisfaction." A line for the customer's signature goes below the statement.

Of course, it is even more convenient if some such statement appears on the regular bill that the customer must sign. This recommendation assumes, of course, that the technician is honest enough to back up his work with a clear, written guarantee. The latter should give the customer all the protection he is entitled to and should remove his misgivings about signing an acknowlment that work has been done.

Another type to watch out for is the wholesale hound. He is the kind who will bring his set to your shop himself, then watch over your shoulder while you work on it. He also makes conversation. In the process he gets you to tell him, perhaps with a little flattery, exactly what part needs replacing and where it is located. Then he tells you that, since he doesn't want to run up a pending bill, he will bring the set back next week, when he has the cash, so that you can complete the repair. His next stop is a downtown outlet for wholesale parts for a replacement and a strip of solder.

To beat this bird at his own game, remember that the only time you need point out the defective part is when you are making up a bill, after the repair. You don't do it for nothing. It has taken you years of learning and experience and a considerable investment in equipment to be able to trace the trouble. Finding it is 90 per-cent of the job. Once the defective part has been found, a grade-school student, at least in many cases, could make the actual replacement.

It may be reasonable to refer to the type of fault in a general way, to let the customer know where he stands, but you don't have to be eager to identify and locate the specific component voluntarily. If the customer is insistent, give him an estimate and charge a reasonable fee for diagnosis. This will make it hardly worth his while to finish the job himself, or insure you of fair payment for work performed. You should have signs clearly indicating that you charge for diagnosis, in any case. This protects you against those who comparison-shop for service bargains.

The amateur tube jockeys work in more than one way. Watch out for them. In one method, a customer walks into your store to buy a tube. He takes it home, puts it in his set—but a short in the receiver has blown out the tube he is now replacing and it also blows the one he just got from you. He not only wants his money back for the tube, but demands you fix the part of the set that your inferior tube, as far as he is concerned, has damaged.

To protect yourself against this type, there should be a conspicuous sign in your shop that says, "All parts sales final." This does not stop you from making a replacement when you think a customer has a legitimate complaint or from backing up your guaranteed work. However, if the customer wants to be a do-it-yourselfer, he should do it on his own kick. Let him take the risks that go along with being a technician himself.

Another variant of the tube jockey will buy three or four tubes, take them home, make sure which one (or more) is causing the trouble, then bring them all back for a refund—on his way to a wholesale house. The precaution already mentioned takes care of this one.

Watch out for the guarantee griper. His method is a simple one, and a familiar one too. You fix something minor in his set. A week or two later he calls for something entirely apart from the original fault. He insists that he has a guarantee that you have to make good. The answer to this one has already been covered to the extent that the nature of the guarantee has been discussed. It should be written and clearly specific as to the fact that it pertains only to work done.

Do you have friends? It is surprising how much money TV technicians lose when they fix the sets of friends. One dealer complains that he had to write off over $300 in unpaid charges built up over a period by so-called buddies. You are sure to have many cronies of this kind—especially when their sets don't work. Remember that business is business and real friends wouldn't make you go out of pocket.

Above all, remember that you have a responsibility not only to yourself but also to your good customers to establish protective measures against those who are not ethical. —30—

Operation "Deep Freeze '61"

Navy icebreaker to be on 20-meter ham band from the Antarctic again this winter.

THE SEATTLE-based Navy icebreaker USS "Staten Island" will be on the 20-meter amateur band from the Antarctic again this winter. Her call sign is K7ISB/Maritime Mobile. Four licensed operators, using a *Hallicrafters* HT-32 and an SX-101, with a 500-watt linear amplifier, hope to run phone patches to the families of the sailors embarked on board.

The station is licensed to Gary Nelson from Tacoma, Washington. Other licensed members of the crew who will be operating the station are Blaine Garrett of Carthage, Missouri, Peter Chaffee of Bellmore, New York, and Larry Douglass of Storm Lake, Iowa. This will be the first trip for Larry and Peter and the second for Blaine and Gary.

You may remember hearing Blaine Garrett previously on operation "Deep Freeze I." He is looking forward to the trip and to renewing contact on the band with many of the old friends he made during his stay of the winter night at McMurdo Sound. He stressed the importance of the services afforded by the state-side amateurs. "Their cooperation, which permits the ship's crew to talk to their loved ones, raises their morale as no music or movie ever could," he said. "We urge their help."

The ship's four licensed operators are looking forward to a successful phone-patch program. The ship's QSL cards include a picture of the icebreaker at work in the ice. All first contacts will be acknowledged with a QSL.

Operation "Deep Freeze '61" will be the sixth of its kind since 1954. One of the most challenging missions of this year's operation will be the attempted penetration of the Amundsen Sea. The "Staten Island" and another Navy icebreaker, the USS "Glacier," will undertake the assignment in February. On this trip into unknown territory the two icebreakers will carry scientists representing the fields of oceanography, ornithology, seismology, geology, and other geographical sciences. During January, the "Staten Island" was engaged in surveys in the Eastern Ross Sea. —30—

The USS "Staten Island" at her usual task of plowing through an Antarctic ice field.

Sound on Tape

By **BERT WHYTE**

I HAD INTENDED to bring you some new information on stereophonic sound perception this month, but a more basic and urgent matter precludes this subject until a later date. Let me preface my remarks in this column by assuring you that I always appreciate letters from you in regard to tape and stereo, and whether your letters are laudatory or voice complaints, you are entitled to your opinions and I respect them.

Without in any way wishing to appear smug, I must say that I am happy that letters of complaint are few and far between. However, a letter I received recently has me a little miffed—after all I'm human too—and the reason is that the person writing the letter questions the technical accuracy of my reviews, in particular regard to the phenomenon of crosstalk. He then compounds my ire, by suggesting that the heads on my playback machine are out of line! Well, sure it could happen; neither I nor my tape machine are infallible. However, since I clean and demagnetize the heads and align the 4-track heads about every two weeks, I rather doubt the unit gets out of adjustment that easily. In all fairness to the manufacturer, *Ampex*, I feel that their head-adjustment mechanism (which is a spring-loaded setup actuated by a machine screw) is not only very easy to use, but it is very precise. I have never encountered any trouble in maintaining optimum settings. Anyway, the writer of the letter contends that my heads must be out of line, because he just doesn't get any crosstalk, even from tapes I reviewed and in which I stated I could discern crosstalk.

Well let us put this matter to rest once and for all. It is conceivable, although rather remotely so, that given a perfectly aligned 4-track head and given an absolutely perfectly duplicated 4-track tape of a type of music which has little in the way of dynamic contrasts, there would be no discernible crosstalk. Unhappily, this is not likely to happen. Keeping the perfectly aligned head on our playback machine as an inviolate factor, there are so many other variables that can crop up in the process of making a commercial dupe, that it is amazing that tape is as good as it is.

Just as a matter of background, if I may be so immodest, I have been making stereo recordings perhaps longer than anyone in this country. I made the very first commercial mono tapes in 1950 when I was with *Magnecord*. With the help of my friend Leopold Stokowski I made experimental stereo classical recordings as far back as 1951, and have been recording commercial stereo with the Maestro in the past few years. I helped to launch the first commercial stereo tapes with the Fine Arts Quartet. I recorded the stereo tapes which were used at the first AM/FM stereo broadcasts over WQXR (New York City) in 1952. I supplied the late Major Armstrong with stereo tapes I recorded for use in his experiments with FM stereo multiplexing. I subsequently did the same thing for Murray Crosby and, using stereo recordings I made, we successfully demonstrated the *Crosby* FM stereo multiplex system before a group of *RCA* officials in 1953. I have made hundreds of stereo recordings on 2-track quarter-inch tape, on 3-channel half-inch tape, and on 3-channel 35-mm. magnetic film. In other words, I think I have a fair knowledge of tape recording in its various forms.

I bring up this point not with the idea of saying "look who I am," but to emphasize that a lot of experience has taught me to be wary of the pitfalls of recording and to accept the fact that between master and commercial dub, there are many variables and much room for error.

As defined by *Ampex*, crosstalk is a transformer-coupling phenomenon between the windings on adjacent head stacks. Now it is perfectly possible that in a given head stack there is sufficient isolation to prevent this coupling, and this will hold true provided that: (1) *the head alignment of the 4-track recorder used to make the dubbing master from the prime master is absolutely accurate; (2) the head alignment on the duplicator playback is absolutely accurate; (3) the head alignment on the duplicator slave machines (and there may be as many as a dozen or more running at the same time) is absolutely accurate; (4) the master duplicator recording bias is correct and stable; and (5) that such high levels of sound are not being impressed on the tape dub as to saturate the tape and exceed the 3 per-cent limit of distortion*. These are just a few of the variables.

The question of musical material is also important as I have pointed out before. If on one pair of tracks on a 4-track stereo tape there is a passage of very high signal intensity caused by a triple *forte* section in the music, and this is juxtaposed to the other pair of tracks where a very quiet, *pianissimo* section is being played, the prevention of transformer coupling or crosstalk is most difficult. Then there are more variables.

I pointed out many months ago at the introduction of the 4-track tapes that the type of playback equipment used to listen to these tapes in the home had a direct bearing on the amount of crosstalk one could discern. I specifically stated that on the lesser quality machines employing relatively small amplifiers and small speakers of limited bass response, crosstalk was virtually absent. Since however, some of the most annoying crosstalk occurs in the very low-frequency region, those possessing big systems with speakers capable of really good low bass response made the crosstalk audible enough to be annoying.

Now to bring in still other variables. The size of the room in which the listening takes place, the acoustic characteristics of that room, and the over-all sound level at which the tape is played back, all can have a profound effect on what one hears as a degree of distortion, or tape hiss, or crosstalk. Quite obviously, in a small, highly damped room, utilizing small speakers with limited bass response and with the music played back at relatively low level, the auditor in that room can say with perfect honesty that he doesn't hear crosstalk and in fact doesn't find the tape hiss to be very prominent or annoying. Contrast this with my own setup, which is a large listening room that has been acoustically treated for optimum stereo perception. And I utilize 120 watts of the finest amplifier power driving two 16 cubic foot enclosures, having sand-filled panels and each weighing over 600 pounds, and each having 48 inches of woofer radiating surface. Playing back tapes or discs at a room-filling but comfortable level, I hear many things which would go unnoticed on a smaller and lesser system.

Finally, let me point out that if head misalignment were indeed the trouble with my machine, then *I would perceive crosstalk on all tapes*, in greater or lesser degree, according to the type of music on the tape. The fact is that I have heard tapes on which crosstalk was almost completely absent, in spite of the fact that the music on the tape was very loud and dynamic. And at the other end of the scale, I have heard a lot of crosstalk from tapes with a relatively placid level of loudness and dynamics. I also have checked my findings on crosstalk and tape hiss and other tape defects on specific recordings, with some of the most eminent engineers in this field and with some of the more erudite critics. We have always concurred in these observations.

To give an example, there is a wonderful performance and generally fine-sounding tape of "Petrouchka" coupled with the "Rite of Spring." It has not been reviewed here because I found unhappily that this tape is one of the worst offenders in matters of crosstalk. My opinion is shared by the other auditors mentioned. I should also add that on certain labels, crosstalk is consistently low, a meaningful thing in terms of the control of as many variables as possible.

I don't think anyone fully understands the crosstalk problem, as yet, but it is bound to be solved in time. In the meanwhile, with all due respect to the undoubtedly well-intentioned writer who brought the subject to my attention, let me assure him that my 4-track heads are properly aligned, and with the particular system I have, when I state in a review that crosstalk is present, you can be certain that this is indeed the case.

MAHLER
SYMPHONY #4
Lisa Della Casa, soprano. Chicago Symphony Orchestra conducted by Fritz Reiner. Victor 4-track FTC-2027. Price $7.95 (approx.).

With this tape it is a real pleasure to welcome *Victor* back to the tape fold. As you know for a long time *Victor* was out of production on reel-to-reel tapes, concentrating instead on their ill-starred cartridge. However sorry we might be for the demise of their cartridge, as they say it is an ill will that blows no good. This tape is particularly welcome, since Mahler and Fritz Reiner have always had an affinity for each other. This is as satisfactory a performance as I have ever heard and certainly it is the best stereo version available.

Reiner allows the lovely lyricism of the work its full measure of expression, never forgetting however, the important rhythmic elements of the score. His tempi are perhaps a shade faster than most purists would like, but I think his approach is right for this most easy to assimilate of all the Mahler symphonies. The soprano part is ably handled by Miss Della Casa, but with not quite the expression afforded by some others in competing versions. Part of this may be due to the pickup she was given, which was rather too distant with poor articulation at times and at other times the voice was covered by the weight of the orchestra.

This is however, the only blot on the sonic escutcheon for all the rest is wonderfully clean and well-balanced sound, with superb woodwind sound and with the fabulous Orchestra Hall acoustics permitting us to hear little inner details of the scoring that would otherwise be too diffuse. The sonority of the basses is something at which to listen and marvel. Here again is a tape with strong dynamic contrasts on both sets of tracks and yet the crosstalk was barely discernible. So a huzzah to Reiner and a well done to *Victor* and we're glad to see you back in action.

TCHAIKOVSKY
THE NUTCRACKER
(ballet in two acts)
L'Orchestre de la Suisse Romande conducted by Ernest Ansermet. London 4-track LCK80027. Price $11.95.

As was the case with the stereo discs of this recording, this is a sonic marvel and a thoroughly delightful performance. On this tape the sound virtues are even more explicit and outstanding. The strings are rich and smooth, the brass crackling bright, woodwinds of sublime purity and rock-solid percussion, except in the unhappy instance of the pistol shot which is surprisingly anaemic. The music is of course some of the most beloved in the classical repertoire, but for those familiar mainly with the music through the Suite, there is much, much more here to delight the ear and tickle your auditory palate. There was crosstalk present on this tape but fortunately it was audible at infrequent intervals and was not overly annoying. Summing up: a tape that everybody will enjoy and should be in the "don't miss" category.

RESPIGHI
THE PINES OF ROME (and works by Gabrielli, Ceste, Frescobaldi, and Palestrina)
Symphony of the Air conducted by Leopold Stokowski. United Artists 4-track UATC2213. Price $7.95.

The works by the old Italian masters are heard in transcriptions by Maestro Stokowski and as such become very effective stereo vehicles. But most customers for this tape will naturally be more interested in "The Pines of Rome." Stokowski's performance is multi-colored and he uses some unorthodox phrasings, but the totality is very effective and holds one's interest as other performances do not. Thus it is my unhappy duty to report that this unique performance is given something less than the best in sound. Tape hiss was much too high, there was frequent low-level crosstalk, but my main quibble was with the balance which seemed all out of proportion, inordinately favoring the left channel. Let's hope next time they will give the Maestro a sound worthy of his talents. —30—

V.H.F. DINNER-HAMFEST

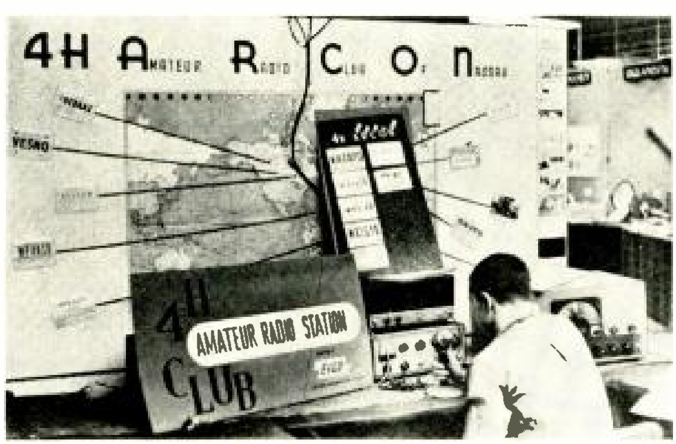
The East Coast V.H.F. Society is announcing their third annual dinner and hamfest, to be held on Saturday, February 25, starting at 7 PM. The affair will be held at Neptune's Inn on Route 4 near River Edge, N. J. Tickets at $5 per person are available from any member of the society, some radio parts distributors in the East Coast area, or directly from Roy King, K2BNQ, 55 Woodland Ave., Montvale, N. J. Ticket deadline is February 12; no tickets will be sold at the door. —30—

A "Yardstick" Quiz

By JOE TERRA

In the first column is a list of unit measurements. They are to be matched with their definitions in the second column. Give it a try and if you are stuck, the correct answers appear on page 133.

