Here is a real value—much more value than in any other clamp-on ammeter. Remember, in Triplet Model 100 you get not only a clamp-on ammeter but a genuine Triplet complete Volt-Ohm-Milliammeter with which you can measure AC volts, DC volts, AC and DC current, and Ohms.

1st news: Triplet Model 10 Clamp-On Adapter
Just plug into any Triplet Model 310 Miniature VOM it becomes an AC clamp-on ammeter to measure AC amperes without cutting or opening current carrying wires. The split transformer yoke opens at the touch of a lever to fit around a single conductor or bus-bar for direct readings of AC amperes from 6 to 300 in 6 steps. Model 10 $14.50 net.

The Model 10 can be separated from the Model 310 as shown in the drawing at left by No. 311 lead attachment. This permits readings in difficult locations. No. 311 leads $1.90 net.

2nd news: Triplet Model 101 Line Separator
Serves to plug in at outlet to divide 2 conductor cords for clamp-on measuring. Makes accurate, rapid-testing of radio and TV sets, phonographs, appliances, motors, etc. possible without opening or splitting double conductors. Also serves to increase ammeter sensitivity 10X and 20X, if desirable, for easier reading. Model 101 $5.50 net.

3rd news: All four parts are available conveniently packaged in one handy, durable, high-quality carrying case. This complete package is known as Triplet Model 100 and is priced at $61.90 net.

Model 100 consists of Model 310 VOM, Model 10 Clamp-On Adapter, Model 101 Line Separator, No. 311 leads and carrying case with provision for all parts.

In addition, to use with the Model 310, the Model 10 Adapter also can be used as a Clamp-On Ammeter with any Volt-Ohm-Milliammeter having a 3 AC volt scale at 5000 Ohms per volt such as Triplet Models 630, 630-A, 630-NA, 631, etc., by employing Triplet No. 611 leads, $1.90 net.

Triplet Model 100 gives you the world's most flexible test equipment for all electrical and electronic applications.
Learn to be a PROFESSIONAL TV Technician AT HOME

N.R.I. SENDS YOU 17" Picture Tube, Components for a TV Receiver, 5" Oscilloscope and Signal Generator . . . all parts for these 4 complete units.

N.R.I. All-Practice Method Trains You in Spare Time to Fix TV Sets Quickly, Correctly, with Confidence

How many times have you day-dreamed of being your own boss? Or thought about what you could do if you were the man who made the decisions. The man who knows the answers — the well trained Technician — enjoys the prestige, gets the better jobs, higher pay.

It's time to stop dreaming. Here is the learn-by-practice training that shows you the way to be the boss, to earn top pay. Television Servicing needs well trained men.

Yes, if you have a basic knowledge of radio and electronics you can make some Television repairs some of the time. You can make some simply by trial and error. But sooner or later you will face Television Service problems you cannot solve. All the diagrams in the world won't help you then. And you can't get the training you need while customers wait.

NRI Is Oldest and Largest Home Study Radio-TV School

Forty years experience, and the record and reputation of NRI, back up this learn-by-doing Professional TV Servicing course. Instead of reading about TV problems, you build and conduct experiments on circuits in a TV receiver. Because you learn methods, "tricks of the trade" used and proved by top TV Servicemen, you recognize and repair defects quickly and accurately. Learn to fix any set . . . any make, any model . . . with confidence. Earn a Diploma that certifies to your training.

Television is Forging Ahead with More Sets, More Color, Hi-Fi

TV Servicing has only started to grow in importance. New sets, portables, color TV, constant changes, improvements make this a genuine "gold rush" for the man who is trained and ready. Know . . . so you can get ahead. Learning how to build and use a professional-type 5" Oscilloscope is part of the practice you get in this NRI All-Practice Training. Installing front-end channel selector strips, distinguishing between faulty blocking oscillator or a defect in the sync circuit, etc., are just a few of the important TV Servicing facts you learn through practice.

Not for beginners

Here is a course for men who know basic theory, either from Radio or TV Servicing experience or planned training, but realize the need for more knowledge to be able to forge ahead. Get details of this course now.

Mail coupon today. Address: National Radio Institute, Dept. 7KFT, Washington 16, D.C.

Send for FREE BOOK

NATIONAL RADIO INSTITUTE
Dept. 7KFT, Washington 16, D. C.

Please send FREE copy of "How to Reach the Top in TV Servicing." I understand no salesman will call.

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

Address..........................................

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

ACCREDITED MEMBER NATIONAL HOME STUDY COUNCIL
OCTOBER, 1957

Radio-Electronics

EDITORIAL
35 High-Fidelity Sound—Hugo Gernsback

AUDIO—HIGH FIDELITY
36 All-Transistor Tape-Head Preamp—Francis A. Cioca
38 Bass Reproduction in Loudspeakers—Edgar Villelaur
40 Record Tracking—Norman H. Crowhurst
43 Audio Specialists—(Cover Feature)
44 Loudspeakers and Acoustic Fundamentals—Paul W. Klipsch
45 Hi-Fi Master Control Unit—Joseph Marshall
49 Design Calculations for R-C-Coupled Amplifiers—Herbert Ravenswood
146 New Records—Monitor

TECHNICAL REPORTS
52 Pictorial Report of New Developments

TEST INSTRUMENTS
53 Automation and the Tube Tester—Harold B. McKay
55 TV Bar Generator for Your Service Kit—Edwin Böh
58 Impact Noise Meter Uses 3 Transistors—Nathanial Riha
59 Build This Amplifier-Rectifier Vtvm for Audio Testing—L. B. Hedge
61 Regulating Bias and Polarizing Voltages—Ronald L. Ives

ELECTRONICS
62 Electronic Surveillance Kit (Part II)—Louis E. Garmin, Jr.
64 A Photo-Sound Unit—Peter J. Vogelgesang
82 Two Channels? Easy—E. L. Safford, Jr.
84 Sensitive Relay Saves Standby Power—Rod Driver

RADIO
89 Multiplexing and You—Don Lewis
93 500-Million-Mc Transceiver—Harold Pallatz
95 Transistor Low-Voltage Supply—I. Queen

TELEVISION
100 Death Rides the Hot Chassis—Fred Shunaman
116 Practical Color Installation (Part II)—Robert G. Middleton
124 TV Service Clinic—Conducted by Robert G. Middleton
132 Flyback Systems—Jesse Dines

174 Books
168 Business and People
99 Corrections
139 New Devices
6 News Briefs
135 New Tubes and Semiconductors

158 Patents
164 Radio-Electronic Circuits
172 Technical Literature
152 Technicians' News
150 Technotes
161 Try This One
99 35 Years ago

NEXT MONTH: HYBRID AND TRANSISTOR AUTO
RADIOS * A TWIN-COUPLED HI-FI AMPLIFIER

ON THE COVER
(Story on page 43)
Tape-recorder repair in progress on a typical service bench at the Sigma Electric Co., New York City, specialists in repair of high-fidelity equipment. Anso color original by Tom Carew

Average Paid Circulation
Over 195,000

Associate Member Institute of High Fidelity Mfrs., Inc.


Subscription Rates: U. S., U. M. possessions and Canada $4.00 for one year; $7.00 for two years; $12.00 for three years. All other countries: $5.00 a year; $9.00 for two years; $13.00 for three years. Subscriptions, address correspondence to Radio-Electronics, Subscription Dept., 634 N. Wesley Ave., Mt. Morris, Ill., or 154 West 14th St., New York 11, N. Y. When requesting a change of address, please furnish your address label from a recent issue. Allow one month for change of address.

Gernsback Publications, Inc., 154 West 14th St., New York 11, N. Y., Chairman of the Board: M. Harvey Gernsback, President; S. Alluck, Secretary.

Branch Advertising Offices and Foreign Agents listed on page 117.

Postmaster: If undeliverable, send Form 3579 to: Radio-Electronics, 154 West 14th St., New York 11, N. Y.


Subscription Rates: U. S., U. M. possessions and Canada $4.00 for one year; $7.00 for two years; $12.00 for three years. All other countries: $5.00 a year; $9.00 for two years; $13.00 for three years. Subscriptions, address correspondence to Radio-Electronics, Subscription Dept., 634 N. Wesley Ave., Mt. Morris, Ill., or 154 West 14th St., New York 11, N. Y. When requesting a change of address, please furnish your address label from a recent issue. Allow one month for change of address.

Gernsback Publications, Inc., 154 West 14th St., New York 11, N. Y., Chairman of the Board: M. Harvey Gernsback, President; S. Alluck, Secretary.

Branch Advertising Offices and Foreign Agents listed on page 117.

Postmaster: If undeliverable, send Form 3579 to: Radio-Electronics, 154 West 14th St., New York 11, N. Y.


Subscription Rates: U. S., U. M. possessions and Canada $4.00 for one year; $7.00 for two years; $12.00 for three years. All other countries: $5.00 a year; $9.00 for two years; $13.00 for three years. Subscriptions, address correspondence to Radio-Electronics, Subscription Dept., 634 N. Wesley Ave., Mt. Morris, Ill., or 154 West 14th St., New York 11, N. Y. When requesting a change of address, please furnish your address label from a recent issue. Allow one month for change of address.

Gernsback Publications, Inc., 154 West 14th St., New York 11, N. Y., Chairman of the Board: M. Harvey Gernsback, President; S. Alluck, Secretary.

Branch Advertising Offices and Foreign Agents listed on page 117.

Postmaster: If undeliverable, send Form 3579 to: Radio-Electronics, 154 West 14th St., New York 11, N. Y.
OCTOBER, 1957

Get into TELEVISION RADIO-ELECTRONICS

Let National Schools of Los Angeles, a Practical Resident Technical School for over 50 years, train you at home by Shop Method for unlimited opportunities in All phases of TV, Electronics, Radio.

You get 19 Big Kits ... all this newest, practical equipment.

GOOD JOBS ... MORE MONEY SECURITY ... ALL CAN BE YOURS!

You are needed in the great modern Television-Electronics industry. Trained technicians are in growing demand, at excellent pay, in sales and service, manufacturing, broadcasting, telecasting, communications, research, and many other important branches of the field. National Schools Master Shop-Method Training, with newly added lessons and equipment prepares you in your spare time, right in your own home, for these fascinating opportunities.

YOU EARN WHILE YOU LEARN

Many students pay for their entire training—spare time earning. We'll show you how you can, too! You receive material that shows you how to earn extra money servicing TV and Radio receivers, appliances, and doing many other profitable jobs.

YOU GET EVERYTHING YOU NEED

Clear, profusely illustrated lessons, shop-tested manuals, modern circuit diagrams, practical job projects—consultation privilege with our qualified staff.

Don't delay your future another day. Send coupon for full information TODAY.

NATIONAL SCHOOLS
Los Angeles 37, Calif.

LEARN ALL 8 PHASES OF THE INDUSTRY
BY SHOP METHOD

1. Television Including Color TV
2. Radio AM, FM
3. Industrial Electronics
4. Communications
5. Sound Recording & Hi-Fidelity
6. Automation
7. FCC License
8. Radar & Micro Waves

We give you parts to build a modern TV set ... all tubes plus large screen Picture Tube ... and a Superhet Receiver. You also receive a Professional Multimeter.

MAIL POSTAGE—FREE COUPON ... NOW!
1. Fill out coupon in Ink.
2. Cut along dotted line and fold coupon.
3. Staple, paste, glue, or tape ends together.
4. Mail today! No postage necessary.

FREE! Career Book in TV Radio-Electronics
PLUS Actual SAMPLE LESSON. No obligation; no salesman will call.

SEND YOUR FUTURE IN TELEVISION RADIO

Your Name:___________
Age:___________
Address:___________
City:___________
Zone:___________
State:___________

[ ] Check if interested ONLY in Resident Training in Los Angeles
VETERANS: Give date of discharge.

BUSINESS REPLY CARD
First Class Permit No. 2087, Sec. 34 & P. I. A. R., Los Angeles, Calif.

POSTAGE WILL BE PAID BY NATIONAL SCHOOLS
4000 South Figueroa Street
Los Angeles 37, California

RG-107

www.americanradiohistory.com
IT'S Blue Chip Quality

IT'S Tung-Sol Quality

Tung-Sol receiving tubes for TV, radio and Hi-Fi replacement are exactly the same as those supplied to leading independent set makers. This one fine quality is your assurance of long, trouble-free service that keeps customers with you year after year. Tell your supplier you'd rather have Tung-Sol Tubes. TUNG-SOL ELECTRIC INC., Newark 4, N. J.

DR. IRVING LANGMUIR, one of America's great scientists, died Aug. 16, 1957. He was 76 years old. Dr. Langmuir was known best in the electronics field for his work on high-vacuum tubes and his invention of the mercury-vapor pump, which made high vacuums possible. His specialty was, however, chemistry rather than electronics, and he taught chemistry at Stevens Institute of Technology until 1909, when he joined the staff of the General Electric research laboratory, where he remained until his retirement in 1950.

Early in his career at the laboratory, he developed the gas-filled lamp as an outgrowth of a "study of bad vacuums" on which he embarked, he said, because engineers were having trouble producing good vacuums. It was found that certain gases prolonged the life of the lamp rather than shortened it, and as a result it is said that he saved the American public nearly a billion dollars a year in electric-light bills.

His researches in oil films—which opened up the new field of two-dimensional or surface chemistry—made him the first American chemist to receive the Nobel Prize, which was awarded him in 1932. In later years his work—in connection with that of other G-E scientists—on artificial precipitation and cloud seeding may result in a measure of weather control which may ultimately prove more important than any of his other accomplishments.

Dr. Langmuir was a lifelong advocate of scientific investigation along the lines from which most knowledge could be gained, rather than with a particular application in view. He referred to this approach as the art of serendipity, which Webster defines as "the gift of finding valuable things not sought for," and stated of his work that "whatever has come in industrial applications has come incidentally from experiments followed for their interest alone."

Dr. Langmuir was a member of a large number of learned societies and received American and foreign awards and medals too numerous to list here. His widow, his son Kenneth and daughter Barbara, all of Schenectady, N. Y., survive him.

OVER-THE-HORIZON communications link just completed between Florida and Cuba utilizes tropospheric scatter propagation for the 185-mile hop. The microwave beam (on the 692-880-Mc band) is aimed slightly upward and portions of the signal scatter in the troposphere and are picked up by high-sensitivity receiving antennas. (See RADIO-ELECTRONICS, August, 1955, page 39, and September, 1956, page 37.) The Federal Telecommunications Laboratories' broad-band technique is used to provide a television path and 100 telephone channels. The Florida-Cuba link (both ends can send and receive) will be jointly operated by International Telephone & Telegraph and the American Telephone & Telegraph Co.

THREE-DIMENSIONAL COLOR TV system for remote servicing of receivers used in development of a nuclear aircraft propulsion system has been announced by General Electric. The closed-circuit system permits use of color-coded parts in reactor components and provides the degree of precise depth perception required for their correct positioning.

In use, the television camera is positioned inside the radioactive area. The camera is equipped with a dual optical system having a perspective similar to that of the observer's eyes. A rotating shutter in the special color TV camera alternately transmits the scene as viewed from the two points to the camera's tube. In the viewing console, light from the image formed on the cathode-ray tube passes through a drum composed of alternate segments of polarizing filters with axes of polarization at right angles to each other. This drum revolves in sync with the TV frame rate of the camera (90 per second) and polarizes alternate frames vertically and horizontally. Thus all left-eye pictures are polarized in one (Continued on page 10)

RADIO-ELECTRONICS
MAIL COUPON TODAY!

DeVry Technical Institute
4141 Belmont Ave., Chicago 41, Ill., Dept. RE-10-N
Please give me your FREE booklet, "Electronics and YOU," and tell me how I may prepare to enter one or more branches of Electronics as listed below.

Name ___________________________ Age ___________________________
Street ___________________________ Apt. ___________________________
City ___________________________ Zone State ___________________

[ ] Check here if subject to military training

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

Men 17-55...

Prepare at Home for an Interesting and Profitable Future in the Great Fields of

ELECTRONICS

as used in

GUIDED MISSILES, ETC.

There are big opportunities for men 17 to 55 in the exciting, profitable fields of Electronics. For more than 26 years we have been preparing men in their spare time at home without interfering with their jobs. During these years, to name a few, we have trained laborers, farmers, clerks, factory workers and salesmen ... following the same basic method used in our Chicago and Toronto training laboratories. So regardless of your experience, why don't you write for FREE facts today? There is no obligation.

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

AN INDEX TO A
BETTER JOB, A BRIGHTER FUTURE

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

NO ADVANCED EDUCATION OR PREVIOUS TECHNICAL EXPERIENCE NEEDED!

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

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

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

DeVRY TECHNICAL INSTITUTE
Formerly DeFOREST'S TRAINING, INC.

4141 BELMONT AVE.
CHICAGO 41, ILLINOIS
Your Independent Service Advertising Program expands with your purchases of CBS tubes

One of a new series of full-page ads appearing in TV GUIDE

We know you like your Independent Service Program and want it expanded. We know it from a nation-wide survey... and from your increasing purchases of CBS tubes. May we remind you: each time you buy CBS tubes, you support your own independent service-dealer campaign. Keep it going... keep it growing... always specify CBS tubes.

SUPPORTING MATERIAL ALSO EXPANDS
- "The Independent Service Business and Your Future" booklet
- Independent Service decal
- 10 new postal cards
- 16 new advertising mats
- Radio and television scripts
- Consumer booklet "On the Care of a Television Set"

Ask your CBS Tube distributor for this tie-in material... or write for illustrated broadside PA-181.

SUPPORTING MATERIAL ALSO EXPANDS

FOR THE BEST IN ENTERTAINMENT TUNE TO CBS

RADIO-ELECTRONICS
CHOOSE ANY 3 OF THESE HIGH-FIDELITY COLUMBIA RECORDS FREE

when you join the Columbia Record Club—and agree to purchase 4 selections during the coming 12 months

YES! You may have, FREE, ANY 3 of these best-selling 12" Columbia records. We make this unique offer to introduce you to the money-saving program of the Columbia Record Club—a program that selects for you each month the greatest works in every field of music, performed by the world's finest artists, brilliantly reproduced on Columbia records.

HOW THE CLUB OPERATES: To enjoy the Club's benefits—mail the coupon, indicating which one of the four Club Divisions best suits your musical taste: Classical, Jazz, Listening and Dancing, Broadway, Movies, Television and Musical Comedies.

Each month you will receive free the Club Magazine which describes the current selections in all four Divisions. You may accept or reject the monthly selection for your Division or, if you may take records from other Club Divisions... thereby assuring you the widest possible choice of recorded entertainment. Or you may tell us to send you no record in any month.

Your only obligation is to purchase four selections from the more than 100 that will be offered during the next 12 months. The records you want are mailed and billed to you at only $3.98 (original cast Musical Shows somewhat higher), plus a small mailing charge.

FREE BONUS RECORDS GIVEN REGULARLY: The 3 records sent to you now represent an "advance" of the Club’s bonus system—given to you at once. After you have fulfilled your membership obligation by purchasing four records, you will receive an additional free bonus record of your choice for every two additional Club selections you accept. Bonus records are superb 12" Columbia records—the very best of the Columbia catalog—just like those shown here.

COLUMBIA RECORD CLUB
Terre Haute, Indiana

FREE—ANY 3 VALUE UP TO $12.94—MAIL ENTIRE COUPON NOW!

COLUMBIA RECORD CLUB, Dept. B27, Terre Haute, Ind.
Please send me as my FREE gift the 3 records indicated here: (Select the records you want by circling 3 numbers in the list at the right)...

and enroll me in the following Division of the Club.

(check one box only)

□ Classical
□ Broadway, Movies, Television and Musical Comedies
□ Jazz

Each month you will send me the Columbia Record Club Magazine which describes the records offered in all four Club Divisions. I have the privilege of accepting the monthly selection in the Division checked above, or any other selection described, or none at all. My only obligation is to purchase four records in the next 12 months at the regular list price plus a small mailing charge. After accepting four records, I will receive a free Bonus record for every two additional records I purchase. If not delighted with membership, I may cancel within 10 days by returning all records.

Name (Please Print)
Address

CIRCLING THE NUMBERS OF THE RECORDS YOU WANT

1. Beethoven: "Moonlight" Sonata; "Pathétique" Sonata; "Appassionata" Sonata. (check the numbers indicated)
4. 78. Day By Day: Doris Day sings 12 popular songs—Including The Sing in You, Autumn Leaves, etc.
6. Kostelanetz Plays J. Leonard Stern & Howard Dietz: Kiss Me, Kate; Where or When, I'll Remember April—2 more.
7. Concert by the Sea: Erroll Garner in an actual Jazz performance at Carmel, Calif. Teach Me Tonight, Where or When, I'll Remember April—2 more.

GIR.
Canada Prices slightly higher.
Address 11-13 Soko St., Toronto 28.

In Canada: Prices slightly higher.
Address 11-13 Soko St., Toronto 28.

If you wish to have this membership credited to an established Columbia Records dealer, authorized to accept subscriptions, please fill in the dealer's name and address.

Dealer's Name
Dealer's Address

OCTOBER, 1957

www.americanradiohistory.com
How to Pass

An FCC License can be

Get Your FCC License

We Guarantee
to train you until you receive
Your FCC License

Completion of the Master Course (both Sections) will prepare you for a First Class Commercial FCC License with a radar endorsement. Completion of Section I only of the Master Course will prepare you for a Second Class Commercial FCC License. We guarantee to train and coach you, without any additional cost, until you receive the FCC License as indicated above. This guarantee is valid for the entire period of your enrollment agreement.

Cleveland Institute Training Results in success with commercial FCC examinations . . . easily . . . and quickly.

every month our trainees get jobs like these:

Boyd Daugherty:
"I recently secured a position as Test Engineer with Melpar, Inc. A substantial salary increase was involved. My Cleveland Institute training played a major role in qualifying me for this position."

Boyd Daugherty
105 Goodwin Ct., Apt. C
Falls Church, Va.

Top Grade Employers Like These Look

Bendix Radio: "We shall look forward to receiving completed applications from your students."

Philco: "We have employed a great number of well qualified electronics personnel who were graduates of Cleveland Institute."

Westinghouse: "We would appreciate your listing our current openings in your monthly Job Opportunities."
FCC License Exams

your Guarantee of Success in Electronics in a Minimum of Time

here's proof . . .

Name and Address    License    Time
Walter Eggers, Pacific Grove    1st    12 weeks
Paul Reichert, West Salem, Ohio    2nd    10 weeks
Harold Phipe, La Porte, Indiana    1st    28 weeks
John H. Johnson, Boise City, Okla.    2nd    12 weeks
James Faint, Johnstown, Pa.    1st    26 weeks

James Glen:
When Jim enrolled, he was a temporary employee of the City of Tacoma, Washington. In the space of 14 months, he completed the Master Course and received his first class license. He is now installing and maintaining mobile and microwave equipment.

James S. Glen, Jr.
2920 Knob Hill Road
Tacoma, Washington

To Cleveland Institute
Aerjet-General
American Airlines
American Telephone & Telegraph Co.
Bendix Radio
Brassfield Airways
Burroughs Corp.
Capital Airlines
Continental
Air Lines, Inc.
Curtiss
General Electric
Glenn L. Martin Co.
Goodyear Atomic Corp.
IBM
International Telephone & Telegraph Co.
Mohawk Airlines
Motorola
North American Aviation, Inc.
Northwest Airlines
Philco
RCA
Ryan Aeronautical Co.
*Plus many others

OCTOBER, 1957

Accredited by National Home Study Council

Cleveland Institute of Radio Electronics
Desk RE-10, 4900 Euclid Ave., Cleveland 3, Ohio

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

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

In what kind of work are you now engaged?  In what branch of Electronics are you interested?

Name ____________________________ Age ______
Address __________________________
City ____________________________ Zone ______ State ______

Special Tuition Rates to Members of Armed Forces
Desk RE-10
Sylvania
TV Damper
Tubes

...New design plus

New heater-cathode design helps Sylvania damper types pass this dynamic arc test with flying colors. Dynamic tests such as this have now been instituted by Sylvania on all important types in every critical TV function. It's Sylvania's way of helping you overcome problems which often make the difference between profit and loss and a happy or unhappy customer.
new dynamic tests
produce high E.L.A.*

Sylvania damper tubes scored an *Earned Life Average of 99.54% in a recent test of types in the 6AX4GT family. This means greater service reliability for you with an absolute minimum of trouble resulting from arcing, heater-cathode shorts and heater burnouts. It’s the result of a new heater-cathode design introduced by Sylvania to meet your service needs.

*Earned Life Average is an established method for evaluating tube life performance; for the service industry it serves as an index of protection against call-backs. These tests were performed in TV sets which simulated field service conditions where high line voltages are encountered.

109 Sylvania damper tubes performed for a total of 132,890 hours out of a possible 133,500 hours for an *Earned Life Average of 99.54%.

To Sylvania this is satisfying evidence that the service industry has been provided with extra protection against the most common damper tube troubles. We think you’ll agree too, that in the long run you’ll profit more with Sylvania.

SYLVANIA

SYLVANIA ELECTRIC PRODUCTS INC.
1740 Broadway, New York 19, N. Y.
In Canada: Sylvania Electric (Canada) Ltd.
University Tower Bldg., Montreal

LIGHTING • RADIO • ELECTRONICS • TELEVISION • METALS & CHEMICALS

OCTOBER, 1957
Excitingly New Components from H. H. Scott

Get the facts! It's brand new! H. H. Scott

Radar Map, which provides a plane's position, altitude, and the

Heaven Manufacturing Co. Fully automatic, the instrument makes a photo-

graphic record of radar information on a slow-moving strip of 10-second tape.

Components NEW Stiging NEW Leads...

Components NEW Stiging... NEW Leads...

Rush me your new catalog! 50-year complete technical speci.

For H. H. Scott Components for 50...
ALLIED'S 1958 CATALOG

404 value-packed pages
the only COMPLETE catalog for everything in electronics

Get ALLIED's 1958 Catalog—it's complete, up-to-date—404 pages packed with the world's largest selection of quality electronic equipment at lowest, money-saving prices. Get every buying advantage at ALLIED: fastest shipment, expert personal help, lowest prices, guaranteed satisfaction...

WORLD'S LARGEST STOCKS

- Latest Hi-Fi Systems and Components
- Money-Saving, Build-Your-Own KNIGHT-KITS
- Recorders and Supplies
- Public Address Systems and Accessories
- TV Tubes, Antennas and Accessories
- Amateur Receivers, Transmitters, Station Gear
- Test & Lab Instruments
- Specialized Industrial Electronic Equipment
- Huge Listings of Parts, Tubes, Transistors, Tools, Books

EASY-PAY TERMS:
Only 10% down, up to 18 months to pay. Available on orders over $45. Fast handling—no red tape.

featuring:
ALLIED'S money-saving knight-kits:
Finest electronic equipment in money-saving kit form. Over 50 quality kits available—Hi-Fi amplifier, tuner and speaker kits, Hobby kits, Test Instruments, Ham kits (see our KNIGHT-KIT values elsewhere in this publication). ALLIED KNIGHT-KITS are easiest to build and they SAVE YOU MORE.

EVERYTHING IN HI-FI
World's largest selection of quality Hi-Fi components and complete music systems—available for immediate shipment from stock. Save on exclusive ALLIED-Recommended complete systems. Own the best in Hi-Fi for less!

ALLIED RADIO
World's Largest Electronic Supply House

Our 37th Year

ALLIED RADIO CORP., Dept. 2-K7
100 N. Western Ave., Chicago 80, Ill.

☐ Send FREE 404-Page 1958 ALLIED Catalog

Name: __________________________________________
Address: _______________________________________
City: ___________________________ Zone: ________ State: _____

OCTOBER, 1957

www.americanradiohistory.com
The TRC
triple-duty microphone by
American

it’s versatile...
lightweight...
low cost, too!

Elgin’s new TRC dynamic microphone offers faithful audio reproduction in the 80-8500 cps range, yet lists from $11.50. It is designed for use with tape recorders...yet has the versatility to perform ideally at meetings and assemblies, wherever p.a. systems are used. The TRC is less than five inches long, weighs only nine ounces, has a polished, chromeplated case. It is omnidirectional and picks up voices within a radius of ten feet under average conditions.

The TRC is also available in crystal and ceramic types.

Get the facts on this new addition to Elgin’s complete line of “American” microphones. Write today for specifications and complete descriptive literature.

ELECTRONICS DIVISION
ELGIN NATIONAL WATCH COMPANY
107 National Street, Elgin, Illinois

Correspondence

HOT WORDS ON BOOSTERS

By telling a Radiological Safety Conference a few months ago that boosters used on aging picture tubes might convert them into sources of X-rays, Dr. James B. Kelley, a research consultant for the New York State Commerce Department started a mild radiation scare. He was reported to have said that he had personally seen TV sets “which had their anode voltages raised from the usual 15,000 to as high as 30,000 or 35,000 volts.” (See “Radiation Scare,” RADIO-ELECTRONICS, August 1957, page 6.)

It seemed inconceivable that any such set could exist but, after all, the doctor is an expert in his own field at least and would not be expected to circulate irresponsible statements. So we wrote to active individuals in a number of TV and electronic service associations, asking if either they or any of their members had ever seen TV’s in which the anode voltage had been boosted as described.

Dear Editor:

It is true that a booster increases the filament voltage. However it lowers the high voltage. It does it this way: As a picture tube gets older it pulls less current and the high voltage, which is unregulated in the average set, goes up. If you put a booster on a set or replace the tube, the set draws more current from the high-voltage supply, which in turn lowers the high voltage.

FORREST L. BAKER
Texas Electronics Association
San Antonio, Tex.

Dear Editor:

I am very puzzled by the comments of Dr. James B. Kelley who is cited as an “industrial consultant for the State Commerce Department” of New York. Either he is referring to some form of “booster” which I, in my 38 years experience in electronics, have never come in contact with or he is confused.

I have never seen one which raises the anode voltage. These devices generally operate on the principle of heating the cathode to a higher degree, thus allowing for more complete usage for the active cathode coating.

In my own service business we use boosters only as a last resort, to obtain the utmost in picture-tube life in hardship cases. We feel that the actual cost of a good picture tube per hour of use is so small as to make squeezing the last drop of highly unpredictable life hardly worth the effort. When a picture tube falls below proper operating level, it is time to buy a new one.

May I suggest that Dr. Kelly either prove his point by an actual demonstration of a standard booster, using standard TV chassis, high-voltage meters and Geiger counters, or cease

www.americanradiohistory.com
The data that Launched Thousands of Careers is yours FREE

Tells how you can be successful in RADIO-TV-ELECTRONICS

Send for Your Free Copy Today!

This is a brand new edition of the book which has launched thousands of men on good-paying careers in radio-tv-electronics. It brings you completely up to date—answers important questions on newest career developments in electronics, including Radar, Guided Missiles, Servomechanisms and Computers, as well as Aeronautical Electronics, Broadcasting (AM, FM, TV), Military, Navy and CAA Electronics, Communications and Electronics Manufacturing.

This book, “Your Future in the New World of Electronics,” also shows you how CREI Home Study leads the way to greater earnings in the booming electronics world. However, CREI does not promise you a “snap.” With an accredited technical school such as this you must study to convert your ambition into technical knowledge you can sell in the fabulous Electronics market.

Since its founding in 1927, CREI has provided thousands of professional electronics men with technical education. During World War II, CREI trained thousands for the Armed Services. Leading firms choose CREI courses for group training in electronics, at company expense, among them United Air Lines, Canadian Broadcasting Corporation, Trans-Canada Airlines, Douglas Aircraft Co., Glenn L. Martin Co., Columbia Broadcasting System, All-American Cables and Radio, Inc., Gates Radio Co., Canadair Ltd., Federal Electric Corp., and U. S. Information Agency. CREI courses are prepared by recognized experts, in a practical, easily understood manner. You get the benefit of time-tested study assignments under the personal supervision of a CREI staff instructor. This is accomplished on your own time, during hours selected by you, and controlled by your own will power. This complete training is the reason that graduates find their CREI diplomas keys to success in radio, TV and Electronics. CREI alumni hold top positions in America’s leading firms. At your service is the CREI Placement Bureau, which finds positions for advanced students and graduates. Although CREI does not guarantee jobs, requests for personnel far exceed current supply. Now is the time of decision for you. Luck will not propel you forward unless it finds you trained. Contacts won’t budge you an inch unless you have the skill to back them up. The answer is: Technical Training—and willingness to learn. Together they will bring you increased earnings in this new Age of Electronics. Fill out the coupon below and mail it now. We’ll promptly send you your free copy of “Your Future in the New World of Electronics.” The rest—your future—is up to you!