1. Ampere	( )	A. Elastance
2. Angstrom	( )	B. Magnetic potential
3. Coulomb	( )	C. 100,000 dynes
4. Daraf	( )	D. Wavelength of light
5. Dyne	( )	E. Loudness
6. Erg	( )	F. 10 million ergs
7. Farad	( )	G. Quantity of x-rays
8. Gauss	( )	H. Length
9. Gilbert	( )	I. Energy and work
10. Henry	( )	J. Electromotive force
11. Joule	( )	K. Capacitance
12. Lambert	( )	L. Current
13. Mho	( )	M. Resistance
14. Mil	( )	N. Conductance
15. Neper	( )	O. CGS unit of force
16. Newton	( )	P. Acoustical absorption
17. Oersted	( )	Q. Electro-acoustical power
18. Ohm	( )	R. Magnetic flux density
19. Phon	( )	S. Charge
20. Roentgen	( )	T. Electric power
21. Sabin	( )	U. Luminance
22. Volt	( )	V. Magnetic intensity
23. Watt	( )	W. Inductance



QSL cards received from all parts of North and South America form a prominent feature of the exhibit set up by members of the 4-H Amateur Radio Club of Nassau in the Science and Industry Building of the recent Long Island Science Fair at Roosevelt Raceway, L.I. The club carries on its contacts with EICO transmitting equipment that was donated by the company to encourage interest in electronic science.

Expanded-Range Voltmeter
(Continued from page 41)

with a directly heated cathode, connected as a diode, acts as a variable resistor. D.c. voltage to operate the bridge is applied at the junction of R_3 and R_4, and also at the junction between R_6 and the tube's cathode.

The equivalent resistance represented by the tube is made to vary with line voltage as follows: the line source is applied to the filament in series with dropping resistance (R_1 and R_2) so that filament voltage varies from .65 volt (when the line is at 105 volts) to .85 volt (when the line is at 130 volts). With filament voltage at this magnitude, a plate potential as low as 50 volts d.c. is sufficient to collect *all* the electrons that will be emitted by the cathode. The output from the rectifier and filter will not go below this minimum value; so variations in plate voltage due to line-voltage fluctuation *will not* materially affect plate current.

In this arrangement, plate current is a function of filament temperature. The latter, in turn, is proportional to the r.m.s. voltage across the filament, and thus also proportional to the true r.m.s. voltage of the line. Since the changes in the bridge are not linear, meter calibration will be non-linear, but this will not affect accuracy or usability.

The meter movement is a 0-1 milliameter unit. A surplus movement was used. The voltage scale was hand-drawn and glued to the faceplate. An accurately known source of variable a.c. voltage can be used for calibration. The author used a precision a.c. voltmeter and a variable autotransformer. To obtain indication over the desired range, the value of resistance in the arm of the bridge that includes R_3 and R_7 may have to be adjusted somewhat by trial and error. This is accomplished by manipulation of the latter resistor's value until the meter has no current through it at the minimum voltage to be measured, but shows full-scale deflection at the highest voltage. With the values given, little change should be required.

When the input line voltage is high (130 volts), R_1 will dissipate slightly over 4 watts, which is rather close to its power rating, and this resistor may change value due to heating. It may therefore be advisable to use a 10-watt resistor to be on the safe side.

There is another precaution, concerning use: since the tube operates at much less than its rated filament voltage, it takes somewhat longer for it to reach temperature stability than would ordinarily be the case. It is therefore advisable to wait about a minute after the voltage has been applied to the meter before taking a reading.

There are no critical problems of lead dress or layout and the required components are few. The constructor should have no problems arranging the circuit inside a housing that is not much larger than the movement used. —30—

Transistor Power Converter

(*Continued from page 64*)

the "Radio Amateur's Handbook," and many other technical handbooks. The smaller areas result in greater temperature rise in the transformer due to the resistance losses, however, here again in the interest of minimum size and weight the smaller limit was chosen. This corresponds to 575 circular mils (2.3×250) and resulted in the choice of No. 22 wire. This wire has an area of 642.4 circular mils.

In order to compute the number of turns required for the secondary winding, it is only necessary to multiply the number of turns in the primary by the ratio of the desired output voltage to the input voltage.

$$N_s = N_p \frac{E_{out}}{E_{in}} \times 1.05 = 26 \times \frac{250}{12} \times 1.05$$

The factor 1.05 allows for a 5% IR drop in the windings and filter components, and results in a secondary of 570 turns. Because of the larger number of turns, an area of 400 circular-mils-per-ampere was allowed for the secondary current of 100 milliamperes. No. 34 wire was used which has an area of 39.75 cm.

The only computation remaining is that to determine the number of turns for the feedback winding which will supply the square-wave driving voltage for the transistors. As a rule of thumb, the feedback winding should have from 20 to 40% more turns than the primary winding for the emitter-follower type circuit. Taking 130% of the primary turns, a figure of 34 turns was used for the feedback winding. Here again, this is the number from the center tap to one end of the winding. For electrical balance, the two halves of the winding should be wound together (bifilar) and the ends connected as described for the primary winding. No. 34 wire is also adequate for this winding.

As a check to see that the wire will fit in the winding space available, it is desirable that the winding factor be calculated prior to the actual winding. The diameter of the hole through the core chosen is 650 mils. The area in circular mils is this number squared.

$$K = \frac{N_p \times cm_p + N_s \times cm_s + N_{fb} \times cm_{fb}}{\text{Area of hole through core, in cm}} =$$

$$\frac{52 \times 642.4 + 570 \times 39.75 + 68 \times 39.75}{422{,}500} = 0.20$$

This winding factor of about 20% should permit even a random wind to fit into the winding space. If this factor is greater than 40%, a larger core should be selected and the computations repeated.

The Converter

As described previously, starting of the converter depends on the leakage current through the transistors. At cold temperatures this leakage current decreases almost to zero and the starting is not reliable. It is, therefore, necessary to provide for a small amount of forward bias to insure starting at low temperature. This is accomplished by the voltage divider composed of 2200- and 47-ohm resistors.

The photograph shows how the resulting converter was packaged. The transformer and bridge rectifier diodes were potted in the rectangular block and fastened to one end of the small inverted "U"-shaped chassis. The transistors were mounted to the sides of the chassis and the dual filter capacitor was attached to the top of the chassis. The bias and filter resistors were located on stand-off terminals inside the chassis.

The converter, including case and cover, weighs 22 ounces and has a volume of 21 cubic inches. It is 83% efficient and has demonstrated satisfactory performance for extended periods of time in ambient temperatures from 85 to +167 F. —30—

GAIN CONTROL COMPENSATION

By DAVE GORDON
Audio Workshop

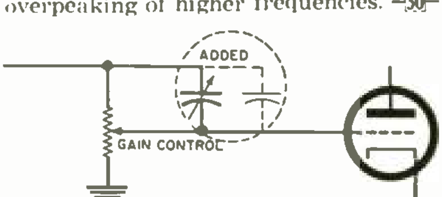
MANY INEXPENSIVE oscilloscopes, especially early models, suffer from disproportionate attenuation of higher frequencies as the gain control is turned to minimum position. This is explained by the fact that the input tube and wiring introduce capacitance to the circuit which, in conjunction with the gain control itself, forms a high-frequency roll-off network. High-fidelity amplifiers may also suffer from this loss as volume level is reduced.

In either case, a simple modification is possible that will reduce the problem considerably. Simply connect a trimmer capacitor between the high end of the gain or volume control and the arm, as shown in the diagram. The trimmer, whose exact value will have to be determined experimentally, can be soldered directly across the potentiometer terminals.

The control is set near its most frequently used adjustment and the trimmer is varied until it provides the best audible or visual response. In the scope, a 10,000-cps square wave can be fed to the input and the trimmer can be adjusted for the flattest top. In an amplifier, the setting can be made while listening to music or by making a square-wave check with a scope.

If the trimmer's maximum setting is not sufficient to provide adequate compensation, a small mica or ceramic capacitor can be shunted across it to increase capacitance, as shown by the dotted lines in the diagram.

The addition acts, with the control's resistance, as a peaking network to cancel out the roll-off action. The least amount of capacitance that will do the job should be used in order to avoid overpeaking of higher frequencies. —30—

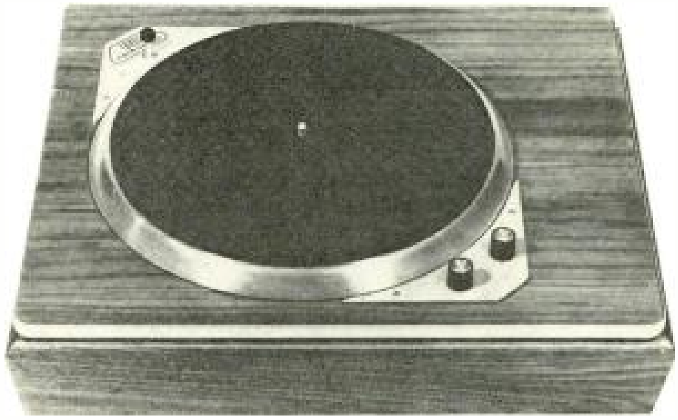


The world of science is the world of the future. There is no career more stimulating, challenging, or rewarding than that of working with topflight scientists and engineers to develop deep space probes and orbital satellite systems . . . package nuclear power reactors to provide economical, long-lasting power anywhere in the world . . . electronics and radioisotopes for use in medicine, agriculture and industry . . . missile systems for the Armed Forces . . . computers and data processing systems which will become accepted necessities by finance, industry and government . . . to develop a thousand and one concepts that will make our world a better and safer place for all. You can have a career—or speed up your present career—in one or more of these areas if you are eligible to enroll in a CREI home-study program . . . a program recognized everywhere as excellent insurance for a secure future, high professional stature, and better income.

New Audio Test Report

ELECTRONICS WORLD LAB TESTED

Fairchild 440 Turntable
Kay Model DV-210 Speaker System



Fairchild 440 Turntable

THE FAIRCHILD 440 is a dual-speed belt-driven turntable with a four-pole induction drive motor and a 4-pound cast and turned aluminum platter.

A two-step pulley on the drive motor provides the 33⅓ and 45-rpm operating speeds, and each pulley has a special surface to keep the flat rubber drive belt centered on it. The belt runs around a sub-rim on the platter, where it is below the level of the motor board and completely out of sight. Speed changing is effected by a vertical shift bar with a knob on top and a pair of flexible fingers near the bottom which straddle the belt next to the drive pulleys. Shifting the knob upwards or downwards brings one finger against the edge of the belt and flips it from one pulley to the other. In its at-rest position, the speed shift fingers are clear of the belt.

Two rotary knobs control the a.c. power switch and a series-connected power potentiometer which varies the magnitude of a d.c. braking current fed to the motor. The d.c. is obtained by way of a small selenium rectifier. The drive-pulley ratios are calculated so that, with the series resistor out of the motor circuit and no d.c. applied, the turntable runs slightly fast. Adding the series resistance cuts the speed down to the proper value.

The manufacturer has incorporated this type of speed control (called the "D.c. Speed Sentinel") to allow accurate speed settings without changing the belt tension with its attendant increase in rumble or slippage.

The platter has a ½-inch polished steel spindle which fits snugly into a machined bearing well and rides on a single ball bearing. The underside of the bearing rests on a flat nylon washer seated at the bottom of the well.

The 440 was supplied for testing along with its special wooden base. The drive motor is shock-mounted in three soft rubber grommets on a ribbed sub-panel, which mounts under the motor board by means of four machine screws. Metal spacer bushings between the motor plate and the underside of the motor board are supposed to hold the assembly at the proper height under the motor board, but they did not do so in our sample unit. With the screws drawn up tight, the platter sat far enough down that it scraped the motor board, so we were obliged to discard the bushings and simply suspend the motor plate from its mounting screws. This problem, which occurred in early-production models of the turntable has been subsequently solved by the manufacturer by use of smaller bushings. Hence, the presently made units should not exhibit this difficulty.

Installation of the turntable was simple and straightforward. All holes line up properly, and the proper clearances were maintained at all critical points.

We ran the 440 for 24 hours to work it in before starting our tests. Some erratic buzzing noises from the drive motor disappeared after three hours of use, and no further irregularities were noted. Wow and flutter in our sample 440 was inaudible, even from a sustained 3,000-cycle test tone.

The speed-change system was smooth and positive in operation, and the vernier speed control's 1½% adjustment range was adequate for most purposes. In our sample unit, a line voltage of 120 upped the motor speed to the point where the vernier control could not drop it to its exactly correct speed, but at 117 volts both nominal speeds could be obtained right on the button. The unit's torque was very high, making it completely immune to slowdown under the range of loads that would be encountered in normal use.

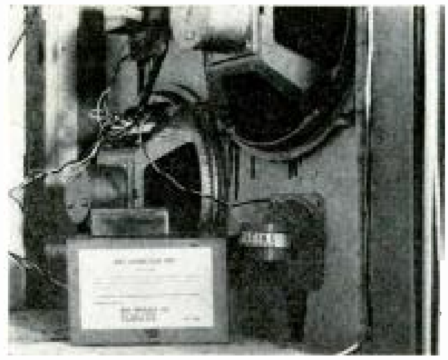
Hum radiation from the drive motor

was fairly low, and this plus its location at the extreme right rear of the motor board make the 440 suitable for use with all but the most hum-sensitive magnetic cartridges.

The *Fairchild* 440 turntable (available at $69.95) is durably constructed and simple in design, so should give long, trouble-free performance under conditions of the most rigorous usage. —30—

Kay Model DV-210 Speaker System

A RATHER unusual hi-fi loudspeaker system has come to our attention recently. It is the Model DV-210, a product of *Kay Speaker Co.* The system consists of a pair of special British 10-inch speakers with dual voice coils, a pair of 4-inch cone tweeters, and a special type of crossover network—called the Kay Corrector Unit—to interconnect these speakers. The 10-inch speakers, with their low resonant frequency of 35 cps, are used as the woofers in the 2-way speaker system. The speakers and network must be wired together by the user and must be installed in a large infinite-baffle enclosure, or built into a closet or wall. In wiring up the system, the two tweeters are connected in parallel through the crossover network, as are the woofers, but here separate leads are run for the two separate voice-coil windings.



According to the manufacturer, the use of the dual voice coil woofers in conjunction with the special crossover network acts to cancel out speaker distortion. Just how this comes about was not explained nor could we get information on the exact circuitry used in the potted crossover network. Because the system is currently in the midst of patent proceedings, this information could not be made available to us. The frequency response claimed for the system when properly mounted or enclosed is from 28 cps to 17,000 cps; the system impedance is rated at 8 ohms; and it is said to handle up to 70 watts of program material.

Since we were not anxious to break open any of our walls or closets to mount the speaker system, we had it installed in a 6.2 cubic foot rectangular infinite-baffle enclosure. This completely sealed enclosure was constructed of ¾-inch stock and it was lined on all inner surfaces with 1-inch fiberglass. We first tried the system out with a 10-watt amplifier, and because of the fairly high speaker efficiency, we were able to produce plenty of sound output. We then connected a somewhat higher quality, higher power amplifier to the system and, with an audio oscillator as signal source, swept through the entire audio range. The speaker system was able to produce output down to about 28 cps and the output, although low in level, appeared to be mainly fundamental with a minimum of doubling. In sweeping upward in frequency, several low-frequency peaks were heard, but we feel that some of these, at least, were the result of standing waves being set up in our fairly small listening room. At the top of the band, we were able to hear some output from the system up to about 17,500 cps, the cutoff frequency of our ears.

We then tried the system out with recorded and FM broadcast program material. The speakers produced quite a rich sound, which was somewhat thin in the treble range and bottom-heavy in the bass. Mid-range performance and transient response appeared to be quite good. For those who do not care for too many highs and who enjoy a full, resonant bass, this speaker system will sound most acceptable.

The Model DV-210 is available directly from the manufacturer at 429A Park Ave., Worcester, Mass. at a price of $134. A model of the kit is also available at $97 with a single woofer and a single tweeter. —30—

Audio Center Technician

(*Continued from page* 59)

placed after 1000 hours. These heads do wear down in use.

Educating the Users

The most effective way of instructing student-users in the proper use of the equipment is to post a set of directions in each booth for them to follow. These should be clear, step-by-step, and refer to controls and materials specifically. As for teaching the teachers, there is another, greater problem. Many of them are not aware of the variety of materials that are available for use in such centers, or of the many different ways in which the facilities can be used.

As to materials, it is generally known that there are exercises in vocabulary, grammar, and pronunciation for English and foreign languages. There is also much material for music-appreciation and music-theory instruction. Many speeches of historical interest have been preserved, as have been other historical programs and events. Dictation exercises for student stenographers are also available. There are recorded dramatic productions and poetry readings.

Students may use equipment to rehearse speeches, readings, or oral reports. Lesson material for memorization can be made available. Self-administered examinations can be used. Programs can be scheduled for sizable groups, originating from the control booth, or individual exercises can be conducted.

Since advancing the optimum use of available facilities is best done by the technician, there are obviously some requirements he should have beyond the one of technical skill. He should preferably be a person with broad interests, some creativity and imagination, and an eye on the future. For the audio center seems to be definitely in the future of the nation's schools.

There are so many possibilities that it is hard to predict in which directions they will develop, but this field is certain to become important. —30—

"Listen to this stereo recording I made at Cape Canaveral."

World Adopts New Length Standard

Meter bar replaced by light wavelength in new standard.

A NEW international standard of length—a wavelength of light—has replaced the meter bar which has served as the standard for over 70 years. The announcement was made from Paris by Dr. Allen V. Astin, Director of the National Bureau of Standards. The action was taken by the 11th General Conference on Weights and Measures, which met in Paris recently.

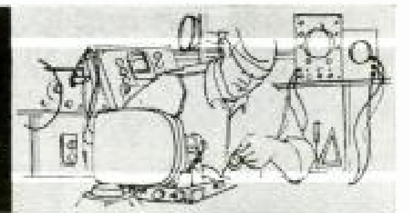
The new definition of the meter as 1,650,763.73 wavelengths of the orange-red line of krypton-86 will replace the platinum-iridium meter bar which has been kept at Paris as an international standard for length since 1889 under the Treaty of the Meter. While not of great concern to the man in the street, these actions are of great importance to those engaged in precision measurement in science and industry.

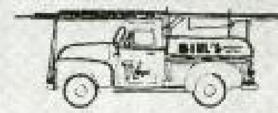
For many years the world has relied on a material standard of length—the distance between two engraved lines on the International Meter Bar kept at Paris. Duplicates of the International Standard were maintained in the standards laboratories of other countries of the world. From time to time it was necessary to return these duplicates to Paris for recalibration, and occasionally discrepant results were obtained. Also, there was doubt regarding the stability of the international meter bar.

The new definition of the meter relates it to a constant of nature, the wavelength of a specified kind of light, which is believed to be immutable and can be reproduced with great accuracy in any well-equipped laboratory. Measurements of the precise length of a wavelength of a certain kind of light may be made by means of an interferometer. With this device, observation of interference effects of monochromatic light, which is split and made to take two different paths, may be made with great accuracy. Once a direct measurement of the wavelength of the light being used has been made, this measurement (or a multiple of it) may be compared optically with the length of a standard meter bar. It is then possible to measure the bar down to the fractional part of a wavelength of the light whose wavelength is being used as a standard.

The new definition of the meter will not materially change the measurement of length. For example, the distance from a point in New York City to a point in Washington, D. C. would be altered by less than three inches, as measured in terms of the old metal standard and the new wavelength standard. In effect, the new standard shortens the meter by a length of less than 1/5000th part of the thickness of one thin dime. —30—

SERVICE INDUSTRY NEWS





AN ETHICAL problem of considerable interest has been given some attention by Allen Roberts in his monthly department, "Sync Pulses," featured in "TSADV News." The latter is the voice of the Television Service Association of Delaware Valley. It begins with a letter from a distributor, whose name is not given, in which the independent service industry is taken to task for the manner in which it handles replacement of in-warranty tubes.

The distributor states, "As far as I can tell, some service men are watching the manufacturers' code dates and bringing the tubes back to the distributor for replacement. All service men can read the code dates. Recently, we have been watching this closely, and it is our belief that fully 80 per-cent of the tubes the distributor replaces free for the dealer are being charged to the consumer. . . . If the dealer charges the customer for the tube and expects the distributor to make it good, then this cannot be anything but dishonesty, because the customer was deprived of something that belongs to him."

If this accusation raises serious questions, the answer given by Roberts also does so. He begins with an objection to having the pot call the kettle black, and goes on to answer with more questions. He wants to know who is going to reimburse the service dealer for the labor cost of replacing tubes (and other parts) that go bad during the warranty period, even though there is no cost for the replacements themselves. Essentially, Roberts points out, this involves defective merchandise sold to the innocent dealer that can involve him in extra costs. In addition, tubes still in warranty when purchased may be out of warranty by the time they are used. If they are defective, the dealer takes the loss. Roberts also wants to know why distributors ship tubes to dealers with expired warranty code dates, or near it.

The answering argument is thus based on the fact that, under the present warranty system, which is certainly far from perfect, the dealer is bound to lose money if he adheres to it strictly. In essence, then, dealers who follow the practice condemned by the distributor are simply correcting a wrong.

The charge and the reply both leave us with many doubts unresolved. To begin with, we are surprised that Roberts has not questioned the distributor's claim that 80 per-cent of all service men use the method attacked. We cannot believe the figure is that high. In fact, we would be interested in hearing from dealers as to whether they use this practice and what they think of it.

We are also concerned with both the morality and practicality of trying to right one wrong with another. Certainly the dealer deserves a better break, but is this the way to get it? As far as making the customer the goat is concerned, isn't the dealer once more avoiding a more important problem? If service is ever to be a dignified profession in which one can earn a fair income, the consumer must first learn that skilled, specialized labor is what he must pay for primarily. He will never learn this as long as dealers hide reasonable rates behind charges for tubes and parts. Ideally the customer should know that he is getting a tube replacement at no charge, but that he must pay for the service rendered, which costs the dealer money.

As for tubes that go out of warranty after purchase but before they are discovered to have defects, or that are shipped to the dealer with expired dates, overhaul of the warranty-distribution system is the only final solution. Since this is not realistically possible for the immediate future, the dealer's only way of protecting himself is to refuse tubes with stale date codes. That drops the problem right back in the lap of the distributor and perhaps the manufacturer. However a compromise is possible. Such tubes can be sold to the dealer at a lower price as unused, first-quality merchandise, but without warranty. This way the dealer knows what he's getting and what risk he takes himself—for a consideration.

License-Support Plea

Those who support service licensing and would like to advance its cause will be interested in a plea made to us by Herbert D. Fitch, chairman of the License-Fund Committee of the Empire State Federation of Electronic Technicians Associations, New York. ESFETA has high hopes of getting a statewide licensing bill through the legislature this year, but still needs money for disseminating information and other expenses incidental to the campaign, although interested dealers in New York State have already contributed heavily.

Fitch's plea is to licensing supporters outside the state. How will they benefit by contributing? He gives several reasons. For one, New York has traditionally been a pioneer in many legislative matters. State governments are hesitant to experiment with untried types of regulatory legislation. This reluctance has certainly been one of the factors blocking the widespread adoption of state-wide license laws. However, when such controls have been shown to work in a large state, such as New York, there has been a pattern of subsequent adoption in other states. Since state licensing has already been pioneered in Louisiana, Fitch feels that its passage in New York will generate the momentum that will carry it into other areas much more easily.

Those who agree with this position can send checks to ESFETA's License Fund, care of Herbert D. Fitch, 315 North Fourth Street, Mechanicville, N.Y. Monies received will not be used for any other purpose. Although we have taken no stand on licensing, for or against, we pass this information on to those interested because it is newsworthy.

Dealer Gets Bad Legal Break

We don't like to lean too heavily on self-pitying, heartbreak tales whose theme is "Pity the innocent, much-abused service dealer," because they usually don't encourage positive action. However, the Electronic Service Dealers Association of Western Pennsylvania reports an incident that may make you mad enough to do something. If not, it will at least alert you to a possible danger.

The owner of a defective, 14-inch portable brought it into a service shop for an estimate. After a complete check, the dealer found three bad tubes, including the CRT, and telephoned the owner to let him know. The latter said he did not want the repair made and he would pick up the set in a few days. When he came in, the dealer requested an estimate fee of $3.50, and the owner hit the ceiling. He refused to pay, said he would refer the matter to his lawyer, and walked out.

The dealer soon received an attorney's letter threatening legal action if the set were not returned and he, in turn, gave it over to his own attorney. The shop owner next heard of the matter when he was summoned to court by the set owner, who demanded damages of $115, plus the cost of renting a TV receiver while his own was being held. The defense was based on the fact that the dealer had a sign posted in his shop stating that a charge would be made for estimating repairs. The court ordered the dealer to return the set without charge *and* to pay the owner $30 for renting a substitute.

The decision leaves one wondering. What can a dealer do to protect himself legitimately against this sort of thing? He should certainly have a large sign and it should be prominently displayed. Individually pointing it out to each customer who asks for an estimate also helps. Better yet, get it in the customer's hands in black and white. He should certainly get a claim check for his set, and there is no reason why a clear statement about estimate fees should not appear on it. —[30]—

Hi-Fi Turntables

(Continued from page 48)

speed of 1800 rpm, equivalent to 30 revolutions per second. This is a very low tone, but it can be heard easily and it can be reproduced by a good loudspeaker. However, it is possible to design a turntable with rumble at the 15- or even 10-cps mark. There are no speakers generally available which can reproduce these very low frequencies, and even if there were, nobody can hear them. However, even this very low frequency, at a high enough level, can produce intermodulation distortion that is audible at the higher audio frequencies.

While most turntables are constructed in accordance with the theory that a powerful motor and a heavy platter provide the most effective means of spinning a record, a few of them are not. These turntables utilize small, low-torque motors and light platters. Their design is based on the fact that modern cartridges and tonearms function at very low tracking pressures, and that motors therefore need not necessarily be as powerful as in the days when tracking pressures were high. Essentially, the lightness of their platters is only relative and is determined by the power of their motors. These turntables take further advantage of the fact that low-torque motors produce very little vibration, and offer fewer problems of motor mounting, isolation and rumble.

Rek-o-kut Model B12GH

Stromberg-Carlson PR500

Speeds and Adjustment

In selecting a turntable for his system, the audiophile must first decide whether he requires a single speed or multi-speed unit. The single-speed turntable is less complicated in structure than the others and theoretically can be made to finer basic standards. For this reason, a turntable for playing 33⅓ rpm records and a changer for 45, 78 and 16⅔ rpm discs find favor in some installations. However, if records other than 33⅓ are played often, a multi-speed turntable is entirely practical from the quality point of view. The speed-changing facility need not introduce any extra hazards of pitch variation or rumble.

Thorens Model TD124

With precision motors that operate at a fixed, constant speed, a speed adjustment control is rarely needed. However, if you sing or play an instrument and wish to perform along with records, a speed adjustment is a necessity to achieve unity of pitch. Not all instruments are tuned to A-440 pitch, and some records sound a trifle higher or lower than others. You must play them at the correct indicated speed to duplicate their original pitch and tempi, but if you want to play along, perhaps on a piano, you may have to slow down or speed up the record to match its pitch with your instrument's.

Weathers Model K834

While most of the turntables available today are marketed in a manner that permits any preferred tone arm to be used, some have tone arms already supplied and mounted by the manufacturer. Where the tone arm is also a high quality product, an ensemble of this type has the advantage of proper and convenient installation. However, as mentioned before, a few of these ensembles are in reality stripped versions of record changers, with economy motors and short tone arms. These are not in the same class as professional type turntables and tone arms.

We would also like to point out that manufacturers of record changers that are able to play single records manually could refer to their units as "automatic turntables." As a matter of fact, one manufacturer has gone so far as to include a dynamically balanced tone arm and a weighted platter in a player that also incorporates the automatic-play feature of a record changer.

Simple Tests

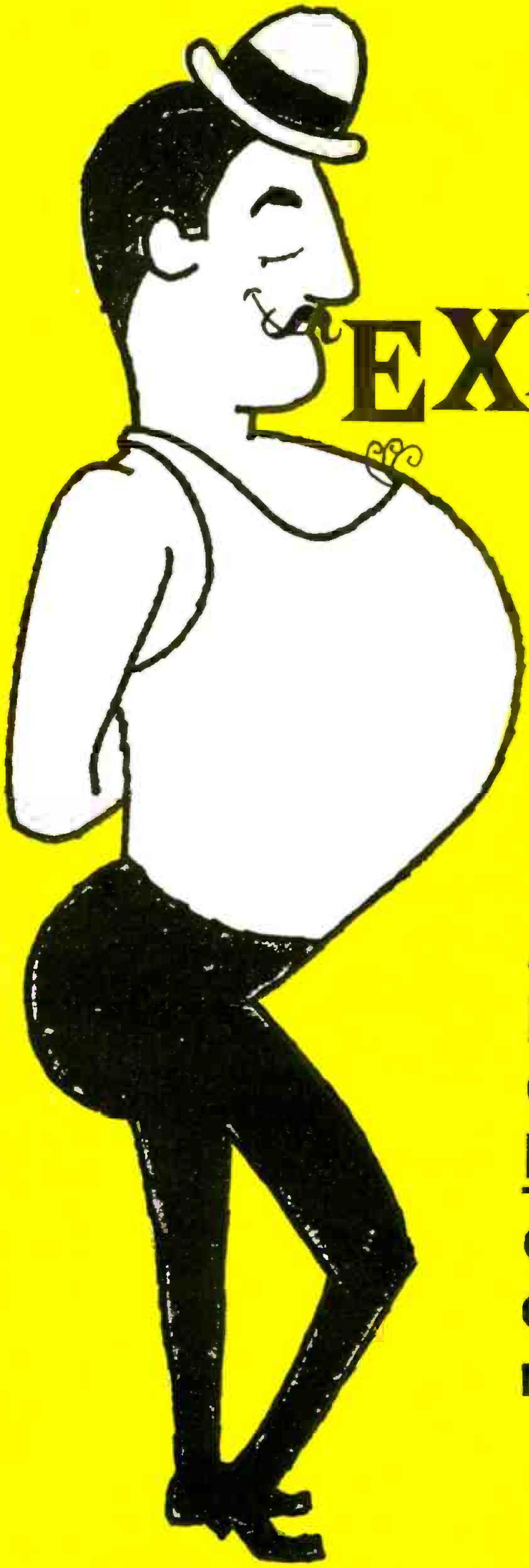
It is, of course, impossible for the audiophile to make his own laboratory tests on individual turntables when he is shopping for one. He can, however, be guided by manufacturers' specifications and he should not hesitate to avail himself of the salesman's knowledge and experience. The salesman can usually suggest a turntable that is compatible with the type of amplifier and speakers with which it will be used.

If possible the turntable recommended by the salesman or requested by the audiophile should be hooked up with an amplifier and speakers similar to those he owns, and tried out in the store.

Place a stroboscope on the turntable and check the accuracy of speed. Some turntables have built-in strobe discs. Do this again while a record is playing so that you know whether speed is maintained under operating conditions. (To meet professional broadcast standards, not more than 21 bars on the strobe disc should appear to move past a given point in one minute.) Listen to a record or two. Solo piano records provide excellent test material. The tones should be firm, steady and clear, not wavery or fuzzy. Turn the volume up and boost the bass to determine how much rumble the turntable produces.

If the piano tones are pleasing and the rumble is not noticeable or objectionable at fairly high volume with the bass emphasized, you have a good turntable. It will enable your records to be played with maximum fidelity and minimum distortion and thereby provide you with maximum pleasure and minimum frustration. —30—

"There, Mr. Frimly! The service charge is paid in full. Now that wasn't so difficult, was it?"

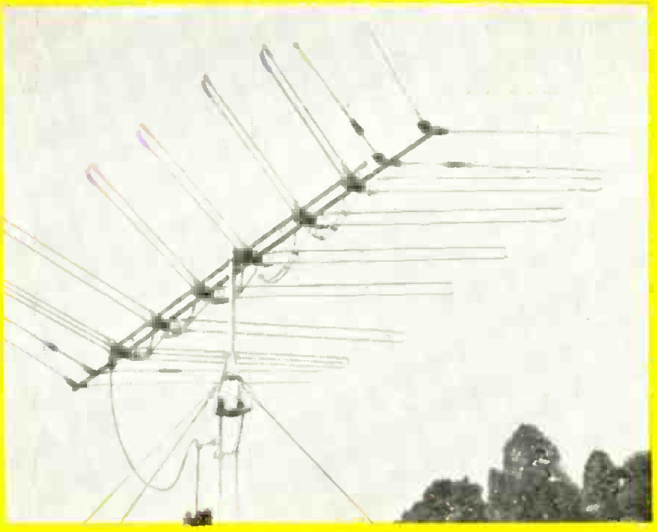


START EXPANDING, MISTER!

you make more with

CHANNEL MASTER

because
Channel Master
builds in more
of what your
customers
need and want!