CREI also offers Residence Training at some high technical level in Washington, D.C. Classes start at regular intervals. Qualified residence school graduates earn degree “Associate in Applied Science.” Check coupon if you prefer residence study.

VETERANS: If eligible for training under the new G.I. Bill of Rights, check the coupon for full information.

Industry Calls for CREI training By Name...SO SHOULD YOU!

Here you see an actual help wanted ad from the San Francisco Examiner, April 1, 1956, one of many which specify “CREI or equal training.” This shows that industry approves CREI training, even insists on it.

FILL OUT AND MAIL TODAY—BEFORE YOU FORGET IT!

CAPITOL RADIO ENGINEERING INSTITUTE
Dept. 1416-B, 3224 15th St., N.W., Washington 10, D.C.
EOPD Accredited Technical Institute Curricula - Founded 1927

Please send me your course outline and FREE illustrated booklet "Your Future in the New World of Electronics"...describing opportunities and CREI home study course in Practical Electronic Engineering Technology.

CHECK □ Electronic Engineering Technology

FIELD OF GREATEST INTEREST □ Broadcast (AM, FM, TV) Engineering Technology

□ Aeronautical Electronic Engineering Technology

□ Television Engineering Technology

Name.................................................. Address.................................................. Age

Street ................................................. Zone................................................. State

City.................................................... State.................................................

In what branch of electronics are you most interested?

To help us answer your request intelligently, please give the following information:

EMPLOYED BY.................................................. TYPE OF PRESENT WORK

SCHOOL BACKGROUND

ELECTRONICS EXPERIENCE

CHECK: [ ] Home Study [ ] Residence School [ ] Veteran

OCTOBER, 1957
Dear Editor:

While we were aware that using a TV filament booster causes no increase in anode voltage, a test was made by Warren Schei, our products director. The results were "absolutely no increase in anode voltage."

To increase the normal 15,000 volts to 30,000 would necessitate a doubling of the horizontal output. This would almost immediately cause a voltage breakdown and shorting before the voltage could build up to that level. The commonly used rectifier tubes have maximum inverse voltages of from 16,000 to 21,000.

There is merit, however, to the dangers of X-ray radiation. The Minnesota Television Service Engineers, Inc., in cooperation with the University of Minnesota, and Setchell-Carlson, Inc., are planning tests on radiation. The results should give us answers as to the amount of radiation and its dangers. If there were no dangers manufacturers would not need to include disclaimers in rectifier-tube cartons, on picture tubes or in service notes. If we must "live with it," what have we got? We hope to find out.

John Hemak
American Institute of Television Service
Minneapolis, Minn.

DR. KELLEY REPLIES

Dear Editor:

I am sorry that I was unable to answer your letter of July 1 sooner but I have been out of the country for some time and as a consequence have fallen behind on my mail.

With regard to the question you raise concerning a report of research done on television boosters I should like to correct what is apparently a misunderstanding on your part. At a Radio- logical Safety Conference held from June 12 to June 14 at Canisius College in Buffalo, N. Y., I delivered a paper entitled "Basic Physical Principles of Ionizing Radiation." I did not discuss television in that paper. However, in an interview with a reporter for the New York Times which I gave after I had delivered my paper I mentioned the fact that I had seen television receivers that had had their voltages boosted to levels which were approximately those at which soft X-rays might be given off.

Since the term booster has a technical significance in the television repair business, there was some confusion over my use of the word boost in a generic rather than technical sense. My opinions are based on sets which I have seen which had very high voltages and also on the fact that color television sets will have substantially higher voltages than black-and-white receivers. What I said was in the nature (Continued on page 22)
Learn PRACTICAL RADIO-TV with 25 BIG KITS
of equipment I send you while
you train with me . . . for valuable
shop bench experience . . .

Prepare for a Good Paying Job—Or Your Own Business

"I Will Train You at Home in
RADIO-TELEVISION
On Liberal No Obligation Plan!"

New Equipment! New Lessons! Enlarged Course! The true facts are yours in my
big new catalog . . . YOURS FREE . . .

JUST MAIL COUPON!

I can train and prepare you in as little as
10 months to step into the big opportunity
Radio-Television service field. Train without
signing a binding contract . . . without oblig-
gating yourself to pay any regular monthly
amounts. You train entirely at home in spare
hours . . . you train as fast or as slowly as
you wish. You’ll have your choice of THREE SPRAYBERRY TRAINING PLANS . . . planned for both beginners as well as the more experienced
man. Get the true facts about the finest most modern Radio-Training available
today . . . just mail the coupon for my big new 56 page fact-filled
catalog plus sample lesson—both FREE.

Train the Practical Way—with Actual Radio-Television Equipment

My students do better because I train both the mind and the hands. Sprayberry
Training is offered in 25 individual training units, each includes a practice giving
kit of parts and equipment . . . all yours to keep. You will gain priceless practical
experience building the specially engineered Sprayberry Television Training Re-
ceiver, Two-Band Radio Set, Signal Generator, Audio Tester and the new Spray-
berry 18 range Mult-Tester, plus other test units. You will have a complete set of
Radio-TV test equipment to start your own shop. My lessons are regularly
revised and every important new development is covered. My students are com-
pletely trained Radio-Television Service Technicians.

See for Yourself . . . Make Your Own Decision
. . . Mail Coupon Today!

The coupon below brings you my big new catalog plus
an actual sample Sprayberry Lesson. I invite you to read
the facts . . . to see that I actually illustrate every item
I include in my training. With the facts in your hands,
you will be able to decide. No salesman will call on you.
The coupon places you under no obligation. Mail it now,
today, and get ready for your place in Radio-Television.

SPRAYBERRY ACADEMY OF RADIO-TELEVISION
1512 Jarvis Avenue, Dept. 20-T, Chicago 26, Illinois

Mail This Coupon For Free Facts and Sample Lesson

SPRAYBERRY ACADEMY OF RADIO-TELEVISION
1512 Jarvis Ave., Dept. 20-T, Chicago 26, Ill.

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

Name ____________________________________________ Age _______
Address __________________________________________
City __________________ Zone __ State _______

Average cost per lesson
ONLY $3.42
Including Kits and Equipment
Now... 2 Ways to Add UHF to Your Fringe Area Color'ceptor

Here's something really new!
A UHF antenna (Winegard Mod. GG-1) that connects in series with the same lead used for the VHF Color'ceptor. No couplers... no loss... no interaction. Perfect results every time! Can be oriented independently from CL-4 or CL-4X. Same general features as on GG-2 shown below. Completely gold anodized. Only $7.95.

New UHF Colinear Yagis
Model GG-2 mounted with CL-4X Color'ceptor

High gain UHF antenna has 4 col. driven elements, 10 directors, 6 reflectors. Pin point directivity. No minor lobes. Flat frequency response. Can be stacked up to 16 bays for up to 21 db gain. Completely gold anodized. Can be ordered factory peaked to favor your channels. Only $14.95.

NEWS NOTE: Color'ceptor, the favorite fringe area antenna of professional installers everywhere, is now even better!—NEW TDM insulators. Low loss, unbreakable—NEW special alloy plus extra reinforcing used in reflectors. Four times more durable—NEW sunfast gold finish. Permanently anodized.

**NEW... SUPER twilight**

FOR THE TWILIGHT*

Biggest Advance Yet In Antenna Design!

Something new and wonderful has happened to antennas! Now you get the "whole ball of wax"... mast, lead-in, Antenna, mount... everything factory-assembled—factory-engineered into one simple, integral unit!

- NO loose parts to assemble
- NO wires to strip

Just take your Twilight out of the box... pop it open... put it up as easy as driving 3 nails... it's as simple as that! Now you can make a complete installation (in most cases without even getting on the roof) in no more time than it takes to pull a TV chassis for repair! Twilight is so easy... it's a breeze to install.

Engineered for results... styled to sell... as new and modern as today!

**SENSITIVITY COMPARISON CHART**

Note extremely linear frequency response of Twilight

---

**NEW PEEK-A-BOO PACKAGE**

Makes beautiful display... lets customer see merchandise without opening carton... has complete sales story pitched to your customers on back of carton.
Winegard

COMPACT...POWERFUL!

WINEGARD TWILIGHT, MOD. TL-283

All Channels 2-83 plus FM Color or Black and White

All aluminum construction...can't stain roof. The Twilight* installation includes: antenna with mast, lead-in wire and set terminal clip attached; universal mounting base with special drive fasteners, roof-sealing gaskets and stand-off insulators. Antenna width: 87"—Height including mount 53". Net wt.: 4½ lbs., Shpg. wt.: 6 lbs. Can be mailed parcel post.

You can buy Twilight two ways: complete installation, Mod. TL-283, list $29.95; Twilight head only with standard mast clamp, Mod. 283, list $19.95.

Absolutely
Nothing
Else
To Buy

Twilight Mounts on ANY Surface—Sloping, Flat, Vertical

Twilight area has many of the reception difficulties of both the fringe and primary areas, almost every type of antenna from rabbit ears to large arrays is used here. None of which were actually designed with the Twilight area's actual requirements in mind.

An extensive survey made by the Winegard Company in the Twilight areas of some of our larger cities brought to light these amazing facts:

- 42% of the TV owners were not really satisfied with their reception
- 72% of these dissatisfied TV viewers were using set-top antennas
- 53% didn't like antennas on top of their set
- 34% said set-top antennas were too difficult to adjust
- 49% thought outside antennas were too big and unsightly
- 34% thought outside antennas were too susceptible to corrosion-stained roofs...and were ruined by weather
- 49% of all set owners questioned were willing to spend up to $30.00 for a TV antenna that would overcome all these objections. 7% would spend up to $60.00

With the above information, Winegard engineers went to work to produce the first antenna designed specifically for the needs and wants of TV set owners in the Twilight area.

We call this new electronic masterpiece...appropriately enough...the Twilight!

SELL THE LINE THAT HELPS YOU SELL!

As Advertised in LIFE
Better Homes & Gardens

List price established nationally in Life magazine at $29.95. Extra long discount structure so you can allow trade-ins or free installation if you wish...and still make your normal profit.

Mr. Dealer:
See Your Winegard Distributor and

Mail Coupon Today!

WINEGARD CO., Dept. RE-10
3000 Scotten Blvd., Burlington, Iowa

☐ Complete information on Twilight plus sales aids.
☐ Other Winegard Do-It-Yourself antennas and kits at low as $14.95.
☐ Complete information on high powered Colorceptor.

Dealer Firm Name: ______________________________________
Address: ________________________________________________
City: __________________________________________ State: ______
high fidelity FM reception

demands a fine antenna...

and the audiophile's best bet for clear, sparkling FM sound is an AMPHENOL broadband FM antenna. Available in two popular models, AMPHENOL FM antennas have been carefully engineered for specific reception problems. The 114-008 "Inline-type" folded dipole and reflector offers the unidirectional directivity pattern, high gain and mechanical rigidity that have made AMPHENOL's tv Inline antenna famous. The 114-010 "Turnstile" double folded dipole is intended for use in urban areas where there are many FM stations. Its circular directivity pattern assures efficient pick-up of such stations.

*Do it yourself
COMPLETE KITS $16.25 each, list

CORRESPONDENCE (Continued from p. 18)
of a warning telling people to be careful, particularly where children are concerned, that they do not put their faces too close to the receiving set (I recommended a distance of 6 feet from the set). It is my feeling that so little is known about both the short- and long-range effects of radiation that, when one is dealing with any instrument potentially dangerous in this area, extreme caution is always advisable. It is a caution I use with my own children and a caution a great many of my colleagues also use.

I had been referring to an increase in the anode voltage and not the servicemen's low-power "booster," which, incidentally, I have on my own TV. I do not know how widely special glasses are used on commercial television receivers. I do know that one of the large manufacturers of the glass envelopes uses barium glass on the face of the viewing tube. This, however, is something that has been developed only in the last several years. I understand from this same manufacturer that a barium lead glass will be used on the color glass envelopes he manufactures. The reason he gave me in both instances was that, while most information to date would seem to indicate that the radiation of a television viewing tube is quite low, he would rather be sure than make a dangerous mistake. The plate glass which is usually in front of the tube is of the same composition as that found in ordinary windows.

JAMES B. KELLEY
Consultant,
Technical Industrial Research

BASEMENT TECHNICIAN

Dear Editor:
I am a part-time "basement technician." So this is how I see things!

For one thing, I do not have the necessary capital—or name—to open up a nice successful full-time service business. Maybe I should go to work for some service company. Well, I admit I might not get the pay I'm enjoying from my present full-time job. And with five kids it's hard to take a cut.

You full-timers have many good arguments and I'm with you on them. The part-timer is inclined to be cut-rate. I'm one who isn't! In my locality I believe a service call should be about $5. They once were! Now it's $3.50.

I put in some 16 months at a full-time radio school (plus a little Navy training). I put a lot of cabbage into test equipment, other than screwdrivers and emission tube testers, so catch me at cut-rating and I'll eat it all.

One thing I would like to know, How many of you full-time boys were once part-timers?

About licensing, I'm for it! No license, no servicing. However, I'd want the license awarded on the basis of technical knowledge and ability.

All I ask is a fair chance to show I'm not incompetent. If you have a "dog," I'd like to try myself against it.

LARRY SCHWARTZ
Canton, Ohio
LEARN ELECTRONICS!
EARN MORE MONEY!

F.C.C. LICENSE—THE KEY TO BETTER JOBS
An F.C.C. commercial (not amateur) license is your ticket to higher pay and more interesting employment. This license is Federal Government evidence of your qualifications in electronics. Employers are eager to hire licensed technicians.

LEARN BY MAIL OR IN RESIDENT CLASSES
Grantham School of Electronics specializes in preparing students to pass F.C.C. examinations. Correspondence training is conducted from Washington and Hollywood; resident DAY and EVENING classes are held in both cities. Either way, we train you quickly and well—NO previous training required. A beginner may qualify for his first class F.C.C. license in as little as 12 weeks.

THE GRANTHAM COMMUNICATIONS ELECTRONICS COURSE
offers you complete preparation for F.C.C. examinations required for a first class F.C.C. license. Even though it is planned primarily as preparation for F.C.C. examinations, it is not a "cram course" but prepares you by teaching you electronics.

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:

<table>
<thead>
<tr>
<th>License</th>
<th>Wks.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leo Bishop, 37 Calle Contenta, Flagstaff, Ariz.</td>
<td>1st 12</td>
</tr>
<tr>
<td>Carl Deare, Jr., P.O. Box 467, Jeanerette, La.</td>
<td>1st 11</td>
</tr>
<tr>
<td>Robert Umthun, 1918 Eye St., NW, Washington, D.C.</td>
<td>1st 21</td>
</tr>
<tr>
<td>Tommy Lesley, 422 Wood St., Maysville, Ky.</td>
<td>1st 9</td>
</tr>
<tr>
<td>Dan Breeze, Station KOVE, Lander, Wyo.</td>
<td>1st 12</td>
</tr>
<tr>
<td>Robert Todd, Station WWBG, Bowling Green, Ohio</td>
<td>1st 13</td>
</tr>
<tr>
<td>Jackson York, 1029 N. Quincy St., Arlington, Va.</td>
<td>1st 15</td>
</tr>
<tr>
<td>Paul Chuckray, 6874 Weber Rd., Affton, Mo.</td>
<td>1st 11</td>
</tr>
</tbody>
</table>

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

TWO COMPLETE SCHOOLS
To better serve our many students throughout the entire country, Grantham School of Electronics maintains two complete schools—one in Hollywood, California and one in Washington, D.C. Both schools offer the same rapid courses in F.C.C. license preparation, either home study or resident classes.

Get your First Class Commercial F.C.C. License in 12 weeks
by training at

GRANTHAM SCHOOL OF ELECTRONICS

HOLLYWOOD DIVISION
1505 N. Western Avenue, Hollywood 27, Calif. Phone: HO 2-1411

WASHINGTON DIVISION
821-19th Street, N.W., Washington 6, D.C. Phone: ST 3-3614

OCTOBER, 1957
5-star feature...

1. the best color TV picture
   the growth of color TV means an even greater demand for CDR Rotors for pin-point accuracy of antenna direction.

2. a better picture on more stations
   CDR Rotors add to the pleasure of TV viewing because they line up the antenna perfectly with the transmitted TV signal giving a BETTER picture... and making it possible to bring in MORE stations.

3. tested and proven dependable
   thousands and thousands of CDR Rotors have proven their dependability over years of unfailing performance in installations everywhere in the nation. Quality and engineering you know you can count on.

4. pre-sold to your customers
   the greatest coverage and concentration of full minute spot announcements on leading TV stations is working for YOU... pre-selling your customers.

5. the complete line
   a model for every need... for every application. CDR Rotors make it possible for you to give your customer exactly what is needed... the right CDR Rotor for the right job.

AR-22
TR-2
TR-4
TR 11 and 12
AR 1 and 2

CDR ROTORS

CORNELL-DUBILIER
THE RADIANT CORP
SOUTH PLAINFIELD, N. J.
CLEVELAND 13, OHIO

www.americanradiohistory.com
VETERANS - NON-VETERANS

Get Into The Field That's Making Headlines

All over the nation the Television-Radio-Electronics industry is making News—News that means opportunity for YOU. You can cash in on the headlines. **I WILL TRAIN YOU AT HOME FOR A TOP-PAY JOB IN TELEVISION**

I will prepare you for a spot in America's fastest-growing industry. You can become a trained technician in your spare time without giving up your present job or social life. No experience needed.

**LEARN BY DOING**

As part of your training I give you the equipment you need to set up your own home laboratory and prepare for a top-pay job or set up your own business. You build and keep a TELEVISION RECEIVER designed and engineered to take any size picture tube up to 21-inch. (10-inch tube furnished. Slight extra cost for larger sizes.)... also a Super-Hat Radio Receiver, AF-RF Signal Generator, Combination Voltmeter-Ammeter-Ohmmeter, C-W Telephone Transmitter, Public Address System, AC-DC Power Supply. Everything supplied, including all tubes.

**STUDY NEWEST DEVELOPMENTS**

My training covers all the latest developments in the fast-growing Television-Radio-Electronics industry. You learn about FM — RADAR — COLOR TV — TRANSISTORS — PRINTED CIRCUITS, etc.

**CHOOSE FROM FOUR COMPLETE COURSES**

1. Radio, FM and Television Technician Course—no previous experience needed.
2. FM-TV Technician Course—previous training or experience in radio required.
3. TV Studio Technician Course—advanced course for trained men.
4. Color TV Technician Course—Includes latest color TV circuits.

**EXTRA TRAINING IN NEW YORK CITY AT NO EXTRA COST!**

After you finish your home study training in Course 1 or 2 you can have two weeks, 50 hours of intensive Lab work on modern electronic equipment at our associate resident school, Pierce School of Radio & Television. THIS EXTRA TRAINING IS YOURS AT NO EXTRA COST WHATSOEVER!

**FCC COACHING COURSE**

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

**Radio-Television Training Association**

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

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

October, 1957

www.americanradiohistory.com
Removes all static and dust while record is played;
new moving coil microphones and transistor amplifier

ESL DUST BUG
The problems of dust, lint, and static buildup on phonograph records and pickup styli have been solved by this ingenious new invention which cleans the record as it is being played. The plush pad is slightly moistened with special, harmless activating fluid supplied in a replaceable applicator. This helps to loosen groove dust and dirt, which is then collected by the pad. It also neutralizes the static charge present in all records. Every point on an LP record is cleaned by the wide pad approximately one hundred times during a single play.

ESL Dust Bug, complete with Dust Bug Fluid in applicator $5.75

ESL MOVING COIL MICROPHONES

ESL TRANSISTOR AMPLIFIER
This hum-free, low-distortion amplifier can provide improved performance with moving coil microphones, for which it is a preamplifier, and with ESL electrodynamic cartridges, for which it is a pre-preamplifier. As its frequency response is flat and unexplained, it does not replace the conventional phono preamplifier. It permits use of greatly superior low-impedance microphones—such as the ESL—with medium-price tape recorders.

Voltage gain: 20-30 dB (110 or 120 voltage step-up) • Signal-to-noise ratio: minus 50 dB • Frequency response: 20-20,000 cps • IM distortion: 1/10 of 1% • Input impedance: 100 ohms • Output impedance: 2,000 ohms • Battery life: 1 year • Hum level: zero

ESL-1 A, complete with battery $16.50

FOR LISTENING AT ITS BEST
Electro-Sonic Laboratories, Inc.
Dept. E • 35-54 Thirty-sixth St • Long Island City 6, N.Y.

Additional information available free upon request to ESL
Learn TELEVISION-RADIO Servicing or Communications by Practicing at Home in Spare Time

WITHOUT EXTRA CHARGE you get special NRI kits developed to give actual experience with TV-Radio equipment. You build, test, experiment with receiver or broadcasting circuits. All equipment yours to keep.

Have the High Pay, Prestige, Good Future of a Skilled TV-Radio Technician

People look up to and depend on the Technician, more than ever before. Offices, plants, homes everywhere are obliged to buy his knowledge and services. His opportunities are great and are increasing. Become a TV-Radio Technician. At home, and in your spare time, you can learn to do this interesting, satisfying work—qualify for important pay. To ambitious men everywhere here in the fast growing Television-Radio field is rich promise of fascinating jobs, satisfaction and prestige as well as increasing personal prosperity.

Increased Opportunities in Growing Field

A steady stream of new Electronic products is increasing the job and promotion opportunities for Television-Radio Technicians. Right now, a solid, proven field of opportunity for good pay is servicing the tens of millions of Television and Radio sets now in use. The hundreds of TV and Radio Stations on the air offer interesting jobs for Operators and Technicians.

More Money Soon—Make $10 to $15 a Week Extra Fixing Sets in Spare Time

NRI students find it easy and profitable to start fixing sets for friends and neighbors a few months after enrolling. Picking up $10, $15 and more a week gives substantial extra spending money. Many who start in spare time soon build full time TV-Radio sales and service businesses.

Act Now—See What NRI Can Do for You!

NRI has devoted over 40 years to developing simplified practical training methods. You train at home. Get practical experience, learn-by-doing. Address: NATIONAL RADIO INSTITUTE, Washington 16, D.C.

NRI Has Trained Thousands for Successful Careers in TV-Radio

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

NOS ALL THE WORK HE CAN DO
"Since finishing NRI Course I have repaired more than 2,000 TV and Radio sets a year. NRI training certainly proved to be a good foundation." H. R. JORDON, Millidgeville, Ga.

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

The Tested Way To Better Pay See Other Side

SAMPLE LESSON AND CATALOG BOTH FREE

This card entitles you to Actual Lesson on Servicing, shows how you learn Television-Radio at home. You'll also receive 64-Page Catalog.

NATIONAL RADIO INSTITUTE, Dept. A Washington 16, D.C.

Please mail me the FREE sample lesson and 64-Page Catalog. (No Salesman will call.)

Name ________________________________ Age __________

Address _________________________________

City ___________________________ Zone State

ACCREDITED MEMBER, NATIONAL HOME STUDY COUNCIL

NO STAMP NEEDED!
WE PAY POSTAGE

The ABC's of SERVICING

Job and Career Opportunities for RADIO-TV TECHNICIANS

Wwww.americanradiohistory.com
Technical "KNOW-HOW" Can Give You Interesting, Important Work
LEARN-BY-DOING with Kits NRI Sends at No Extra Charge

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

YOU BUILD Signal Generator
You build this Signal Generator. Learn how to compensate high frequency amplifiers, practice aligning typical L.F. amplifiers in receiver circuits. Make tests; conduct experiments.

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

For Higher Pay, Better Jobs
Be a Television-Radio Technician

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

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

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

No Experience Necessary—NRI Sends Many Kits for Practical Experience
You don't have to know anything about electricity or Radio to understand and succeed with NRI Courses. Clearly written, well-illustrated NRI lessons teach TV-Radio-Electronic principles. You get NRI kits for actual experience. All equipment is yours to keep. You learn-by-doing. Mailing the postage-free card may be one of the most important acts of your life. Do it now. Reasonable tuition. Low monthly payments available.
Address: NATIONAL RADIO INSTITUTE, Washington 16, D.C.

NRI Graduates Do Important Work

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

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

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

See Other Side for more information on the Tested Way to Better Pay

Sample Lesson
64-page CATALOG both FREE

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

Business reply card
No postage stamp necessary if mailed in the United States

Postage will be paid by
NATIONAL RADIO INSTITUTE
Washington 16, D.C.

www.americanradiohistory.com
how long would it take you to solve this service problem?

PHOTOFACT helps you lick problems like this in just minutes for only *2½¢ per model!

Let's take a look at this problem: A condition such as this can exist only when there is no signal reaching the picture tube or the audio output stage. Using the Tuner Service data (found in every PHOTOFACT TV Folder), first isolate the trouble by connecting an amplitude-modulated signal to the mixer-grid test point "D." The appearance of one or more black bars on the face of the tube would indicate that the trouble is probably in the tuner. So look for the following possible causes:

1. Defective oscillator-mixer tube
2. Defective RF amplifier tube
3. Open plate-load resistor in the oscillator stage
4. Failure of the feedback capacitor in the oscillator stage
5. Open decoupling resistor
6. Dirty or faulty contacts
7. Cold solder joint

Using the applicable PHOTOFACT Folder you can troubleshoot and solve this problem in minutes. Here's how:

Check the oscillator-mixer and RF amplifier tubes. Tubes okay?—Then: Check voltages on the tube pins (they're right on the schematic) for open oscillator plate-load resistor, open RF decoupling resistor, faulty feedback capacitor, dirty switch contacts or cold solder joints.

Every PHOTOFACT Television Folder contains complete detailed information on Tuners, including separate Schematics, separate Keyed Chassis Photographs, Parts Lists, Alignment Points, Test Points, and Field Service Adjustments that will help you quickly locate the proper parts to replace and tell you how to do a touchup or thorough alignment job after making the necessary repairs. These features are a plus exclusive in PHOTOFACT.

Whatever your problem or favorite servicing procedure may be—you will always find all of the information you need at your fingertips in PHOTOFACT. For only *2½¢ per model, PHOTOFACT helps you solve your service problems in just minutes—helps you service more sets and earn more daily!

*Based on the average number of models covered in a single set of PHOTOFACT Folders.

MONEY BACK GUARANTEE!

Got a tough repair? Try this—at Howard W. Sams' own risk: see your Parts Distributor and buy the proper PHOTOFACT Folder Set covering the receiver. Then use it on the actual repair. If PHOTOFACT doesn't save you time, doesn't make the job easier and more profitable for you, Howard W. Sams wants you to return the complete Folder Set direct to him and he'll refund your purchase price promptly. GET THE PROOF FOR YOURSELF—TRY PHOTOFACT NOW!

FOR SERVICE TECHNICIANS ONLY

Fill out and mail coupon today for free subscription to the Sams Photofact Index—your up-to-date guide to virtually any receiver model ever to come into your shop. Send coupon now.

HOWARD W. SAMS & CO., INC.

Howard W. Sams & Co., Inc.
2205 E. 46th St., Indianapolis 5, Ind.

Mr. I'm a Service Technician: [] full time; [] part time

My Distributor is:

Shop Name

Attn:

Address:

City _______ Zone _______ State _______
Use
RAYTHEON
All-Set
TV & RADIO
TUBES

for all set replacement work!

You’ll save yourself trouble if you standardize on Raytheon “All-Set” Tubes for replacement work.
Here’s why:
Raytheon “All-Set” Tubes are designed to give perfect service in many makes and models of receivers because Raytheon sells Tubes to almost every set manufacturer. To satisfy the many and varying needs of so many manufacturers, these tubes must combine top quality performance and dependability. This successful combination makes Raytheon “All-Set” Tubes tops for replacement. Always use Raytheon “All-Set” Tubes to satisfy your “all-set” customers.

TV-Radio service is your business . . . serving you is ours

RAYTHEON MANUFACTURING COMPANY
Receiving and Cathode Ray Tube Operations,
Newton, Mass. • Chicago, Ill. • Atlanta, Ga. • Los Angeles, Calif.
Raytheon makes all these:
Receiving and Picture Tubes, Reliable Subminiature and Miniature Tubes,
Semiconductor Diodes and Transistors, Nucleonic Tubes, Microwave Tubes.

www.americanradiohistory.com
RCA offers you the finest training at home in Radio-TV electronics, TV servicing, Color TV.

SEND FOR THIS FREE BOOK NOW!

RCA INSTITUTES, INC.
A SERVICE OF RADIO CORPORATION of AMERICA
350 West Fourth Street, New York 14, N.Y.

Pay-as-you-learn. You need pay for only one study group at a time. Practical work with very first lesson. All text material and equipment is yours to keep. Courses for the beginner and advanced student.

RCA Institutes, Inc., Home Study Dept. RE-107
350 West Fourth Street, New York 14, N.Y.
Without obligation, send me FREE 52 page CATALOG on Home Study Courses in Radio, Television and Color TV. No Salesman will call.

Name _______________________________ Please Print

Address ____________________________________________________________

City ___________________ Zone __________ State __________________________

KOREAN VETS! Enter discharge date ________________

To save time, paste coupon on postcard

OCTOBER, 1957
Shown at Bell Laboratories, Murray Hill, N.J., are, left to right, F. J. Herr, S. T. Brewer, L. R. Snoke, E. E. Zajac and F. W. Kinsman.

They’re wiring the seas for sound

These five Bell Labs scientists and engineers may never “go down to the sea in ships.” Yet, they’re part of one of the most exciting sea adventures of modern times. Along with many other specialists, they are developing the deep-sea telephone cable systems of the future.

Here’s how they join many phases of communications science and engineering—to bring people who are oceans apart within speaking distance.

F. J. Herr, M.S., Stevens Institute, is concerned with systems design and analysis. He studies the feasibility of new approaches and carries out analysis programs to select optimum parameters for a proposed system design.

S. T. Brewer, M.S. in E.E., Purdue, communications and electronics engineer, explores new designs for sea-bottom amplifiers needed to step up power of hundreds of simultaneous telephone conversations.

L. R. Snoke, B.S. in Forestry, Penn State, is the team biologist. He investigates the resistance of materials to chemical and microbiological attack in sea water. Materials are evaluated both in the laboratory and in the ocean.

E. E. Zajac, Ph.D. in Engineering Mechanics, Stanford, is a mathematician. He studies the kinematics of cable laying and recovery. Cable’s dynamic characteristics, ship’s motion, the mountains and valleys in the ocean bottom—all must be taken into account.

F. W. Kinsman, Ph.D. in Engineering, Cornell, solves the shipboard problems of storage, handling and “overboarding” of cable. New machinery for laying cable is being developed.

Deep-sea cables once were limited to transmitting telegraph signals. Bell Labs research gave the long underwater cable a voice. New research and development at the Labs will make this voice even more useful.
NEW! 12-WATT Williamson-type HIGH FIDELITY INTEGRATED AMPLIFIER HF12 with Preamplifier, Equalizer & Control Section KIT $34.95 WIRED $57.95

Compact, beautifully packaged & styled. Provides complete "in-cabinet" facilities and high fidelity performance. Direct tape head & mag phono pick-up. HARTB (tape & control (phone) feedback equalizations, 6-tube circuit, dual triode for variable turnover bass & treble feedback-type tone controls. Output Power: 12 watts, 25 W, pk, 1M pf. (60 & 6000 cps @ 41) 1% distortion, 12 W @ 6 W, ±1.5 db. Freq. Resp.: 1 W: ±3 db 12 W - 50 kc 12 W: ±5 db 25 W - 20 kc Harmonic Distortion: 2% ±4.2 db 15% ±5 W, 30 W, 2% ±11 W. 12 W @ 6 W. 1% distortion, 12 W: ±1.5 db 12 W: ±3 db 1% distortion. Linear Feedback: Excellent square wave reproduction (4 usec. rise-time); negligible ringing, rapid settling on 10 kc square wave. Inverse Feedback: 20 db, Stability Margin: 12 db. Damping Factor: 100. Receiver Connections: 4, 8, 16 ohms. Tone Control Range: 10 kc, 2 dc, 30 W, ±500 W, ±1% distortion. Distortion Feedback equalization: 5 filters common recording curves for L1 & T8s including RIAA. Low-distortion feedback tone controls: provide large boost or cut in bass or treble with mid-freqs & volume unaffected. Centrals printed-circuit "Wired Control" panel: complete control with concentric level control. 4 hi-level switched inputs (tuner, tv, tape, aud.). 3 level inputs (separate front panel in many preamps). Input sockets (concurrent use of changer & turntable). Power up kick & loading of sound provided for all quality cartridges. Head-bal. control. DC super-imposed on filament supply. 4 convenience outlets. Extremely flat wideband freq. resp.: -1 db 8-100,000 cps, ±1 db 12-50,000 cps. Extremely sensitive. Negligible hum, noise, harmonic or 1% distortion. Size: 4 7/8 x 12 1/2 x 16 x 4 7/8, 8 lbs.