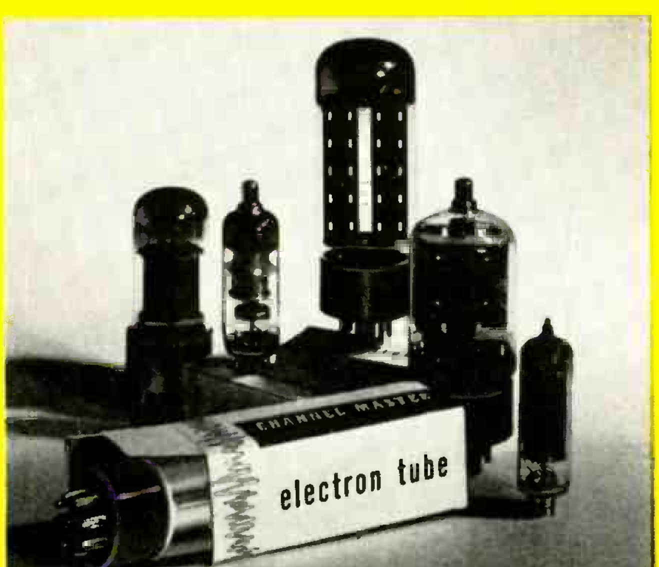


78% more Picture-Power in CHANNEL MASTER T-W ANTENNAS!

The unique Traveling Wave principle—already fully proved and approved in deep-fringe areas—is now further **improved!** The new Super 10, with 10 elements, pushes the fringes back even farther—provides unsurpassed super-fringe performance for "picture-poor" homes. Up to 78% more gain than the famous 7-element T-W. Greater front-to-back ratio, exceptional mechanical strength. Another fringe-area powerhouse is the new Super 8—with 4 driven elements, 4 parasitic elements.

More accuracy in CHANNEL MASTER AUTOMATIC ROTATORS!

For best reception, an antenna must be aimed **accurately** — not in **jumps** of 10 or 15 degrees. The Channel Master Tenn-A-Liner is the only automatic rotator that can be aimed within ONE DEGREE of the required direction. And is so easy to operate even a child can do it! Greater turning power, fool-proof control box, elimination of solenoids means quieter operation. No other rotator compares with this one!



Extra Dependability in CHANNEL MASTER PREMIUM QUALITY TUBES!

Longer life, unfailing uniformity, completely dependable performance—are what your customers expect of their tubes. And Channel Master Premium Quality Tubes give them all three of these qualities to spare! The Channel Master tube line also takes care of over 75% of your service calls. America's fastest-growing line?...You **bet!**

CHANNEL MASTER

works wonders in sight and sound

Ellenville, New York

Mac's Service Shop

(*Continued from page* 44)

money smelling of perfume and face powder, Barney. Women are very important to our business. If they like us and our service, they talk about it; if they don't like us, they talk about that, too; but in either case, being women, they talk. We know what an effective two-edged sword word-of-mouth advertising is. It is most important we keep it cutting for us instead of against us.

"So let's not try to force our women customers to act and think like men. Instead, let's try to arrange our business practices to please them."

"Like how?" Barney asked dubiously.

"Let's remember that since they do not know much about electronics they are forced to form their opinion of our service by things they *do* understand: Do we arrive promptly at the time we said we would? Are we clean and neat? Is our manner friendly without being familiar? Are we pleasant to any children or pets in the house? Do we use a drop-cloth to protect the rug? Are we careful not to scatter cigarette ashes around? Do we work quickly and efficiently? Do we give the impression we know what we are doing?"

"It shouldn't be too tough to get 'yes' answers to those questions," Barney observed.

"It isn't. Actually we should do all these things anyway; but you must remember life is a more 'personal' thing to a woman than it is to a man. The trick is to make the women customers feel you are doing these things out of consideration for them *personally*. They want to feel you are taking a personal interest in their TV trouble.

"I never forget a lesson I learned a few years back from a barber who was extremely popular with women customers. They came to his shop from all over town to have him trim their bobs. One day while waiting for a haircut, I watched him working on a woman customer. After he had her hair all trimmed and combed in place, he stepped back and studied her face for several seconds with a frown of concentration on his face. Then he moved around behind her, held his scissors *a good inch away from her hair*, and snipped them vigorously four or five times. Now he again studied her face while a deep smile of satisfaction spread over his countenance. 'There now; how's that?' he asked triumphantly as he turned her around to face the mirror. Watching, I know that the few seconds he spent snipping those scissors in mid-air added more to her satisfaction with her haircut than did a large part of the previous half hour spent doing the actual work.

"I remember this; and often, when I am all through with a job, I stop in the doorway and then go back to the set and straighten out a mussed doily on top of it or wipe a fingerprint from the cabinet or tuck a line-cord out of sight. It only takes a few seconds to do this, but it says to the woman you are trying to give her the very best service of which you are capable, down to the smallest detail."

"All right," Barney interrupted; "you and your scented money have convinced me. I'm going to remember everything you've said, and from here on in I'm going to try very hard to be a ladies' man."

"You'd be a lot more convincing if you had remembered to give me back my dollar," Mac said with a teasing grin as he reached over and plucked it from the breast pocket of Barney's shop coat, where the youth had absent-mindedly tucked it. —30—

New TV Designs for 1961

(*Continued from page* 36)

connecting leads to a fixed antenna, which may not be conveniently available.

Philco

This year *Philco* has certainly designed new models with the service technician in mind. The *J* line especially contains a number of features which make servicing easier. All coils, for example, can be tuned from the top of the chassis and, in addition to clear and detailed markings on the top of the printed-wiring board, access to the bottom is provided through holes in the bottom plate. Probably the most unusual feature is the use of "component packs," which are small sub-assemblies which, in turn, are wired to the printed board. Fig. 7 shows a typical "component pack" mounting some power resistors, and also illustrates a method for replacing a defective resistor. Only *Philco's* portable unit operates directly off the a.c. line; all other models have a power transformer and silicon voltage doublers. A thermistor is used in the vertical-deflection yoke to maintain vertical size during warm-up.

RCA

All of the new *RCA* TV models use power transformers, some with a 5U4 rectifier and others with silicon doublers. They all also use printed-wiring boards, marked in clear detail. Two innovations are featured this year. One is an improved color-TV set which, in the author's opinion, represents merely another step in the annual evolution of color receivers and does not use any radically new or startling circuits. The second innovation heralds the beginning of the commercial application of *RCA's* new Nuvistor tube. A type 6CW4 triode is used in the r.f. stage of the *RCA* KRK98 tuner, together with a conventional mixer-and-oscillator tube. The Nuvistor's low interelectrode capacitance and gain make it quite suitable for v.h.f. use, permitting high sensitivity with low noise.

Setchell-Carlson

This manufacturer has introduced some improvements of the designs it has been featuring for the past few years, but still uses only hand-wired

chassis. In their deluxe sets, *Setchell-Carlson* uses a revised arrangement of their well-known "unitized" chassis construction. Fig. 6 shows the neat, uniform, plug-in construction of the six aluminum sub-chassis which are mounted on the main deck to form a complete receiver. The service technician who has spare assemblies in stock can troubleshoot simply by substituting a known good one for a suspected sub-chassis. Otherwise the main deck must be removed, the underside must be exposed, and regular troubleshooting procedures are required.

Among the features of all *Setchell-Carlson* sets is the plug-in horizontal flyback transformer and the so-called "picture tube saver." This latter is simply a 3-ohm, 5-watt resistor in series with the CRT filament. When the picture tube has aged, a plug is inserted into a socket which shorts out the resistor and applies a higher filament voltage to the picture tube, with the usual "boost" or rejuvenating effect.

Sylvania

The 1961 *Sylvania* models are, like most of this year's crop, improved versions of last year's design. If we were to select a particular circuit for discussion, the single-tube, remote-control, reflex system at the receiver would be our choice for originality and ingenuity. Fig. 8 shows the simplified diagram and illustrates how a single tube performs the functions of three different stages.

To understand circuit operation, a general picture of remote function is necessary. When the remote, channel-selector transmitter is activated by the user, it sends out an 8-kc. signal picked up by the control receiver at the TV set, which initiates tuner rotation. However, there is a mechanical indexing arrangement on the rotating portion of the tuner. This has been pre-set at the time of installation so that it permits rotation to continue as the tuner skips past inactive channels, but stops rotation as soon as an active channel is reached.

The pentode section of the 6AW8 amplifies the received 8-kc. signal conventionally, and feeds it to the grid of the triode for further amplification. The twin-diode voltage doubler at the triode plate rectifies amplified signal and feeds it back to the grid as a positive d.c. bias. This causes the triode to conduct heavily enough to pull in the plate relay, but incoming a.c. signal can still vary this heavy average current. Thus the triode simultaneously acts as an a.c. signal amplifier and a d.c. amplifier-driver for the relay.

When the relay is pulled in, the motor circuit is completed through ground and the tuner begins to rotate. As it rotates through inactive channels, the indexing system closes the "homing" switch and keeps it closed. This applies an additional positive voltage to the triode grid from "B+" through R_3. This added bias becomes necessary to hold in the relay because, by this time, the remote transmitter is no longer sending out its 8-kc. signal. Thus there is no longer any positive output from the signal-detecting rectifier and doubler.

When the rotating tuner reaches an active channel, the indexing arrangement opens the homing switch. This removes all positive voltage from the triode grid, permitting the tube to cut off. The relay opens, removing power from the motor, and the tuner comes to rest on the active channel.

Westinghouse

As in the previous year, accessibility, layout, and printed-circuit serviceability distinguish this manufacturer's line. With the exception of the portable versions, all sets use step-up, isolating power transformers followed by conventional tube rectifiers. Thermistors, as noted for other manufacturers, are used in the vertical-output stages.

Zenith

This company was one of the early ones to incorporate the compensating thermistor in the vertical-output circuit. Naturally, that feature is continued in this year's receivers. For the rest, *Zenith* continues the use of conservative design practice in that all sets are hand-wired, use power transformers, and feature tested, well-established circuitry. Service technicians will be happy to hear that new *Zenith* portables incorporate removable bottom plates on their cabinets. This makes it possible to perform much under-chassis troubleshooting without so much as having to pull the chassis out of its cabinet.

As a step in the direction of improved reliability, a newly designed flyback transformer is being used. Shown in Fig. 9, this unit is reported to be outstandingly immune to failure. The alkyd cup, indicated by the pencil, is the result of a new encapsulating process. It is supposed to be effective in virtually eliminating any chance of arcing and corona. It also prevents deterioration from dust and aging. Burned-out windings due to external shorting are still possible, of course, but at least such defects won't lead to small conflagrations in the high-voltage cage.

Conclusion

In perspective, the thought occurs that the title of this article might more correctly have referred to "design impovements" rather than to "new designs." However, that would have flouted the annual tradition we have pursued for the past eight years. Nevertheless, we may look forward to 1962 with some optimism.

The possibility is good that transistors will be in much more widespread use. The modestly accelerating rate of color-TV acceptance may also bring us to the point where we begin to see a boom in color. With wider use of transistorized and color sets, there will be more room for experimentation with circuitry. It is not unreasonable to expect that, when we review the 1962 models, there will indeed be a worthwhile number of new designs as against mere improvements, no matter how commendable the latter may be. —30—

The R. F. Plasma Torch

(*Continued from page* 31)

1. The local temperatures attained with a given power input are relatively high. Compare for instance the temperature reached with a 250-watt soldering iron versus those attained by 250 watts in the plasma torch. This suggests the fusing or welding of high melting point metals, the only limit being the power available for a given cross-section of material.

2. Contamination can be controlled or prevented by selection of a suitable gas to be used as a fuel. Oxidation can be controlled. Closed systems can theoretically be engineered since the gas may be re-used over and over again. Acting simply as an energy transfer medium, it does not require replacement.

3. The efficiency of a system of this type is somewhat higher than might be expected. Measurements seem to indicate that the efficiency approaches that of induction or dielectric heating apparatus where 50-55 per-cent of the electrical input energy to the plate of the tube appears as actual heat in the load.

4. Once a plasma is generated there are several methods of adding excess energy to the system to force the temperatures to extremely high levels. In the torch described above it is possible that under 1 per-cent of the gas is electronically active and the rest performs no useful purpose. In fact, the excess inactive gas probably cools the flame and scatters the recombining ions. For instance, improved coupling of the electrical energy may improve the system.

As the radio-frequency types of plasma torch described above are strictly experimental they may or may not supplant other devices in the future. The *Amperex Electronic Corporation* does not manufacture plasma torches but serves only as a supplier of electronic tubes to the communications field and to industry in general. The application work described was done to stimulate new uses of electronic tubes.

Conclusion

It may be concluded that plasma research now being conducted in many centers by the world's top scientists will produce many new and beneficial facilities in all branches of industry.

These plasmas, in the form of ionized gases which pervade vast volumes of our atmosphere and which we have used for almost a century in our gaseous electronic tubes, have in the last few years, taken on a new importance.

Generation of high temperatures for industrial processing, extremely high energy densities for the production of controlled nuclear energy, plus the possibilities of plasma engines for space transportation, are all fields which will benefit greatly in future years from the wide research now being conducted in plasma physics. -30-

83 YX 929. Stereo Tape Record-Play Preamp Kit. $79.95 (less case)

One of the many great Knight-Kit stereo component kits. Professional quality; superb performance with virtually any 3-head tape transport; separate dual-channel recording and playback preamps; permits tape monitoring, sound-on-sound and echo effects. Packed with quality features for every possible stereo and monophonic function...

Simply these and 59 knight A PRODUCT a pleasure to build...

83 YX 928. FM-AM Hi-Fi Tuner Kit. $49.95

Typical Knight-Kit hi-fi value—incomparable at the price. With AFC, tuned RF stage on FM, multiplex jack. Straight FM tuner kit also available at $38.95. For deluxe Stereo FM-AM and FM tuner kits, see the Allied catalog...

The most satisfying do-it-yourself experience awaits you when you build a Knight-Kit! You'll marvel at the sheer ease of assembly, absolutely assured by exclusive "show-how" manuals, wall-sized picture diagrams, step-by-step do-and-check instructions, pre-cut wire, "visi-packed" parts and an engineering perfection that eliminates guesswork. You'll get perfect results. You'll enjoy with pride a true custom-built electronic product, professionally engineered and styled—the best you can own. And to top off your pleasure, you'll save substantially at the unbeatable Knight-Kit price...

83 YX 927. 20-Watt Stereo Hi-Fi Amplifier Kit. $39.95

Biggest bargain in quality Stereo hi-fi. Has special clutch-type dual-concentric level control; simplified control facilities; DC preamp filaments. Similarly styled 32-Watt Stereo Amplifier Kit with full frequency center channel available at a low, low $59.95...

83 YU 934. Deluxe 70-Watt Stereo Hi-Fi Amplifier Kit. $119.95

Super-power to drive any of today's speakers, a do-it-yourself stereo masterpiece, featuring: special "blend" control; full-range center channel; tape-source monitor; dual phasing switches; Stereo paralleling switch. For deluxe 40-watt Stereo amplifier at only $76.95, and 60-watt Stereo amplifier, see the Allied catalog...

83 YX 712-2. Superhet Citizen's Band Transceiver Kit. $79.95

Dual-conversion for highest sensitivity and selectivity; crystal-controlled operation on any 2 channels, plus manual tuning. Another Knight-Kit Citizen's Band Transceiver is available at an amazing low $39.95—see the Allied catalog for full details...

Great!

other money-saving

Knight-kits®

OF ALLIED RADIO

and you own the best

83 YX 258. 4-Band "Span Master"® Receiver Kit. $25.95

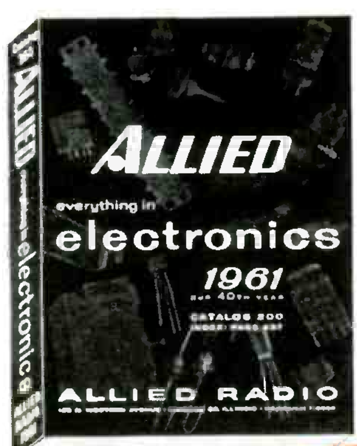
Fabulous performer for world-wide reception; thrilling shortwave adventures, plus fine Broadcast; band-switching, 540 KC to 30 MC; with cabinet. For additional receiver kits, radio-intercom, clock-radio, transistor radios, intercom systems, electronic labs and other great hobbyist Knight-Kits, see the Allied catalog...

money back guarantee

Every Knight-Kit is unconditionally guaranteed to meet our published specifications for performance or your purchase price is refunded in full.

only $2 down

It's easy to buy any Knight-Kit: only $2 down on orders up to $50; $5 down up to $200; $10 down over $200—up to 24 months to pay.



83 Y 125. Electronic VTVM Kit. $25.75

High sensitivity general-purpose VTVM; 11 meg input resistance; balanced-bridge circuit; 4½" meter. One of many fine instrument kits including 5" scopes, AC VTVM, tube checkers, signal tracer, audio generator, sweep generator, and others, described in detail in the Allied catalog...

Featured

IN THIS VALUE-PACKED 1961

444-PAGE ALLIED CATALOG

Send coupon today for the 1961 Allied electronics catalog (the world's biggest), featuring the complete Knight-Kit line. See the best in electronic kits—save on *everything* in Electronics. Send for your FREE copy now!

free *send coupon today!*

ALLIED RADIO, Dept. 10-B1
100 N. Western Ave., Chicago 80, Ill.

☐ Send Free 1961 Allied Catalog No. 200

Name____________________
PLEASE PRINT

Address____________________

City__________ Zone____ State______

sold exclusively by

also available in Canada

ALLIED RADIO

pioneer in electronic kit development

our 40th year

An Intercom Adapter

By **ROBERT A. GARDENGHI**

Convert any audio amplifier to an intercom unit by simply adding switch, output transformer, speaker.

HAVE you ever been in dire need of an intercom and found yourself casting a wistful eye at your audio amplifier? Or have you ever needed temporary two-way communication for such projects as orienting your TV antenna, etc.? If you have ever faced such a dilemma, build this intercom adapter by means of which you can instantly convert just about any audio amplifier into an intercom—either temporarily or permanently. You can even convert your hi-fi amplifier into a temporary intercom. The author has used the adapter successfully with a 20-watt hi-fi amplifier, a three-tube a.c.-d.c. phono amplifier, and a tiny, 200-milliwatt transistor amplifier.

The adapter is simplicity itself and consists of a d.p.d.t. switch and matching transformer. When connected as shown in Fig. 1, the device will alternately connect one speaker to the output of the amplifier and the other to the input, depending on the position of the d.p.d.t. switch. Whenever a given speaker is connected to the amplifier input it serves as a microphone. Thus, operation of the d.p.d.t. switch allows one to talk or listen, as desired.

Construction of the adapter requires no special precautions and details may be varied to suit the builder. The schematic of the adapter involves that portion of the diagram enclosed within the dotted box in Fig. 1. In the original model, the switch, transformer, and suitable terminals were mounted on a small piece of wood. An ordinary toggle switch was used but a spring-return type may be used to provide push-to-talk operation.

The transformer specs are not critical and almost any type of output transformer may be used. The one used by the author was removed from an old a.c.-d.c. receiver that had outlived its usefulness.

If a push-pull output transformer is used, disregard the center tap on the primary. Irrespective of the transformer used, the important thing is to connect it properly, *i.e.*, what was the primary or plate side (high-impedance winding) of the transformer is now used as the secondary and connects to the input of the amplifier while the secondary or voice-coil side (low-impedance winding) now serves as the primary.

When connecting the adapter to the amplifier, be sure to connect the common terminal to the "ground" side of the input and output of the amplifier. Shielded wire should be used for the lead to the amplifier input, making sure that the shield is connected to the common terminal. No special wire is necessary for the other connections. Ordinary a.c. cord or bell wire is convenient and economical. Obviously, the adapter should be located near the amplifier to simplify connection and conserve wire.

Although the device is practically fool-proof, a word of caution is in order in the event that the adapter is used with an a.c.-d.c. amplifier. Such equipment can be *lethal* since one side of the a.c. power line is connected to the amplifier ground. When using such equipment, it is good practice to polarize the power plug so that the ground side of the power line is connected to amplifier ground. This can be easily checked by connecting a neon test lamp between the amplifier chassis and an external ground. If the lamp lights when power is applied, the chassis is "hot" and dangerous. Reverse the plug to extinguish the lamp. This will indicate that the chassis is at ground potential and, hence, safe. –30–

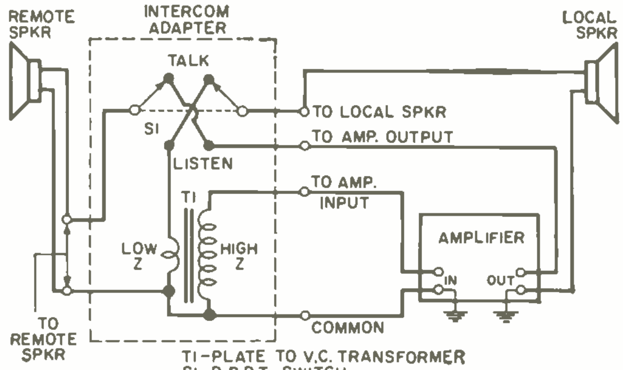


Fig. 1. The adapter unit, shown here within the dotted box, is seen to consist of an inexpensive single-ended output transformer, a double-pole, double-throw switch, and an extra speaker. Connections to the audio amplifier are indicated here.

Manufacturers' Literature

1961 CATALOGUES

Available free on request through the mail are the 1961 catalogues of the following electronics parts dealers: *Allied Radio Corp.*, 100 N. Western Ave., Chicago 80, Ill.; *Lafayette Radio Electronics Corp.*, 165-08 Liberty Ave., Jamaica 33, N.Y.; and *Radio Shack Corp.*, 730 Commonwealth Ave., Boston 17, Mass.

The catalogue of *Harvey Radio Co., Inc.*, is available to "industrial buyers, audio engineers, and other interested individuals" at *Harvey's* headquarters, 103 W. 43rd St., New York 36, N.Y.

The catalogue of *Federated Electronics* is available from any of its eight warehouses, located in Anaheim, Calif.; Shrewsbury, Red Bank, N.J.; Mountainside, N.J.; Newark, N.J.; Allentown, Pa.; Easton, Pa.; Los Angeles, Calif., and New York, N.Y.

The catalogue of *Harrison Radio Corp.* is available at this company's quarters at 225 Greenwich St., N.Y. 7, N.Y., or at Hillside Ave. and 145th Street, Jamaica, Long Island, N.Y.

TRANSISTOR MANUAL

General Electric Co., Semiconductor Products Dept., Kelley Bldg., Liverpool, N.Y. has published a fifth edition of its "Transistor Manual," a handy reference on transistors and application principles. Copies cost $1.00.

TUBE INFORMATION SERVICE

B & K Manufacturing Co., Dept. B, 1801 W. Belle Plaine, Chicago 13, Ill. has announced a "New Tube Information Service" which provides data on new tube types as they are announced by tube manufacturers. Issued every three months, this service is available to owners of *B & K* tube testers on annual subscription of four issues at $2.50 per year, or $1.50 each for individual copies.

B & K also has issued a new catalogue, No. AP-16, which describes its line of test equipment.

SERVICING-AIDS CATALOGUE

GC Electronics Co., Div. of *Textron, Inc.*, 400 So. Wyman St., Rockford, Ill. has published a colorful 64-page volume that describes this company's lines of TV and radio chemicals, alignment tools, service aids, and hardware.

AMPEREX TUBES

Amperex Electronic Corp., Advertising Dept., 230 Duffy Ave., Hicksville, Long Island, N.Y. is offering a 25-page condensed tube catalogue. Free copies may be obtained by writing on company stationery to the manufacturer.

SEMICONDUCTOR CHART

United File-O-Matic, Inc., 60 Madison Ave., Hempstead, N.Y. has published a new 68-page composite chart of semiconductors, listing more than 4000 types as well as the 38 manufacturers who make them. The chart is available without charge to subscribers to "File-O-Matic," a catalogue service for parts distributors.

BRITISH SURVEY

Heywood & Co., Ltd., Drury House, Russell Street, Drury Lane, London W.C.2, England has published a 54-page survey of the field of electronics in Great Britain. Written by Cyril C. Gee, British electronics editor, the book is entitled "The Structure and Future Prospects of the Electronic-based Industries in the United Kingdom" and is priced at 5s. plus 9d (approximately $0.80) postage.

JAPANESE TRANSISTORS

Electronic Transistors Corp., 9226 Hudson Blvd., North Bergen, N.J. has issued a new interchangeability chart which lists all Japanese-made radio transistors and the company's own American-made replacements. For a free copy, write to the company.

CBS TECHNICIAN'S HANDBOOK

CBS Electronics' Advertising Service, 100 Endicott St., Danvers, Mass. has announced a 1960 edition of *CBS* "Technician's Handbook," which covers tubes and semiconductors for technicians.

Receiving, industrial, hi-fi, special-purpose, and foreign tubes are included. The 480-page volume also provides data on transistors, crystal diodes, picture tubes, and a cross-reference chart on transistors. Price is $1.95.

BATTERY CATALOGUE

Bright Star Industries, Clifton, N. J. has released a catalogue listing eight new batteries designed specifically for transistor radio and electronic instrument service.

A feature of the new catalogue is a condensed replacement guide which lists this company's batteries for over 700 radio models made by 63 domestic and foreign manufacturers.

TRUCK-COST RECORD BOOK

International Harvester Co., 180 N. Michigan Ave., Chicago 1, Ill. is offering a new "Truck-Cost Record Book" and "Driver's Daily Report" to assist truck users in evaluating performance of their equipment.

To obtain copies, write to the manufacturer's Customer Relations Department.

CB ANTENNA

Gyro Electronics Co., 36 Walker St., New York 13, N. Y. has issued Bulletin No. T86B which describes its dual ground-plane Citizens Band antenna No. DGP-27 and a single ground-plane CB antenna, No. SPG-27.

Also described in the bulletin is a dual-conversion transmitter and receiver unit.

TV TUBE REJUVENATORS

Perma-Power Co., 3100 N. Elston Ave., Chicago 18, Ill., is offering a leaflet covering its line of "TV Tube Briteners." Models are illustrated, priced, and briefly described.

NEW FERRITE STANDARD

Ferrite Manufacturers Association, 60 E. 42 St., N.Y. 17, N.Y. has issued a new standard designated No. 34-60 and entitled "Recommended Specification for Transformer Cores of Ferro-Magnetic Oxides for Telecommunication." Copies may be obtained from the association at 50 cents each.

R.F. TEST EQUIPMENT

Telonic Industries, Inc., 60 N. First Ave., Beech Grove, Indiana has published a 60-page catalogue on r.f. test equipment. The new booklet describes this company's line of sweep generators and other equipment for laboratory or production-line applications. Copies may be requested by writing to Mr. Lou Abbott at the company. —30—

Within The Industry

(Continued from page 16)

customers in analyzing their requirements . . . *Fairchild Recording Equipment Corporation* has appointed **GEORGE ALEXANDROVISH** as chief engineer of its professional and consumer product line . . . **JOHN L. WILKES** has joined *P. R. Mallory & Co. Inc.* as assistant to the president. The new post includes administrative duties in manufacturing, marketing, and finance . . . **ROY H. OLSON** has joined *Hughes Aircraft Company.*

* * *

OTTO FRIED has been appointed manager of the electronic circuits section of *Shure Brothers, Inc.*, Evanston, Ill. Formerly chief engineer at *Knight Electronics Corp.*, Chicago, Mr. Fried also has served in the engineering departments of *Zenith Radio Corp.* and *Allied Radio Corp.* Mr. Fried is a native of Prague, Czechoslovakia and studied for two years at Charles University in that city. He holds both bachelor's and master's science degrees from the Illinois Institute of Technology. During World War II, he was a radar maintenance technician with the U.S. Army.

Mr. Fried is a member of the American Institute of Electrical Engineers, the IRE, and the Acoustic Society of America. He also belongs to Eta Kappa Nu and Rho Epsilon, honorary engineering societies.

* * *

BENJAMIN ELECTRONICS SOUND CORP. has been formed to import, manufacture, and distribute electronic sound products. Located in Corona, Long Island, N.Y., the organization will handle as its first product line the "Miracord" record changer and the "Stereotwin" cartridge, products of the *Electroacustic GMBH (Elac)* of Kiel, West Germany . . . **SARKES TARZIAN, INC.,** Bloomington, Ind. has announced formation of a new magnetic recording tape division, to produce and market magnetic recording tapes . . . **DICTOGRAPH PRODUCTS, INC.** has acquired all of the outstanding stock of *Edward P. Casey Sound Systems, Inc.*, New York, and will operate it as a wholly owned subsidiary under the name of **CASEY DICTOGRAPH SYSTEMS, INC.** . . . **GENERAL INSTRUMENT CORP.,** manufacturer of semiconductors and other electronic devices has acquired 30 percent ownership in **MATERIALS RESEARCH CORP.,** of Yonkers, N. Y., specialists in metallurgical and materials research. . . . **BLONDER-TONGUE LABORATORIES, INC.** has acquired controlling interest in **BENCO TELEVISION ASSOCIATES, LTD.** of Toronto . . . **EDO CORP.** has acquired **ELECTRIC INDICATOR CO., INC.** of Stamford, Conn. . . . **STANDARD KOLLSMAN INDUSTRIES, INC.** has formed a new subsidiary known as **KOLLSTAN SEMICONDUCTOR ELEMENTS, INC.**

-30-

Bats Bat Antenna

By **HARTLAND B. SMITH, W8VVD**

Unexpected perils of ham operation in the country.

THIS PAST SUMMER, while operating my ham station as a portable in northern Michigan, I encountered a rather strange phenomenon. I had tried to avoid BCI and TVI difficulties by keeping my ham activities as unobtrusive as possible. For this reason, I had erected an invisible transmitting antenna—a single strand of No. 28 wire, strung from the wall outside my upstairs bedroom to a tree located about 75 feet from the cottage where I was staying.

When I first put up the radiator, I refrained from pulling it tight, as I didn't wish to cause undue strain on the rather fragile appearing wire. However, after the antenna had satisfactorily withstood a number of fierce storms, I decided that I could safely remove the noticeable sag at the center of the span. When I had finished taking up the slack, the wire was literally as taut as a fiddle string.

That night, a few minutes after going to bed, I heard a rather loud twang. Something had struct my antenna. I decided that a wind-whipped tree branch must have hit the aerial. In a moment I turned over in bed, pulled the covers up a little higher over my ears and attempted to go to sleep. However, each time I'd begin to doze off, another twang would awaken me. Finally, in desperation, I hopped out of bed, took off the window screen, unhooked the antenna and let it fall to the ground.

By this time, I was wide awake. I realized that there wasn't any wind blowing and that I had been very careful to avoid tree limbs when installing the antenna. Consequently, I concluded that some air-borne creature or creatures must have been smashing into it. What kind of animals flit about at night? Why bats, of course. And the area around the Straits of Mackinac, my summer QTH, abounds in these furry little flyers. Sure enough, bats were hitting my antenna.

The following morning I put the wire up again, but I allowed enough slack to damp out any vibrations which might be started by a careless bat. From then on, I was able to sleep peacefully, without twanging interruptions. A couple of weeks later I tightened the antenna once more, just to see if the problem would arise again. It did. Needless to say, for the rest of the summer I operated with a slack wire aerial.

Most readers undoubtedly know about the wonderful radar system that makes it possible for bats to fly unscathed through a maze of wires strung in a darkened laboratory. Apparently, the rather fine wire I was using didn't reflect enough sound energy for detection by the bats. —30—

NEW for 61 FROM INTERNATIONAL

A New "Advanced Engineered" All Transistor, Crystal Controlled Short Wave Converter

AMATEURS • CITIZEN LICENSEES • CIVIL AIR PATROL

Mobilette 61, International's *new improved* all transistor, crystal controlled converter provides a "quick and easy" way to convert your car radio for short wave reception. Mobilette 61 units cover a specific band of frequencies providing a *ONE MEGACYCLE* tuning range. Mobilette units are quickly interchangeable.