See the "BEST BUYS" NOW IN STOCK at your nearest distributor. Fill out coupon on other side for FREE CATALOG.
for COLOR & Monochrome TV servicing

FREE CATALOG

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

MAIL COUPON NOW!

**NEW! TV-FM SWEEP GENERATOR & MARKER #368**

KIT $69.95  WIRE $119


**NEW! RF SIGNAL GENERATOR #324**

KIT $26.95  WIRE $39

150 kc to 435 mc with ONE generator! Better value than generators selling at 2 or 3 times its cost! Ideal for IF-RT alignment, signal tracing & trouble-shooting of TV, FM, AM sets. marker gen.: 400 cps audio testing lab. work. 6 funk. bands. 1.5 kc to 6 kc. 900 kc-1200 kc. 1.5, 10 mc. 2.5-11.1 mc. 11.1-43.5 mc. 43.5 mc-114 mc. 114 mc-413 mc. 413 mc-1.144 mc. Freq. accurate to +1.5%. 6; 1 vernier tuning & excellent spread at most important alignment freqs. Freqd. tuning dial. plexiglas window. edge-light hairlines. Culpits & osc. directly plate-modulated by K-follower for improved mod. Variable depth of int. mod. 0.5% by 400 cps Culpits osc. Variable gain ext. amplifer (3-step) included in 3-band. Tuned-mounted coils shielded for max. accuracy. Fine & Coarse (3-step) RF attenuation. RT output 100,000 mc. AF sine wave output 10 v. 50-ohm output. Z. wave-jack top-hat binding posts for AF input; coaxial coaxימר & shielded cable for RF output: 12AU7. 12AV7. selenium rectifier. snuf-operated. Deep-etched satin aluminum panel; rugged grey wrinkle steel cabinet.

**NEW! DYNAMIC CONDUCTANCE TUBE & TRANSISTOR TESTER #666**

KIT WIRE $69.95  $109.95

COMPLETE with steel cover and handle.


Send for FREE CATALOG

EICO® 1300 Northern Blvd., Long Island City 1, N.Y.
HIGH-FIDELITY SOUND

... A New Approach to Higher Fidelity...

The basic principles of sound reproducing are comparatively ancient, as viewed by modern audio engineering. Only two fundamental principles are used in loudspeakers common today. The first is Dr. Alexander Graham Bell's electromagnetic telephone of 1876, now adapted into a loudspeaker. Bell's old vibrating 2-inch-diameter iron diaphragm has been expanded into a large vibrating cone (the latter is attached to a voice coil which floats in the magnetic field.) Roughly the same principle, however, remains. The second is Prof. Amos Emerson Dolbear's 1870 condenser (capacitance) telephone which worked on the "static" principle. It had two 2-inch iron or steel diaphragms separated about ½ inch. One diaphragm was fixed, the other left free so it could vibrate. The transmitting line was connected to the two diaphragms. This arrangement works on the same principle of molecular motion and thermo effects. Unfortunately, it requires a very large horn, if it is to cover the full range.

As we all know, our modern loudspeaker reproducers—good as they are—leave much to be desired. They do not reproduce with complete fidelity—they only approximate in fact. The sound reproduction is a compromise. Indeed, if we wish the best reproduction possible with present-day means, we must use several reproducers simultaneously, one (or more) for the lower notes plus one (or more) for the higher register.

The main reason for this deficiency is that up to now we have no inertialess loudspeakers, with the possible exception of Siegfried Klein's Ionophone, which works on a combination of molecular motion and thermo effects. Unfortunately, it requires a very large horn, if it is to cover the full range.

As we see it, we should dissociate ourselves from the fixed idea prevalent for over 80 years that we must move large masses of air in order to hear. Hence our present-day loudspeaker cones which we fashion to "grip" the surrounding atmosphere.

Have you ever placed your ear tightly to a solid wood telegraph or telephone pole and listened to the loud "singing" wires 40 feet above your head? This is sound conduction (often molecular) through a solid. Several decades ago, the same interesting phenomenon occurred when boys, living on the prairie, placed their ears against a rail on the ground to listen to an invisible oncoming (or receding) train many miles away. And the sound often was very loud, too. (Today's modern railroad signalling requires insulated joint bars between the rails. This cuts down long-distance sound reception.)

The writer made use of this principle when he patented the Osophone, in 1923, the first bone-conduction speaker, which near-deaf people held between their teeth. They could hear speech or music well, entirely through the osseous part of the cranium.

Another interesting example can be cited. Many years ago, we visited an experimenter friend of ours on Long Island. He was living in an old house supported in the cellar by several large round wooden beams, each about 8 inches in diameter. To the center post he had attached a large loudspeaker in such a manner that the speaker's armature was fixed solidly into the wooden pole. The loudspeaker itself was supported by the cement floor. The result: music and sound were propagated clearly throughout the entire house. The sound—and radio—could be switched off or on from any room on all floors.

These examples are given merely to illustrate how sound can be propagated in the absence of air. What we are trying to say is that the orthodox "grip" on the air by means of large vibrating "driven" surfaces is not necessarily a future requirement of high-fidelity loudspeakers.

At the same time, it is true that humans, immersed in ambient air, normally hear best when sound vibrations impinge via air columns of their ears onto their tympanums. But it makes no difference how the sound waves are propagated, by what means, so long as the end result—high-fidelity sound reproduction—is perfect, or at least near perfect.

It would appear that inertialess molecular speakers would stand the best chance of succeeding in the end. The reasons seem obvious. Today's ideal audio reproducer is called the "tweeter" to recall the faithfully tens of thousands of different sounds in every imaginable combination, with all sorts of overtones, resonances, timbres and intensities, in frequencies from 2 to 20,000 cycles. This seems an impossible task for a single vibrating or oscillating surface or set of surfaces. They cannot faithfully reproduce at the same time an entire orchestra with all its various instruments, plus a large singing chorus. At best we get an approximation, but a large percentage of true tones are lost.

An oscillating cone or surface swings to and fro. It has inertia. This requires time. During the long swing, on a low note, the cone must also vibrate at a higher rate to reproduce higher notes that may have to be reproduced simultaneously. They are thus out of phase, hence are not fully rendered. The molecular speaker on the other hand has no parts that move. It is inertialess, hence it cannot be out of phase.

This brings to mind a very early molecular type of inertialess telephone. Th. Du Moncel, in the magazine Le Téléphone (Paris, 1882) reported the invention as follows: "To convince himself whether the telephone effect of his instrument was based upon molecular or transverse vibrations, in the 1880's, Dr. Clément Ader, the French inventor, constructed a telephone without diaphragm or membrane; with it he could reproduce only articulated sounds, but not the human voice. Soon, however, by changing his central magnetic rod to various dimensions, he noticed that the intensity of the reproduction increased as the diameter of the magnetic rod was reduced. Finally, he used an iron wire only 1 millimeter in diameter. By rigidly fixing the wire in his instrument, reproduction of the voice and words became audible. The effect was even better when he fixed the iron wire rigidly at the top and weighted the free end with a large and heavy metal mass. The iron wire itself was surrounded along its middle by an induction coil which did not touch the iron wire."

Du Moncel explained the action as follows: "The molecular oscillations of the iron wire are principally effective along its longitudinal axis. They propagate themselves faster than normal (transverse) oscillations which are communicated to the inert metal mass; this action results in minute shocks which amplify the mechanical effect of the oscillations in the iron wire. The resulting total effect of the suspended metal mass then communicates itself along the iron wire to the upper fixed suspension of the wire, which is a solid block of copper. From here on, audio oscillations result which are now transmitted to the surrounding air by the instrument. There is of course no horn but instead a small wooden saucer-like surface."

It may be hoped that future audio loudspeaker research will be in the molecular direction. It holds great hope for high fidelity.

—H.G.

www.americanradiohistory.com
All Transistor Tape-Head Preamp

Completed unit in its tiny case.

Other side of the unit.

Sandwich construction aids compact layout.

Fig. 1—Preamplifier circuit with a positive ground.

Miniature two-stage preamp plugs into an octal socket

By FRANCIS A. GICCA *

An ideal use for the transistor, in the audio field, is in a tape recorder preamplifier. Let's look at some requirements of a good tape preamp and we'll quickly see why a transistor unit can outperform its vacuum-tube cousin.

A tape head is a low-impedance device—usually about 500 ohms. For optimum performance it's important for a preamp to have a similar input impedance. High-frequency response of the head suffers seriously unless it is matched to a low-impedance preamp input.

Generally, it is not the mechanical gap width of the head that limits the high-frequency response, but the stray capacitance across the head's windings. For example, a typical tape head has a mechanical gap width of .0002 inch, a resistance of 500 ohms and a stray capacitance across the windings of 20 pf. This head at 7½ ips has a mechanical gap cutoff frequency of 37,500 cycles (f0 = 7.5 gap-width). With a preamp that has an input impedance of 1 megohm, the head's stray capacitance will cause the half-power point (3 db down) to be about 8,000 cycles. But, if our preamp has an input impedance of 500 ohms, the half-power point becomes about 16 mc. This allows the head's mechanical gap width to be the dominant high-frequency limitation.

For a vacuum-tube preamp to have an input impedance of 500 ohms we must use an input transformer. A good, wide-range input transformer is expensive. It easily picks up stray hum fields and we may lose high-frequency response in the transformer's secondary due to its stray capacitance. On the other hand, a grounded-emitter transistor stage has, by its very nature, a low input impedance.

Noise and hum are two other important problems. The NARTB tape-playback characteristic helps to minimize noise by calling for a 10-db gain reduction at 10,000 cycles. Vacuum tubes are noisier at these higher frequencies—the thermal-noise region. A 10-db gain reduction at 10,000 cycles reduces the effect of this noise.

Transistors have about the same noise problems as vacuum tubes. It is true that transistors generally have more noise at low frequencies than vacuum tubes.
Audio—high fidelity

Fig. 2—Negative-ground circuit hooked to tape deck and inverter for auto use.

To tape deck and inverter for auto use. characteristic we use a simple R-C shaping circuit between V2's collector and ground. Since the NARTB curve follows the ideal 6-db-per-octave curve of an R-C network such an equalization circuit is simple and very effective for achieving the right response. The circuit is shown in Fig. 1. Its overall simplicity is evident and its performance leaves nothing to be desired. A transistor preamp should be designed so that it can drive high-level inputs of audio control units, since most high-fidelity installations use such a control unit as the master control center for the system. Since the average tape head has about 8 mV output at 1,000 cycles, preamp gain of 32 db at this frequency would provide 0.2 volt of signal to the control unit. This is adequate for almost all control units.

Fig. 3—Switching arrangement using car radio as tape recording amplifier.

The NARTB tape characteristic calls for a maximum bass boost 26 db above the 1,000-cycle reference level, so our preamp must have a maximum gain of 58 db at extremely low frequencies to give an output of 0.2 volt. With careful design two 2N106 transistors supply this gain.

The grounded-emitter configuration was chosen as it has a low input impedance, high gain and is relatively stable. Bias current for the transistor base is obtained by using a resistive divider from the collector to ground. This type of biasing circuit also applies both dc and ac stabilizing negative feedback around the stage, helping to minimize transistor drift and individual variations. The use of emitter feedback in the form of a series emitter resistor also adds stability and allows us to adjust each stage for maximum flat frequency response by properly bypassing the emitter resistor.

To obtain the NARTB tape-playback switch in your car radio to connect the preamp to your radio's power amplifier. The preamp will have to be modified slightly to operate with a negative ground. Fig. 2 shows this circuit. (For cars with a positive ground, the Fig. 1 circuit can be used.—Editor)

To modify your car radio for a tape player system, merely break the lead from your radio's volume control, and add a switch between this lead and the detector stage to allow you to switch from the radio to the preamp. This wiring change is shown in Fig. 3.

If your car has a 12-volt battery, insert a 15,000-ohm 2-watt resistor between the battery and the preamp power input and use a 12-volt inverter.

Construction details

There are many ways in which the transistor preamp can be built. I constructed my model using two phenolic boards with spacers glued between them. (Perforated bakelite boards can be used.—Editor) This allowed me to mount the entire preamp in a 1 1/2 x 1 1/2 x 2 1/4-inch Muntal case. This was a junkbox item. A small Bud Minibox is just as good. Input, output and power leads are brought into the preamp through an octal plug.

A conventional chassis will do just as well. The finished size is larger than the phenolic-sandwich type of construction, but a lot easier to build. It is wise to plan your layout so that the finished chassis will fit into a miniature case. The shielding from stray hum pickup, obtained by enclosing the preamp in a case is well worth the small cost.

To keep the input transistor noise low, use 1% deposited-carbon resistors for R1, R2, R3 and R4.

Be sure to use a single wire as a ground bus. Connect all grounds to this wire which should be connected to your chassis only at pin 3 of the octal plug. This eliminates hum from the

O C T O B E R, 1 9 5 7

www.americanradiohistory.com
Bass Reproduction in Loudspeakers

By EDGAR VILLCHUR

One view on the relationship between cone excursion and bass reproduction

The correspondence column of the May, 1957, issue of this magazine contained a letter from Paul W. Klipsch which I read with considerable interest. The issues raised are both important and fundamental and deserve treatment at some length. I subscribe entirely to the accuracy of the data quoted, but cannot agree with Mr. Klipsch's conclusions.

It has been known for a long time that a speaker cone must move increasingly greater distances as the frequency enters the bass regions. This relationship (among others) was pinned down in 1942 by Frank Massa in his classic book, Acoustic Design Charts.

Chart No. 61 of Massa's book shows the relationship between the acoustic output of a vibrating diaphragm, in watts, to the distance of travel at various frequencies. Mr. Klipsch specifically points out in his letter, on the basis of the above, that the excursion required of a directly radiating 12-inch speaker cone, for 1 acoustic watt at 30 cycles, is 2.8 inches.

These figures are as accurate today as when they were published 15 years ago, but they must be interpreted with the same rigor that was used in their original formulation. They do not mean that a 12-inch loudspeaker cone has to vibrate over the impractical distance of almost 3 inches to reproduce 30-cycle energy at concert level in the home. If this were so, direct-radiator speakers would be incapable of reproducing the pedal line of a pipe organ or the explosive thud of a bass drum.

Bass power

The amount of bass power created by a speaker cone depends upon three things: (1) the cone travel, or excursion, relative to the frequency, (2) the size of the cone and (3) the solid angle in which the speaker is mounted. The significance of the first two factors is fairly obvious since the larger the cone, and the farther it moves, the more air will be pumped back and forth. The third factor is equally significant but the reasons for it being so are not as obvious.

Consider the hypothetical situation in which a loudspeaker system (including a 1000-ohm resistor) is suspended on a rope, in the center of the universe. There will be a tendency for energy at higher frequencies to be concentrated in the area directly ahead of the speaker, but bass frequencies will be radiated equally in all directions. Bass sound levels in front of the speaker are thus watered down relative to the treble by their better dispersion and are weaker in comparison.

Now let us place the speaker system behind an infinite baffle so that the speaker looks out on only half the universe. The treble portion of the signal will not be concentrated any more than it would be by the natural directive characteristics of the speaker but the bass, which was formerly radiated in all directions, is now restricted. The cone gets a better bite of the air that it engages at low frequencies and the area in front of the speaker receives a double concentration of bass.

Following the same analysis, halving the solid angle of radiation once more doubles the bass power again.

Translated into practical terms, this means that, when a speaker is mounted in a two-sided corner (such as at the junction of the floor and wall), the bass power radiated into the room, with bass excursions, will be doubled compared to that produced by a speaker mounted in the center of a flat wall. If
the speaker is mounted in a three-sided corner—the junction of two walls and the floor, for example—the bass power will be quadrupled.

Massa is very explicit about the solid angle seen by his radiating diaphragm, as he must be for his data to be meaningful. The figures he gives are for diaphragms radiating into 180° or, as he puts it, into semi-infinite space. His figures can thus only be applied to practical speakers in the mid-wall position. If we place our speaker in a corner on the floor, the same 2.8 inches of cone excursion will radiate an effective 4 watts of acoustic power at 30 cycles, rather than 1 watt.

The order of magnitude of acoustic power that we are discussing here is tremendous and, for a living room of even large size, literally ear-shattering. Massa’s book also contains data on the number of acoustic watts required for musical reproduction at concert-hall level, in rooms of various sizes and reverberation periods (Chart No. 72). For a typical living room of, say, 3,000 cubic feet, we would require about 0.4 acoustic watts total sound power.

**Required cone excursion**

It is highly unlikely that all of the sound would ever appear at 30 cycles. Assuming, however, that it did, we would require cone excursions of 0.8 inch peak to peak with the speaker mounted in a corner. If we used a more reasonable assumption, that no more than half of the total power would appear at 30 cycles, we find that ½-inch exciters will give us just a bit less than the 0.2 acoustic watt required.

The $64,000 question then becomes: Is a direct-radiator 12-inch loudspeaker capable of linear ½-inch excursions? Or, to put it another way, can such a speaker radiate clean 30-cycle energy when its cone has to vibrate over a distance of ½ inch?

The answer must be given in terms of practical demonstration rather than theory. At least one commercial direct-radiator speaker system is capable of such linear excursions and demonstrations of the capability have been made before professional groups—an AES meeting at the New York Trades Show Building in September, 1956, and an IRE meeting at MIT in May, 1957.

The test setup that was used is shown in Fig. 1. The speaker is fed by a high-powered amplifier, driven from a signal generator tuned to 30 cycles. The resulting sound output of the speaker is picked up by a microphone and the waveform is displayed on an oscilloscope screen so that deviations from the sine-wave pattern may be observed. A Strobobat light, tuned a few cycles off frequency, is played on the speaker cone, visually converting the vibrations to a slow, clearly observable breathing.

Viewing moving parts under a Strobobat light is a common industrial technique. The speaker cone, of course, is still vibrating at 30 cycles, but the apparent velocity of each repeated vibration is slowed down to the point where each motion can be seen and the distance easily gauged.

Fig. 2 is a photograph of the scope trace produced by the output of the microphone in front of the speaker. This waveform represents actual sound output from the speaker when the cone is undergoing ½-inch excursions at 30 cycles, the speaker in a 45° corner. The amount of electrical power that had to be used to produce this sound is not really relevant to the discussion here but it happened to be 39 watts to the rated speaker impedance.

**Audio—High Fidelity**

Mr. Klipsch, in speaking of performance at 30 cycles, chose a frequency region particularly favorable to the direct-radiator speaker system. I believe that the absolute 30-cycle power capability of a really good direct radiator, at low distortion levels, is greater than that of any commercial horn small enough to be used in the home. A ½ octave higher, however, the power capability of a good horn would swamp that of the direct radiator.

As for Mr. Klipsch’s joking about a “miniature 32-foot wavelength,” I have always appreciated his keen and often biting humor. I am sure, however, that Mr. Klipsch does not mean to infer that a speaker system must have physical dimensions commensurate with wavelength of the low-frequency sound it is designed to produce. There is no direct relationship between wavelength and the size of a direct-radiator speaker structure since enclosure resonance is not employed as a design element and horn-mouth reflectors do not have to be considered. In the acoustic suspension system there is no such relationship whatsoever, direct or indirect. Massa’s data clearly show that our 0.5 watt of 30-cycle acoustic energy can be radiated from a diaphragm of any size (1 inch, let us say) provided that the diaphragm can move far enough in a linear manner.

There has been a running battle in hi-fi circles between self-styled “horn men” and “long-throw infinite-baffle men,” each type of combatant serving with devotion. The truth is that both of the design approaches represented are valid and each presents advantages over the other in particular applications. The point made in this article is that, when the problem is clean reproduction of 30-cycle energy (admittedly not too great in importance compared to other problems), a linear direct-radiator speaker system always has the advantage over a reasonably sized horn.

---

This article—as the author points out—presents one view on the subject of bass reproduction. Another view is presented on page 44 by no less doughty a champion than Paul Klipsch himself.
Record Tracking

Improper tracking can hurt the quality of a hi-fi system. Learn why it does and how to check for it.

By NORMAN H. CROWHURST

Judging from correspondence on the subject of mounting tone arms, there is some confusion about tracking — why records mistrack and how different constructions of tone arms and the method of mounting them obviate or minimize mistracking.

The record groove carries lateral vibrations that should move the stylus back and forth at right angles to the groove. As the groove is a very slight spiral and thus almost a perfect circle, with its center corresponding with the center of the disc, the stylus should move back and forth along a radius from the record's center.

All modern pickups carry the stylus on a stylus arm, pivoted so the arm moves over a relatively small arc. When the stylus arm is in line with the groove, the stylus moves at right angles to the direction of the groove. This relationship is illustrated in Fig. 1-a.

If the stylus arm gets out of line, the stylus movement is not at right angles to the direction of the groove. Then, as the modulation in the groove moves the stylus from side to side, it also moves it a little back and forth along the groove. At one point it will move with the disc and half a cycle later it will move against it (see Fig. 1-b).

This will distort sine-wave modulation in the groove so it has a slope as shown in Fig. 1-c. This is equivalent to adding a second-harmonic component to the groove modulation.

A small amount of second harmonic added to a sine wave is not very important. It is not audibly different from a pure sine wave. Because of the natural octave relationship, the ear identifies the two tones and cannot discriminate the second-harmonic component. The more important effect is due to what happens to other frequencies that may...
be present with the same low-frequency sine wave.

Suppose the groove also contains a frequency six times as high as this low-frequency sine wave. This means there will be three waves going up the low-frequency wave and three waves coming down. The second harmonic, added by friction to track properly, results in frequency modulation of the higher frequency. The part of the low-frequency wave which is stretched out in time, due to the stylus tending to follow the groove round with the turntable, will take longer tracing its three cycles than in the straight line on the outer radius, which produces a lower frequency than during the period when the stylus comes back again and momentarily makes the effective frequency higher (Fig. 1-4).

All the program, except the low-frequency tone which is causing it, gets frequency-modulated. This form of IM distortion produces a dithery effect in the reproduction, much like any other kind of IM distortion. This is why it is important that the stylus arm in the pickup should be in line with and nearly as possible, at all points across the record, so the stylus moves truly at right angles to the groove.

Producing good tracking

Now that we know what is wanted, let's examine different ways of doing it. The first thing to try is a straight arm with the pickup in line with the arm. This means the stylus moves at right angles to the end of the arm, as shown at Fig. 2. Variation of the mounting point will differ across the groove at which the tracking is correct. At all other positions across the record (different radii of playing) the tracking will be incorrect.

By picking one radius and then moving the arm across the record, we can see which stylus movement is in error. Note that the stylus arm or pickup head at a radius smaller than the correct one requires to be offset outward; while at a larger radius than the correct one it requires to be offset inward. The error is approximately proportional to the deviation from correct radius (Fig. 3).

The first step toward improving this situation uses an offset. The pickup is mounted at an angle to the end of the arm (and the mounting point for the arm has to be altered). If we put a considerable offset on, we can see why the right offset corrects matters very considerably.

Using too much offset, as shown in Fig. 4, there will again be only one radius of correct tracking for any particular mounting position of the arm. But this time, when the pickup is playing at a smaller radius the offset has to be more inward than that actually used. At a radius larger than the correct one the offset has to be more outward, and we have reversed the situation that prevailed with the straight arm.

Somewhere in between these two extremes the offset will be much nearer to correct all the way across the record. This is what determines the correct offset, as shown by Fig. 5. This time we set the arm mounting to give perfect tracking at one radius near the middle of the playing area of the record. Then the deviation is very much smaller and also it is in the same direction, whether you go inside or outside the correct radius. Both ways the angle of offset should be a little bit more inward. But the deviation from correct has become extremely slight.

An even closer approximation to correct tracking can be achieved by slightly moving the mounting point for the arm, putting it a small fraction of an inch further from the turntable's center, the offset slightly incorrect at the center of the playing band. Now there will be two points across the record where the offset is correct and it will be incorrect at the inside, the center and the outside of the playing band. The direction of deviation will be the same at the inside and outside and in the opposite direction of the center of the playing area.

This reduces the maximum angle of tracking error to a very small amount — about 1° or less, depending upon the dimensions of the arm and the record.

At this point it should be mentioned that it is immaterial, as far as tracking is concerned, whether the pickup is mounted at an angle, on a straight arm or in line with the end of a curved arm, provided the basic geometry is the same (Fig. 6).

When the arm is correctly mounted, distortion due to tracking error is extremely small; in fact it will be smaller than distortions due to other causes at present—that in the record due to recording equipment, in many instances, and also in the pickup due to nonlinearity of damping material and other factors. However, high-fidelity enthusiasts are perfectionists so they seek to eliminate all possible causes of distortion however small.

One method is to use a radial arm, which theoretically gives perfect tracking all the way. In this case the pickup is mounted on a slide rather than on a hinged arm (see Fig. 7). This needs a short pickup arm from the slide to the stylus point, which is not necessarily a serious disadvantage.

The difficult thing in this design is to get a sufficiently free sliding action because a good pickup should require no more than 1 gram vertical force on the stylus to keep it in the groove. It requires a very free sliding action to get the friction down to a very small fraction of a gram, which is necessary if we are to avoid displacement of the stylus due to friction.

The trapezoid arm

Another approach uses the double-hinge arm; the B-J is an example of this construction. This is based on the information shown in Figs. 3 and 5 for the straight and offset arms. If we use, basically, a straight arm and then change the angle of offset as the pickup moves across the record, we can make a first-degree correction for track-
creased number of links

The straight offset, across the record.

may be because the angle of the provided arm with correction for the is smaller.

The link motion of the arm is shown virtually as a trapezoid.

The problem with this kind of arm is that, instead of having one tone-arm pivot, you have four. This leads to the possibility of four times as much friction in the movement. Also there are four times the possibility of play or slack, developing looseness in action. Extremely good pivots must be used, without any play whatever and with extreme freedom of movement to prevent introduction of any friction that may oppose the movement of the stylus across the record.

The principal reason the straightforward simple arm with an offset continues to be preferred is because it has only one pivot in a horizontal direction at the mounting point of the tone arm.

Using just the simple arm with an offset, the length of the arm deter-

mines the amount of deviation. Doubling the arm's length reduces the amount of deviation across the record by about one-half.

Conversely, using a smaller recorded area, as occurs on the 45-rpm record, a shorter arm can be used with a smaller deviation, provided the offset angle is correct for this particular range of radii. This was the reasoning behind the development of the original 45-rpm records: to produce a more compact unit with a shorter tone arm while still maintaining the same degree of accuracy in tracking available with the larger recordings and using a much longer tone arm.

The right offset

The correct offset for a tone arm (which is not usually adjustable so, if your tone arm is not correct, there is little you can do about it) is determined by the range of playing radii encountered in the record. The following table gives the average range of playing radii for different types of records, together with the design radius on which correct offset for this type should be based.

<table>
<thead>
<tr>
<th>Type of Record</th>
<th>Inside Radii (inches)</th>
<th>Outside Radii (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>45-rpm</td>
<td>3.0</td>
<td>3.65</td>
</tr>
<tr>
<td>78-rpm, 10-inch</td>
<td>2.75</td>
<td>3.57</td>
</tr>
<tr>
<td>78-rpm, 12-inch</td>
<td>2.75</td>
<td>4.75</td>
</tr>
<tr>
<td>33-rpm, 16-inch</td>
<td>2.75</td>
<td>5.75</td>
</tr>
<tr>
<td>33-rpm, 12-inch</td>
<td>2.75</td>
<td>5.75</td>
</tr>
</tbody>
</table>

The old 78-rpm records go down to a smaller inside radius than do the modern LP's. If we take the whole range of recordings including both LP's and 78's as a basis, we should come up with a slightly different answer for offset angle from that using only LP's. If you want to play 45's as well, this further complicates your choice. I prefer to use an offset and mounting position to suit 12-inch LP's and allow a little more tracking distortion at the inside of 78's and 45's. As the distortion on 78's usually starts out larger than on LP's, this seems to be the best balance of arrangement.

The offset should be such that the correct playing position, when only one correct playing position is selected, is a little inside of the mean radius of playing, as shown in Fig. 10. Then the tone-arm mount is moved a small fraction of an inch farther away from the turntable so as to have two correct radii, near the inside and outside of the playing band.

How to set up

Finally we come to the question of how to set up the arm correctly to produce the best approximation to correct tracking across the record. In the case of a straight arm the best compromise is to have the tracking correct about one-third of the distance from the inside radius to the outside radius. This will then minimize the error at both inside and outside radius—both will be about equal.

For the offset arm there are a number of procedures. Most manufacturers specify either an overhang, by which is meant the distance between the stylus point and the turntable center when the arm is swung so as to cross the center of the turntable, shown as A in Fig. 11, or the spacing between the turntable center and the tonearm mounting point, shown as B in Fig. 11.

Gauges of different construction have also been described for measuring the overhang with a certain degree of precision. I have found another approach quite useful and use an ordinary transparent protractor. This method has the advantage of giving a much better visual idea of just what you are trying to do and not requiring a specially made tool.

It consists of laying the protractor

![Fig. 8—Simplified construction shows action link-movement (trapezoid) arm.](image)

![Fig. 9—A narrower band of recording makes a shorter tone arm possible without increasing tracking error.](image)

![Fig. 10—Possible deviation from proper tracking with an offset arm.](image)
Fig. 11—Offset-arm mounting is specified in overhang (A) or distance from tone-arm mount to turntable center (B). 

across the disc so the straight line between 0° and 180° lies along the radius of the record or turntable. Then the 90° line will be a tangent to the radius or should lie along the groove at this point. The stylus is rested upon the intersection or center point of the transparent protractor. If you now look along the 90° line between the pickup

Fig. 12—Checking tracking visually. 

arm and the protractor, you will be able to see whether the stylus arm of the pickup is in line with the 90° line on the protractor (see Fig. 12). If it is and the position you have chosen for the stylus point to rest represents the medium radius of playing, you are pretty close to the correct mounting point for the tone arm. If not, the tone arm, turntable and protractor can be moved to find a suitable mounting point.

Technically, when you get these two in line you should move the tone-arm mounting point from 1/16 to 1/10 inch farther away from the turntable's center. This will then get the correct position where there are two points of correct tracking and a minimum deviation across the record. Using this method, however, you will find it is extremely difficult to tell when you are exactly right, within 1/10 inch, especially if you are using a tone arm with a length of 9 inches or more.

You can also use this method to check accuracy of tracking through the record from inside to outside and if you need to, choose a better compromise for the mounting position. It may also give you some idea of how academic are the claims that the offset arm does not achieve perfect tracking. The degree by which it misses is really so small as to be inconsequential compared to other causes of distortion.

Another view of the service bench featured on our cover.

The photograph on our front cover shows a corner service bench used by service technicians of the Sigma Electric Co., New York City, to do special audio service work.

On the upper shelf is a D & R flutter meter and a Barker & Williamson distortion meter, necessities for checking quality high-fidelity record players, tape recorders, tuners and amplifiers.

On the lower shelf, at the left, part of a voltage-regulated power supply is seen. To its right, in the corner, is a Variac, into which the Ampex 601 undergoing servicing is plugged. The Ampex tape unit, already partially stripped down for inspection and repair, is in the foreground. The right side of the lower shelf is occupied by an audio amplifier, specially designed to accommodate a very wide variety of inputs and outputs so that any preamp, tuner or record changer can be thoroughly checked. At the extreme rear, on the bench, a General Radio oscillator, for determining frequency response of high-fidelity equipment, can be seen.

Sigma Electric is now completely an audio service company. All types of high-fidelity equipment are repaired.

Amplifiers, preamps, tuners, tape recorders and record changers, from an inexpensive home unit to precision broadcast equipment passes through their repair shop. An official service station for nine brands of tape recorders and an even larger number of tuners and amplifiers, Sigma employs 21 persons, including 5 doing clerical, counter and shipping work. The other 16 are technicians or assistants.