Check these all new features! New and improved circuit for increased gain . . . New internal jumper for positive and negative grounds . . . New RF amplifier, mixer/oscillator . . . New separate input for broadcast and short wave antennas . . . Installs neatly under dash.

Mobilette 61 is available in a wide choice of frequencies covering the Amateur bands 75 through *6 meters,* Citizens band, *Civil Air Patrol* low band frequencies, WWV time and frequency standards.

Designed for 12 VDC, Mobilette 61 will operate on 6 VDC at reduced output.

See the Mobilette 61 at your dealer today.

Complete, ready to plug in and operate, only $22.95

Any frequency in the range 2 MC to 50 MC available on special order $25.95

International Mobilettes cover these short wave bands.

Catalog No.	Frequency
630 - 110	6 meters (Amateur) 50 - 51 MC
630 - 111	10 meters (Amateur) 28.5 - 29.5 MC
630 - 112	11 meters (Citizens) 26.9 - 27.3 MC
630 - 113	15 meters (Amateur) 21 - 21.6 MC
630 - 114	20 meters (Amateur) 14 - 14.4 MC 15 MC (WWV)
630 - 115	40 meters (Amateur) 7 - 7.4 MC
630 - 116	75 meters (Amateur) 3.8 - 4.0 MC
630 - 117	10 MC (WWV)
630 - 118	CAP (Low Band)
630 - 119	Special Frequencies 2 MC - 50 MC

MOBILETTE 61 VHF

VHF frequencies for Aircraft, 108-135 mc; Amateur and Civil Air Patrol, 144-148 mc; Two-Way Communications, 150-170 mc. Special VHF transistors in both RF amplifier and mixer circuits.

Complete $49.50

Cat. No.
630 - 120 VHF Special 100 to 170 mc
630 - 121 VHF Special 54 to 100 mc

Write for International's complete catalog of precision radio crystals, and quality electronics equipment . . . yours for the asking.

INTERNATIONAL
CRYSTAL MFG. CO., INC.

18 NORTH LEE — OKLA. CITY, OKLA.

What's New in Radio

CB COMPONENTS

Philmore Manufacturing Co., Inc., 130-01 Jamaica Ave., Richmond Hill 18, N.Y. is offering a new line of Citizens Band equipment in modular or component form, enabling the buyer to purchase equipment as needed without duplication. The units are designed to

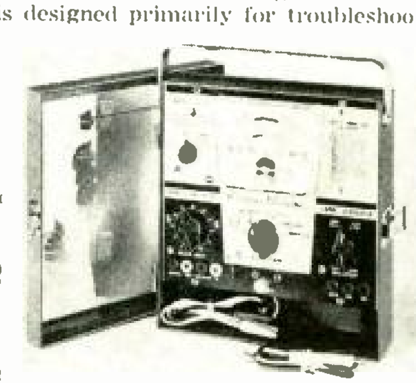
take up a minimum amount of auto dashboard space and are available in kit form or factory-wired.

Shown here is the CT-1 transmitter which provides six switch-selected crystal-controlled channels, and full 5-watt plate input power, the maximum FCC legal limit.

Also available is a CB and 10-meter converter which allows instant selection of standard broadcast or CB operation of the existing auto radio. Other units in this series include an a.c. power supply, a transistor-powered mobile supply, and a field-strength meter and load box. Full details are available from the manufacturer.

TRANSISTOR TESTER

Service Instruments Corp., (Sencore), Addison, Ill. has introduced its "Transi-Master," Model TR-110. The new instrument is designed to test quickly all transistors in their circuits with a new a.c. gain check and without the use of set-up charts. According to the company, normal circuit shunt impedances will not affect the readings. This check is designed primarily for troubleshoot-



ing, and therefore indicates on the meter as "good" or "bad." As a further aid in troubleshooting, the "Transi-Master" provides a signal tracer for locating troubles from speaker to antenna, a 12-volt voltmeter for testing batteries and voltage dividers, and a 50-ma. meter for monitoring the current drawn by the entire transistor set or a single stage.

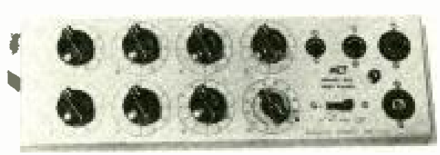
The "Transi-Meter" also serves as a d.c. transistor checker for out-of-circuit testing. It also has a direct reading *beta* scale useful for matching transistors in audio work.

COMBINATION FLASHLIGHT-TESTER

Selcin Corp., Box 88, Medford 55, Mass. has announced its "Flash-Test," a new combination continuity-tester and flashlight. In addition to providing regular "spotlight coverage," the new device also tests continuity of appliances and fuses. Simply designed, it is said that even children can use it with ease. An additional use, as a signal light with extension cord for boats, trailers, and in other applications, also is suggested by the manufacturer of the unit.

B&K TUBE-TEST PANEL

B&K Manufacturing Co., 1801 W. Belle Plaine, Chicago 13, Ill. has announced its new Model 610 test panel



that enables owners of the company's "Dyna-Quik" tube testers to test all tubes. By adding the new Model 610 to the firm's Model 500, 550, or 650 tube testers, the user retains the advantage of fast, multiple-socket testing, and gains freedom from obsolescence.

The new accessory test panel comes in three types, completely wired and ready to install. For further information write to the manufacturer requesting Bulletin No. A8610.

SSB STRIP RECEIVER

Westrex Corp., a division of *Litton Industries*, 540 W. 58 Street, N.Y. 19, N.Y. has introduced a single-sideband strip receiver that provides flexibility, modular construction, high stability, and low IM distortion. The basic receiver is designated as Type 600, and has continuous coverage in the 1.7 to 32 mc. range. Basic to the system are the r.f., i.f., a.f., and power-supply modules. Additional modules are available for multiplexed voice signals, circuit testing, frequency shift multiplexed printer signals, a.f.c. frequency synthesizer, and r.f. module switching. A module also is available for diversity combining.

Modules may be rack or cabinet mounted. Detailed specifications are available from the manufacturer.

TWO-WAY RADIO

Gonset Div., Young Spring & Wire Corp., 801 S. Main St., Burbank, Calif. has made available a new 2-way radio, the Model G-150 "Business Communicator." The set operates within the 150-174 mc. frequency range assigned by the FCC for a wide variety of business and professional services. The same basic G-150 unit is used for base station and mobile installations. The equipment is self-contained, and includes transmitter, receiver, power supply, and loudspeaker. The transmitter is amplitude modulated. The receiver is a double-conversion superheterodyne type. Both are crystal-controlled so that manual tuning is not involved. Operation is full press-to-talk, controlled by a switch on the microphone. No licenses are required to use the equipment. A booklet, giving full details, is available free from the manufacturer.

PERSONAL P.A. SYSTEM

J. B. Moore Laboratories, Inc., Box 606, Opa-Locka, Fla. has introduced an 11-ounce "personal" public-address device that may be worn on the person to handle group meetings up to 100 persons. Powered by a 9-volt mercury battery, the "PPA" uses a transistorized circuit, and uses a microphone that is mounted on an extendable boom which recesses into the case when the unit is not being used.

"PPA" is said to amplify the voice 10 times. It drains 15 ma. from the battery. Estimated useful battery life, in intermittent service, is stated as nearly 150 hours.

HAM TRANSMITTER KIT

Heath Co., Benton Harbor, Mich. announces a new "Heathkit" amateur radio transmitter in kit form. Designated the DX-60, it is the successor to this company's DX-40. Features include a built-in low-pass filter for harmonic suppression; neutralized final for high stability; grid-block keying; and easy access to crystal sockets on the rear chassis apron. A front-panel switch selects any of four crystal positions, or external v.f.o. The modulator and power supply are built in, and operation is by a single-knob bandswitch with *pi*-network output.

The unit covers ham bands from 80 through 10 meters and may be used with carrier-controlled phone or on c.w. The DX-60, which has a maximum power input of 90 watts, also may be run at reduced power for operation by holders of novice ham tickets.

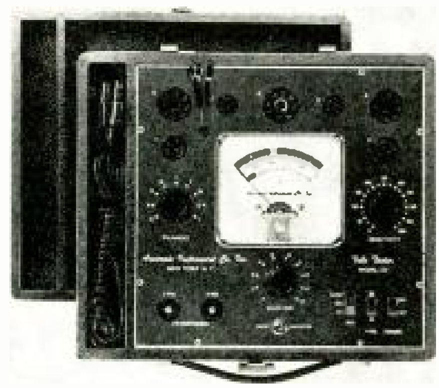
MINIATURIZED POWER SUPPLIES

Victory Electronics, Inc., 50 Bond St., Westbury, N.Y. has announced a new line of power supplies designed to meet the demands of transistorized equipment, and available in modular form. In bringing out the new line, the recently established company claims that it has achieved "marked advances in the state of the art in regard to miniaturization, transistorization, and lightweight but rugged construction."

Among the products offered are: a transient voltage protector; the "Varia-Volt," a high-voltage supply for use in specialized instruments; the "Varia-Volt King," an ultra-miniature d.c.-d.c. converter for use with infrared systems; an inverter for changing d.c. to regulated 400-cycle a.c.; a frequency changer for converting d.c. to unregulated 400-cycle a.c.; a dual output unit; a variant for changing a.c. to regulated d.c.; a dynamotor and d.c. to d.c. converter; and a high-voltage, high-power unit. For full details, contact the manufacturer.

TUBE TESTER

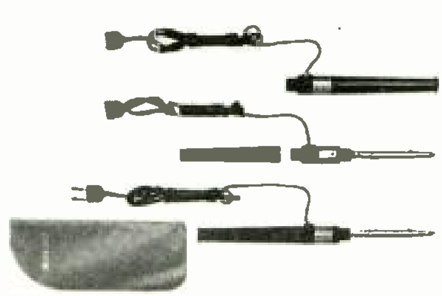
Accurate Instrument Co., Inc., 9 W. Prospect Ave., Mt. Vernon, N.Y. announces its Model 151 tube tester, first



of a new line of test equipment available at radio parts jobbers. According to the manufacturer, the new device will test over 1000 tube types for shorts, leakage between all elements, filament continuity, and emission. Circuit design enables the use of a single rotary switch. Types handled by the tester include 7-pin miniature, octal, loctal, 9-pin noval miniature, and new T-9. Five-year tube data is included free.

HANDY SOLDER PEN

L. I. Electro-Labs, Inc., a subsidiary of *Progressive "Edu-Kits," Inc.*, 1186 Broadway, N.Y., has announced a new solder pen, Model A1000. This tool is a



30-watt pencil-type soldering iron which features a removable handle that may also be used to cover the tip and barrel. This is said to permit the iron to be carried safely, even while hot.

60-WATT TRANSMITTER

EICO, 33-00 Northern Blvd., L.I. City 1, N.Y. has brought out a compact, rugged 60-watt c.w. transmitter, available either as a kit or in factory-wired and tested form. Designated as Model 723, it features a one-knob bandswitch covering 80, 40, 20, 15, and 10 meters;

a one-knob "off-standby-tune-transmit" switch; a panel meter which may be switched into either grid or plate circuit of the final; and a modulator accessory socket for modulator input, antenna relay, v.f.o. power take-off, and emergency power input.

Effective TVI suppression is achieved through filtering and by-passing. Mounted on a copper-plated chassis, the unit weighs about 15 pounds.

TRAVELLING-WAVE ANTENNAS

Channel Master Corp., Ellenville, N.Y. announces development of two new travelling-wave antennas for all-channel, far-fringe area reception. These two antennas are designated the Super 10 T-W, and the Super 8 T-W. The former is a powerful 10-element antenna, consisting of six of this manufacturer's T-W hairpin-driven dipoles with four parasitic low-band and colinear high-band elements. According to the manufacturer, this combination produces new performance highs, both in gain and in front-to-back ratios.

The Super 8 T-W features four driven and four parasitic elements, said to be "perfect for those locations not sufficiently remote to justify the use of a Super 10 T-W." Literature on both types is available from the manufacturer.

COMPACT TUBE TESTER

Lafayette Radio, 165-08 Liberty Ave., Jamaica 33, N.Y. has introduced a portable tube tester designed for field use

by the technician. Known as the TE-15, it measures 8⅛" deep by 9¾" wide by 2⅜" high and weighs only six pounds, yet it can test most of the tube types employed in radio, high fidelity, and television. Sockets accommodate 7-pin miniature, 9-pin miniature, octal base, loctal base, noval, and subminiature types. An alligator clip lead enables testing tubes with top caps.

Switches enable testing for shorted elements, cathode emission, and filament continuity. The large meter is calibrated from 0 to 100, and has a red-green "replace-good" scale, plus a special scale for checking diodes. Tube charts and test-setting data are contained in a slide-out tray.

S.W. CONVERTER

International Crystal Mfg. Co., Inc., 18 North Lee, Oklahoma City, Okla. has announced its "Mobilette 61," a broadcast-to-short-wave converter for standard automobile radios.

Using three transistors and crystal-controlled, the device may be installed

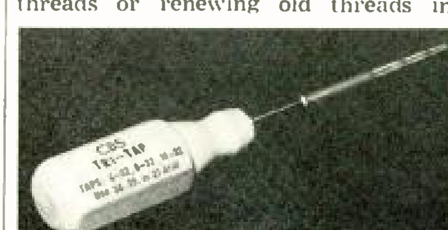
under the dashboard. A single switch places the unit in or out of operation. When not in use, the "Mobilette 61" allows the automobile radio to operate in the standard broadcast range. The new converter permits reception in specific portions of six amateur bands, the 27-mc. class D Citizens Band, 10- or 15-mc. WWV time broadcasts, and low-band Civil Air Patrol.

IN-CIRCUIT TESTER

Mercury Electronics Corp., 77 Searing Ave., Mineola, N.Y. has introduced its Model 600 tester which will check all power rectifiers (selenium, germanium, silicon, copper oxide, and so on) without disconnecting the rectifier from the circuit. An instant reading is provided when the test leads of the instrument are connected across the rectifier, and a test-switch is pressed. The instrument is furnished with a $4\frac{1}{2}$-inch meter with 3-color scales.

"TRI-TAP" TOOL

CBS Electronics, Danvers, Mass. has announced a new tool for tapping new threads or renewing old threads in



metal or plastic. Known as the "Tri-Tap," the tool combines three popular tap sizes: 6-32, 8-32, and 10-32. It is available through distributors of *CBS* tubes.

COIL TUNER REPLACEMENT KIT

Standard Kollsman Industries, Inc., 88-08 45th Ave., Elmhurst 75, N.Y. is offering a new kit, containing popular *Standard Coil* field replacement parts used by service technicians for *Standard* tuners manufactured from 1947 through 1957. Designated as Model 31T-3890, the kit contains mechanical and electrical parts to be used in conjunction with Section II of the *Standard* Cross Reference Guide.

For additional details and price on this new tuner replacement kit, consult your local distributor or write to the manufacturer direct at the Elmhurst address. —30—

PHOTO CREDITS

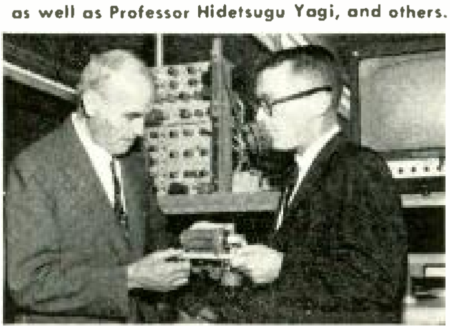
Page	Credit
Cover	Dick Nodel
30, 31	Ampex Electronic Corp.
50, 51	Allied Radio Corp.
60, 61	Jim Gardner
96	Nassau Radio Club Photo
76	Lafayette Radio

Answer to "Yardstick Quiz" appearing on page 96

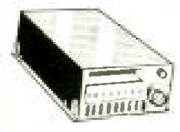
1. L	12. U
2. D	13. N
3. S	14. H
4. A	15. Q
5. O	16. C
6. I	17. V
7. K	18. M
8. R	19. E
9. B	20. G
10. W	21. P
11. F	22. J

23. T

Charles P. Ginsburg (right) of Ampex Corp., who led the development of the "Videotape" television recorder, became the first native-born American to receive the "Valdemar Poulson Gold Medal" from the Danish Academy of Technical Sciences. Ginsburg and Ampex founder and chairman of the board Alexander M. Poniatoff are shown with the unique recording head assembly which made practical the recording of TV sound and picture on magnetic tape. Behind them is the original prototype of the "Videotape" recorder, built in 1956 and still used daily by Ginsburg in his research laboratory. The Danish award was established in 1939 to honor Valdemar Poulsen, discoverer of magnetic recording. Past award recipients include Sir Robert Wattson-Watt, Dr. E. F. W. Alexanderson, Sir Edward Appleton, Dr. Balthazer van der Pol, Dr. Harald Trap Friis, as well as Professor Hidetsugu Yagi, and others.