Although general service work, including radio and television, was once handled (see photo on page 37, Radio-Electronics for June, 1954), at present the only deviation from high-fidelity audio units is the servicing of electronic-flash equipment. For this specialized work they hold franchises from four manufacturers of electronic-flash equipment.

The firm is owned by Arthur Peikes and Wilfred Goldstick, both of whom hold Bachelor of Science degrees from the University of Toronto Engineering School. Sigma Electric was started when these two men formed a partnership in 1949 to construct audio accessories on a contract basis and to service Brush tape recorders.
Loudspeakers and acoustic fundamentals

By PAUL W. KLIPSCH*

M y letter in the May issue (reprinted here) has stirred a response from an unexpected quarter. It was far from my mind to offend one of the internationally respected pioneers — elder statesmen — in the audio art. I was pointing at some of the "new and marvelous inventions" which violate the principles of physics.

The response by Mr. H. A. Hartley (July, 1957) points out quite accurately that 1 acoustic watt in a living room would produce painful sound pressures. The response also accuses me of abandoning the scientific attitude and becoming dogmatic and inaccurate. I regret provoking this response because I have no desire to trap or provoke anybody into an inadvertent misstatement.

The facts behind my letter are:

As for the amount of motion to produce distortion, I refer to G. L. Beers and H. Belar "Frequency-Modulation Distortion in Loudspeakers," Proceedings of the IRE, Volume 31, No. 4, pages 132-38, April, 1943. They showed that a cone producing an excursion of ¼ inch (amplitude of 1/16 inch) produced 10% distortion by frequency modulation of a 5,000-cycle tone, expressing distortion as sideband amplitude. They mentioned that as low as 3% distortion causes perceptible change in quality. Probably listeners were less discerning in 1943 than now.

In good tape machines a total wow and flutter of 0.1% is just barely tolerable. Taking this to be true for the frequency-modulation distortion of a loudspeaker, then the cone must move less than 1/1,000 the velocity of sound or less than 34.4 centimeters per second. The amplitude of motion is expressed by the equation:

\[ A = A_0 \sin \omega t \]

where \( A \) is the displacement at instant \( t \), \( A_0 \) is the maximum displacement (in each direction) and \( \omega \) is \( 2\pi \) times frequency, the equation for velocity of movement is found by differentiating:

\[ V = \frac{dA}{dt} = A_0 \omega \cos \omega t \]

The maximum velocity occurs when \( \cos \omega t = 1, \) or \( V = A_0 \).

Thus, at a frequency of 50 cycles per second, \( \omega = 2\pi \times 50 = 314 \), and we have decided that \( V \) must not be more than 34.4 cm/sec. So the maximum permissible value of \( A_0 \) is

\[ A_0 = \frac{V}{\omega} = 34.4/314 = 0.11 \text{ centimeter or .043 inch maximum amplitude or .066 inch maximum excursion.} \]

This "just tolerable" distortion excursion of .066 inch is a little larger than the .06 inch used in my original "fundamentals"; the difference is not an error, but a rather close agreement.

Experience indicates the factual significance of fluttering frequency shifts even as small as 0.1%. The higher the modulated frequency the greater the audible distortion, usually, up to about 6,000 cycles.

These facts pertain whether the cone is driven by a voice coil or a baffle handle, is hung on a high-compliance suspension or low, or is high or low efficiency. Actually the "fault" would exist with a "perfect" speaker. Modulation distortion is not a fault but a property of a vibrating surface or air boundary layer; it is minimized by reducing excursion.

Far from abandoning the scientific attitude and becoming dogmatic and inaccurate, I would point to the vast supporting literature behind my statements, and the simple mathematics above. Kellogg used many speaker units to limit excursion to .06 inch in a year when intermodulation distortion had not yet been mentioned. (E. W. Kellogg, "Means for Radiating Large Amounts of Low-Frequency Sound," Journal Acoustic Society of America, Volume 3, No. 1, Part 1, pages 84-110, July, 1931. Mr. Kellogg was co-inventor of the Rice-Kellogg speaker. See Transcript AIEE, 1925.) (The name Kellogg was unfortunately misspelled "Keller" in my original letter.)

This is not to deny that many speaker drive mechanisms can disadantly handle ¼ inch or larger excursion, with relatively low harmonic distortion. But

---

*KLIPSCH & ASSOCIATES, HOPE, ARK.

---

THE MAY LETTER

Dear Editor:

Much air must be moved to radiate appreciable power at low frequencies.

The following table shows the excursion necessary to produce one acoustic watt output and the acoustic power output capability of a 10-inch piston (equivalent to a 12-inch speaker) executing an excursion of .06 inch (peak amplitude of .03 inch) which is regarded as about the maximum limit for tolerable distortion.

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Acoustic Watt</th>
<th>Excursion at 0.06-inch</th>
<th>Power Radiated at 0.06 inch</th>
<th>Velocity (A0)</th>
</tr>
</thead>
<tbody>
<tr>
<td>60</td>
<td>0.7</td>
<td>0.0072</td>
<td>0.0608</td>
<td>0.086</td>
</tr>
<tr>
<td>50</td>
<td>1.0</td>
<td>0.0066</td>
<td>0.0608</td>
<td>0.086</td>
</tr>
<tr>
<td>40</td>
<td>1.5</td>
<td>0.0060</td>
<td>0.0608</td>
<td>0.086</td>
</tr>
<tr>
<td>35</td>
<td>2.0</td>
<td>0.0057</td>
<td>0.0608</td>
<td>0.086</td>
</tr>
<tr>
<td>30</td>
<td>2.8</td>
<td>0.0045</td>
<td>0.0608</td>
<td>0.086</td>
</tr>
</tbody>
</table>

These figures are independent of box shape, suspension compliance or amplifier power supplied.

The facts of life in acoustics are simply that the undistorted output of a small cone at low frequencies would be too small to hear, regardless of the "response curve".

In 1931 E. W. Kellogg proposed the use of 54 cones of 8-inch diameter to radiate 1 watt at 30 cycles, and the use of a corner horn. Structural designs have improved in the following 25 years but acoustical fundamentals have not changed.

There have been little speakers with big claims since the Edison phonograph of 1901, but nobody has devised a miniature 32-foot wavelength.

PAUL W. KLIPSCH

KLIPSCH & ASSOCIATES

H OPE, AR K.

---

A SIX-TUBE control unit needs justifying. Even the crankiest hi-fi crank is likely to be taken aback by such extravagance, although several commercial units use five or six tubes. My justification is that it produces a versatility beyond that of commercial control units and approaches that of equipment used by broadcast stations and recording companies. The complete circuit is in Fig. 1.

The principal feature is the tone control circuit. Any two octaves from 20-3000 cycles can be boosted 20 or 25 db with an insignificant increase in distortion. The bass and treble channels have six peaking points about an octave apart which are selected by switching.

This is highly useful to the record collector. Anyone who has tried playing ancient recordings on a modern hi-fi system knows that they usually sound pretty horrible. With this equalizer the majority of them produce a satisfying sound.

Its versatility is also useful to the amateur recorder who makes off-the-air, off-the-record or live recordings. A rolloff or high-frequency filter provides a way to minimize noise, beatnote interference, phase distortion in FM and similar distractions with little loss of musical quality.

The biggest problem of hi-fi is to provide at a level tolerable in the home a tonal balance with some resemblance to that in the concert hall. Both people and rooms require different listening levels and the rooms themselves require compensation. No single loudness curve, slope, crossover or single combination of them can possibly suit anything but a fraction of the needs. This control unit will provide just about any conceivable tonal balance to take care of almost any acoustic condition, playback level or any listener’s personal taste.

Finally it provides a way for many hard-of-hearing persons to enjoy high fidelity. Loss of hearing involves, not only a loss in hearing acuity, but usually a serious modification of the hearing curve too. Most of the hard-of-hearing have holes in their hearing curves and unfortunately these holes do not always appear at the ends of the spectrum where they can be compensated by ordinary tone controls.

The tone control circuit of this unit fills any two such holes with 20-25 db of boost. The network is that used in most audiometers to measure and test hearing. Not everyone will find perfect compensation, but the control unit will do a good job for many. Each individual can adjust the controls for the

Loudspeakers and Acoustic Fundamentals (Continued)

music is not just one single tone or frequency at a time; it is a terrifically complex mixture of high and low tones. Even if the bass speaker is crossed over to a tweeter or mid-range at 500 cycles, a mixture of 40 and 400 can produce unpleasant distortions when the diaphragm amplitude becomes large. Again, intermodulation is not a fault but a property of sound radiators performing large excursions.

The remedy to limit distortion is adequate radiating area and reduced excursion. As Kellogg proposed in 1931, a group of 8-inch cones can be used to produce large amounts of power.

Mr. Hartley states in his reply, “If we accept the Massa data . . . which I, for one do not . . . ” The reference is to Acoustic Design Charts, Frank Massa, Blakiston, 1942. Granting that any particular piece of data in any publication might be in error, due perhaps in a misprint, I checked the particular data by computation from earlier and more basic information and as far as I could tell the data were accurate. Incidentally, the basis for the information goes back to 1877 when a great British physicist derived the function of a piston vibrating in a hole in an infinite wall (Lord Rayleigh, Theory of Sound, MacMillan, 1877). The Massa data were not used without question, they were checked.

Mr. Hartley closed his remarks with an attack on the choice of driver units used in our speaker systems. No defense is needed here, for our bass driver is capable of nearly ¾ inch total excursion with very low harmonic distortion. And a ¾-inch motion of an 15-inch speaker cone can really pump a lot of air. But this when used in a horn develops large pressures at almost invisible amplitudes, due to the way the acoustic matching of the horn provides an air load for the diaphragm. With these very small amplitudes, the doppler and amplitude distortions are extremely low, compared with what the same driver would produce as a direct radiator.

For my part, I would question by what measure a speaker is required to pass a test of ½-inch excursion without cross-modulation and by what measure a speaker of any size can be claimed to be flat to cycles or to be non-resonant in spite of being a mass suspended on a compliance.

Hermeneutics, the art of not being fooled, could well be applied to this new high-fidelity art wherein hard-well-established facts are disputed, wishful thinking is copy for ads and articles, and truth becomes a relative quantity. An easy presumption would be placed on intellectual honesty, and the reader should school himself in hermeneutics and learn to distinguish fact from opinion and well-grounded opinion from mere wishing. I believe my own writings have been marked for the reader to distinguish between facts I present and my opinions.

Front panel of the completed unit.
The tone control circuit uses three parallel channels: the flat, bass and treble. Tone control networks are the Wien-bridge type and provide a broadly peaked curve. Each channel gives a choice of six peaking points about an octave apart. The extreme positions in each channel will have the effect of changing the crossover and slope.

In normal use these positions may be used to increase the presence of some favored instrument. You can also improve the quality of old acoustic records. An output jack is provided for a recorder—this output is unaffected by the tone control.

Concentric controls are used for both volume (loudness) and gain (level). The volume control varies the gain of the flat channel. Relative boost of both bass and treble channels will vary with the setting of this control. At maximum the bass and treble channels cannot produce more than 6 db of boost, while at minimum 20 or 25 db is possible. Therefore, the volume control provides an automatic increase or decrease of boost with volume level to take care of the Fletcher-Munson effect and is actually a loudness control.

The volume control adjustment is exactly opposite to that generally used. Usually the tonal balance is adjusted at maximum output levels. When the volume is reduced, the loudness control curve is supposed to provide compensation which produces a good balance at the desired level. This is the wrong way of getting the desired end and is not used in this unit. The control is

Fig. 1—Circuit of the hi-fi master control unit.
turned to minimum and GAIN CONTROL is set for a desired loudness of mid-frequencies. Now the bass and treble controls are adjusted for the desired balance. Then when volume is increased with the volume control, bass and treble boosts are reduced until at maximum volume you have just about a flat response. For broadcasting and similar uses the volume is regulated with the GAIN CONTROL, which has no effect on the compensation.

The unit has enough gain to provide at least 2 volts of output, either with 20-dB boosts at any two points or flat. The tone controls provide only boost and no means for attenuation. There is a treble filter with a 12-dB-per-octave slope and a continuously adjustable crossover between 4,000 and 15,000 cycles.

The total IM distortion at a 2-volt output ranges between 0.3 and 0.7%. At lower levels it is insignificant.

A simple filter is included to attenuate transients due to warped or eccentric records, FM squelches, shortwave fading, beeatnotes of stations on the same broadcast channel but whose frequencies differ by 1–20 cycles, etc. The filter does little good on rumble whose frequency is usually between 20–30 cycles. If you are troubled by rumble, considerable relief can be obtained by reducing the value of the output capacitors of the phono preamp and the following input capacitor to .05 or .03 µf.

Power supply

An independent well filtered power supply with dc for the heaters is essential. Any attempt to feed this preamp from the power amplifier's power supply is almost certain to result in motorboating or instability. The supply diagrammed (Fig. 3) uses two regulator tubes to supply 255 volts to the tone control stages and 150 volts to the phone channel. The .05-µf capacitors in shunt with the regulators minimize hash. If the preamp shows any tendency to oscillate at mid or high frequencies, try removing this capacitor before making any other checks. Dc for the heaters is necessary to keep hum down. Even 1 or 2 mv of hum applied to the first phono tube will produce an output of several hundred millivolts.

Building the unit

The construction uses Sec-Zak chassis components and Vector turret walls. The chassis comes in pieces like an Erector set. I used two 16-inch rails for the front and back, two 8-inch rails for sides, one 8-inch bottom plate and a 6-inch top plate. The rear rail is set in from the front. Don't worry about fastening it to the side rails since the top and bottom plates will tie the whole works together. (These chassis are available at many radio parts distributors or can be obtained from U & F Manufacturing Co., 10929 Vanowen St., N. Hollywood, Calif.)

The Vector turret walls are combinations of terminal strips and tube sockets and are available in almost any combination. Here we use one two-tube wall for the equalizer, a three-tube wall with one socket removed and a two-tube wall for the rest of the stages. If you cannot obtain these, the more easily available Vector turret sockets may be used instead.

The turret walls are mounted on the rear rail along with the mike transformer, input and output plugs and level controls. Resistors are mounted on one side of the walls, capacitors (and a few resistors) on the other side. Connections from tube sockets to components are short. Connections between components are made on the wall. A common ground bus of heavy wire is run along the edge of the turret walls under the last series of holes.

Components which are grounded are mounted so that the tinned lead of the grounded end can be put through the hole, wrapped around the ground bus and soldered. The terminals at the bottom of the walls are used for voltage supply and any interconnections which may be required.

The controls are mounted on the front rail. A couple of these R21-S4 and R20-S3 are not commercially available: the combination of double-pole six-position rotary switch and a concentric potentiometer. If a standard 3-inch chassis is used, there will be room for independent switches and potentiometers. Replacing the push-button switch with a rotary unit will also give more room. Capacitors in the tone control channels are grouped at the switches.
When the front and rear rails are wired as far as they can be, the side rails are attached to the front and the 6-inch plate is temporarily fastened with three or four screws. Now start interwiring. I used fine shielded and insulated phone input leads for the leads from the input jacks to various portions of the circuit. This shielding is necessary. Except where a short direct connection was possible, I ran these interconnecting leads along the ground bus and then cabled the works with twine. Except for shielding the indicated leads, there is nothing critical about the wiring. Duplicate the layout as closely as possible for highest insurance, but if a similar but not exactly identical layout is used, no trouble should arise. I used deposited-carbon resistors in all stages preceding the roll-off stage, but believe that if deposited-carbon types are used only for the plate loads and wirewound resistors for cathode loads, the others can well be good quality carbons.

Power supply construction

The power supply is separate. In my case it is mounted on the same chassis which supplies power to two amplifiers. There is nothing critical about it, especially if the two regulator tubes are used to establish voltages. The 12-volt ac can be obtained either from a 12-volt filament winding or 6.3- and 5-volt windings wired in series. (If you do not get about 12-volt ac, reverse one winding.) You can use the 5-volt winding for a rectifier with a separate cathode, or use a 6-volt rectifier with cathode (6W4 or 6X4) on the 6-volt winding (see Fig. 3).

Please note that there is a series parallel connection of the 6DK7, 6AT6 and 59-ohm resistor. This value is critical if you want a reasonable life from these tubes. Adjust the potentiometer in the heater supply to provide no more than 12 volts. Remember, the voltage will rise if you remove a tube. The total heater drain of the dc string, wired as indicated, is 1.05 amperes. No other adjustment is necessary.

I had no trouble with oscillation or motorboating. If any occurs, the chances are 9 to 1 you have one of the two feedback loops (one in the phone equalizer and the other in the cutoff filter) wired wrong, having already used the wrong value resistor or capacitor or the regulator tubes are not operating properly.

You should have no trouble with hum if you shield the leads indicated and follow the layout. Excessive noise, especially hash and crackling, may be the result of a bad tube or of badly soldered joints which might rectify the hum field which exists in any house.

You are quite likely to have some trouble with microphonic tubes, especially the 12AU7. It can be replaced with the taller 12B17 which seems to be free of microphonism. The newer 12A17-A is even less microphonic.

If you want to use a high-impedance mike without the transformer, connect the mike input to the phone-equalizer switch the same way the transformer now is. Incidentally, the transformer of a Ferranti, Electro-Sonic, Fairchild, etc. pickup can be connected directly across the 100,000-ohm input load. Any load up to 100,000 ohms can be provided by varying the load potentiometer. Calibrate with an ohmmeter.

The panel is a piece of 1/16-inch aluminum 4 inches wide. Drill it at the same time you drill the front chassis rail by clamping the two together. It was sprayed with Spray-O-Namol in a dark gray glossy finish. Wrap, crackle and other finishes are also available in spray cans. (A paint spray that dries to a hard opaque finish is available and can be used.—Editor) Do your spraying outside. The fine mist is likely to spread all over the house and cause domestic havoc. It's tough on the lungs, too. When dry, apply decals for the controls.

Because of the complications in the circuit and construction and in use, I recommend this unit only for special requirements. For most home listening the control unit for Golden Ears (March, 1954, RADIO-ELECTRONICS) will be fully satisfactory. But those who need and can use the versatility will find this control unit like nothing they ever used or heard before.

In RADIO-ELECTRONICS for November:

Hybrid and Transistor Auto Radios
By Jack Darr

Twin-Coupled Hi-Fi Amplifier
By Norman Crowhurst
H ave you ever found a circuit that didn’t perform according to the calculations for it? This too common occurrence is often dismissed as being an inherent discrepancy between theory and practice—the idea being that calculations cannot be that accurate or else the measurements may be wrong, so let’s just make some adjustments and try to get it right experimentally.

This procedure takes time. Sometimes it completely fails to give us the desired results. It is much better to put theory and practice together and make them both work for us. It has been said that theory is the guide to practice and practice the ratification of theory. Applying this principle to our work on audio-coupling circuits can save considerable time in making calculations and experiments.

Let’s start with a simple coupling arrangement (see Fig. 1). The tube may be a triode or pentode, with an ac resistance designated $R_e$. Plate current is fed from $E$ plus through coupling resistor $R_c$ and signal voltages are coupled to the grid resistor of the next stage ($R_G$) through capacitor $C$. We will leave complications, like the cathode-bias resistor, its decoupling and any plate decoupling, for the moment to get the simple circuit straight. Then we can take these factors one at a time.

Gain calculation

The first common mistake, even found in some textbooks, is in stage gain calculations. The accepted method is to take the quoted amplification factor of the tube ($\mu$) and then use the formula:

$$A = \mu \frac{R_L}{R_e + R_L}$$

where $R_L$ is the plate load resistance and $R_e$ the tube ac resistance. When using $R_e$, don’t forget to include the effect of the grid resistance of the following stage. The usual error consists of taking $R_c$ to be just the plate coupling resistor, while the true value for calculating mid-band gain requires using the resistance of $R_e$ and $R_G$ in parallel.

Even this leaves us liable to some error because we are taking for the amplification factor of the tube a quoted value which may not be realized under the operating condition we are using. However, for a good approximate gain figure, take the amplification factor of the tube and use the above formula. Use a corrected value for $R_e$, taking into account the effect of $R_G$. This will give us results as close as it is possible to obtain without referring to a complete set of tube characteristics.

To see what the error could amount to, let’s take values from a typical triode circuit. Let $\mu$ be 100 and $R_e$ 77,000, $R_L$ 220,000 and $R_G$ 470,000 ohms.

If we assume $R_G$ is just $R_e$:

$$A = \mu \frac{220,000}{220,000 + 77,000}$$
$$A = 0.1$$

If we use the correct value of $R_G$ which consists of 220,000 and 470,000 ohms in parallel or 150,000 ohms:

$$A = \mu \frac{150,000}{150,000 + 77,000}$$
$$A = 0.66$$

The difference, as you can see, is appreciable.

The corresponding formula usually used for pentode stages is $A = g_m R_e$.

Here we assume that $g_m$ is a mutual conductance of 2 ma per volt (.002 mho or 2,000 $\mu$hos) and we use the same values of $R_e$ and $R_G$, 220,000 and 470,000 ohms, respectively. The gain, making an incorrect assumption that $R_L$ is 220,000 ohms, is:

$$A = g_m R_e$$
$$A = 0.002 \times 220,000$$
$$A = 440$$

On the other hand, using the correct value of 150,000 ohms for $R_e$, the gain is:

$$A = g_m R_e$$
$$A = 0.002 \times 150,000$$
$$A = 300$$

This is difference of more than 3 db.

Calculating the gain of a stage tells us what it will contribute to overall amplifier gain and, if we make similar mistakes in several stages of an amplifier, we may end up 10 or 20 db short.

We also want to know the frequency response, first of all, for each stage, and then for the whole amplifier. Where feedback is used, this is especially important because accurate prediction of the response for individual stages is necessary to determine whether the amplifier will be stable or why it gets into a region of instability.

Low-frequency response

First, let’s take the low frequencies. A common but erroneous statement says: The low-frequency response is obtained by comparing the reactance of coupling capacitor $C$ with the resistance of $R_e$. When the reactance is equal to the resistance, the frequency response is 3 db below maximum at the low-frequency end.

Fig. 1—Simple R-C-coupled stage; $C_p$ is total of stray capacitances shown.

Fig. 2—Step-by-step deduction of how circuit elements contribute to low-frequency response.
AUDIO—HIGH FIDELITY

This statement fails to take into account the ac resistance of the tube and coupling resistor, both of which enter into the correct formula for predicting low-frequency response. Fig. 2 shows a step-by-step derivation of the correct low-frequency network.

We start by redrawing the circuit to take into account all the impedances. As series elements we have the parallel combination of R. and R. in series with C feeding grid resistor R. In considering response it makes no difference if we switch the positions of C and the parallel combination of R. and R.. Then, by redrawing this arrangement, see the resistors appear as a simple fixed potentiometer with coupling capacitor C feeding, it becomes evident that the correct frequency response is determined by comparing the reactance of C with the combined resistance of R. in series with the parallel combination of R. and R.

How will this adjustment affect our calculation? Let's take the same example as for the gain calculations and assume a .02-af coupling capacitor is used. With the triode arrangement the .02-af capacitor will have a reactance of 470,000 ohms at 17 cycles. To obtain the correct value we should add to 470,000 ohms the equivalent of 220,000 and 77,000 ohms in parallel, or 57,000 ohms. The capacitor will have a reactance of 527,000 ohms at 15 cycles. This is not too serious an error.

Now let's turn to the pentode. This time we will assume that a grid resistor of 220,000 ohms is used and that the pentode plate resistance R. is 1 meg-ohm. The parallel combination of 1 megohm and the plate coupling resistor's 220,000 ohms is 180,000 ohms. The usual statement which compares the capacitive reactance with the grid resistance would set the 3-db point at the frequency where the reactance of C is 220,000 ohms. That's 36 cycles. Using the correct value of 400,000 ohms obtained by adding 180,000 and 220,000 ohms, the 3-db point is 20 cycles, a large difference.

High-frequency response

Here, too, we find a number of common errors. The correct solution is found by taking all the circuit resistances effectively in parallel. This can be seen in Fig. 3 which shows the equivalent circuit for high-frequency losses. The accepted method of proving that this reduces to an equivalent of three resistors in parallel involves Thevenin's theorem. A little simple reasoning may be better.

Let's take the effect of C. with each part separately. If R. is removed, the output voltage will differ from the input voltage due to the current C. draws through the parallel combination of R. and R.. Now suppose that R. and R. are replaced with a high resistance approaching infinity to produce a constant current feed through C. and R. in parallel. Under this condition there will be a 3-db drop when the reactance of C. is equal to the resistance R..

Now combine these two ideas to see the effect of C. when R. and R. are effective as well as R.. We see that first the output voltage is reduced due to the current C. draws through the parallel combination of R. and R.. It is also reduced due to the current which C. bypasses from R.. But there is only one value of current in C.. So the voltage drop must be due to the combined current that C. draws from the equivalent parallel circuit of R., R., and R..

Omission of R., R., or R. from this calculation will throw the result into error. In the example given, a combination of 77,000, 220,000 and 470,000 ohms works out to 52,000 ohms. The combination of 1 megohm with two 220,000-ohm resistors in parallel produces a total value of 42,000 ohms. The degree of error will depend upon which value gets overlooked.

The biggest error occurs in the case of the triode circuit if the ac resistance is overlooked. The equivalent value of 220,000 and 470,000 ohms in parallel is 150,000 ohms instead of 52,000 ohms. This represents a change in the turnover point of approximately 3 to 1.

The value of C. is a little difficult to estimate. It is made up of the combination of the plate-to-ground capacitance of the previous tube, the effective grid-to-ground capacitance of the following tube (including any that may be due to Miller effect) and stray capacitance of the wiring. Under the last heading should be included stray capacitance due to the coupling capacitor itself. Often a large coupling capacitor will have as much stray capacitance to ground as all the rest of the circuit put together, and often gets overlooked. Metalized capacitors are particularly susceptible to producing a large stray ground capacitance.

Interstage equalizers

Before going on to consider the effect of decoupling components, we turn to interstage equalizers because each of the decoupling arrangements can be converted into the equivalent of an equalizer circuit. The same kind of error already mentioned with respect to simple coupling circuits can also occur in the calculation of response of compensating networks, particularly for treble or bass boost, using the arrangements shown in Figs. 4 and 5.

What often happens in calculating the response of these arrangements is that only the obvious components are taken into account. The plate resistance of the preceding stage is often forgotten in both circuits, and in the bass boost circuit a grid resistor is necessary to insure correct bias voltage on the following stage. This also can get left unconsidered sometimes. Using a step-by-step method of transposition to
see how the equivalent boils down to the simple basic circuits, Figs. 6 and 7 show how the hidden circuit resistances are taken into account in each case.

In Fig. 6-a the basic equivalent circuit is developed from the practical treble boost circuit of Fig. 4. This is rearranged following the method of Fig. 2, to get an arrangement in which the resistances appear as a straight fixed potentiometer in combination with a simple frequency-discriminative circuit involving a single capacitor and two resistances shown at 6-d. The equivalent values and derivation for the symbolic quantities r and R are shown at the bottom of the figure. What often happens in this circuit is that R is taken to be just the value of R, which is not correct. To this must be added the parallel combination of R, and R. to get the equivalent value of R.

When the correct circuit values have been ascertained the treble-boost response can be predicted by the method shown in George Fletcher Cooper’s articles on this kind of circuit (Radio-Electronics, December, 1950; February, 1951), combining an inverted rolloff (A) with a direct rolloff (B) in the manner shown in Fig. 9.

In this case the use of incorrect values results in taking r as just equal to R1, whereas in fact it is the complicated expression shown. The next common error is leaving out the parallel combination of R, and R, even when this is incorporated, sometimes grid resistor Rg is omitted.

An accurate prediction of the response requires that all these values be taken into account to find the effective value of the resistance r.

In this case omitting the resistors R, and R, from consideration will result in an effective value of r smaller than it should be. On the other hand, omission of R from consideration results in a value of r larger than it should be. Incomplete consideration in this case can result in an error either side of the correct value.

Decoupling circuits
The only kind of decoupling circuit that can be accurately predicted, without some reference to tube characteristics that are not usually available, is the plate decoupling. This prediction is illustrated in Fig. 10. Fig. 10-a is the actual circuit. The remaining figures show the derivation of the equivalent practical circuit. In this case a transformation effect is introduced to simplify the ultimate calculations.

C1 is tapped across a junction between R, and R, in Fig. 10-b. To get an equivalent that can be further reduced, the values of C, R, and R, are transformed from an equivalent Y into an equivalent delta network. The conversion for this is shown at the bottom of Fig. 10. From this point the network may further be reduced to a simple equivalent which can be used for design purposes.

Cathode and screen decoupling produce an effect opposite to that of plate decoupling. This cannot readily be reduced to an equivalent circuit because it depends on certain tube characteristics. However, it is not very difficult to calculate on the basis of empirical information.

In the case of cathode decoupling, the height of step introduced will depend upon the amount of feedback which the cathode resistor produces. This can easily be checked by removing the capacitor and checking the change of gain that it produces at a mid-frequency. This is usually about 6 db.

When the reactance of the capacitor is equal to the bias resistance, the feedback effect will be zero when the capacitor is completely removed. This means that the 0-db point on the inverted rolloff in Fig. 11 occurs at the frequency where the reactance of the decoupling capacitor is equal to the bias resistance. If the step is 6 db high, representing a 2-to-1 ratio, the rolloff point will be at twice the frequency of the inverted rolloff point.

The same procedure can be used for deducing the response due to screen decoupling. The screen decoupling capacitor is removed and the change of gain at a mid-frequency is noticed. The inverted rolloff point will then occur at a frequency where the reactance of the decoupling capacitor is equal to the screen feed resistor. The direct rolloff point will be higher than this by a ratio equal to the change in gain.

Suppose the change in gain was 12 db and the screen decoupling consists of a 0.1-μf capacitor with a 150,000-ohm resistor. The reactance is equal to this resistance at 10 cycles so the inverted rolloff will be at 10 cycles and the direct rolloff at 40. A point 20 cycles from the mid-point of 20 cycles the response will be 6 db down due to this screen decoupling.

As you have seen, a slight error can cause a lot of difficulty. The next time you calculate gain, response or boost for an R-C amplifier use all the values. They can save you a lot of work. END
THERMOMETER THAT TRANSMITS its indications by radio was developed to measure the temperature inside a penguin egg. Biologists wanted to know how cold the penguin embryo gets and, since the penguin carries its egg with it when it moves from place to place, it would have to work by radio. Object of the study is to find out how living things survive cold—possible application to human life includes research for enzymes that will aid man to adapt to cold or even make it possible to lower human body temperature during operations, etc.

The thermometer is inserted in an egg that has been emptied and filled with gelatin. A thermistor measures the temperature and a transistor is the heart of the transmitter. It is powered by three mercury cells that occupy less than \( \frac{1}{4} \) cubic inch and run 125 hours. The transmitter shown next to the king penguin egg has an operating range of 80 feet and is accurate to within 0.2°F.

SPEAKERS MOUNTED OUTSIDE the cabinet is the startling feature of the Periphonic Speaker System, by General Electric Co., Ltd. of England. Sound is radiated through a small slot into the cabinet from the peripheries of two metal-cone loudspeakers mounted as shown in a V-shaped enclosure on the outside of the cabinet. The air coupling of these speakers, which move in opposite directions, reduces the distortion which occurs with a single unit, particularly at bass frequencies. The complete system, with the speakers mounted below the cabinet, reproduces the lower frequencies from 2,000 cycles down to 30 cycles. Six tweeters, two mounted on the front and both sides of the cabinet cover the frequency range above 2,000 cycles.

GIANT RADIO TELESCOPE, Jodrell Bank, Cheshire, England, is to be 10 times more powerful than any other in existence. Built for Manchester University for the exploration of the skies by radio astronomy, the lensless telescope is expected to be able to reach out into space to a distance of 1 billion light years. It has a directable reflector 218 feet in diameter, and the completed structure weighs 2,000 tons.

NOISE RECEPTION is the sole purpose of this radio station. Called the dog house by scientists at Boulder Laboratories of the National Bureau of Standards, it is one of a world-wide chain of observation stations that, during the International Geophysical Year, are recording static and radio noise largely generated by thunderstorms. The wires radiating out from the 21.75-foot vertical whip antenna, near the center of the building, are part of an elevated radial system used to stabilize reception.
AUTOMATION has reached the tube-tester field in the form of an instrument which checks all important aspects of a vacuum tube under actual service conditions and literally does it in one-two-three fashion.