ARC-3 RECEIVER!



Complete with All Tubes Exc. Used $16.95

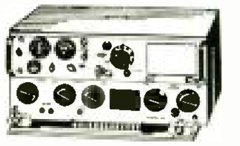
Like NEW $21.50
Used $14.95

Crystal-controlled 17-tube superhet, tunes from 100 to 156 MC., AM., on any 8 pre-selected channels. 28-volt DC power input. Tubes: 1-9002, 6-6AK5, 1-12SH7, 3-12SG7, 1-9001, 1-12H6, 2-12SN7, 1-12SL7, 1-12A6.

ARC-3 TRANSMITTER

Companion unit for above, tunes 100 to 156 MC on any 8 pre-selected channels, 9 tubes, crystal controlled, provides tone and voice modulation. 28V DC Power input. Complete with all Tubes: 3-6V6, 2-832A, 1-12SH7, 1-6J5, 2-6L6. Exc. Used .... Only $16.95
Like new condition $22.50

AN/ART-13 100-WATT XMTR



11 CHANNELS
200-1500 Kc
2 to 18.1 Mc

$48.50

Complete with Tubes

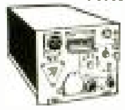
Famous Collins Autotune Aircraft Transmitter, AM, CW, MCW. Quick change to any of ten preset channels or manual tuning. Speech amplifier/clipper uses carbon or magnetic mike. Highly stable, highly accurate VFO. Built in Xtal controlled calibrator. PP813's modulate 813 in final up to 90%, class "B." A Real "HOT" Ham buy at our low price! Orig. cost $1800. Exc. Used $48.50
0-16 Low Freq. Osc. Coil for ART-13 .... 7.95
24V Dynamotor for ART-13 .... 11.95
Same as above less meter 39.50
We carry a complete line of spare parts for above.

POWER SUPPLY for BC-620, 659, available for 6, 12 or 24 Volts DC. Specify $8.95

BC-659 TRANSMITTER & RECEIVER

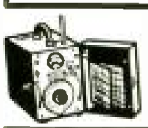
27 to 38.9 Mc. F.M. Two preselected channels crystal controlled. 5 watts. Complete with speaker, tubes. Used $10.95
Less tubes, used $5.95

NAVY AIRCRAFT RADIO RECEIVER



MBB CRV 46151—190 to 9050 Kc in 4 bands. 6 Tube Superhet communications receiver, with local and remote tuning, band change, sharp and broad tuning, AVC, CW, illuminated dial. Complete with tubes and dynamotor. BRAND NEW $34.50
Like New $26.50
Power Supply 110 V. AC. Wired $8.50

BC-906 FREQ. METER—SPECIAL



Cavity type, 145 to 235 Mc. BRAND NEW, complete with antenna. Manual included. OUR LOW PRICE $10.88

SCR-625 MINE DETECTOR

Complete portable outfit in original packing, with all accessories. Brand New $27.50

MICROPHONES

Model	Description	Excellent Used	BRAND NEW
T-17	Carbon Hand Mike		$5.45
T-30	Carbon Throat Mike	$ .34	.74
T-45	Army and Navy Lip Mike		1.25
TS-9	Handset		3.88
TS-11	Handset		3.95
TS-13	Handset		4.25
RS-38	Navy Type		4.75

HEADPHONES

Model	Description	Excellent Used	BRAND NEW
HS-23	High Impedance	$2.19	$4.49
HS-33	Low Impedance	2.69	4.59
HS-30	Low Imp. (featherwt.)	.90	1.65
H-16/U	High Imp. (2 units)	3.75	7.95

TELEPHONICS—600 ohm Low Impedance HEADSETS BRAND NEW. PER PAIR $3.25
CD-307A Cords, with PL55 plug and JK26 Jack .... .99
Earphone Cushions for above—pair .... .50

EE-8 ARMY FIELD PHONES. Excellent condition checked out, perfect working order, complete with all parts less battery. Each $12.95

TG-34A CODE KEYER

Self-contained automatic unit, reproduces code practice signals recorded on paper tape. By use of built-in speaker, provides code-practice signals to one or more persons at speeds from 5 to 25 WPM.
Checked out, exc. used $18.95
Single Reels of Tape, Each $1.85
BRAND NEW $22.50

5-TUBE AMPLIFIER

Made by Pioneer Instrument Co. Uses 2—6SN7, 1—6N5, 2—6H6 tubes.
BRAND NEW .... VERY SPECIAL $2.49

STANDARD TUBES

Removed from Brand New Gov't Equipment

RECEIVING					
6AG5	.35	12SG7	.75	807	.95
12AT7	.45	6J5	.65	813	6.95
6AK5	.40	6H6	.55	814	2.25
6C4	.25	6SL7	.85	815	2.15
6AL5	.38	12A6	.45	826	.44
6AC7	.55	SPECIAL PURP.		1625	.29
6J6	.32	2C39	3.50	4X-150	5.95
6V6	.65	3E29	4.25	6072	2.50
				1P25A	7.95

BC-605 INTERPHONE AMPLIFIER BRAND NEW .... Each $4.95

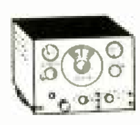
234-258 MC RECEIVER

AN/ARR-2

BRAND NEW 11-tube UHF Tunable Receiver with schematic. Only a few at this low price!
Complete with tubes $8.88

Send Name, Address on Post Card for FREE CATALOG of Wonderful Surplus Buys!

TS-16/APN TEST SET



For aligning and calibration of radio altimeters. May be used to check calibration of count or circuits and modulator sweep freq. and bandwidth of transmitter. Audio-oscillator range: 340 to 7250 cycles. 13/14 V.DC input. Complete with tubes, connecting cables, instruction summary. BRAND NEW ... $9.95

BC-603 FM RECEIVER

20 TO 27.9 MC.
Excellent Used $14.95
BRAND NEW $18.95

10-channel, pushbutton or continuous tuning. Complete with speaker, squelch and ten tubes: 3-6AC7, 1-6J5, 2-12SG7, 1-6H6, 1-6V6, 2-6SL7.
EXTRA SET OF 10 TUBES FOR ABOVE brand new in original boxes $3.95
FT-237 Mounting Base for BC-603 Brand New $5.95
12 or 24V Dynamotor for Above. Exc. Used $4.25 .... Brand New $5.50
BC-683 FM Receiver, 27 to 38.9 Mc. Complete with all tubes. Like New $33.33
BC-604 TRANSMITTER—Companion unit for BC-603 Rcvr above. With all tubes. BRAND NEW $6.95
We carry a complete line of spare parts for above.

SPECIAL! BC-603 FM RCVR CONVERTED FOR ANY FREQ.—30 TO 50 MC.

BRAND NEW! Checked out, perfect working condition, ready for operation. Specify Frequency desired (between 30-50 Mc) when ordering $27.50

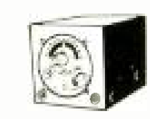
AC POWER SUPPLY FOR BC603, 683 Interchangeable, replaces dynamotor. Has On-Off switch. NO RECVR. CHANGE NEEDED. Provides 220 VDC @ 80 Ma. 24VAC @ 2 Amps $9.25
Complete 240-page Technical Manual for BC-603, 604 .... $3.15

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. Input 115 V 60 cy. LIKE NEW $69.50
Tuning Units: TN16, TN17, TN18 .... each $39.50
TN19 .... each $89.50

RECEIVER SPECIALS!

BC-312 MOBILE RECEIVER 6 Bands, 1500 Kc to 18 Mc. With Tubes and 14V Dynamotor. Exc. Used $59.50
BC-342 RECEIVER 1.5 to 18 Mc. AC only. Exc. Used $69.50
BC-348 SUPERHET Receiver 200 to 500 Kc and 1.5 to 18.00 Mc. Voice, tone, CW. Self-contained dynamotor for 24 VDC. Like NEW $69.50

BC1206-C BEACON RECEIVER



195 to 420 Kc. made by Setchel-Carlson. Works on 24.28 volts DC. 135 Kc. IF. Complete with 5 tubes. Size 4" x 4" x 6". Wt. 4 lbs. BRAND NEW $9.99
Brand New, less tubes $5.95
USED, with tubes 5.95
USED, less tubes 2.95

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-Recever, complete with all 18 tubes, top rack and metal case.
COMBINATION. Exc. Used $29.50

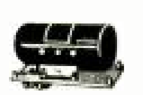
DYNAMOTOR ASSEMBLY

Very fine unit, made by Collins Radio. Consists of TWO Dynamotors mounted on filter base.

	INPUT	OUTPUT
Dynamotor #1	12VDC @ 3.8A	220VDC @ 100 Ma.
Dynamotor #2	12VDC @ 9.9A	400VDC @ 180 Ma.

BRAND NEW, in original packing, shpg wt 29 lbs.
OUR LOW PRICE $7.95

MOBILE-MARINE DYNAMOTOR



Model DM35

Input 12V DC. Output: 625 V DC @ 225 Ma, for press-to-talk intermittent operation. Shpg. wt. 14 lbs.
OUR LOW PRICE, BRAND NEW $8.95

OTHER DYNAMOTOR VALUES:

Type	Input	Output	Excellent Used	BRAND NEW
DM-25	12V 2.2A	250V .050A		$4.50
DA-1A	28V 1.6A	230V .100A		3.25
DM-28	28V	224V .07A	2.75	4.75
DM-32A	28V 1.1A	250V .05A	2.45	4.45
DM-33A	28V 5A 28V 7A	575V .16A 540V .25A	1.95	3.75
DM-34D	12V 2A	220V .080A	4.15	5.50
DM-53A	28V 1.4A	220V .080A	3.75	5.45
DM-64A	12V 5.1A	275V .150A		7.95
PE-73C	28V 20A	1000V .350A	8.95	14.95
PE-86	28V 1.25A	250V .050A	2.75	3.85

BD-77 DYNAMOTOR Input 14V @ 39A. Output 1000V @ .350A with starting solenoid, Filter Box and Mounting Base .... Like New $14.95

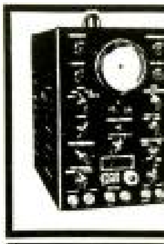
SCHEMATIC DIAGRAMS For any equipment on this page, each .. 65c

Please include 25% Deposit with order—Balance C.O.D. or Remittance in Full. 50c Handling Charges on all orders under $5.00. All shipments F.O.B. Our Warehouse, N.Y.C. All Merchandise subject to Prior Sale and Price Change.

G & G RADIO SUPPLY CO.

Telephone: CO 7-4605
51 Vesey St. New York 7, N. Y. — 75-77 Leonard St. New York 13, N. Y.

TS-100AP 'SCOPE



(WORTH $750)
OUR LOW PRICE $29.50

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 115 V 50 to 1000 cycles AC. Excellent used, like new, with all tubes including crystals and C.R. Tube.
BRAND NEW $59.50

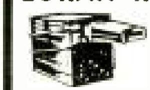
FAMOUS BC-645 TRANSCEIVER

15 Tubes 435 to 500 MC

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—WE 316A. Now covers 460 mc. BRAND NEW. Brand new BC-645 with tubes, less power supply in factory carton. Shipping weight 25 lbs. SPECIAL! $19.50
PE-101C Dynamotor, 12/24V input $7.95
UHF Antenna Assembly 2.45
Complete Set of 10 Plugs 5.50
Control Box 2.25

SPECIAL "PACKAGE" OFFER: BC-645 Transceiver, Dynamotor and all accessories above. COMPLETE, BRAND NEW, While Stocks Last $29.50

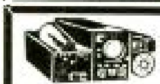
LORAN R-65/APN-9 RECEIVER & INDICATOR



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 $1200.00. Our Price $79.50
Used, less tubes, crystal and visor, but with 3BP1 C.R. tube $29.50
28 Volt Inverter Power Supply, New .... P.U.R.
Shock Mount for above $2.95
Circuit diagram and connecting plugs available.
We carry a complete line of spare parts for above.

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, complete with tubes. Exc. used $49.50
Receiver-Indicator as above, BRAND NEW $88.50
28V Inverter Power Supply, New .... P.U.R.
Shock Mount for above $2.95
We carry a complete line of spare parts for above.

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 Sup. 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. Excellent Used, less tubes $5.95
MD-7 MODULATOR for T-23, complete with 4 tubes. LIKE NEW $9.95

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 $5.95

SCR-274 COMMAND EQUIPMENT

ALL COMPLETE WITH TUBES

Type	Description	Used	Like NEW
BC-453	Receiver 190-550 KC	$12.95	$14.95
BC-454	Receiver 3-6 Mc	10.45	12.45
BC-455	Receiver 6-9 Mc	11.50	13.95

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

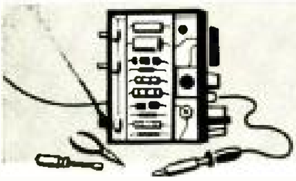
BC-457 TRANSMITTER—4-5.3 Mc. complete with all tubes and crystal, BRAND NEW .. $8.95
BC-458 TRANSMITTER—5.3 to 7 Mc. Complete with all tubes and crystal. BRAND NEW $9.75
BC-459 TRANSMITTER—7-9.1 Mc. complete with all tubes and crystal $13.95
T19 TRANSMITTER 3-4mc complete with all tubes and crystal. Exc. used $9.95
BC 696 TRANSMITTER 3-4 mc complete with all tubes and crystal. Exc. used $9.95
BC-456 Modulator .... USED 3.45 NEW 5.95
ALL ACCESSORIES AVAILABLE FOR ABOVE

WILLARD 6-VOLT MIDGET STORAGE BATTERY

3 Amp. Hour. BRAND NEW. 3⅝" x 1-13/16" x 2⅜". Uses Standard Electrolyte .... Only $2.95

2 VOLT BATTERY "PACKAGE"

1—2V. 20 Amp. Hr. Willard Storage Battery. Model #20-2. 3" x 4" x 5½" high $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



ELECTRONICS MARKET PLACE

RATE: 60¢ per word. Minimum 10 words. April issue closes February 3rd Send order and remittance to: ELECTRONICS WORLD, One Park Ave., N. Y. C. 16, N. Y.

RADIO ENGINEERING & INSTRUCTION

ELECTRONICS! Associate degree—29 months. Technicians, field engineers, specialists in communications, missiles, computers, radar, automation. Start September, February. Valparaiso Technical Institute, Dept. N, Valparaiso, Indiana.

ENGINEERING Education for the Space Age. Northrop Institute of Technology is a privately endowed, nonprofit college of engineering offering a complete Bachelor of Science Degree Program and Two-Year accredited technical institute curricula. Students from 50 states, many foreign countries. Outstandingly successful graduates employed in aeronautics, electronics, and space technology. Write today for catalog—no obligation. Northrop Institute of Technology, 1183 West Arbor Vitae Street, Inglewood 1, California.

USED Correspondence Courses and Books sold and rented. Money back guarantee. Catalog free. (Courses Bought.) Lee Mountain, Pisgah, Alabama.

FOR SALE

BUY War Surplus Direct from the Government—Jeeps; Trucks; Tractors; Boats; Airplanes; Helicopters; Walkie-Talkies; Radar; Electronics; Misc.—Send for Brody's "U.S. Depot Directory & Procedures" $1.00. Box 425-(RT), Nanuet, New York.

GOVERNMENT Surplus Receivers, Transmitters, Snooperscopes, Parabolic Reflectors, Picture Catalog 10¢. Meshna, Malden 48, Mass.