Operation One consists of plugging a tube into a socket and placing a card in a slot. This immediately tests the tube for shorts, leakage and grid emission. Pushing a button marked 2 tests the transconductance, and button 3 tests the tube for gas.

The new device is Hickok's Cardmatic Tube Testing Machine (models 123 and 123A) and its construction permits anyone who can read the words GOOD and REPLACE to test tubes with laboratory accuracy.

The outstanding mechanical feature of the tester is a multiple-contact sandwich switch. This consists of an assembly of plastic panels about the size of a postcard. The bottom part of the unit contains over 170 specially designed switch-contact units.

These units are made up of plungers resembling copper nails, which, when pushed downward through copper sleeves, enter and make contact with other sleeves below. (See Fig. 1.)

In operation, a card corresponding to the tube type to be tested is put in a slot in the sandwich and pushed until it touches a snap-action switch at the rear of the unit (Fig. 2). This triggers an electromagnet inside the instrument case, which pulls the sandwich assembly down on the copper switch plungers.

If there is a hole in the card over any given switch plunger, it will not be pushed through to the bottom sleeve and the switch remains open. In positions where the card is not punched, it bears down on the switch plunger and closes the circuit.

A notch cut in the top of the card coincides with the plunger for the sensitive snap-action switch if the card is inserted upside down. This safeguard prevents the test from being made until the card is right side up.

When a test is completed, the card is released by pressing a large button which mechanically restores the sandwich assembly to normal, lifting it upward. This action releases the card so that it can be withdrawn. It also pulls upward on the switch plungers of all made contacts, causing them to withdraw from the bottom sleeve and again become open.

Short test

Once a card and tube have been placed in the machine, operation is almost completely automatic. The first operation, that of testing for inter-electrode shorts, is done at once, without even pushing a button.

A voltage divider places a voltage gradient across all electrodes in the tube. The gradient is such that five neon indicators which peer out from under a tiny hood remain dark if no shorts exist. If a resistance path is present between tube elements, it sets the voltage distribution. The lamps flash for a high- or glow steadily for a low-resistance path in the tube.

Grid emission, a highly objectionable defect not revealed by some tube testers, shows up on the short test because of the way the dc neon lamp supply is polarized when connected to the tube.

Heat-cathode leakage is indicated by the first of three scales on the meter. A definite reject point is indicated (by the words GOOD and REPLACE) but this point may be as low as 10 microamperes for some tubes. The holes in the card determine the test placed on the tube.

An aim in the instrument's design is to overcome the principal objection that many radiomen have to all tube testers, that "the best test of any tube
is how it acts in the circuit for which it was designed.”

**Military standards**

A 6X4 is usable with a 150-µa leakage (at 100 volts) between heater and cathode, while an if amplifier such as the 6AU6 cannot tolerate a leakage of over 10 µa. TV damper diodes also are rejected if leakage exceeds this value. The reject points in all Cardmatic tests are determined by using standard military specifications as a guide.

In all cases, the tester automatically applies conditions which simulate those encountered in actual service. For instance, diodes may be classed as falling into at least six basic operational groups. These include full-wave high-voltage group (5U4); half-wave low-voltage group (6AF5); TV damper (6W4); TV high-voltage diodes (1B9); high-perveance detectors (6AL5) and low-perveance diodes (6AV6).

Each of these groups is given tests common to the group as well as specific tests called for by the individual tube type. Thus, a 5U4 and a 6X4 will both be tested in a circuit using a high-voltage center-tapped ac winding and a load resistance with filter capacitor. The 5U4 will be required to deliver its handbook rating of 200 ma and the 6X4, 70 ma or show as replace (Fig. 3).

Television damper tubes such as the 6W4 must withstand high inverse voltages in service, therefore the Cardmatic applies a set of conditions which will test this feature. A low voltage applied to the plate of such a tube readily tests its emission characteristic, and this may be sufficient for some classes of service. For damper service, however, 1,200 inverse volts are applied because this is what the tube might be expected to withstand in actual service.

**Graph of plate curves of a 6BQ6 TV deflection amplifier.**

Sometimes, in testing diodes, gassy tubes may arc, causing the meter to slam beyond full-scale deflection. If this happens, a protective relay trips, turning the tester off before any harm can be done. Actual laboratory tests with defective tubes have shown this machine balks and refuses to test gassy tubes.

**Triodes**

Penetodes and triodes may be operated in one of two basic modes—fixed bias and self-bias.

A fixed-bias test is a stringent one to apply if a tube is intended for self-bias operation. This is because self-bias provides a kind of self-regulating effect for the tube when in operation. Thus, a tube under self-bias conditions will show a mutual conductance rating closer to the published value, while fixed bias would indicate replace long before the tube would fail otherwise.

The tester selects the correct mode before applying a mutual-conductance test to a tube. However, while mutual conductance is perhaps the most important measurement that can be made on most tubes, some tubes in certain applications require an additional test.

An example of this is television horizontal deflection amplifiers which must supply high current. Tubes of this type have plate-voltage current curves like those shown in the graph. These curves feature a knee where plate saturation is reached at about 60 volts, with a given screen voltage. In service this tube must sweep from near cutoff to full saturation at the knee of this curve. Therefore, the test applied to a tube like the 6BQ6-6GT checks mutual conductance and makes an additional test for high emission at the knee of the curve.

Tubes which contain two units in one envelope, or extra elements such as the two control grids in the 6DT6, are tested with two or more cards—one for each tube functions.

The Cardmatic model 123A contains a couple of features not found on the 123. These include a cathode-activity or Life Test and a provision for testing regulator tubes.

**Life test**

The Life Test is an approximation, but it is one used with good results by large tube users such as the telephone company. This feature is operated by a spring-loaded switch which decreases the heater voltage by 10%. If a tube has considerable reserve life left, the mutual conductance does not change appreciably. Tubes in which emission drops as much as 25% for a 10% heater-voltage reduction may be considered as being near the end of their useful life.

The Hickok automatic tube testers do not use a calibration for line voltage. Instead the critical electrode voltages applied to the tube are obtained from regulated power supplies, making line-voltage calibration unnecessary.

But perhaps the most outstanding feature of the new machines is the means by which they can be made to test themselves. Normally a tube tester must be regarded as a sort of a standard tubes are selected or rejected on the basis of a reading obtained on the meter of such a tester. Yet the tester itself can lose its calibration or otherwise get out of order, and the user may be none the wiser until he has thrown away a lot of good tubes.

The conventional tube tester is checked by specially calibrated tubes—tubes which have been tested by a laboratory. These tubes are retested on a tube checker of doubtful accuracy to see if the same readings are obtained as were produced in the laboratory.

None of this is necessary with the Cardmatic. Each instrument comes supplied with a set of special test cards. To use them, you have only to remove a small panel on the side of the instrument, which exposes a set of potentiometer shafts (see Fig. 4). Each card is placed in the slot assembly and the corresponding potentiometer adjusted to a specified reading on the meter scale. The card itself tells the amount of deflection which should be obtained on the meter.

These adjustments compensate for aging of the tubes inside the tester and they are not dependent upon the use of standard or protest tubes.

One of the principal ideas which governed the design of the tester was the creation of a foolproof instrument which could be operated by the customer himself. This is in line with the thinking which is placing tube testers in supermarkets and drugstores. The Cardmatic is designed to have a profound appeal to this class of customer. This could be especially true in radio shops which are meeting the supermarket competition by allowing customers to do their own tube testing.

However, beyond this obvious applicability, the automatic self-tester machine has a strong appeal to industry because of its foolproof operation. If the machine is used in special industrial applications where tubes are operated in something other than their nominal manner, some special care can be supplied, which will be punched out to supply a test for any type of tube operation required.

---

**Fig. 4—Potentiometer adjustments are used in calibrating the instrument.**
By EDWIN BOHR

This television bar generator occupies no more toolbox room than a couple of SU's. It is just the thing for either home-service calls or bench work. There are no vacuum tubes—transistors are used throughout—and the unit is entirely self-contained.

No dangling and tangling power cord is needed. A single 4-volt mercury battery supplies enough power for about 2 years of operation in a shop with plenty of work to get out.

The circuit contains three oscillators and uses four transistors. One oscillator generates a carrier signal in the 30-mc range. Harmonics from this oscillator fall within the TV channels, producing good signals even in the high end of the VHF band.

This 30-mc oscillator uses a surface-barrier transistor made by Philco. These transistors cost more than conventional junction varieties. But, if you really need a bar generator in your service work, this additional cost will not be prohibitive. The generator, including battery, can be assembled for around $32.

Other transistors used in the unit are two G-E type 2N107 and a G-E 2N355. The 2N107 transistors function in a multivibrator that generates the horizontal bar frequencies for modulating the carrier oscillator. This audio-frequency signal is also very handy for signal-injection checking of amplifiers and audio stages of radios and TV sets.

The vertical bar generator oscillates at 10 times the horizontal sweep frequency. This is well into the VHF region and we found that an L-C tuned-circuit oscillator is necessary for adequate frequency stability. A miniature transistor type if transformer, with additional shunt tuning capacitance, serves this purpose.

Circuit details

Looking at the schematic (Fig. 1), you can see that the circuit is pretty simple and naturally divides itself into

---

Fig. 1—Circuit of the miniature generator.

Fig. 2—This panel layout was found to be the best.
three sections: carrier oscillator, vertical bar generator and horizontal bar generator. Of course, the carrier oscillator is the heart of this unit.

As you probably know, we must apply a bias to transistors to cause collector current to flow. Also, the bias circuit should be designed to maintain a constant collector current, despite temperature changes and varying transistor characteristics.

Resistors R2 and R3 connect across the battery supply and provide a constant bias voltage to both the L-5108 carrier oscillator transistor (V2) and the vertical bar 2N135 transistor (V1). This voltage is applied to the transistor base circuits. The emitter resistors of these transistors are chosen for the desired collector current.

Resistor R4 determines the nonoscillating current of V2. The assigned value of 470 ohms sets this current at about 1 ma. However, when the circuit begins to oscillate, rectification at the emitter-base junction changes this bias, automatically placing the operating point in the class-C region.

With V2 oscillating vigorously, the rectified signal may reach an average value of 0.3 volt. Notice the higher negative voltage of V2's emitter. Ordinarily, if this were an amplifier rather than an oscillator, the emitter potential would then be approximately 0.1 volt lower than the value of the base voltage.

Choke L2 is a simple coil of wire designed to keep the 30-mc carrier out of R4 and the bar-generating circuits. The exact wire size and turns are not too important.

A feedback tap for the emitter is placed approximately three-quarter turn from the -4-volt end of coil L1. This, we found, produced the strongest carrier. If you wish to experiment with this tap position, turn off all modulation, connect a low-range voltmeter across R4 and place the tap for maximum voltage reading.

Although the oscillator is fixed-tuned, it could easily be made variable by replacing fixed capacitor C7 with a variable one. Coil L1 is a five-turn section from a prewound type 3003 Miniductor. This coil has a diameter of ½ inch and a pitch of 16 turns per inch. If you wish, you can wind your own coil from No. 20 wire. The exact wire size is noncritical, but the coil should be wound on a form and doped for rigidity.

Notice the oscillator coil is placed near the geometric center of the case (see photos). This reduces loading effects of the small steel cabinet.

A single loop of stiff wire, insulated with spaghetti, couples the oscillator carrier to the output jacks. A 270-ohm series resistor R5 is necessary to eliminate standing waves on the leads connecting the generator to the TV set.

Switch S1, in one position, connects the output of S2 to V2's emitter for modulation and also connects the pick-up loop to the output jack J2. This position of S1 is marked on the panel. The other positions of this switch connects S2 directly to the output jack J2. The outputs of either the horizontal or vertical bar generators are then available for direct injection into video amplifiers.

In our model of this generator, S2 is an eight-position switch, but only four positions are electrically active. One dead position is necessary to turn off modulation. Only a five-position switch is needed. I used the extra terminals of the eight-position unit for tie points.

There are two switch positions for both of the modulating oscillators. One provides a signal attenuated by 100 for signal injection into high-gain amplifiers without overloading them. For modulating the carrier, S3 must be in the unattenuated positions.

Vertical bar generator

The vertical bar generator uses a 455-kc IF transformer, shunted with both a fixed capacitance of 0.01 μf and a variable tuning capacitor. These capacitances are in addition to the capacitance inside the transformer can. Capacitor C1 is variable. The one shown in the photographs is a two-gang superhet type. We used it only because it was on hand. This two-gang capacitor is a Lafayette MS-270 but, because of its lower cost, we recommend a single-gang MS-274 be used. They are very compact, solid-dielectric types.

The IF transformer we used is a Lafayette MS-268-A. This type is desirable because it can be tuned from the top — in fact, from either end.

A vertical-bar modulating signal is taken from the emitter of V1. It might appear that C3 would bypass all this signal to ground. It does not. At the oscillator frequency, its reactance is roughly 700 ohms.

Two inexpensive G-E 2N107 transistors, operating in a multivibrator circuit, produce a horizontal-bar modulating frequency. Because of the nonlinear operating conditions for this type of circuit and variations in low-cost transistors, the values of C9 and C10 may have to be varied somewhat. This is a job that must, of course, be left until the generator is completed.

If the frequency-varying control R9 does not have enough range to produce the number of desired bars, lower the values of these capacitors to increase the number of bars and vice versa.

Despite the low internal impedance of the mercury battery, a bypass electrolytic C8 is placed across the horizontal bar generator supply voltage. This prevents feedback through the collector supply.

Construction

The cabinet is a control and switch
case, fabricated from steel with welded end plates.

This is a small case but there is enough room to mount all parts with a generous margin of space and accessibility. The completed electronic package is strong enough to drop from a service truck without major damage.

A front-panel layout (Fig. 2) shows where to place the controls and switches. This is an optimum arrangement—the result of several hours' planning—and I suggest very strongly that it should be followed exactly.

The insulating-board chassis is supported by two aluminum brackets. In my model, these brackets are held to the front panel by the same screws that secure the chrome handle. If you do not want to use a handle, use the handle holes for ordinary screws. A 6-32 screw fastens the brackets.

Four small right-angle brackets hold the insulating-board chassis to the aluminum brackets.

A strap of perforated aluminum, cut from a large sheet sold at the local hardware store, holds the mercury cell in place. One end of the strap hooks around the insulating-board chassis and the other end wraps over the aluminum bracket and is held there by a self-tapping screw.

We attached rubber feet to the case with aluminum rivets. These are also sold in hardware stores. The rivet is pushed into the rubber bumper and through a hole in the case. Then a short spacer (a sawed-off piece of volume-control shaft works very well) is pushed against the rivet head inside the bumper and rested against the work bench. Then peen the rivet inside the case, using a punch if necessary.

Wiring the generator

I suggest wiring the horizontal bar generator first. When it is complete, it can be checked by connecting its output to headphones or into the video amplifier of a TV set. An audio growl with a rather high pitch should be heard in the phones. Horizontal bars should be seen on the screen.

Now, assemble the carrier oscillator. If it is oscillating, the emitter voltage should be greater than the base voltage. If it does not oscillate, and the voltages check OK at the base and collector, add more capacitance to C7 or try changing the tap on L1. The L-5108 (V2) is a hot little transistor and I have never had any trouble getting it to work, but I offer these suggestions as a safety measure.

Generous leads are left on all the transistors. This protects them from abusive soldering practices and breaking leads at the case.

Be sure of your wiring for the L-5108. If it is wired correctly, nothing should go wrong. But even a momentary wrong voltage can ruin its microscopic internal connecting leads.

With this much wired, you should be able to receive the carrier with horizontal bar modulation. If not, check your switches and wiring for possible errors.

Next, wire the vertical bar generator. This will produce vertical stripes on the TV screen, of course. If the generator works except for these bars, try reversing the leads numbered 1 and 2 on the if transformer or increase the value of C3. With variable capacitor C1 in mid-position, adjust the if transformer slug, with an insulated screwdriver (nonmetallic), until the desired number of vertical lines are obtained.

As you can see in the photographs, leads were soldered to the mercury battery. It is easy to solder to a mercury cell if you scrape the surface and quickly tin it with a hot iron. Then tack a pretrimmed wire in place with the iron.

Here is one last construction note. If it is anticipated that high voltages may accidentally ever be applied to J1 and J2, I recommend that a .01-mfd capacitor, with a suitable voltage rating, be placed in series with resistor R5.

Using the unit

This is simple. Just flip S3 to the ON position, connect J1 and J2 to the set's antenna terminals and switch on the modulation. The number of bars and their sync are adjusted from the front panel. Receiver brightness and contrast are adjusted for the best pattern.

The tuned-circuit constants gave us a signal on channels 5, 8 and 13. For other channels, vary the value of C7.

This circuit shows that transistors are becoming more capable replacements for vacuum tubes, especially in high-frequency applications. In the not-too-distant future I hope to have a completely transistorized color bar and dot generator, both in the same size case.

TEST INSTRUMENTS

RADIO-ELECTRONICS believes that its readers have the right to know just what to expect when they buy tubes through mail order advertising. That's why since January 1956, we have been insisting that mail-order tube advertisers warrant that the tubes they are offering for sale are new and unused, not mechanical or electrical rejects, or not washed or rebranded. If they do not meet these requirements, or if they are in any way substandard, the advertiser must say so specifically in his ad.
IMPACT

NOISE METER USES 3 TRANSISTORS

A transistorized instrument to measure impact noise without an oscilloscope

By NATHANIEL RHITA

IMPACT noise—the sound of drop hammers, typewriters and gas engines—is important to industrial technicians who must study it to be able to control and reduce it. These sounds generate complicated wave trains that vary greatly from one instant to the next. Fig. 1 is a typical handclap wave and Fig. 2 that of a small drop hammer. In each case the peak pressure is approximately 118 db (above .0002 microbar). An ordinary sound-level meter alone is of little use in measuring impact noise which varies so much in so little time. The oscilloscope method is effective but very complicated and expensive. General Radio Co. has an instrument (No. 1556-A) designed to measure impact noise.

This meter uses three transistors and one tube. It is intended for use with a noise-level meter or analyzer.

Fig. 3 is a simplified diagram of the new instrument. The first transistor, V1, is a phase inverter so that either positive or negative noise pulses can be measured by means of S1. V2 and V3 form a highly stable amplifier with negative feedback. Output can be switched into separate networks.

With S2 in the QUAII-Peak position the network has a rise time less than 1 millisecond and a slow decay, about 0.6 second. Therefore, the capacitor can follow successive peaks quite closely. This position is useful for measuring recurring noises like the explosions of a gas engine.

In the peak position, the attack time is only 100 microseconds, practically instantaneous. The peak voltage is stored on a capacitor which has no discharge path. This voltage is stored for several seconds without appreciable loss so it may be measured by the voltmeter tube V4 at a later time.

The time average network provides seven different time constants (not shown) so its capacitor charges for a short or long interval as desired. This voltage also remains on a capacitor for subsequent measurement. This network indicates the average level of a noise as measured over a definite period of time. Peak and average levels of an impact noise are important, but so is the duration of the noise. Most impact noises (Figs. 1, 2) begin with an initial peak then decays indefinitely. The wave duration may be defined by the time taken for its peak to fall 8.7 db. This is called the time constant of the impact decay. The time constant is determined from the peak and average levels of the

Fig. 1—Oscillogram of a handclap. Horizontal scale 2 msec per division.

Fig. 2—Oscillogram from a small drop hammer. Horizontal scale 10 msec per division.

Fig. 3—Simplified circuit of the meter.

Fig. 4—Chart of relationship between the ratio of the peak-to-average value and the time constants of an impact (plus those of the circuit) noise as well as the charging time (averaging time) of the capacitor network. These relationships are shown in Fig. 4.

As an example, let the impact meter be set to an averaging time of .01 second. A noise is now measured as having a peak of 115 db and an averaged level of 98 db. This gives a difference of 17 db. The chart shows that the time constant is twice the averaging time. Therefore, the impact decay time is 2 x .01, or .02 second.

END
Amplifier-Rectifier VTVM for Audio Testing

First of a series of articles on apparatus and techniques for testing hi-fi equipment

By L. B. HEDGE

Scales for meter. Drawn for 90° movement.

Adding an electronic switch to the test setup makes visual comparison of input and output waveforms much easier. It also allows recognition of distortion of a much lower order than that identifiable with a scope alone. Phase-shift measurements can be made with a scope with or without an electronic switch, although the switch and scope method is generally more accurate and less involved (see Fig. 2).

Including a narrow-band filter (analyzer) in the setup—an instrument which suppresses any selected frequency in the audio range, while giving negligible attenuation to the higher harmonics of the selected frequency—permits measuring total harmonic distortion (Fig. 4). (See "Measuring Distortion" and "Distortion Totalizer" in the December, 1951, and August, 1954, issues, respectively.) Adding a mixing network (See "Build an IM Analyzer," December, 1953) to supply a mixture of a 60-cycle signal with the output of an audio oscillator to the amplifier input permits determining intermodulation distortion by measurements made with the scope and analyzer (Fig. 4).

Except for certain readings made directly from the scope in the intermodulation and phase-shift tests, all measurements are af voltage measurements. Because of this basic function of voltage measurements in testing procedures and because af voltage measurements are also necessary for adjusting oscillators and other af test equipment, the logical unit with which to start an af test setup is an af voltmeter.

Why an A-R vtvm

Since audio tests require voltage measurements over a range from a few millivolts (inputs to preamps) to over 100 volts (output signal across the primary of a power output transformer), over a wide frequency range (30 to 15,000 cycles at least; 15 to 50,000 cycles for special tests and analysis), and with a minimum loading of the test circuit by the meter, an amplifier-rectifier (A-R) type vtvm is indicated for the job. Although the A-R type vtvm responds to the mean (average) voltage rather than the root-mean-square (effective) voltage for pure sine-wave inputs, the errors resulting from using meter readings for effective voltage values will be less than 4% for waves containing up to 10% in harmonics and much smaller for waves with smaller harmonic content. No more accurate instruments of high input impedance, wide frequency range and extended voltage range are available as simple and economical units. The A-R vtvm's accuracy is quite adequate for tests in which the decibel is the significant unit and basic scale for reference standards.

The meter is quite conventional in general concept and form. It differs from more conventional instruments of this type, however, in two significant features:

1. The indicating meter used is not...
TEST INSTRUMENTS

a supersensitive unit — a 5-ma meter is used instead of the conventional 200-μa meter.

2. The two voltage scales (each of which is used with successive multipliers of successive powers of 10) differ from each other by a factor of 2.5 (0.4) instead of the more conventional √10 (√0.10), with db intervals of 12 and 8 instead of 10 and 10.

The first of these differences makes possible the use of cheaper, more readily available and less delicate meter movements. To provide the additional current in the meter circuit, a "power" output stage is required, but the actual power requirements are sufficiently low that no essential complication results therefrom. The second feature permits the use of even values of precision resistors in the voltage range multiplier and considerably simplifies the meter scales, both in layout and for reading, since the same scale divisions are used on each range scale.

Including the compensating capacitors extends the accurate range beyond 90,000 cycles. If the extended frequency range is required, connections A and B should be left open on assembly and completed as part of the calibration procedure described later. The inductance L1 consists of two TV width controls in series and is set at maximum inductance (16 mh each).

Meter scales

Layout of the meter scales is indicated at head of article. Voltage scales can be drawn using the diagram as a template for 90° meter movement scales. Scales for meter movements other than 90° can be drawn with ruler, compass and protractor without difficulty. Scale markings for the dbm (0 = 0.7746 volts — .001 watt at 600 ohms) are shown in the table in terms of the 0 — 1,2 volt scale.

On completion of the vtvm assembly, the cascode bias potentiometer (R12) should be set at approximately mid-position, and the feedback potentiometer (R11) (calibration control) set at maxi-

Fig. 4—Adding a 60-cycle source and mixer prepares for IM distortion tests.

Layout and construction of the meter system are critical in only a few aspects. Since the input stage of the amplifier is a high-gain stage with high input impedance and operating at a low input signal level, complete shielding of the unit is necessary to prevent inaccuracies due to stray signal pickup. The unit shown in the photos is built into a wooden frame with a light sheet-copper shield attached to the outside and with a metal front panel and perforated rear cover plate. If a metal cabinet is used, ventilation should be provided for the tubes and transformer. Heater supply wiring should be twisted to minimize hum pickup. The masonite subpanel is attached to the meter by the two meter terminals. The insulated panel reduces stray capacitances in the circuit wiring. These capacitances tend to reduce the high-frequency response of the amplifier and consequently of the meter itself.

Capacitors C1, C2 and C3 (See Fig. 5) provide high-frequency compensation for the range attenuator network. With these capacitors omitted, the meter unit provides readings that are accurate to within a fraction of a decibel from 15 to more than 20,000 cycles.

Fig. 5—Circuit of the A-R vtvm.

In the meter's case.

www.americanradiohistory.com
Regulating Bias and Polarizing Voltages

Use neon bulbs as voltage regulators

REGULATION of bias and polarizing voltages used in many types of electronic equipment, test instrument power supplies, etc., is quite costly power-wise when standard regulator tubes are used. Each tube uses 1½ to 3 watts, which is radiated as heat. The regulator circuit uses and radiates heat an additional wattage determined by the IR loss in the dropping resistor. This power loss is particularly annoying because the current consumed by the bias or polarizing circuit is usually less than 1 ma, and in some instances is actually much less than 1 μa. Therefore the power needed to control the bias or polarizing voltage is several thousand times that used in the regulated circuit.

This power waste can be reduced by a factor of 5 or more in many low-voltage low-current regulated supplies by using neon bulbs as regulators. Experiments show that many neon bulbs, drawing from 1/25 to 1 watt, have a constant voltage drop of about 55 through a very wide range of current consumptions, and hence make ideal voltage regulators.

A typical bias rectifier circuit and regulator, using neon-bulb regulation, is shown in Fig. 1. Output voltage, at various ac inputs, is plotted in Fig. 2, output being set at 3 volts when line voltage was 117. Some shifting of the end points of the plateau of the curve is possible by changing the value of the lower resistor. The length of this plateau can be extended by using a higher-wattage neon bulb and shortened with a bulb of lower wattage. In general, the very small neon bulbs such as the NE-2 and NE-51 are not very satisfactory as regulators, but all resistive stable neon bulbs of higher wattage seem to work very well. Bulbs with a symmetrical arrangement of the electrodes are completely nonpolar and work equally well on either socket connection. Bulbs with asymmetrical electrode arrangement tend to be polar and may work better if the connections are reversed.

When operated about midway between the "will-fire" current and the catalog rating, the life of standard neon bulbs is measured in tens of thousands of hours.

What does that mean?

A reader recently asked us what the ABC on our contents page meant. We quickly replied that it meant Audit Bureau of Circulations. But when we thought about it for a while, we realized that was not the complete answer. That insignia means Radio-Electronics is a member of a nonprofit association established 43 years ago to insure dependable circulation statements and accurate details about the character of circulation. It is an expression of honesty—a mark of character. Radio-Electronics is proud to be a member of the group privileged to display it.
LAST month we described the main components that make up an electronic surveillance kit. You now have the amplifier, an rf pickup and an induction pickup. To extend the versatility of your kit, a variety of other pickups, listening devices, cables, spare parts and tools are needed. These are the items described here.

Vibration pickup

Few of the accessories included in an electronic surveillance kit are as versatile as a vibration pickup. The unit is used for such tasks as locating a suspected time bomb; listening through doors, windows and partitions; detecting hidden machinery or even opening combination locks and safes. Basically, it is an electromechanical transducer, converting physical vibrations into audio-signals. (See diagram.)

The pickup consists of a standard crystal or ceramic phonograph cartridge mounted in a thick-walled metal case. The model shown in the photographs was assembled from a discarded microphone. The original, defective cartridge was removed and the phon cartridge installed. A hardened nail or metal spike is mounted in one side of the case so that it bears against the cartridge's outer case. A 3- or 4-foot shielded output cable is provided, with the braid connected to one cartridge terminal and the metal housing, and the center lead to the cartridge's other terminal.

In operation, the point of the spike is held against the source of vibrations—a package, safe, door or wall partition. The vibrations travel along the spike to the phon cartridge's case and are transferred to it. The case tends to vibrate around the element, which in turn resists this vibration by virtue of its own inertia. A twisting action results, producing an electrical signal in the cartridge element. The signal is fed to the amplifier.

The telephone pickup is one of the standard flat inductive pickup coils stocked by many local and mail-order radio parts distributors and intended for use with high-gain tape recorders. A plug to match the amplifier's input jack is added to the output cable. In use, the telephone pickup is simply placed under the base or next to the receiver of the telephone with which it is to be used. This unit has more sensitivity than the induction pickup, but it is not satisfactory for line pickup.

Intended for use as a plant in a suspect's room or office, a remote microphone permits the operator to overhear personal and business conversation. It consists of a thin crystal microphone cartridge attached to a 30- to 50-foot length of shielded cable and a plug to match the amplifier input. Small-diameter shielded cable is essential to permit concealment under rugs, behind baseboards, along moldings or behind furnishings. The kit may be equipped with several remote microphones since they must often be expendable.

A standard headset is the output de-
vice most commonly used. It is a high-
impedance magnetic or crystal earphone
equipped with a plug to match the am-
plifier's output jack. Any standard head-
set is available, but it is best to choose a unit that is comfortable to wear, com-
 pact and lightweight. Sturdy construc-
tion is another must since the headset may, on occasion, receive rough treat-
ment in transportation and handling.

Essentially a high-impedance mag-
netic or crystal hearing-aid type ear-
phone equipped with a plug to match the amplifier's output jack, a special earphone is used for undercover work where the operator may be seen by other people.

In a typical situation, the amplifier will be concealed in an inside coat pocket and the special earphone mounted so the operator appears to be an ordinary hard-of-hearing individual wearing a hearing aid. Actually, the operative may have the vibration or rf pickup concealed in the palm of one hand, with the connecting cable inside his coat sleeve.

Cable requirements
An assortment of properly terminated shielded cables is essential if the kit is to have maximum utility. These cables may be from 4 to 6 feet long, with one end terminated in a plug to match the input and output amplifiers. The other end of each cable is terminated in another connector.

While the exact number and variety of accessory cables needed are largely a matter of individual preference, the following types may be considered as basic to any well-designed general-purpose kit:

1. Recorder Cable—terminated in a connector to fit a standard tape or wire recorder. It is used to connect the amplifier to a recorder when it is necessary or desirable to obtain a permanent record of monitored conversations.

2. Extension Cable—terminated in a female cable jack like those on the amplifier. It is used to extend the reach of the accessories.

3. Special Clip Cable—terminated in alligator clips and short lengths of flexible wire, is an all-purpose cable. It is used for tapping lines or connecting a special pickup or output device to the amplifier.

Spare parts
In making up the electronic surveillance kit, it must be remembered that an agent or operative using the kit in the field must have ready access to a stockroom. Everything needed to keep the kit in operating condition or to facilitate the installation of the various accessories must be included in the kit.

A spare-parts kit may be assembled in a small multicompartment plastic box and should include: a supply of light and dark wiring; small rolls of transparent and black Scotch tape; a small magnifying glass; spare A and B batteries; a small penlight or flashlight; an electrician's pocket knife; a neon line-voltage tester; a set of tubes for the amplifier; and special-purpose adapters.

Where space permits and where the kit may be in the field for extended periods of time, a supply of hookup wire and shielded cable plus a small roll of rosin-core solder might be included with the spare parts.

Tool kit
Small hand tools are essential to the proper installation and use of many of the kit's components. An agent must be able to pry baseboards or moldings away from walls so he can hide micro- phone wires; reinstall moldings without leaving scratches or tell-tale marks; remove carpet and upholstery tacks to facilitate hiding a microphone or cable; cut small holes in walls or partitions for feeding a wire through or for use as a peephole; make minor repairs to the components in his kit and measure distances accurately in order to locate hidden wall compartments.

The following tools should be included as a minimum complement: small claw hammer;awl type drill; saw; tape measure; small hacksaw; assortment of screwdrivers; a pair of long-nose pliers with a wire cutter or a separate diagonal cutter.

Optional tools, useful for some types of work but not absolutely essential, include a small soldering iron, a hand drill and assortment of bits, tweezers and a small set of wrenches.

Although not a functional part of the kit, the type of carrying case is extremely important. The case must be small, sturdy, lightweight and camouflage its contents.