TUBES—TV and Radio tubes, Guaranteed—Save up to 80% — Write: Emkay Electronics, P.O. Box 142, Blythebourne Station, Brooklyn 19, N. Y.

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.

DIAGRAMS for repairing radios $1.00. Television $2.00. Give make, model. Diagram Service, Box 672-RN, Hartford 1, Conn.

RADIO & TV Tubes at Manufacturer's prices! 100% Guaranteed! Brand New! No re-brands or pulls! United Radio, Box 1000-W, Newark, N. J.

AUTO Radio Distributor, Selling, Servicing. Becker Blaupunkt, FM-AM, other European, American Sets. Save 30%+. Square Electronics, 150-60 Northern Blvd., Flushing, N. Y.

GOLD-Silver Detectors. Latest types. Five models including transistors. Violites for tungsten etc. Geiger counters. No finer instruments anywhere. Free information. Detectron, Dept. 2-N, Sylmar, California.

PARTY Records—Sampler, catalog $1.00. 3 different $3.00 postpaid. DRC—11024 Magnolia, No. Hollywood, Calif.

ELECTRONIC Surprise Package! 5 pounds assorted parts. $25.00 value. Only $2.98. KPJ Sales, Box 1252-A, Studio City, California.

SCHEMATICS For Repairing, Wiring, Government Surplus Receivers, Transmitters, Test Sets, $1.00 Each. Give Model. Free List Bill Slep Company, Drawer 178EW, Ellenton, Florida.

SOMETHING for sale? Place a classified ad in this section. Low-cost, fast results. It's easy.

2 Heath CB-1's. Factory Checked. 110 & 12 V. $80.00. Bunten Pharmacy 19th & Logan, Cheyenne, Wyo.

WANTED

CASH Paid! Sell your surplus electronic tubes. Want unused, Clean radio and TV receiving, transmitting special purpose, Magnetrons, Klystrons, broadcast types. Want military and commercial lab test equipment such as G.R.H.P., AN UPM prefix. Also want commercial Ham Receivers and Transmitters. For a Fair Deal write: Barry Electronics Corp., 512 Broadway, New York 12, N. Y. (Walker 5-7000).

WANTED: Teletype Equipment; Parts; Test Equipment; Collins Receivers. Cash; or Trade for New Ham Gear. Alltronics-Howard Co. Box-19, Boston 1, Mass. (Richmond 2-0048.

WANT to buy good equipment and accessories? Place a low-cost classified ad in this space.

WANTED: Military or industrial Laboratory Test Equipment. Electronicraft, Box 399, Mt. Kisco, New York.

BUY, Sell or Trade, Short-Wave Ham & Citizens Receivers, Transmitters. Trigger-W9IVJ 7361½ W. North Ave. River Forest, Ill. Chicago :Tuxedo 9-6429. Mon-Fri, 12N-9PM; Sat. 9AM-5PM.

TAPE & RECORDERS

DON'T Buy Hi-Fi components, kits, tape, tape recorders until you get our low, low return mail quotes "We Guarantee Not To Be Undersold." Wholesale catalog free. Hi-Fidelity Center, 1797NC First Avenue, New York 28, N.Y.

AMPEX, Concertone, Magnecord, Presto, Bogen, Tandberg, Pentron, Sherwood, Rek-O-Kut, Scott, Shure, Dynakit, others. Trades. Boynton Studio, Dept. RT, 10 Pennsylvania Ave., Tuckahoe, N. Y.

SELF-Hypnosis tape. New! Free literature. McKinley-Smith Co., Dept. T6, Box 3038, San Bernardino, Calif.

RENT Stereo Tapes—over 1,500 Different—all major labels—free catalog. Stereo-Parti, 811-G, Centinela Ave., Inglewood 3, California

OVER 245,000 buyers and sellers will read your ad when placed in this space. It costs only 60¢ per word; minimum of 10 words including your name and address.

HIGH-FIDELITY

DISGUSTED with "Hi" Hi-Fi Prices? Unusual Discounts On Your High Fidelity Requirements. Write. Key Electronics, 120 Liberty St., New York 6, N. Y. Cloverdale 8-4288.

RECORDERS, Components. Free wholesale catalogue. Carston 125-R, East 88. N.Y.C. 28.

ARE prices on Hi-Fi components too high? Write Dixie Hi-Fi, 12402 Connecticut Avenue, Silver Spring, Maryland.

HI-FI From Japan. Finest imported tuners, amplifiers, recorders, etc. Free catalog. KPJ Sales, Box 1252-A, Studio City, California.

PROMPT Delivery, We Will Not Be Undersold. Amplifiers, Tape Recorders, Tuners, Etc. No Catalogs, Air Mail Quotes. Compare. L. M. Brown Sales Corp., 239 E. 24 St., N. Y. 10, N. Y.

BUSINESS OPPORTUNITIES

$12,500 Yearly Income! Sell your own Tape Recordings as Freelance International Recording Representatives. Present equipment sufficient. Only $1.00 brings Copyrighted, comprehensive plan. International Recording. Box 202, Irvington, New Jersey.

SOMEONE "borrowing" your personal copy of Electronics World each month? You ought to be taking advantage of Electronics World convenient re-sale plan. Sell copies in your store . . . perform a good service for your customers . . . with no risk involved. For details, write: Direct Sales Department, Electronics World, One Park Avenue, New York 16, New York.

MISCELLANEOUS

INVENTIONS Wanted for immediate promotion! Patented, unpatented. Outright cash; royalties! Casco, Dept. BB Mills Building, Washington 6, D. C.

SHOPPING GUIDE
Classified

A HANDY GUIDE TO PRODUCTS, NOT NECESSARILY ELECTRONIC, BUT OF WIDE GENERAL INTEREST.

PHOTOGRAPHY—FILM, EQUIPMENT, SERVICES

OPTICAL—Science—Math Bargains—Request Free Giant Catalog "CJ"—144 pages—Astronomical Telescopes, Microscopes, Lenses, Binoculars, Kits, Parts. Amazing war surplus bargains. Edmund Scientific Co., Barrington, New Jersey.

FREE! New 1961 catalog of all Photographic Books Available. For your copy send postcard with name and address to Catalog Popular Photography Book Service, One Park Ave., New York 16, N. Y.

STAMPS & COINS

FREE! $1.00 worth, your choice, from first stamp selection. No strings! Adults only. Rush request now. Philatelics, Dept. EMG-F, New Paltz, N. Y.

WRITE Martin Lincoln, Electronics World, 1 Park Avenue, New York 16, N.Y. for information on how to place a classified ad in this section.

HELP WANTED

EARN Extra money selling advertising book matches. Free Samples furnished. Matchcorp, Dept. MD-21, Chicago 32, Ill.

HIGH Paying Jobs in Foreign Lands! Send $2.00 for complete scoop! Foreign Opportunities, Box 172, Columbus 16, Ohio.

BUSINESS OPPORTUNITIES

FREE Book "990 Successful, Little-Known Businesses." Work home! Plymouth-455M, Brooklyn 4, New York.

MAKE $25-$50 Week, clipping newspaper items for publishers. Some clippings worth $5.00 each. Particulars free. National, 81-DG, Knickerbocker Station, New York.

CIVIL Service Jobs—overseas, U.S.A.—mechanical, clerical, professional. List $1.00. Civil Service Bulletin, 115G Haypath Road, Plainview, New York.

MISCELLANEOUS

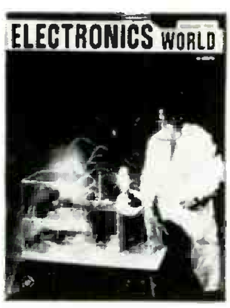
AUTHORS! Learn how to have your book published, promoted, distributed. Free booklet "ZD", Vantage, 120 West 31 St., New York 1.

PLENTY Jobs Nationwide-Worldwide. Hel. Elsinger, Box 12, Detroit 13, Mich.

"WINEMAKING," "Beer, Ale." Highest powered methods. Illustrated. $2.20. Eaton Bookstore, Box 1242-X, Santa Rosa, California.

FLYING Saucer Model $2. Walkie-Talkie $59.95. Tape Recorder $39.95, Checkwriter $29.95. Tweco, 155, Indio, Calif.

SOMEONE "borrowing" your personal copy of Electronics World each month? You ought to be taking advantage of Electronics World convenient re-sale plan. Sell copies in your store . . . perform a good service for your customers . . . with no risk involved. For details, write: Direct Sales Department, Electronics World, One Park Avenue, New York 16, New York.



INDEX OF Advertisers

FEBRUARY 1961

Printed in U.S.A.

2 great SPRAGUE DIFILM® tubulars

are tops in their field . . . take your choice!

For maximum reliability and performance under toughest conditions

SPRAGUE DIFILM® BLACK BEAUTY®

For extremely small size and exact original replacement

SPRAGUE DIFILM® ORANGE DROP®

Sprague Black Beauty tubulars are missile-type capacitors. Actually, they are low cost versions of the famous Sprague capacitors now being used in every modern military missile. Where positive reliability is important, make no mistake, use Black Beauty Difilm Molded Capacitors! You get the most for the least with Black Beauties!

Difilm Black Beauties are engineered to withstand the hottest temperatures to be found in TV or auto radio sets—in the most humid climates. Further, unlike straight polyester film tubulars, these capacitors operate in a 105°C environment—without derating!

Black Beauty tubulars are tough units, too—no fragile shell to break—you can't damage them in soldering. For your convenience, every capacitor is marked twice . . . no need to twist capacitor around to read rating.

- ***The heart of these Sprague Difilm Capacitors can't be beat!*** **It's a dual dielectric combination of Mylar® polyester film and special capacitor tissue—resulting in capacitors which are superior to all other comparable tubulars.**
- **Sprague's rock-hard solid HCX® impregnant fills voids and pin holes found in the plastic film.**
- **Difilm capacitors have high insulation resistance, low power factor, and excellent capacitance stability and retrace under temperature cycling!**

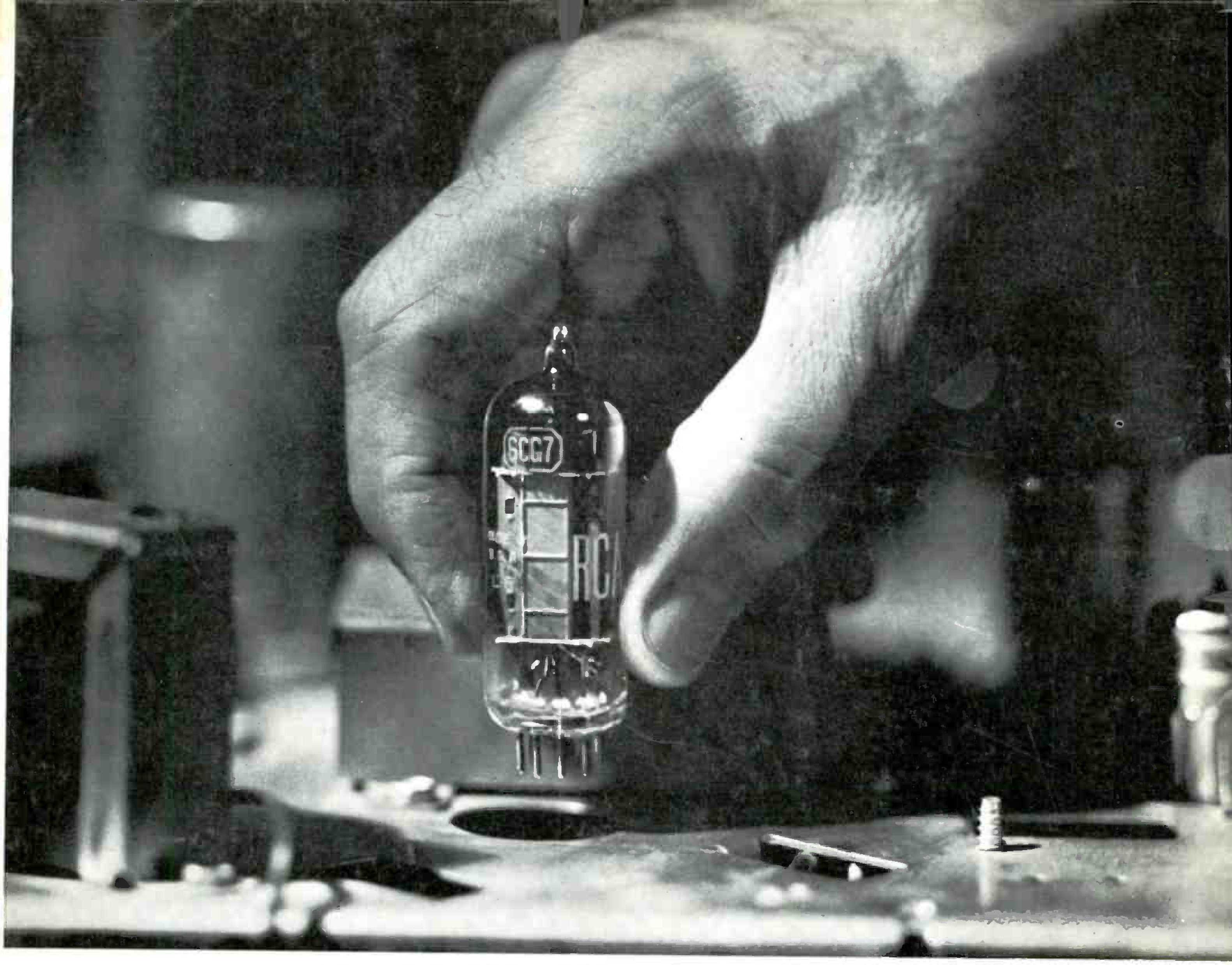
Sprague Difilm "Orange Drops" are a "must" for your service kit where only an exact replacement will fit. They are the perfect replacement for dipped capacitors now used by leading manufacturers in many popular television receivers. And when a dipped tubular is called for, you'll find that Orange Drops outperform all others, safeguarding your work and reputation for quality service.

Orange Drops are specially designed for easiest possible installation. Radial leads are crimped to assure neat mounting parallel to printed wiring boards . . . extremely small size makes them fit handily in tight spots. They'll beat heat and humidity because the solid, rock-hard capacitor section, double-dipped in bright orange epoxy resin, is well protected against moisture. A perfect team-mate for Black Beauty.

±10% CAPACITANCE TOLERANCE IS STANDARD AT NO EXTRA COST

Difilm Black Beauty and Difilm Orange Drops are packaged in sturdy, reusable rigid plastic Kleer-Pak® boxes. Your distributor is stocked in all the popular ratings. Order some today. You can count on Difilm.

SPRAGUE®
THE MARK OF RELIABILITY



WHEN YOU REPLACE A TUBE . . .

You have a lot at stake each time you replace a receiving tube in a customer's set. Your professional reputation, your customer's confidence, your day's profits—even future business—all depend on the quality of that replacement tube.

It is RCA's constant aim to provide receiving tubes you can install with confidence. To this end, RCA carefully controls every step of the tube making process from initial design to final test.

QUALITY BY DESIGN—Some of the foremost tube experts in the industry collaborate on each new RCA tube design. Engineers, chemists, physicists, metallurgists, production specialists, field representatives, all contribute their own skills and knowledge before a new RCA tube design ever leaves the drafting board.

IMPROVED QUALITY FROM NEW AND IMPROVED MATERIALS—All parts and materials in RCA tubes are either *produced* or *processed* by RCA under strictest quality control. Moreover, RCA scientists search constantly for new and better materials which will still further improve performance of RCA tubes. Many tube types you install today benefit from new cathode and plate materials developed in RCA labs.

QUALITY IN MANUFACTURING—Because tube construction is just as important as design and materials, RCA maintains a system of supervisory microscopic inspection at key points on every production line to detect any flaw in assembly. And to minimize the chance of human error, RCA has automated certain critical steps in tube production.

QUALITY BY TESTING AND CONTROL—Before shipment, *every single RCA receiving tube* is factory-tested for every significant characteristic. *A tube that fails one single test is rejected and destroyed. So there is no such thing as a "second" when you buy RCA.* In addition, thorough aging of tubes and rating-lab tests assure strict adherence to performance specifications.

This is why YOU CAN REPLACE WITH CONFIDENCE with RCA tubes . . . and why RCA tubes give you an extra advantage on every service job. Electron Tube Division, Harrison, N. J.

RCA®

The Most Trusted Name in Electronics
RADIO CORPORATION OF AMERICA