A skate carrying case, with the various components held in place by small brackets and coil-spring straps, does a good job. A sturdy fiber case will serve as well; rubber, cloth or leather straps can be used to secure the components in position. Care should be taken in designing mounting brackets and straps--they must hold each item securely in position even when the kit is subjected to rough handling, and permit the ready removal and replacement of any component.

For camouflage purposes, many oper-
atives prefer that the electronic surveil-
ance kit be mounted in a small leather briefcase or a dispatch case. For maxi-
um protection against accidental dis-
covery, the entire kit may be concealed under a false bottom in an overnight bag or suitcase, or even hidden in concealed pockets in a large overcoat.

Space limitations prohibit a detailed discussion of all possible applications of the Surveillance Kit. In general, how-
ever, its function is to assist an agent in obtaining information and in detecting the use of technical espionage equipment such as planted radio trans-
mitters.

The basic operational setup includes one of the pickup devices, the amplifier and an output device. For example, the rf pickup, amplifier and standard headset might be used for searching a room for a small hidden transmitter. In another instance, the vibration pickup, amplifier and standard headset might be used for opening a safe in a suspect's office or in listening for ticks in a pack-
age suspected of containing a bomb.

Often, the recorder cable is used to connect the amplifier to a standard tape or wire recorder to make a permanent record. For example, the vibration pickup, amplifier, recorder cable and a recorder might be used to record a sus-
pect's conversation through a wall or partition. In more favorable circum-
stances, the remote microphone (hidden in the suspect's room) could be used for the same purpose. The amplifier's gain, coupled with the normal gain of a good recorder, gives an amazing sensitivity.

While the use of many kit components may be obvious from their very nature, their value depends greatly on the skill of the individual agent. As he acquires experience in using the kit, he can de-
velop tricks and special techniques of his own to obtain the most from each piece of equipment.
FAST films and fast shutters are the tools of the modern action photographer; the technical achievements of the photographic industry have eliminated the problem of the long exposure. Remarkable action pictures are being made every day by photographers who use comparatively simple camera equipment and ordinary films. For example, a photographer at ringside, using a press type camera and flash bulbs, can successfully stop the swiftest punch a fighter can throw. He can stop the punch, that is, if his own reflexes are quick enough to anticipate it and trip the shutter at the proper instant. A photographer could stop a baseball player in the middle of a home-run swing of the bat, too, if he were capable of deciding in a fraction of a second whether the batter was going to follow through. So, while the photographer has the equipment with which to take fast action pictures, he is still confronted with the problem of synchronizing that equipment with the action he wishes to photograph.

Because sound almost always accompanies action, it is an excellent synchronization medium. A camera shutter tripped by the crack of a bat is sure to photograph the batter at the peak of his swing. The same would be true of a golfer striking a golf ball or a football player kicking. Sports is by no means the only field in which a sound-synchronized camera can be used. Any photogenic, fast-action phenomenon that makes sound is a good subject. It might be cars colliding at a thrill show or the blasting of rock in a stone quarry. There is material for countless prize-winning photos everywhere, and a sound-triggered camera will guarantee good results every time.

The first step in building a sound-triggered camera is the construction of an electrically actuated shutter. Many press type cameras come equipped with solenoid-actuated shutters, and those persons fortunate enough to possess such cameras have much of the problem already solved. It is virtually impossible to describe the construction of a mechanism that would be adaptable to all types of cameras. Instead, a principle is described from which an
actuating mechanism can be adapted to any particular make of camera.

The mechanism illustrated was constructed to fit a Rolleicord IV camera. The power required to trip the shutter is supplied by a 1-inch coil spring. The spring is stretched and the mechanism is cocked before each exposure. The shutter-trigging lever is held in the cocked position against the tension of the spring by the armature of a sensitive relay. A short pulse of electricity sent through the relay coil pulls the armature free of the triggering lever and releases it, thereby tripping the shutter and making the exposure. The action is almost instantaneous. The base of the mechanism is designed to be mounted by sandwiching it between the camera and tripod, eliminating the necessity of fastening anything to the camera. The device is very simple and can be adapted to almost any camera.

Closeup of camera-trigging device.

The electronic portion of the unit is equally simple. A 4-inch PM speaker is used as a microphone. The speaker feeds a two-stage audio amplifier through a voice-coil-to-grid transformer. The first tube of the amplifier is a pentode connected for maximum voltage gain; the second stage is triode-connected for lower output impedance. The sensitivity control is connected between the two stages.

The output of the amplifier is fed to the starter anode of an OA4-G. This tube is normally nonconducting because the voltage from cathode to anode is insufficient to cause ionization. However, a comparatively low voltage applied to the starter anode will start ionization and cause the entire tube to conduct. The cathode of the OA4 is returned to ground through the coil of the shutter-triggering device. Each time a sound hits the microphone, the amplified voltage fires the OA4 which in turn trips the shutter of the camera.

Once the OA4 is fired, it will continue to conduct until the plate voltage is removed. To eliminate the necessity of opening the plate circuit of the OA4 after each exposure, the plate voltage is supplied to the tube through a 220,000-ohm resistor. This resistor charges the 10-µf capacitor to the battery terminal voltage. However, when the OA4 conducts, it discharges the 10-µf capacitor in less than a second. The resistance of the plate resistor is such that it will not sustain tube conduction.

The capacitor discharge current is more than sufficient to energize the coil of the triggering mechanism but, since the peak current of the OA4 must be limited to 100 ma, the resistance of the coil on the triggering mechanism should not be less than 2,000 ohms.

That is the case, a plate type relay may be installed in the cathode circuit of the tube and the normally open contacts used to energize the solenoid with the proper voltage. The contacts of the relay can be connected directly to the external receptacle of the flash gun unit.

Resistors: 1—5,600, 1—100,000, 2—220,000, 1—330,000 ohms. 1—33 megohms, 1/2 watt; 1—megohm pot, audio taper (sensitivity); 1—megohm pot, linear taper (threshold).

Miscellaneous: 1—0.05, 2—0.02, 1—0.05 µf, 200 volts, 1—10 uf 660-volt electrolytic capacitors; 1—5.5-volt A battery (Burgess No. or equivalent); 2—90-volt B batteries (Burgess Nos. or equivalent); 1—phone jack; 1—pent switch; 2—10A4s and sockets; 1—OA4-G and socket; 1—4-inch PM speaker; 1—transformer, voice coil to grid (Stancor A-4744 or equivalent); 1—chassis and cabinet; 1—triggering device.

The starter anode of the OA4 must be operated in positive dc bias obtained from the threshold potentiometer. This potentiometer is adjusted just below the point where the OA4 will fire without additional voltage from the amplifier.

Most commercial shutter solenoids have too low a resistance to be used in the cathode circuit of the OA4. If such

Everybody benefits when everybody gives the UNITED way
everybody's doing it!

Motion picture and TV personality, Jackie Coogan, looks on with unbelieving interest as his 14-year-old son, Anthony, prepares to assemble his latest Heathkit, a hi-fi FM tuner. The Coogans have found out about the fun and savings of building their own electronic equipment the Heathkit way... so why don't you?

Heathkits®

...fun to build and a thrill to own!

and here's why...

1. You get higher quality at lower cost by dealing direct, and by doing your own assembly.
2. You receive personal, friendly, service (before and after sale) for complete satisfaction.
3. You benefit from the latest in engineering designs because of our concentration on kit-form equipment only.
4. You may depend on performance as advertised—backed by Heath's world-wide reputation for quality.
5. You can take a full year to pay with the HEATH EASY TIME PAYMENT PLAN.

You'll get plenty of these detailed pictorial diagrams in your Heathkit construction manual to show where each and every wire and part is to be placed. Everything you do is spelled out in pictures so you can't go wrong. That's what makes it such fun!

...fun to build and a thrill to own!
HEATHKIT EXTRA PERFORMANCE 70-WATT AMPLIFIER KIT
For really high performance, with plenty of reserve power, the W-6M is a natural. The full 70-watts output will seldom, if ever, be required. However, this reserve insures distortion-less sound on power peaks. The W-6M will loaf along at normal listening levels and yet is always ready to extend itself when program material demands it, without the least amount of strain. The output circuit employs 6550 tubes with a special-design Peerless output transformer for maximum stability at all power levels. A quick-change plug selects 4, 8, and 16 ohms or 70-volt output and the correct feedback resistance. A variable damping control is also provided for optimum performance with any speaker system. Extremely good power supply regulation is possible through the use of a heavy-duty transformer along with silicon diode rectifiers, which are noted for their very long life, and yet are smaller than a house fuse. Frequency response at 1 watt is ±1 db from 5 cps to 80 kc with controlled hf rolloff above 100 kc. At 70 watts output harmonic distortion is below 2%, 20 to 20,000 cps and IM distortion below 1%, 60 and 6,000 cps. Hum and noise 88 db below full output. In addition to high performance, its fine appearance makes it a pleasure to display in your living room. Proper layout of chassis insures ease of assembly by eliminating those cramped and difficult places to get at. Clear instructions—and top-quality components. Get started now and make this amplifier the heart of your hi-fi system. Shipped express only. Shpg. Wt. 50 lbs.

MODEL W-6M: Consists of W-6M kit, plus WA-P2 preamplifier. Express only. Shpg. Wt. 59 lbs. $109.95

HEATHKIT HIGH FIDELITY FM TUNER KIT
This tuner can bring you a rich store of FM programming, your least expensive source of high fidelity material. It covers the complete FM band from 88 to 108 mc. Stabilized, temperature-compensated oscillator assures negligible drift after initial warmup. Features broadbanded circuits for full fidelity, and better than 10 uv sensitivity for 20 db of quieting, to pull in stations with clarity and full volume. Employs a high gain, cascade RF amplifier, and has AGC. A ratio detector provides high efficiency demodulation without sacrificing hi-fi performance. IF and ratio transformers are prealigned, as is the front end tuning unit. Special alignment equipment is not necessary. Edge-lighted glass dial for easy tuning. Here is FM for your home at a price you can afford. Shpg. Wt. 8 lbs.

MODEL FM-3A: $25.95 (with cabinet)

HEATHKIT BROADBAND AM TUNER KIT
This AM tuner was designed especially for high fidelity applications. It incorporates a special detector using crystal diodes, and the IF circuits feature broad band-width, to insure low signal distortion. Audio response is ±1 db from 20 cps to 9 kc, with 5 db of preemphasis at 10 kc to compensate for station rolloff. Sensitivity and selectivity are excellent, and tuner covers complete broadcast band from 550 to 1600 kc. Quiet performance is assured by 6 db signal-to-noise ratio at 2.5 UV. Prealigned RF and IF coils eliminate the need for special alignment equipment. Incorporates AVC, two outputs, two antenna inputs, and built-in power supply. Edge-lighted glass slide-rule dial for easy tuning. Your "best buy" in an AM tuner. Shpg. Wt. 8 lbs.

MODEL BC-1A: $25.95 (with cabinet)

HEATHKIT MASTER CONTROL PREAMPLIFIER KIT
Designed for use with any of the Williamson-type amplifiers, the WA-P2 has five switch-selected inputs, each having its own level control to eliminate blasting or facing while switching through the various inputs, plus a tape recorder output. A hum control allows setting for minimum hum level. Frequency response is within ±1 1/2 db from 15 to 35,000 cps. Equalization provided for LP, RIAA, AES, and early 78's. Separate bass and treble controls. Low impedance cathode follower output circuit. All components were specially selected for their high quality. Includes many features which will eventually be desired. Shpg. Wt. 7 lbs.

MODEL WA-P2: $19.75 (with cabinet)
HEATHKIT ADVANCED-DESIGN 25-WATT HIGH FIDELITY AMPLIFIER KIT

Designed especially to satisfy critical audio requirements, the W-5M incorporates the extra features needed to complement the finest in program sources and speaker systems. Faithful sound reproduction is assured with a frequency response of +1 db from 5 to 160,000 cps at 1 watt, and harmonic distortion is less than 1% at 25 watts, with IM distortion less than 1% at 20 watts. Hum and noise are a full 99 db below rated output, assuring quiet, hum-free operation. Output taps are 4, 8 and 16 ohms. Exclusive Heathkit features include the "tweeter saver", and the "bas-bal" balancing circuit, requiring only a voltmeter for indication. Years of reliable service are guaranteed through the use of conservatively rated, high quality components. KT66 tubes and Peerless output transformer are typical. Shipped express only. Shpg. Wt. 31 lbs.

MODEL W-5: Consists of W-5M kit above plus model WA-P2 preamplifier. Express only. Shpg. Wt. 38 lbs. $79.50

MODEL W-5M
$59.75

HEATHKIT DUAL-CHASSIS 20-WATT HIGH FIDELITY AMPLIFIER KIT

The model W3-AM is a Williamson-type amplifier built on two separate chassis. The power supply is on one chassis, and the amplifier stages are on the other chassis. Using two separate chassis provides additional flexibility in installation. Features include the famous acrosound model TO-300 "ultralinear" output transformer and 5881 tubes for broad frequency response, low distortion, and low hum level. The result is exceptionally fine overall tone quality. Frequency response is +1 db from 6 cps to 150 kc at 1 watt. Harmonic distortion is less than 1% and IM distortion is less than 1.3% at 20 watts. Hum and noise are 88 db below 20 watts. Designed to match the speaker system of your choice, with taps for 4, 8 or 16 ohms impedance. A very popular high fidelity unit employing top quality components throughout. Shipped express only. Shpg. Wt. 29 lbs.

MODEL W-3A: Consists of W-3AM kit above plus model WA-P2 preamplifier. Express only. Shpg. Wt. 37 lbs. $69.50

MODEL W-3AM
$49.75

HEATHKIT SINGLE-CHASSIS 20-WATT HIGH FIDELITY AMPLIFIER KIT

The model W4-AM Williamson-type amplifier will amaze you with its outstanding performance. A true Williamson circuit, featuring extended frequency response, low distortion, and low hum levels, this amplifier can provide you with many hours of listening enjoyment with only a minimum investment compared to other units on the market. 5881 tubes and a special Chicago-standard output transformer are employed to give you full fidelity at minimum cost. Frequency response extending from 10 cps to 100 kc within +1 db at 1 watt assures you of full coverage of the audio range, and clean clear sound amplification takes place in circuits that hold harmonic distortion to 1.5% and IM distortion below 2.7% at 20 watt output. Hum and noise are 95 db below full output. Taps on the output transformer are at 4, 8 or 16 ohms. Shipped express only. Shpg. Wt. 26 lbs.

MODEL W-4A: Consists of W-4AM kit above, plus model WA-P2 preamplifier. Express only. Shpg. Wt. 35 lbs. $59.50.

MODEL W-4AM
$39.75

Heathkits...

By DAYSTROM

bring you the lasting satisfaction of personal accomplishment

HEATHKIT GENERAL-PURPOSE 20-WATT HIGH FIDELITY AMPLIFIER KIT

The model A-9C will provide you with high quality sound at low cost. Features a built-in preamplifier with four separate inputs, and individual volume, bass and treble controls. Frequency response covers 20 to 20,000 cps within +1 db. Total harmonic distortion is less than 1% at 3 db below rated output. Push-pull 6L6 tubes are used, with output transformer tapped at 4, 8, 16 and 500 ohms. A true hi-fi unit using high-quality components throughout, including heavy duty "potted" transformers. Shpg. Wt. 23 lbs.

MODEL A-9C
$35.50

www.americanradiohistory.com
HEATHKIT "BASIC RANGE" HI-FI SPEAKER SYSTEM KIT
The extremely popular Heathkit model SS-1 Speaker System provides amazing high fidelity performance for its size. Features two high-quality Jensen speakers, an 8" mid-range woofer and compression-type tweeter with flared horn. Covers from 50 to 12,000 CPS within ±5 db, in a specially designed ducted-port, bass reflex enclosure. Impedance is 8 ohms. Cabinet measures 11 1/2" H x 23" W x 11 1/4" D. Constructed of veneer-surfacd plywood, 1/4" thick, suitable for light or dark finish. All wood parts are precut and predrilled for easy, quick assembly. Shpg. Wt. 80 lbs.

HEATHKIT "RANGE EXTENDING" HI-FI SPEAKER SYSTEM KIT
Extends the range of the SS-1 to 100,000 CPS. Uses 15" woofer and super-tweeter both by Jensen. Kit includes crossover circuit. Impedance is 16 ohms and power rating is 35 watts. Measures 29" H x 23" W x 17 1/4" D. Constructed of veneer-surfaced plywood, 1/4" thick. Easy to build! Shpg. Wt. 80 lbs.

HEATHKIT "LEGATO" HIGH FIDELITY SPEAKER SYSTEM KIT
The quality of the Legato, in terms of the engineering that went into the initial design, and in terms of the materials used in its construction, is matched in only the most expensive speaker systems available today. The listening experience it provides approaches the ultimate in esthetic satisfaction. Two 15" theater-type Altec Lansing speakers cover 25 to 500 CPS, and an Altec Lansing high-frequency driver with sectoral horn covers 500 to 20,000 CPS. A precise amount of phase shift in the crossover network brings the high frequency channel into phase with the low frequency channel to eliminate peaks or valleys at the crossover point, by equalizing the acoustical centers of the speakers. The enclosure is a modified infinite baffle type, especially designed for these speakers. Cabinet is constructed of veneer-surfaced plywood, 3/4" thick, precut and predrilled for easy assembly. Frequency response 25 to 20,000 CPS. Power rating, 50 watts program material. Impedance is 16 ohms. Cabinet dimensions 41" L x 22 1/4" D x 34 1/4" H.

HEATHKITS... let you save up to 1/2 or more on all types of electronic equipment.

HEATHKIT SINE-SQUARE GENERATOR
The new AG-10 provides high quality, sine and square waves over a wide range, for countless applications. Some of these are: radio and TV repair work, checking scope performance, as a variable trigger source for telemetering and pulse work, and checking audio, video and hi-fi amplifier response. Frequency response is ±1.5 db from 20 CPS to 1 MC on both sine and square waves, with less than .25% sine wave distortion, 20 to 20,000 CPS. Sine wave output impedance 600 ohms, square wave output impedance 50 ohms, (except on 10v ranges). Square wave rise time less than .15 usec. Five-position band switch—continuously variable tuning—shielded oscillator circuit—separate step and variable output attenuators in ranges of 10, 1, and .1 volts for both sine and square wave, with extra range of .01 volt on sine wave. Both sine and square wave can be used at the same time without affecting either wave form. Power supply uses silicon-diode rectifiers. Shpg. Wt. 12 lbs.

HEATHKIT AUDIO ANALYZER KIT
The AA-1 is actually three instruments in one compact package. It combines the functions of an AC VTVM, an audio wattmeter, and an intermodulation analyzer. Input and output terminals are combined, and high and low frequency oscillators are built in. VTVM ranges are 0-0.1, .03, .1, .3, 1, 3, 10, 30, 100 and 300 volts (RMS). Wattmeter ranges are .15 mw, 1.5 mw, 15 mw, 150 mw, 1.5 w, 15 w and 150 w. IM scales are 1%, 3%, 10%, 30% and 100%. Provides internal load resistors of 4, 8, 16 or 600 ohms. A tremendous dollar value. Shpg. Wt. 13 lbs.
HEATHKIT "GENERAL PURPOSE" S" OSCILLOSCOPE KIT
The model OM-2 Oscilloscope is especially popular with part-time service technicians, students, and high fidelity enthusiasts. It features good vertical frequency response ±3 db from 4 cps to over 1.2 mc. A full five-inch CRT, sweep generator operation from 20 cps to over 150 kc. Stability is excellent and calibrated grid screen allows precise signal observation. Extra features include external or internal sweep and sync, 1-volt peak-to-peak calibrating reference, 3 position step-attenuated input, adjustable spot shape control, push-pull horizontal and vertical amplifiers, and modern etched-metal circuits. Easy to build and a pleasure to use. Ideal for use with other audio equipment for checking amplifiers. Shpg. Wt. 21 lbs.

MODEL OM-2 $42.50

HEATHKIT AUDIO WATTMETER KIT
The AW-1 Audio Wattmeter can be used in any application where audio power output is to be measured. Non-inductive LOAD resistors are built in for 4, 8, 16 or 600 ohms impedance. Five power ranges cover 0.5 mw, 50 mw, 500 mw, 5 w, and 50 w full scale. Five switch-selected db ranges cover -10 db to +30 db. All indications are read directly on a large 4½" 200 microampere meter. Frequency response is ±1 db from 10 cps to 250 kc. Precision type multiplier resistors used for high accuracy, and crystal diode bridge for wide-range frequency response. This meter is used in many recording studios and broadcast stations as a monitor as well as servicing. A fine meter to help supply the answers to your audio operating or power output problems. Shpg. Wt. 6 lbs.

MODEL AW-1 $29.50

HEATHKIT AUDIO SIGNAL GENERATOR KIT
The model AG-9A is "made to order" for high fidelity applications, and provides quick and accurate selection of low-distortion signals throughout the audio range. Three rotary switches select two significant figures and a multiplier to determine audio frequency. Incorporates step-type and a continuously variable output attenuator. Output indicated on large 4½" panel meter, calibrated in volts and db. Attenuator system operates in 10 db steps, corresponding to meter calibration, in ranges of 0-003, 01-03, 1-3, 1.3 and 10 volts RMS. "Load" switch permits use of built-in 600-ohm load, or external load of different impedance. Output and frequency indicators accurate to within ±5%. Distortion less than 1% between 20 and 20,000 cps. Total range is 10 cps to 100 kc. Shpg. Wt. 8 lbs.

MODEL AG-9A $34.50

HEATHKIT HARMONIC DISTORTION METER KIT
All sounds consist of dominant tones plus harmonics (overtones). These harmonics enrich the quality and brightness of the music. However, additional harmonics which originate in the audio equipment, represent distortion. Used with an audio signal generator, the HD-1 will accurately measure this harmonic distortion at any or all frequencies between 20 and 20,000 cps. Distortion is read directly on the panel meter in ranges of G-1, 3, 10, 30 and 100% full scale. Voltage ranges of 0-1, 3, 10 and 30 volts are provided for the initial reference settings. Signal-to-noise ratio measurements are also permitted through the use of a separate meter scale calibrated in db. High quality components insure years of outstanding performance. Full instructions are provided. Shpg. Wt. 13 lbs.

MODEL HD-1 $49.50

Heathkits...
are well known for their high quality and reliability.

HEATHKIT AUDIO VTVM KIT
This new and improved AC Vacuum Tube Voltmeter is designed especially for audio measurements and low-level AC measurements in power supply filters, etc. Employs an entirely new circuit featuring a cascode amplifier with cathode-follower isolation between the input and the amplifier, and between the output stage and the preceding stages. It emphasizes stability, broad frequency response, and sensitivity. Frequency response is essentially flat from 10 cps to 200 kc. Input impedance is 1 megohm at 1000 cps. AC RMS voltage ranges are 0.01, .03, .1, .3, 1, 3, 10, 30, 100 and 300 volts. Db ranges cover -52 db to +52 db. Features large 4½" 200 microampere meter, with increased damping in meter circuit for stability in low frequency tests. 1% precision resistors employed for maximum accuracy. Stable, reliable performance in all applications. Shpg. Wt. 5 lbs.

MODEL AV-3 $29.50

70
HEATHKIT COLOR BAR AND DOT GENERATOR
The CD-1 combines the two basic color service instruments, a Color Bar Generator and White Dot Generator in one versatile portable unit, which has crystal-controlled accuracy and stability (no external sync lead required). Produces white-dots, cross hatch, horizontal and vertical bars, 10 vertical color bars, and a new shading bar pattern for screen and background adjustments. Variable RF output on any channel from 2 to 6. Positive or negative video output, variable from 0 to 10 volts peak-to-peak. Crystal controlled sound carrier with off-on switch. Voltage regulated power supply using long-life silicon rectifiers. Gain knowledge of a new and profitable field by constructing this kit. Shpg. Wt. 12 lbs. **MODEL CD-1** $59.95

**Heathkits...**
**by Daystrom**
are guaranteed to meet or exceed advertised specifications

HEATHKIT TV ALIGNMENT GENERATOR KIT
This fine TV alignment generator offers stability and flexibility difficult to obtain even in instruments costing several times this low Heathkit price. It covers 3.6 mc to 220 mc in four bands. Sweep deviation is controllable from 0 to 42 mc. The all-electronic sweep circuit insures stability. Crystal marker and variable marker oscillators are built in. Crystal (included with kit) provides output at 4.5 mc and multiples thereof. Variable marker provides output from 19 to 60 mc on fundamentals and from 57 to 180 mc on harmonics. Effective two-way blanking to eliminate return trace. Phasing control. Kit is complete, including three output cables. Shpg. Wt. 16 lbs. **MODEL TS-4A** $49.50

HEATHKIT "EXTRA DUTY" 5 OSCILLOSCOPE KIT
This fine oscilloscope compares favorably to other scopes costing twice its price. It contains the extra performance so necessary for monochrome and color-TV servicing. Features push-pull horizontal and vertical output amplifiers, a SUPU CRT, built in peak-to-peak calibration source, a fully compensated 3-position step-type input attenuator, retrace blanking, phasing control, and provision for Z-axis modulation. Vertical amplifier frequency response is within +1.5 and -5 db from 3 CPS to 5 MC. Response at 3.58 MC down only 2.2 db. Sensitivity is 0.025 volts RMS/inch at 1 kc. Sweep generator covers 20 CPS to 500 kc in five steps, five times the usual sweep obtained in other scopes through the use of the patented Heath sweep circuit. Etched-metal circuit boards reduce assembly time and minimize errors in assembly, and more importantly, permit a level of circuit stability never before achieved in an oscilloscope of this type. Shpg. Wt. 21 lbs. **MODEL 0-11** $69.50

HEATHKIT ELECTRONIC SWITCH KIT
A valuable accessory for any oscilloscope owner. It allows simultaneous oscilloscope observation of two signals by producing both signals, alternately, at its output. Four switching rates. Provides gain for input signals. Frequency response ±1 db, 0 to 100 kc. A sync output is provided to control and stabilize scope sweep. Ideal for observing input and output of amplifiers simultaneously. Shpg. Wt. 8 lbs. **MODEL S-3** $21.95

HEATHKIT VOLTAGE CALIBRATOR KIT
This unit is an excellent companion for your oscilloscope. Used as a source of calibrating voltage, it produces near-perfect square wave signals of known amplitude. Precision 1% attenuator resistors insure accurate output amplitude, and multivibrator circuit guarantees good sharp square waves. Output frequency is approximately 1000 CPS. Fixed outputs selected by panel switches are; .03, .1, .3, 1.0, 3.0, 10, 30 and 100 volts peak-to-peak. Allows measurement of unknown signal amplitude by comparing it to the known output of the VC-3 on oscilloscope. Shpg. Wt. 4 lbs. **MODEL VC-3** $12.50

**Functional styling with clean uncluttered look**

COLOR BAR AND DOT GENERATOR

"EXTRA DUTY" SCOPE

TV ALIGNMENT GENERATOR

VOLTAGE CALIBRATOR

ELECTRONIC SWITCH

HEATH COMPANY A Subsidiary of Daystrom, Inc. BENTON HARBOR 20, MICH. OCTOBER, 1957
HEATHKIT TUBE CHECKER KIT
Eliminate guesswork, and save time in servicing or experimenting. The TC-2 tests tubes for shorted elements, open elements, filament continuity, and operating quality on the basis of total emission. It tests all tube types encountered in radio and TV service work. Sockets are provided for 4, 5, 6 and 7-pin, octal, and locotubes, 7 and 9 pin miniature tubes, 5 pin hytron miniatures, and pilot lamps. Tube condition indicated on 4½" meter with multi-color "good-bad" scale. Illuminated roll chart with all test data built in. Switch selection of 14 different filament voltages from .75 to 117 volts. Color-coded cable harness allows neat professional wiring and simplifies construction. Very easy to build, even for a beginner. Shpg. Wt. 12 lbs.

MODEL TC-2
$29.50

HEATHKIT HANDITESTER KIT
The small size and rugged construction of this tester makes it perfect for any portable application. The combination function-range switch simplifies operations. Measures AC or DC voltage at 0-10, 30, 300, 1000 and 5000 volts. Direct current ranges are 0-10 ma and 0-100 ma. Ohmmeter ranges are 0-3000 (30 ohm center scale) and 0-300,000 (3000 ohm center scale). Very popular with home experimenters, electricians, and appliance repairmen. Stips easily into your tool box, glove compartment, coat pocket, or desk drawer. Shpg. Wt. 3 lbs.

MODEL M-1
$14.50

HEATHKIT PICTURE TUBE CHECKER KIT
The CC-1 can be taken with you on service calls so that you can clearly demonstrate the quality of a customer's picture tube in his own home. Tubes can be tested without removing them from the receiver or cartons if desired. Checks cathode emission, beam current, shorted elements, and leakage between elements in electromagnetic picture tube types. Self-contained power supply, and large 4½" meter. CRT condition indicated on "good-bad" scale. Relative condition of tubes fluorescent coating is shown in "shadowgraph" test. Permanent test cable with CRT socket and anode connector. No tests to burn out, designed to last a lifetime. Luggage-type portable case. Shpg. Wt. 10 lbs.

MODEL CC-1
$22.50

HEATHKIT ETCHED-CIRCUIT VTVM KIT
This multi-purpose VTVM is the world's largest selling instrument of its type—and is especially popular in laboratories, service shops, home workshops and schools. It employs a large 4½" panel meter, precision 1½% resistors, etched metal circuit board, and many other "extras" to insure top quality and top performance. It's easy to build, and you may rely on its accuracy and dependability. The V7-A will measure AC (RMS) and DC voltages in ranges of 0-1.5, 5, 15, 50, 150, 500 and 1500. It measures peak-to-peak AC voltage in ranges of 0-4, 14, 40, 140, 400, 1400 and 4000. Resistance ranges provide multiplying factors of X 1, X 10, X 100, X 1000, X 10k, X 100k, and X 1 megohm. Center-scale resistance readings are 10, 100, 1000, 10k, 100k, 1 megohm and 10 megohms. A db scale is also provided. The precision and quality of this VTVM cannot be duplicated at this price. Shpg. Wt. 7 lbs.

MODEL V7-A
$24.50

Heathkits...
by daystrom
let you fill your exact needs from a wide variety of instruments

HEATHKIT 20,000 OHMS/VOLT VOM KIT
This fine instrument provides a total of 25 meter ranges on its two-color scale. It employs a 50 ua 4½" meter, and features 1½% precision multiplier resistors. Requires no external power. Ideal for portable applications. Sensitivity is 20,000 ohms-per-volt DC and 5000 ohms-per-volt AC. Measuring ranges are 0-1.5, 5, 50, 150, 500, 1500 and 5000 volts, AC and DC. Measures direct current in ranges of 0-1500 ua, 15 ma, 150 ma, 500 ma and 15 a. Resistance multipliers are X 1, X 10 and X 10,000, with center-scale readings of 15, 1500 and 150,000 ohms. Covers -10 db to +65 db. Easy to build and fun to use. Attractive bakelite case with plastic carrying handle. Shpg. Wt. 8 lbs.

MODEL MM-1
$29.50

High quality test gear you will be proud to own

TUBE CHECKER

Priced low to fit your budget

HANDITESTER

PICTURE TUBE CHECKER

ETCHED CIRCUIT VTVM

20,000 OHMS/VOLT VOM

www.americanradiohistory.com
HEATHKIT RF SIGNAL GENERATOR KIT
Even a beginner can build this prealigned signal generator, designed especially for use in service work. Produces RF signals from 160 kc to 110 mc on fundamentals in five bands. Covers 110 mc to 220 mc on calibrated harmonics. Low impedance RF output in excess of 100,000 microvolts, is controllable with a step-type and continuously variable attenuator. Selection of unmodulated RF, modulated RF, or audio at 400 CPS. Ideal for fast and easy alignment of radio receivers, and finds application in FM and TV work as well. Thousands of these units are in use in service shops all over the country. Easy to build and a real time saver, even for the part-time service technician or hobbyist. Shpg. Wt. 8 lbs.

$19.50

HEATHKIT LABORATORY RF GENERATOR KIT
Tackle all kinds of laboratory alignment jobs with confidence by employing the LG-1. It features voltage-regulated B+, double shielding of oscillator circuits, copper-plated chassis, variable modulation level, metered output, and many other "extras" for critical alignment work. Generates RF signals from 100 kc to 30 mc on fundamentals in five bands. Meter reads RF output in microvolts or modulation level in percentage. RF output available up to 100,000 microvolts, controlled by a fixed-step and a variable attenuator. Provision for external modulation where necessary. Buy and use this high-quality RF signal generator that may be depended upon for stability and accuracy. Shpg. Wt. 16 lbs.

$48.95

HEATHKIT DIRECT-READING CAPACITY METER KIT
Here's a fast, simple capacity meter. A capacitor to be checked is merely connected to the terminals, the proper range selected, and the value read directly on the large 4½" panel meter calibrated in mmf and mfd. Ranges are 0 to 10 mmf, 1,000 mmf, .01 mfd, .1 mfd full scale. Not affected by hand capacity. Shpg. Wt. 7 lbs.

$29.50

HEATHKIT MICROVOLT SIGNAL TRACER KIT
This handy instrument uses an electron beam "eye" tube as an indicator to measure capacity in ranges of .00001 to .005 mfd, .5 mfd, 50 mfd and 1000 mfd. Also measures resistance from 100 ohms to 5 megohms in five ranges. Checks paper, mica, ceramic and electrolytic capacitors. Selection of five polarizing voltages. Shpg. Wt. 7 lbs.

$19.50

HEATHKIT IN-CIRCUIT CAPACITOR CHECKER KIT
With the CT-1 it is no longer necessary to disconnect one capacitor lead to check the part, you can check most capacitors for "open" or "short" right in the circuit. Fast and easy—save your valuable time in the service shop or lab. Detects open capacitors from about 50 mmf up, or shorted capacitors from about 50 mmf up, so long as the capacitor is not shunted by excessively low resistance value. Will detect shorts or capacitors up to 20 mfd (not shunted by less than 10 ohms). (Does not detect leakage.) Employs 60 cycles and 19 megacycle test frequencies. Electron beam "eye" tube used as indicator. Compact, easy-to-build, and inexpensive. Test leads included. Shpg. Wt. 5 lbs.

$7.75

HEATHKIT VISUAL-AURAL SIGNAL TRACER KIT
Although designed originally for radio receiver work, the T-3 finds application in FM and TV servicing as well. Features high-gain channel with demodulator probe, and low-gain channel with audio probe. Traces signals in all sections of radio receivers and in many sections of FM and TV receivers. Built-in speaker and electron beam eye tube indicate relative gain, etc. Also features built-in noise locator circuit. Provision for patching speaker and/or output transformer to external set. Shpg. Wt. 9 lbs.

$23.50
HEATHKIT IMPEDANCE BRIDGE KIT

The model IB-2A employs a Wheatstone Bridge, a Capacity Comparison Bridge, a Maxwell Bridge, and a Hay Bridge in one compact package. Measures resistance from 0.1 ohm to 10 megohms, capacitance from 100 mmf to 100 mfd, inductance from 0.1 mh to 100 h, dissipation factor (D) from 0.002 to 1, and storage factor (Q) from 0.1 to 1000. A 100-0-100 ua meter provides for null indications. The decade resistors employed are of 1% tolerance for maximum accuracy. Completely self-contained. Has built in power supply, 1000-cycle generator, and vacuum-tube detector. Special two-section filter circuit functions to eliminate hum and ripple. Instruction manual has entirely new schematic that clarifies circuit functions in various switch positions. A true laboratory instrument, that will provide you with many years of fine performance. Shpg. Wt. 12 lbs.

$59.50

MODEL IB-2A

HEATHKIT "LOW RIPPLE" BATTERY ELIMINATOR KIT

This modern battery eliminator incorporates an extra low-ripple filter circuit so that it can be used to power all the newest transistor-type circuits requiring 0 to 12 volts DC, and the new "hybrid" automobile radios using both transistors and vacuum tubes. Its DC output, at either 6 or 12 volts, contains less than 3% AC ripple. Separate output terminals are provided for low-ripple or normal filtering. Supplies up to 15 amps on 6 volt range or up to 7 amps on 12 volt range. Output is variable from 0 to 8 or 0 to 16 volts. Two meters constantly monitor output voltage and current. Will also double as a battery charger. Shpg. Wt. 23 lbs.

MODEL BE-5

$39.95

HEATHKIT ISOLATION TRANSFORMER KIT

The model IT-1 is one of the handiest units for the service shop, home workshop or laboratory. Provides complete isolation from the power line. AC-DC sets may be plugged directly into the IT-1 without the chassis becoming "hot". Output voltage is variable from 90 volts to 130 volts allowing checks of equipment under adverse conditions such as low line voltage. Rated for 100 volt amperes continuously or 200 volt amperes intermittently. Panel meter monitors output voltage. Shpg. Wt. 9 lbs.

MODEL IT-1

$16.50

HEATHKITS... are designed with high-quality, name-brand components to insure long service life

HEATHKIT "Q" METER KIT

At this price the laboratory facilities of a Q Meter may be had by the average service technician or home experimenter. The Q Meter permits measurement of inductance from 1 microhenry to 10 millihenry, "Q", on a scale calibrated up to 250 full scale, with multipliers of 1 or 2, and capacitance from 40 mmf to 450 mmf = 3 mmf. Built in oscillator permits testing components from 150 kc to 18 mc. Large 4½" panel meter is featured. Very handy for checking peaking coils, chokes, etc. Use to determine values of unknown condensers, both variable and fixed, compute data for coil winding purposes, or measure RF resistance. Also checks distributed capacity and Q of coils. No special equipment is required for calibration. A special test coil is furnished, along with easy-to-follow instructions. Shpg. Wt. 14 lbs.

MODEL QM-1

$44.50

HEATHKIT REGULATED POWER SUPPLY KIT

Here is a power supply that will provide DC plate voltage and AC filament voltage for all kinds of experimental circuits. The DC supply is regulated for stability, and yet the amount of DC output voltage available from the power supply can be controlled manually from 0 up to 500 volts. At 450 volts DC output, the power supply will provide up to 10 ma of current, and provide progressively higher current as the output voltage is lowered. Current rating is 130 ma at 200 volts output. In addition to furnishing B+ the power supply also provides 6.3 volts AC at up to 4 amperes for filament. Both the B+ output and the filament output are isolated from ground. Ideal unit for use in laboratory, home workshop, ham shack, or service shop. A large 4½" meter on the front panel reads output voltage or output current, selectable with a panel switch. Shpg. Wt. 17 lbs.

MODEL PS-3

$35.50
HEATHKIT DX-20 CW TRANSMITTER KIT
The Heathkit model DX-20 "straight-CW" transmitter features high efficiency at low cost. It uses a single 6Q6A tube in the final amplifier stage for plate power input of 50 watts. A 6CL6 serves as crystal oscillator, with a SU4GB rectifier. It is an ideal transmitter for the novice, as well as the advanced-class CW operator. Single-knob band switching is featured to cover 80, 40, 20, 15, 11 and 10 meters. Pi network output circuit matches various antenna impedances between 50 and 1000 ohms and reduces harmonic output. Top-quality parts are featured throughout, including "potted" transformers, etc., for long life. It has been given full "TVI" treatment. Access into the cabinet for crystal changing is provided by a removable metal pull-out plug on the left end of the cabinet. Very easy to build from the complete step-by-step instructions supplied, even if you have never built electronic equipment before. If you appreciate a good, clean signal on the CW bands, this is the transmitter for you! Shpg. Wt. 18 lbs.

HEATHKIT DX-35 PHONE AND CW TRANSMITTER KIT
The DX-35 transmitter can be thought of as the "little brother" of the DX-100. It features both phone and CW operation on 80, 40, 20, 15, 11 and 10 meters. A single 6146 tube is used in the final amplifier stage to provide full 65 watt plate power input on CW, or controlled carrier modulation peaks up to 50 watts for phone operation. Modulator and power supplies are built right in and single knob band switching is combined with a pi network output circuit for complete operating convenience. The tight fitting cabinet presents a most attractive appearance, and is designed for complete shielding to minimize TVI. Back panel control provides convenient switch selection of three different crystals, reached through access door at rear of cabinet. A most remarkable power package for the price. Complete step-by-step instructions with pictorial diagrams to assure your success in assembly. Shpg. Wt. 24 lbs.

HEATHKIT DX-100 PHONE AND CW TRANSMITTER KIT
Listen to any ham band between 160 meters and 10 meters and note how many DX-100 transmitters you hear! The number of these fine rigs now on the air testifies to the enthusiasm with which it has been accepted by the amateur fraternity. No other transmitter in this power class combines high quality and real economy so effectively. The DX-100 features a built in VFO, modulator and power supplies, complete shielding to minimize TVI, and pi network output coupling to match impedances from approximately 50 to 600 ohms. Its RF output is in excess of 100 watts on phone and 120 watts on CW, for a clean strong signal on all the ham bands from 10 to 160 meters. Single-knob band switching and illuminated VFO dial and meter face add real operating convenience. RF output stage uses a pair of 6146 tubes in parallel, modulated by a pair of 1625's. High quality components are used throughout, such as "potted" transformers, silver-plated or solid coin silver switch terminals, aluminum heat-dissipating caps on the final tubes, copper plated chassis, etc. This transmitter was designed exclusively for easy step-by-step assembly. Shpg. Wt. 107 lbs.

Heathkits... by Daystrom are designed by licensed ham-engineers, especially for you

HEATH COMPANY A Subsidiary of Daystrom, Inc. BENTON HARBOR 20, MICH. OCTOBER, 1957

FUNCTIONAL DESIGN...
The transmitters described on this page were designed for the ham, by hams who know what features are desirable and needed. This assures you of the best possible performance and convenience, and adds much to your enjoyment in the ham shack.
Automatically turns off transmitter and gives visual signal.

HEATHKIT "AUTOMATIC" CONELRAD ALARM KIT
This conelrad alarm works with any radio receiver; AC-DC transformer operated—or battery powered, so long as the receiver has AVC. Fully complies with FCC regulations for amateurs. When the monitored station goes off the air, the CA-1 automatically cuts the AC power to your transmitter, and lights a red indicator. A manual "reset" button reactivates the transmitter. Incorporates a heavy-duty six-ampere relay, a thyratron tube to activate the relay, and its own built-in power supply. A neon lamp shows that the alarm is working, by indicating the presence of B+ in the alarm circuit. Simple to install and connect. Your transmitter plugs into an AC receptacle on the CA-1, and a cable connects to the AVC circuit of a nearby receiver. A built-in sensitivity control allows adjustment to various AVC levels. Receiver volume control can be turned up or down, without affecting alarm operation. Build a Heathkit CA-1 in one evening and comply with FCC regulations now! Shpg. Wt. 4 lbs.

HEATHKIT "Q" MULTIPLIER KIT
The Heathkit Q Multiplier functions with any AM receiver having an IF frequency between 450 and 460 KC, that is not "AC-DC" type. It derives its power from the receiver, and needs only 6.3 volts AC at 300 ma (or 12 VAC at 150 ma) and 150 to 250 volts DC at 2 ma. Simple to connect with cable and plugs supplied. Adds additional selectivity for separating signals, or will reject one signal and eliminate heterodyne. A tremendous help on crowded phone and CW bands. Effective Q of 4000 for sharp "peak" or "null". Tunes any signal within IF band pass without changing the main receiver tuning dial. A convenient tuning knob on the front panel with vernier reduction between the tuning knob and the tuning capacitor gives added flexibility in operation. Uses a 12AX7 tube, and special high-Q shielded coils. Instructions for connecting to the receiver and operation are provided in the construction manual. A worthwhile addition to any communications, or broadcast receiver. It may also be used with a receiver which already has a crystal filter to obtain two simultaneous functions, such as peaking the desired signal with the crystal filter and nulling an adjacent signal with the Q Multiplier. Shpg. Wt. 3 lbs.

HEATHKIT GRID DIP METER KIT
A grid dip meter is basically an RF oscillator for determining the frequency of other oscillators, or of tuned circuits. Extremely useful in locating parasitics, neutralizing, identifying harmonics, coil winding, etc. Features continuous frequency coverage from 2 mc to 250 mc, with a complete set of prewound coils, and a 500 ua panel meter. Front panel has a sensitivity control for the meter, and a phone jack for listening to the "zero-beat." Will also double as an absorption-type wave meter. Shpg. Wt. 4 lbs.

Low Frequency Coil Kit: Two extra plug-in coils to extend frequency coverage down to 350 kc. Shpg. Wt. 1 lb. No. 341-A. $3.00

HEATHKIT ALL-BAND COMMUNICATIONS-TYPE RECEIVER KIT
This communications-receiver covers 550 kc to 30 mc in four bands, and provides good sensitivity, selectivity, and fine image rejection. Ham bands are clearly marked on an illuminated dial scale. Features a transformer-type power supply—electrical band spread—antenna trimmer—headphone jack—automatic gain control and beat frequency oscillator. Accessory sockets are provided on the rear of the chassis for using the Heathkit model QF-1, Q Multiplier. Accessory socket is handy, also, for operating other devices that require plate and filament potentials. Will supply +250 VDC at 15 ma and 12.6 VAC at 300 ma. Ideal for the beginning ham or short wave listener. Shpg. Wt. 12 lbs.

Cabinet: Fabric covered cabinet with aluminum panel as shown. Part no. 91-15A. Shpg. Wt. 5 lbs. $4.95.

Heathkits...

are outstanding in performance and dollar value.
HEATHKIT REFLECTED POWER METER KIT
The Heathkit reflected power meter, model AM-2, makes an excellent instrument for checking the match of the antenna transmission system, by measuring the forward and reflected power or standing wave ratio. The AM-2 is designed to handle a peak power of well over 1 kilowatt of energy and may be left in the antenna system feed line at all times. Band coverage is 160 meters through 2 meters. Input and output impedances are for 50 or 75 ohm lines. No external power is required for operation. Meter indicates percentage forward and reflected power, and standing wave ratio from 1:1 to 6:1. Power losses between transmitter output and antenna tuner may be very easily computed by inserting the AM-2 in the line connecting the two. No insertion loss is introduced into the feeder system, due to the fact that the AM-2 is a portion of coaxial line in series with the feeder system and no internal connections are actually made to the line. Complete circuit description and operation instructions are provided in the manual. Cabinet size is 7 3/8" x 4 1/16" x 4 1/8". Can be conveniently located at operating position. Shpg. Wt. 3 lbs.

MODEL AM-2
$15.95

HEATHKIT BALUN COIL KIT
The Heathkit Balun Coil Kit, model B-1, is a convenient transmitter accessory, which has the capability of matching unbalanced coax lines, used on most modern transmitters, to balance lines of either 75 or 300 ohm impedance. Design of the bifilar wound balun coils will enable transmitters with unbalanced output to operate into balanced transmission line, such as used with dipoles, folded dipoles, or any balanced antenna system. The balun coil set can be used with transmitters and receivers without adjustment over the frequency range of 60 through 10 meters and will easily handle power inputs up to 250 watts. Cabinet size is 9" square by 5" deep and may be located any distance from the transmitter or from the antenna. Completely enclosed for outdoor installation. Shpg. Wt. 4 lbs.

MODEL B-1
$8.95

HEATHKIT 6 OR 12 VOLT VIBRATOR POWER SUPPLY KITS
These little power supply kits are ideal for all portable applications with 6 volt or 12 volt batteries, when you are operating electronic equipment away from power lines. By replacing the power supplies of receivers, small public address systems, or even miniature transmitters with these units, they can be used with conventional 6 or 12 volt batteries. Use in boats, automobiles, light aircraft, or any field application. Each unit provides 200 volts DC output at up to 60 milliamperes. More than one power supply of the same model may be connected in parallel for increased current capacity at the same output voltage. Everything is provided in the kit, including a vibrator transformer, a vibrator, 6X4 or 12X4 rectifier, and the necessary buffer capacitor, hash filter, and output filter capacitor. Shpg. Wt. 4 lbs.

6 VOLT
MODEL VF-1-6
$7.95

12 VOLT
MODEL VF-1-12
$7.95

HEATHKIT VARIABLE FREQUENCY OSCILLATOR KIT
Enjoy the convenience and flexibility of VFO operation by obtaining the Heathkit model VF-1 Variable Frequency Oscillator. Covers 160-50-40-30-15-11 and 10 meters with three basic oscillator frequencies. Better than 10 volt average RF output on fundamentals. Plenty of output to drive most modern transmitters. It features voltage regulation for frequency stability. Dial is illuminated for easy reading. Vernier reduction is used between the main tuning knob and the tuning condenser. Requires a power source of only 250 volts DC at 15 to 20 milliamperes and 6.3 volts AC at 0.45 amperes. Extra features include copper-plated chassis, ceramic coil forms, extensive shielding, etc. High quality parts throughout. VFO operation allows you to move out from under interference and select a portion of the band you want to use without having to be tied down to only two or three frequencies through use of crystals. "Zero in" on any fellow's signal and return his QSO on your own frequency! Crystals are not cheap, and it takes quite a number of them to give anything even approaching comprehensive coverage of all bands. Why hesitate? The model VF-1 with its low price and high quality will add more operating enjoyment to your ham activities. Shpg. Wt. 7 lbs.

MODEL VF-1
$19.00
HEATHKIT ELECTRONIC IGNITION ANALYZER KIT

Previous electronic experience is not necessary to build this fine ignition analyzer. The construction manual supplied has complete step-by-step instructions plus large pictorial diagrams showing the exact placement and value of each component. All parts are clearly marked so that they are easily identified. The IA-1 is an ideal tool for engine mechanics, tune-up men, and auto hobbyists, since it traces the dynamic action of voltage in an ignition system on a cathode-ray tube screen. The waveform produced is affected by the condition of the coil, condenser, points, plugs, and ignition wiring, so it can be analyzed, and used as a "sign-post" to ignition system performance. This analyzer will detect inequality of spark intensity, a poor spark plug, defective plug wiring, breaker-point bounce, an open condenser, and allow setting of dwell-time percentage for the points. An important feature of this instrument is its ability to check dynamic performance, with the engine in operation (400 to 5000 RPM). It will show the complete engine cycle, or only one complete cylinder. Can be used on all types of internal combustion engines where breaker-points are accessible. Use it on automobiles, boats, aircraft engines, etc. Shpg. Wt. 18 lbs.

MODEL IA-1

$59.95

HEATHKIT PROFESSIONAL RADIATION COUNTER KIT

This Heathkit professional-type radiation counter is simple to build successfully, even if you have never built a kit before. Complete step-by-step instructions are combined with giant-size pictorial diagrams for easy assembly. By "building it yourself" you obtain the modern-design, professional radiation counter priced far below comparable units. Provides high sensitivity with ranges from 0-100, 600, 6000 and 60,000 counts-per-minute, and 0-0.2, 1, 1 and 10 miliroentgens-per-hour. Employs 900-volt bismuth tube in beta/gamma sensitive probe. Probe and 8-foot expandable cable included in kit price, as is a radiation sample for calibration. Use it in medical laboratories, or as a prospecting tool, and for civil defense to detect radioactive fallout, or other unknown radiation levels. Features a selectable time constant. Meter calibrated in CPM or mR/hour in addition to "beep" or "click" from panel-mounted speaker. Prebuilt "packaged" high voltage power supply with reserve capacity above 900 volt level at which it is regulated. Merely changing regulator tube type would allow use of scintillation probe if desired. Employs five tubes (plus a transistor) to insure stable and reliable operation. Kit price includes batteries. Shpg. Wt. 8 lbs.

MODEL RC-1

$79.95

HEATHKITS...

are supplied with comprehensive instructions that eliminate costly mistakes and save valuable time

HEATHKIT ENLARGER TIMER KIT

The ET-1 is an easy-to-build electronic device to be used by amateur or professional photographers in timing enlarger operations. The calibrated dial on the timer covers 0 to 1 minute, calibrated in 5-second gradations. The continuously variable control allows setting of the "on" cycle of your enlarger, which is plugged into a receptacle on the front panel of the ET-1. A "safe light" can also be plugged in so that it is automatically turned "on" when the enlarger is turned "off." Handles up to 350 watts with built-in relay. All-electronic timing cycle insures maximum accuracy. Timer does not have to be reset after each cycle, merely flip lever switch to print, to repeat time cycle. A control is provided for initial calibration. Housed in a compact plastic case that will resist attack of photographic chemicals. A fine addition to any dark room. Shpg. Wt. 3 lbs.

MODEL ET-1

$115.00

HEATHKIT BATTERY TESTER KIT

The BT-1 is a special battery testing device that actually "loads" the battery under test (draws current from it) while it is being tested. Weak batteries often test "good" with an ordinary voltmeter but the built-in load resistance of the BT-1 automatically draws enough current from the battery to reveal its true condition. Simple to operate with "good-wake-replace" scale. Tests all kinds of dry cell batteries within ranges of 0-15 volts and 0-180 volts. Slide switch provides for either 10 ma or 100 ma load, depending on whether you're testing an A or B battery. Not only determines when battery is completely exhausted, but makes it possible to anticipate failure by noting weak condition. Ideal for testing dry cell hearing aid, flashlight, portable radio, and model airplane batteries. Test batteries in a way your customers can understand and stimulate battery sales. Shpg. Wt. 2 lbs.

MODEL BT-1

$8.50

RADIO-ELECTRONICS
HEATHKIT CRYSTAL RADIO KIT

The Heathkit model CR-1 crystal radio is similar to the "crystal sets" of the early radio days except that it has been improved by the use of sealed germanium diodes and efficient "high-Q" coils. The sealed diodes eliminate the critical "cats whisker" adjustment, and the ferrite coils are much more efficient for greater signal strength. Housed in a compact plastic box, the CR-1 uses two tuned circuits, each with a variable tuning capacitor, to select the local station. It covers the broadcast band from 540 to 1600 kc. Requires no external power whatsoever. This receiver could prove valuable to emergency reception of civil defense signals should there be a power failure. The low kit price even includes headphones. Complete step-by-step instructions and large pictorial diagrams are supplied for easy assembly. The instruction manual also provides the builder with the basic fundamentals of signal reception so that he understands how the crystal receiver functions. An interesting and valuable "do-it-yourself" project for all ages.

Shpg. Wt. 3 lbs.

HEATHKIT BROADCAST BAND RADIO KIT

This table-model broadcast radio is fun to build, and is a fine little receiver for your home. It covers the standard broadcast band from 550 to 1600 kc with good sensitivity and selectivity. The 5W PM speaker provides surprisingly good tone quality. High-gain IF transformers, miniature tubes, and a rod-type built-in antenna, assure good reception in all locations. The power supply is transformer operated, as opposed to many of the economy "AC-DC" types. It’s easy to build from the step-by-step instructions, and the construction manual includes information on operational theory, for educational purposes. Your success is assured by completely detailed information which also explains resistor and capacitor color codes, soldering techniques, use of tools, etc. A signal generator is recommended for final alignment. Shpg. Wt. 10 lbs.

Cabinet: Fabric covered cabinet with aluminum panel as shown. Shpg. Wt. 5 lbs.
Part no. 91-9A, $4.95.

HEATHKIT TRANSISTOR PORTABLE RADIO KIT

Heath engineers set out to develop a "universal" AM radio, suitable for use anywhere. Their objective was a portable that would be as much "at home" inside as it is outside, and would feature top quality components for high performance and long service life. The model XR-1 is the result of these efforts. Six name-brand (Texas Instrument) transistors were selected for extra good sensitivity and selectivity. A 4" by 6" PM speaker with heavy magnet was chosen to insure fine tone quality. The power supply was designed to use six standard size "D" flashlight cells because they are readily available, inexpensive, and because they afford extremely long battery life (between 500 and 1000 hours). Costs you no more to operate from batteries than what you pay for operating a small table-model radio from the power line. An unbreakable molded plastic was selected for cabinet material because of its durability and striking beauty. Circuit is compact and efficient, yet components are not excessively crowded. Transformers are prealigned so it is ready for service as soon as construction is completed. Has built in rod-type antenna for reception in all locations. Cabinet dimensions are 9" L x 8" H x 3½" D. Comes in holiday gray, with gold-anodized metal speaker grille. Compare this portable, feature by feature, to all others on the market, and you'll appreciate what a tremendous dollar value it represents!

Shpg. Wt. 4 lbs.

HEATHKIT....

BY DAYSTROM
are easy and fun to build, and they let you learn by "doing-it-yourself"

HEATH COMPANY A Subsidiary of Daystrom, Inc. BENTON HARBOR 20, MICH.

OCTOBER, 1957
protects against possible explosion and fire from undetected fuel vapor

HEATHKIT FUEL VAPOR DETECTOR KIT

Protect your boat and its passengers against fire or explosion from undetected fuel vapor by building and using one of these fine units. The Heathkit Fuel Vapor Detector protects the extent owner installation acid batteries, regardless of H x t tells the or decks radio stations where it in from your boat batteries. The kit (6 simple and ables when the to one of nate the has been The HEATHKIT every 2" switch has been designed especially for the boat owner, having previous experience. Models Features indicates the presence of fumes on explosion and boat and its passengers. Dimensions now offer you completely modern marine equipment with outstanding design features

HEATHKIT BATTERY CHARGE INDICATOR KIT

The Heathkit model CI-1 Marine Battery Charge Indicator has been designed especially for the boat owner, although it has found use in service stations, power stations, and radio stations where banks of batteries are kept in reserve for emergency power. It is intended to replace the hydrometer method of checking storage batteries, and to eliminate the necessary for working with acid in small, below-decks enclosures. Now it is possible to check as few as one, or as many as eight storage batteries, merely by turning the switch and watching the meter. A glance at the meter tells you instantly whether your batteries are sufficiently charged for safe cruising. Dimensions are 2-7/8" x 5-11/16" H x 2" D. Operates on either 6 or 12 volt systems using lead-acid batteries, regardless of size. Simple installation can be accomplished by the boat owner in fifteen minutes. Shpg. Wt. 3 lbs.

HEATHKIT ELECTROLYSIS DETECTOR KIT

The Heathkit model ED-1 Electrolysis Detector indicates the extent of electrolysis currents between the boat's common ground and underwater fittings, except on boats having metal hulls. These currents, undetected, could cause gradual corrosion and deterioration of the propeller or other metal fittings below the water line. It is particularly helpful when installing electrical equipment of any kind, to determine proper polarity when power is obtained from a shore supply. Easy-to-build, the model ED-1 consists of a hermetically-sealed, waterproof meter, special sensing plate, and sufficient wire to install, including the necessary hardware. Mounts on instrument panel where it can be easily seen. Requires no power for operation, and gives instant warning to guard your boat for a lifetime. Shpg. Wt. 2 lbs.
HEATHKIT TRANSISTOR
RADIO DIRECTION FINDER KIT

The Heathkit Transistor Radio Direction Finder model DF-1 is a self-contained, self-powered, 6-transistor super heterodyne broadcast radio receiver incorporating a directional loop antenna, indicating meter, and integral speaker. It is designed to serve primarily as an aid to navigation when out of sight of familiar landmarks. It can be used not only aboard yachts, fishing craft, tugs, and other vessels which navigate either out of sight of land or at night, but also for the hunter, hiker, camper, fisherman, aviator, etc. It is powered by a 9 volt battery. (A spare battery is also included with the kit). The frequency range covers the broadcast band from 540 to 1600 kc and will double as a portable radio. A directional high-Q (fig) antenna is incorporated which is rotated from the front panel to obtain a fix on a station and a 1 ma meter serves as the null and tuning indicator. The controls consist of: tuning, volume and power (on-off), sensitivity, heading indicator (compass rose) and bearing indicator (antenna index). Overall dimensions are 7½” W x 5½” H x 5½” D. Supplied with slip-in-place mounting brackets, which allow easy removal from ship bulkheads or other similar places. Shpg. Wt. 5 lbs.

**How Can You Miss?**

The Heath Company maintains a technical consultation service, should you experience some sort of difficulty in construction or operation. Although only very a small percentage of our customers ever have occasion to use this service (usually only beginners in electronics) it is still reassuring to know that technical help is available when needed. A service department is also available, should you wish a complete factory check of operation and alignment or repair. After you build your first Heathkit you'll realize how easy it is.

**Free Catalog**

Send for this informative booklet listing more than 100 "do-it-yourself" kits.

---

**Order Blank**

**Note:** All prices subject to change without notice.

Enclosed find ( ) check ( ) money order for ( )

Please ship C.O.D. ( ) postage enclosed for ( ) pounds.

On Express orders do not include transportation charges—they will be collected by the express agency at time of delivery.

On Parcel POST orders include postage for weight shown. ORDERS FROM APO'S must include full remittance. All prices F.O.B. Benton Harbor, Mich.

![Image of Heathkit Transistor Radio Direction Finder](https://example.com/heathkit-transistor-radio-direction-finder-image.png)

<table>
<thead>
<tr>
<th>QUANTITY</th>
<th>ITEM</th>
<th>MODEL NO.</th>
<th>PRICE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Available after November 15**

**Send Free Heathkit Catalog**

---

OCTOBER, 1957
Once in a great while an idea comes along which is so simple and practical, that it becomes an outstanding contribution to the field of radio control. Such an idea is the brainchild of Lt. Col. William Sydor, which allows anyone who has a single-channel receiver to make a simple addition and get two control channels.

If a standard single-channel receiver secondary relays (Price 100-ohm type shunted by a 100-mf 15-volt electrolytic capacitor) as illustrated in Fig. 1, two control channels are available when the proper code is transmitted. Note that if the receiver relay (Ry1) armature is caused to vibrate so that the time it is away from, say, contact X is less than the time it takes capacitor C1 to discharge through the windings of Ry2, that relay will be actuated and remain so as shown. The same reasoning applies to relay Ry3. This vibratory action of the armature then must be in the vicinity of 25 to 30 cycles. When this pulse rate is transmitted, control relays Ry2 and Ry3 are actuated and open the control circuits. Now, we must be able to close (de-energize) either relay as desired if the control circuit is to be operated at will.

If the pulse rate becomes a continuous carrier or tone, the receiver relay does not vibrate. It is energized and the armature makes contact with Y, staying there as long as the signal is transmitted. This causes Ry3 to remain energized, holding its control circuit open, but allows Ry2 to de-energize and close its circuit. The reverse is also true: if the signal is cut off, the receiver relay armature remains on contact X, holding Ry2's circuit open and allowing Ry3 to close its control circuit. The code then consists of a fast pulse rate for no control, full signal for channel 1 and no signal for channel 2.

The coder

The coder is as simple as the decoder. It consists of a relay connected to form a buzzer. If the relay is similar to the one used in the receiver, the receiver relay will be able to follow its vibrations. The variable resistor and the capacitor across the relay allow some control of the vibrating frequency (see Fig. 2).

To use the unit, close switch S1, causing the armature to vibrate. Adjust resistor R and the receiver plate relay so that the receiver's control relays operate properly. To send signals to channel 1 or channel 2, either S2 or S3 is depressed. Because of the high vibration frequency and the low delay time, it is possible to send pulses fast enough (using the pushbutton switches) to operate the compound type escapements in either channel. This allows up to six functions of control and fail-safe neutrals.

Several types of pulser units are available. They are constructed with circular magnets. These units, when fed a pulse-width-pulse-spacing code, allow proportional control of, say, a plane rudder. See Chapter 2, Radio-Control Handbook (Gernsback Library). It seems quite feasible to modify such a unit to replace the two decoder relays, as shown in Fig. 3. Centering springs are required so that the magnet armature will spring away from the contact when pulsing is stopped and not result in a bounce which might cause a standard escapement to skip.

This method could be used to energize a steering motor for a boat or car.

A second idea which also seems feasible, if you are experiment-minded, would be to construct a unit to replace all three relays. Such a unit is shown in Fig. 4. If you build a solenoid with a winding equivalent to that of a 8,000-10,000-ohm relay and add a light compression spring within the hollow core so the magnetic plunger is pulled against it when the coil is energized, it is possible to cause the moving armature attached to the plunger to float between the two control contacts. A solenoid is suggested since the pull on the plunger is roughly proportional to the current flowing through the windings and the magnetic path is not broken by an air gap as in a relay type of unit.

With such a device, small and light, the receiver relay stage could be modified so that the amount of current drawn through the tube would be proportional to a pulse-spacing-pulse-width variation. Pulses would be transmitted as before, but this time the width and spacing would be adjusted until the armature of the solenoid floated between the two contacts. Operation of the two channels would then be as previously described. The details are left to the builder's ingenuity, but remember, two channels are better than one.

Modify your one-channel remote-control system for two-channel operation

By E. L. Safford, Jr.

Fig. 1—Circuit of decoder unit.

Fig. 2—Encoder unit circuit for two-channel operation with a one-channel remote-control circuit in either channel. This allows up to six functions of control and fail-safe neutrals.

Several types of pulser units are available. They are constructed with circular magnets. These units, when fed a pulse-width-pulse-spacing code, allow proportional control of, say, a plane rudder. See Chapter 2, Radio-Control Handbook (Gernsback Library). It seems quite feasible to modify such a unit to replace the two decoder relays, as shown in Fig. 3. Centering springs are required so that the magnet armature will spring away from the contact when pulsing is stopped and not result in a bounce which might cause a standard escapement to skip.

Fig. 4—Spring-loaded solenoid could replace all three relays in receiver circuit.
Exclusive

"T-GUARD"

STYLUS

only with the

PICKERING

FLUXVALVE

FLUXVALVE TWIN SERIES 350 — A turn-over cartridge providing a rapid change of stylus point radius. Available in 12 models featuring many combinations of styli, prices start at a modest $24.

The FLUXVALVE features exclusive hum rejection circuit — requires no adjustment!

FLUXVALVE SINGLE SERIES 370 — A miniature high quality cartridge for use in any type of auto-changer or manual player arm. Available in 5 models, prices start at a low $17.85.

PICKERING'S introduction of the truly miniature FLUXVALVE magnetic phonograph cartridge represents a new era in high fidelity cartridge design. This newest of PICKERING cartridges brings the music lover the most exciting and safer idea in a stylus assembly since PICKERING introduced the first lightweight high fidelity pickup more than a decade ago.

The "T-Guard" stylus assembly is a quick-change, easy to slip-in unit which eliminates precarious finger-nail fumbling. Its practical "T" shape provides a firm and comfortable grip for safe and easy stylus change.

The most flexible cartridge in the world... the FLUXVALVE is the only cartridge with the remarkable ½ mil stylus... exclusive only with PICKERING. The FLUXVALVE can be used with any one of five styli, to meet any requirement or application... to play any record, at any speed.

If you are planning to buy a new cartridge—the fact that PICKERING developed this revolutionary stylus is important to you! All of the research, development and planning that went into the "T-Guard" stylus is conclusive proof of the superlative engineering skill in every FLUXVALVE model you buy.

Model 194D UNIPoise Pickup Arm — A new... lightweight... integrated arm and cartridge assembly containing the FLUXVALVE with exclusive "T-Guard" stylus. The complete assembly — tone arm and cartridge — is only a fraction of the weight of conventional tone arms.

The high compliance of the "T-Guard" stylus, with the lightweight tone arm and single friction-free pivot bearing assures distortionless tracking of microgroove and standard groove recordings. Available with the ½, 1 or 2.7 mil diamond stylus, prices from $59.85.

"For those who can hear the difference" FINE QUALITY HIGH FIDELITY PRODUCTS BY

PICKERING & COMPANY, INC., Oceanside, N. Y.
Sensitive Relay Saves Standby Power

By ROD DRIVER

LIGHT, voice and radio are but a few examples of the signals that will operate this relay which stands by indefinitely, drawing practically no power.

A relay that operates on voltage changes and draws only a few µa from the control element is not new, but it usually requires tubes that deteriorate and whose filaments draw power while the circuit is inactive. This circuit uses a cold-cathode tube that lasts almost indefinitely if operated within its ratings and the only power consumed when standing idle is that drawn by a 100,000-ohm potentiometer across the ac line.

The heart of the circuit is a Chatham 313C gas-filled, cold-cathode trigger tube. It has a cathode, anode and a starter anode, and operates like a positive-grid thyratron.

The main gap (anode to cathode) will not conduct current until the anode is about 185 volts positive. Then the tube voltage drops instantly to 75, the main-gap sustaining voltage, and the current depends only on the resistance in series between the tube and power supply.

The starter gap (starter anode to cathode) behaves like the main gap but, being closer spaced, has a firing voltage of 70 and a sustaining voltage of 60. Again there must be enough series resistance in the circuit to limit the current to a safe value.

The tube is useful for control purposes due to the fact that a current of a few microamperes in the starter gap slightly ionizes the gas in the tube and greatly reduces the voltage necessary to fire the main gap. Fig. 1 shows how the main-gap firing voltage depends on the starter-gap current. As in a thyratron, once the main gap has fired the starter has no more control over it. The only way to stop conduction is to reduce the anode voltage below the sustaining value.

To use the tube as a relay, it is necessary to add the control voltage to a pedestal voltage high enough to give a total of 70 volts or more on the starter anode, while simultaneously applying voltage to the main gap. The load (relay) is in the main-gap series circuit. The problem is to get a high enough voltage from the control so that control signals will fire the tube but variations in the pedestal supply voltage will not.

The relay circuit

The relay circuit shown in the photos and in Fig 2-a needs no dc power supply. The 313C tube operates satisfactorily on ac because it conducts very little current in the reverse direction.

The circuit used on 117 volts ac can operate only at instants when the anodes are positive. The sensitivity control is set so that the peak voltage from the cathode is less than 70, say 65 volts. Terminals 3 and 4 connect to the control and, if it is putting out 5 volts with terminal 4 positive, the starter gap will fire. The starter-gap current will then fire the main gap which conducts current until the voltage falls below the sustaining value.
Photocell relay

A phototube connected to the relay circuit as shown in Fig. 3-a will close the relay on increasing light intensity. Almost any gas or vacuum phototube (868, 929, 930, etc.) will work. The load resistor can be anywhere from 1 to 20 megohms. Higher resistances usually give a more sensitive circuit.

As the light increases, the increased photocube current gives a greater voltage drop across the load resistance and raises the starter anode voltage. The intensity level that fires the tube depends on the sensitivity control setting.

If you want decreasing values of light to operate a relay, connect the phototube as shown in Fig. 3-b. Note that the cathode of the phototube connects to the bottom line lead of Fig. 2-a. Add a terminal connected to this line if you intend to use the relay this way.

Sound-powered relay

A carbon microphone connected through a 6-volt battery and a high-$\pi$ transformer to the control terminals gives a sound-operated relay (Fig. 4). I used a Stancor A-4747 input transformer which has a 1 to 137 ratio.

To operate, adjust the sensitivity control to a point slightly below firing voltage, and turn on the microphone. This unit could serve as a sound-powered burglar alarm or for controlling displays by voice commands.

Radio-powered relay

A crystal set such as shown in Fig. 5, coupled to the control terminals through a high-impedance stepup transformer, will turn on the relay whenever the radio station tuned starts broadcasting. The idea for this application came from the Sylvania booklet Electronic Shortcuts for Hobbyists. A good outdoor antenna and a good ground will be essential in most cases.

The relay operates on the audio signals rather than on the carrier and the difficulty lies in getting a suitable transformer to step up the audio voltage. Ideally it would have an input impedance of 3,000 ohms or more and a ratio of 1 to 10 or more. The closest standard transformer I have found that will work is the Stancor A-4726 (discontinued) which has an input of 2,500 ohms and a ratio of 1 to 6.3. (This is the transformer shown in the photograph.) Others that may be tried are the Chicago IN-16 and Triad A-422 universal interstage transformers with 1-to-6-turns ratios.

Using the Stancor A-4726, the circuit
how to pick up the chips in the

Non Color-Blind HELIX

SELL COLOR

NOW WITH BRILLIANT ALCOA SPEC.

Yes Mr. Service Dealer

Your thousands of Colortenna orders and reorders prove it...
You like the idea of an integrated antenna line that assures you the right antenna answer for every reception problem...
You like the idea of the red helix which identifies the Colortenna to prospects as an outstanding performer in black and white and color...

And in 1958

You'll love the spectacular new JFD Colortenna line that will send your antenna profits rocketing to new highs. Put its dynamic selling power to work for you by seeing your JFD distributor now.

CASH IN ON THE SELL-A-BRATION SWEEPSTAKES!
Over $100,000.00 worth of prizes given so far to TV dealers and servicemen!
3 GRAND PRIZES TO SERVICE-DEALERS with highest totals for season, September 1, 1957—March 31, 1958.

Winners to be announced May 19, 1958.

First Prize ALL-Expenses Paid Trip for Two to Paris
Second Prize ALL-Expenses Paid Trip for Two to Bermuda
Third Prize ALL-Expenses Paid Week-End for Two at the Waldorf-Astoria in New York

EVERY COLORTENNA COUNTS FOR FREE PRIZES!
Wallace 16 Pc. Tableware Set
Only 14 Power Helix—PX911S
12 Spalding GOLF Ball Set
Only 25 Star Helix—SX711
Chatham Orlon Blanket
Only 11 Wonder Helix—WX811S
Samsonite Ladies Case
Only 38 Wonder-Helix—WX811
Samsonite Men's "Quick-Tripper"
Only 40 Wonder-Helix—WX811
Aluminum Fishing Tackle Box
Only 11 Star Helix—SX711S

PLUS HUNDREDS OF OTHER BRAND-NAME PRODUCTS
GLEAMING GOLD ANODIZING GIVES YOU MORE TO SHOW! . . . MORE TO SELL!

New . . . new . . . new! Gold Colortennas with ALCOA Spec. fade-proof gold anodized finish that catches the eye and makes them buy.

NEW UNBREAKABLE "KRALASTIC" INSULATORS

You get the toughest, hardest, strongest insulators money can buy. Matchless electrical, physical and weathering properties for better performance all year, every year.

NEW RIGIDIZED REFLECTORS

Twice the strength—twice the rigidity. Every element over 30 inches long is now reinforced with 16 inch aluminum dowels in center. Never before so many dynamic selling features packed in one antenna.

THE FUSE IS LIT! Get Set FOR THE COLORTENNA BOOM in 1958

IN PROFITS! PERFORMANCE! PREMIUMS! PROMOTION!

See your JFD distributor.

ELECTRONICS CORP.
Brooklyn 4, N. Y.
Pioneers in electronics since 1929
New items to save time, make money

...literally hundreds of them, in Centralab's new Catalog 30

Tells you what's new at your Centralab distributor.
Keeps you up to date on the latest developments that make servicing of radio, TV, and electronic equipment faster and more profitable.

Shows hundreds of new, exciting items it pays you to know about — new values in Packaged Electronic Circuits — new volume controls — new ceramic capacitors — new switches — new transistor amplifiers.

Everything is arranged so that it's easy to find just what you're looking for.
Ask your Centralab distributor for your free copy. Or write us today.

Centralab

A DIVISION OF GLOBE-UNION INC.

8221 EAST KEEFE AVENUE • MILWAUKEE 1, WISCONSIN

ELECTRONICS

Fig. 4 — Sound-powered control for stand-by relay.

C — 365-μuf tuning capacitor
D — 1N414 crystal diode
J — phone jack
L — ferrite-core antenna coil
T — input transformer (see test)

Fig. 5—Crystal-radio control circuits.

adjustment is critical. Tune the crystal set to a powerful station, using the headphones or, better yet, a high-resistance (20,000 ohms per volt) dc voltmeter, to get maximum output. If you use a voltmeter, disconnect the transformer while tuning as it shorts out the direct voltage. Series or parallel capacitance tuning (Fig. 5) may also help, depending on your antenna.

Finally adjust the sensitivity control so that the relay just closes on the loud audio signals and doesn't close at all when the station is detuned. After adjusting, unplug the headphones to get more output to the relay.

If left tuned to a particular station frequency, the relay circuit can turn on a receiver or sound an alarm when that station starts broadcasting.

Other applications

You can operate the relay circuit with many other controls — thermistors, capacitance circuits and wired wireless controls, for example. The only requirement is that they give voltage changes of at least 3 volts if dc or 4-volt peaks at not more than 5,000 cycles per second. Be sure that any control used is isolated from ground as the relay has an internal ground from the power line.

The relay will work better on any low-output control if it is supplied from a dc source (top line Fig. 2-a positive). Modify the main-gap limiting resistor (R3 in Fig. 2-a) so that the current is no more than 10 ma after the tube voltage drops to 75. The tube will then drive a less sensitive relay. If you use batteries for the power supply, the circuit becomes more dependable for small-signal triggering since line-voltage fluctuations are eliminated. Also, when using dc, no locking circuit and relay capacitor are necessary. Once energized, the relay will stay closed until the main-gap voltage is reduced.
Multiplex Services Corp., New York, N.Y.

THE FCC authorized multiplexing by FM broadcast stations two years ago, and since then several stations have gone into this field. It provides a way for a single FM station to transmit additional programs privately at the same time as regular public broadcasts. Multiplex transmissions cause no interference with the public or main FM channel. If you turn the dial of your FM receiver to a station that is multiplexing, you will hear the usual program on the public channel, with no trace of the multiplex transmission. However, if you are a subscriber with a multiplex receiver, you then would hear the special program being transmitted by the station's subchannel.

How it works

At the FM station, an FM subcarrier having a center frequency such as 41 kc is impressed pick-a-back on the main carrier wave. This is accomplished in a special exciter unit of the FM transmitter by a slight shift in the phase of the frequency-modulated main carrier at a specific point in the frequency-multiplex chain of the transmitter (see Fig. 1). The subcarrier is impressed on the main carrier at a level such that the main carrier is frequency-modulated 10 to 20% by the subcarrier. The subcarrier, in turn, is frequency-modulated by the audio program signals associated with the multiplex service. The frequency deviation of the subcarrier usually is plus or minus 6 to 12 kc, depending on the type of system, transmission requirements and other factors. The frequency deviation of the main channel is reduced so that modulation is approximately 70% on program peaks, or about 3 db below the maximum modulation percentage permitted by FCC rules and regulations.

At the receiver, the main carrier is amplified and detected in the normal manner by a special FM receiver. This function basically is in the manner of conventional receivers but is designed throughout to provide maximum phase linearity.

A receiver with suitable performance characteristics is important. Any appreciable nonlinearity will increase the amount of intermodulation and introduce crosstalk in the subchannel from the main-channel signals.

In multiplex receivers now in commercial service (see Fig. 2), one or two stages of rf amplification are employed to give maximum sensitivity and increase quieting action. By a conventional heterodyne method, using a crystal-controlled oscillator, the main FM carrier is beat downward to an intermediate frequency such as 10.7 mc. This signal is usually passed through two or more if stages, each having good phase-linearity characteristics. The amplified RF carrier next goes through one or two limiter stages, also designed to minimize intermodulation due to nonlinearity. Then the FM signal is demodulated by a wideband discriminator with good linearity characteristics. From the main discriminator, the audio program signals, modulating the main carrier, may be passed through a standard de-emphasis network and audio amplifier to operate one speaker in a stereophonic system, for example. From the main discriminator, the multiplex subcarrier is fed through a bandpass filter which accepts subcarrier signals within a given subchannel frequency range and rejects signals of other frequencies. After the desired subcarrier has been filtered in this manner, it is amplified, limited and fed to an FM subcarrier demodulator whose function is to convert the frequency variations in the subcarrier to audio program signals.

Following the demodulation process, audio-frequency signals from the subcarrier discriminator are applied to a low-pass filter which removes the residue of the subcarrier. Where hi-fi multiplex reception is required, the low-pass filter may be designed to cut off at a ...
The World's Most Extensive
Now you can select your Jensen loudspeaker

New Performance Levels in New Price Ranges

**UNAX**
SINGLE ELEMENT

The new Jensen UX Series provides a new high in single-cone single voice coil loudspeakers at unusually low cost, actually outperforming comparable (and even more complex) units selling for much more. A listening test will convince you that this is a maximum value buy in hi-fi listening pleasure.

Of course, there are special design elements that enable us to give so much for so little. The cone is artfully dual acting, the center sector operating effectively for unusually extended highs, while the whole moves to reproduce the lows. Withal, there is superb balance and cleanliness. And, if you choose, you can step up performance later with the inexpensive KTX-2 Step-Up Kit which substitutes a compression driver tweeter for the top.

UX-80, 8-in. Speaker. Net $14.50
UX-120, 12-in. Speaker. Net $19.50

**DUAX**
2-ELEMENT SYSTEMS

A step-up in the reproduction scale is the DX Series in which two carefully coordinated cones are driven by one voice coil. (Some call these "coaxials," but we reserve the name for still more elaborate systems and higher performance.) The separate auxiliary radiator gives the designer a chance to attain a wider frequency range than with a single cone (albeit dual acting as in UX Series). The result is, with low cost, additional performance and added listening pleasure. We know of no similar speakers with equal sound, none with as high efficiency or as low distortion at anywhere near DX Series cost. Again you can step up performance easily at anytime with KTX-2 Kit to substitute high-order compression driver tweeter operation at the high end.

DX-120, 12"; 1-lb. mag. Net $25.50
DX-150, 15"; 1-lb. mag. Net $35.50

**COAXIAL**
3-ELEMENT SYSTEMS

Still better than the "all paper" system with single voice coil is the use of a compression driver tweeter for the highs. The least expensive way to do this is to nestle a super-tweeter coaxially inside the cone; it must cross over high in the frequency scale at 3500 to 4000 cycles. The third element is the diffusion radiator which shapes and disperses middle-high response. (Some call such speakers "Triaxial," though Jensen alone is entitled to use this registered name, applied by us to true 3-way speakers only.) Again, we guarantee more and better sound, cleaner hi-fi at lower cost, than all comparable speakers. And you can step up performance correctly and impressively with a real C.D. horn 600-4000 cps mid-range (KTX-3 Kit) that leaves you with a real 3-way system.

12" Models. CX-120*...$49.50
CX-225 $59.50
15" Models. CX-150*...$66.50
CX-255 $76.50

*Denotes 1-lb. magnet; others 1¼ lbs.

SELECTING A HI-FI SPEAKER? YOU'LL WANT THESE HELPFUL, INFORMATIVE BOOKS


www.americanradiohistory.com
High Fidelity Loudspeaker Line
from this new complete range of types and sizes.

...All with Traditional Jensen Quality

COAXIAL
2-WAY SYSTEMS

By using two completely independent (but carefully coordinated) speakers, each with its own magnetic system, voice coil and cone, the true two-way system spans the frequency range to obvious advantage in smoothness and extent, cleanliness, low distortion and uniformity of angular dispersion.

Coaxial mounting makes them a convenient unitary package. Please note that we at Jensen use the term "coaxial" only in referring to a speaker with two completely independent systems.

Lowest in cost in the Jensen coaxial family is this fine group of speakers employing "cone" type direct radiator units for both tweeter and woofer. Available in 8, 12 and 15-inch models, they provide a maximum of value in true two-way system speakers.

K-80, Coaxial, 8-in. Net $16.75
K-210, Coaxial, 12-in. Net $27.50
K-310A, Coaxial, 15-in. Net $39.75

The highest type of performance in the coaxial two-way loudspeaker is attained by the use of a compression-driver horn-loaded tweeter for the high end. When properly designed, there results an outstanding clarity, realism and instrumental separation not achieved by lesser designs.

By adopting the expensive "thru-bore" construction, the tweeter horn can be made long enough to operate at the lowest practicable crossover frequency, a very desirable feature for the very best sound.

In this manner, the very popular Jensen H-222 and H-520 give you the "tops" in fine coaxial performance. Crossover is at 2000 cycles. Though many will see no need to, you can step-up performance to full three-way with KTX-1 Range-Extender Supertweeter Kit.

H-222, Coaxial, 12-in. Net $62.50
H-520, Coaxial, 15-in. Net $79.50

TRIAXIAL* & TRIAX*
3-WAY SYSTEMS

The true three-way speaker system divides the range in three parts with three electrically and acoustically distinct and independent elements, each designed to perform near-ideally in its portion of the range.

The famous G-610A TRIAXIAL was the first (and until our new G-600), the only speaker made in accordance with this concept! It employs a heavy woofer and two compression driver horn-loaded elements for m-f, and h-f channels. (The woofer cone acts as the final section of the m-f horn.) Its performance is so outstanding that it easily rates as the world's most wanted hi-fi speaker.

Now, for those who would like a G-610A, but are dissuaded by the price tag, Jensen announces the new lighter, less expensive G-600 TRIAX with similarly outstanding features and performance.

G-610A, Triaxial, 15". Net $252.75
G-600, Triax, 15". Net $129.50

* T. M. Reg.®

Jensen Manufacturing Company
6601 South Laramie Ave., Chicago 38, Illinois
Division of The Muter Co. In Canada, Copper Wire Products, Ltd., Toronto

Send for Free Data Sheet 165-B

www.americanradiohistory.com
point slightly above 15,000 cycles. From the low-pass filter, the audio signals on the multiplex channel are amplified and appear at the loudspeaker.

**Multiplex uses**

Up to now, virtually all FM multiplexing by broadcast stations has been for supplying background music in restaurants, hotels, factories, offices and other commercial establishments. Receipt by nonauthorized persons is not intended. If, however, any commercial or unauthorized reception is considered to be a violation of the basic protective provisions of Section 605 of the Communications Act, which assures privacy for users of radio or wire services.

Background music presently is the most profitable and obvious use for multiplex although this transmission method is not limited to that service alone. Like any other new medium, its potentials and applications will increase as the art matures and expands. This is where stereophonic broadcasting comes in.

Until now, stereophonic music has been broadcast by transmitting the stereo programs through two stations, usually the AM and FM outlets of the same broadcasting company. Two receivers are required, one AM and one FM. With multiplexing a single FM station can be used for both stereo channels by transmitting one stereo signal on the public channel and the other on a multiplex channel. The listener needs only one FM receiver with a multiplex adapter.

The quality of stereophonic programs by multiplex was demonstrated for the first time in 1950 by William S. Halstead of Multiplex Development Corp. and later by Major Armstrong, shortly before his death. Special programs by an instrumental trio were transmitted from the studio of FM broadcast station KE2XKH in downtown Manhattan, New York City. Reception tests were at the Reeves Sound Studios, in mid-Manhattan, for the representatives of the broadcast industry, FCC, other Government agencies and the press. In these first transmissions, the presence effect of the artists was remarkable, with listeners being able to sense the relative location of the different instruments of the trio and the movement of a singer as she moved between microphones. Since these early tests, additional stereo transmissions have been conducted with two 15,000-cycle channels. These numerous tests showed that stereophonic transmission by multiplex is not only practical but offers a superior way of rendering this high-fidelity service.

Following these demonstrations, the FCC was petitioned to permit the use of multiplexing by FM broadcast stations. It required nearly 5 years for authorization, due to the question of the legality of adding a private point-to-point type of service to a public broadcast channel. This cuts squarely across the basic definition as to what constitutes a public broadcast service. (Similarly, the present subscription TV controversy concerns using a public-service channel for a nonpublic function.) Approval of the multiplex petition recognized that multiplexing would permit certain FM stations to continue for a time to render specialized program services by what is termed the "simplex" transmission method. These stations were profitably engaged in transmission of special background music on their public channels, with commercials and other nonmusic material being deleted automatically by ultrasonic control or beep signals.

Simplexing provided many FM stations with enough revenue to weather the economic storms of this broadcast medium. However, the FCC considered that music directed to subscribers was not a public service as called for by FCC rules and regulations. Multiplexing permits these stations to move their simplex operation from the main channel to a subchannel. They can then derive revenue from sponsored main-channel programs as well as draw income from subscribers to the subchannel service.

As presently visualized, the multiplex stereophonic receiver would be available in either of two forms—a specially designed receiver with built-in multiplex circuitry or a multiplex adapter which would attach to your present receiver. There would be separate volume controls and you could tune in the main channel of any station or flick a switch to bring in the subchannel. If stereophonic music is broadcast, both could be picked up simultaneously.

**Existing FM receivers**

Ordinary FM radios were not engineered for multiplex reception. However, most of these receivers can be upgraded by the addition of minor parts or circuit changes. An adapter then can be attached without serious crossstalk problems. Service technicians could do this. Suitable multiplex kits containing the necessary components and a schematic could be packaged and stocked by radio shops. A receiver with built-in multiplex will probably be in the price range of present good-quality FM receivers. A multiplex adapter for a home FM receiver will cost about the same as an inexpensive FM tuner.

Initially stereophonic broadcasts will be a repetition of the chicken-and-egg process experienced in the development of television and other forms of broadcast. Although two stations are not automatically sold before a station begins broadcasting. Like the birth and growth of television, a station must initiate this broadcasting to a ghost audience with demonstrations to interest the general public before there is a market.

The growing number of excellent stereophonic tapes now on the market will be the basic material for programs. Many broadcasts now picked up live would also be broadcast stereophonically, thereby increasing the quality of such transmissions. Stereophonic would add a great deal to the realism and dramatic effect of plays and other shows.

In certain parts of the United States where there are relatively few radio stations, it is conceivable that multiplexing may be used primarily for providing a variety of programs rather than for stereophony. At present, for example, many daytime-only stations provide evening programs on their affiliated FM transmitter. In some areas, it is very difficult to provide static-free AM programming at any time of day or night. The listener's choice becomes severely limited. Since such places cannot support a great number of FM stations, it might be more practical for an FM station to perhaps provide sports programs, network programs and other nonmusical shows on the main channel and transmit music and news on a subchannel. This way, one station could have twice as many programs as at present, twice as much advertising income, twice as many listeners—and its technical operating expenses would still be about the same as before. Such an arrangement would not prevent providing stereophonic music.

Although there are other excellent uses for this development, which can all be in our future, the primary thought is that multiplex is with us now. Radio stations need only begin multiplexing a service such as stereophonic programs. The public has already given the welcome acceptance to stereophony, so there will undoubtedly be a similar response when it is initiated in this new multiplex entertainment medium.
OCTOBER, 1957

500-Million-Mc Transceiver

This super-high-frequency communications system uses cesium-vapor lamps

By HAROLD PALLATZ

No license of any kind is required for this two-way communications system. The waves transmitted by the cesium vapor lamps are only some 40 millionths of an inch long (about 500 million megacycles per second). These frequencies act more like light waves than radio waves and in fact are only slightly removed from the visible spectrum. The waves travel in straight lines and distance is limited only by the power of your equipment or the curvature of the earth, whichever comes first.

Circuit hookup is very simple and is actually easier than for regular transmitters (see diagram). All you need is an audio amplifier, dc power supply (18 volts at 3 amperes) and a cesium vapor lamp. The lamp is modulated by the audio amplifier output. Per greater distance a parabolic reflector can be placed behind the lamp. The reflector concentrates the waves in a small highly directional beam and directs waves that would ordinarily be lost as stray radiation. For night work where no light should show at all, the faint pink glow of the lamp may be eliminated with an infra-red filter.

The receiver section consists of the same amplifier with a speaker replacing the lamp in the output and a phototube replacing the microphone at the input. A dpdt toggle switch changes from "transmit" to "receive" and the entire system may be used as a transceiver. (The components of my receiver are simply soldered to the photocell socket terminals and receiver and mike are alternately plugged into the amplifier.)

Voice transmission will be virtually

Circuit of the transceiver.

Completed cesium-vapor lamp transmitter. Phototube and function-selector switch not installed.

RADIO

Completed cesium-vapor lamp transmitter. Phototube and function-selector switch not installed.
You get the best features of both in the Thorens CBA-83

Not a changer, not a conventional turntable, but so easy to use you can play it in the dark!

Place your precious records, by hand as gently as you please, on the 12-inch turntable of the Thorens Audiomatic CBA-83. Press the button—there's one for 7, 10, or 12-inch records. That's all you do!

A precision mechanism takes over and lowers the stylus gently and silently into the lead groove. No cueing light required. No stooping to look for the stylus point. No sighting along a cueing mark. No danger of scraping over the first few grooves. You don't need a steady hand—your hand need never touch the tone-arm at all!

Easy playing is just one feature of the Thorens Audiomatic. Take the motor, for example. Like all Thorens units, the Audiomatic is powered by a famous Swiss-precision direct-drive motor to assure silent operation. Accurately machined, electronically-balanced fast-rotating parts hold wow, flutter to less than 1/2%. Ask for the Thorens CBA-83 Audiomatic record player at your hi-fi dealer's today! Its performance will surprise you.

And don't forget to send for free booklet "Hi-Fi and Your Budget." Write Thorens Company, Dept. E107, New Hyde Park, N.Y.

CB-83 manual player (above) starts when tone arm is lifted, shuts off silently, automatically at end of record. Has same Swiss-precision motor as CBA-83. From changer to transcription turntable, there's a Thorens for every need.

ONE YEAR GUARANTEE. Now all Thorens units are covered by a 1-year guarantee—4 times as long as the usual 90-day electronic equipment guarantees! Ask your hi-fi dealer about this.

SWISS MADE PRODUCTS
HI-FI COMPONENTS • LIGHTERS • SPRING-POWERED SHAVERS • MUSIC BOXES
NEW HYDE PARK, NEW YORK

RADIO
distortion-free as the lamp response is from dc to 10,000 cycles. Clarity will depend mainly upon your audio system. Static and other transmission noises in regular radio-wave transmitters will be almost nonexistent. About the only noise you are likely to run into is possible pickup from a street light or other bulb operating on ac. This is minimized by the directivity of the units. Normal daylight does not have a rapidly changing light level. About the only thing daylight will do is put a bias on the phototube (never point a phototube at the sun), which in some cases will require a readjustment of the input gain control. Daylight transmission may also require more shielding of the phototube, particularly on long-distance transmissions, to prevent the weaker signals from becoming completely masked out.

Dc power supply
It is very important to have a hum-free dc power supply, just as it is in a transmitter intended for speech. The diagram shows the circuit of a typical unit. A 18- or 24-volt aircraft battery (lead storage type) that will stand 3 amperes of constant drain can also be used.

This will give you hum-free results but has the inconvenience of requiring constant attention for recharging and refilling. Since cesium vapor lamps have a negative resistance characteristic, some means of limiting the maximum current must be used. For this we use a slide type wirewound resistor.

In use, the two filaments of the lamp are lit for about a minute (up to 15 minutes on breaking in a tube for the first time). Do not turn on the B supply until the filaments have been on for a minimum of 30 seconds. An arc is struck by tapping on the microphone (this causes a high-voltage peak across the lamp which ignites the arc). The slider is moved on the resistor until approximately 3 amperes are flowing through the lamp. The filaments can then be turned off and the plate current should be about the same. If you have difficulty in starting your lamp, you can tilt it slowly until it starts.

Since the penetration of infra-red waves is slightly different from light waves, you will still be able to communicate even under conditions of poor visibility due to fog. The size of the water-vapor molecule is the restricting agent. Water-vapor particles smaller than the wavelength of our transmitter are relatively transparent. Large vapor particles will in some cases completely stop the rays.

For code enthusiasts, the microphone may be replaced with an oscillator and a telegraph key. Communication will be the same as with low-frequency radio waves but will have the advantages of simpler construction and no code speed requirements. When your code speed does pick up from these practice sessions it will be easier to obtain higher-grade licenses.
transistor
LOW-VOLTAGE SUPPLY

Need ac, dc, pure dc or regulated dc? Then you want this transistorized device

By I. QUEEN
EDUCATIONAL ASSOCIATE

ALMOST every experimental laboratory, individual researcher or service shop needs some kind of low-voltage power supply. This power source provides three types of output: ac, regular dc and pure dc. The ac is suitable for filament supplies, motors and relays. Regular dc is for low-hum filament circuits, small dc motors and relays, battery charging, electroplating and wherever a 5% ripple can be tolerated. The pure dc source is actually a battery eliminator as its ripple is less than 0.1%. It is excellent for audio circuits using power transistors and can energize portable transistor radios. Pure dc is available either as unregulated variable voltage or as regulated 12.6 volts.

Except for the regulated output, the voltage is variable in small steps. The ac has a maximum of 19-20 volts at 3 amps, the same voltage at about 2 amps continuous. The pure dc delivers 14 volts maximum at 1 amp. If more is drawn the voltage drops. The load is always insulated from the line. Peak-to-peak ripple at full output is less than 10 mv. Note that this is the peak-to-peak value observed on a scope. The rms value is far below this, and is therefore well below 0.1%. The pure dc therefore closely approaches a battery supply.

None of the circuits is critical in any way. You don't have to use components identical to those described here and you don't need to include all the circuits. Perhaps you don't want or need the regulated feature or maybe you can do without a variable voltage. It's easy to adapt this device to fit your own needs.

The ac circuit
A tapped transformer secondary provides the variable voltage output. Three center-tapped filament transformers, each 6.3 volts, are connected in series to provide a total of 19 volts (see Fig. 1). Each transformer should be rated at 3 amps. These transformers are common radio items.

To select voltage, a tap switch is needed. Grayhill type 5006 is excellent for the purpose since it has six terminals, is tiny and can handle up to 5 amps.

The transformer shown in the photos is an old model-train type which happened to be available. It was removed from its metal case (which was ready to fall apart) and the tapped leads connected to the Grayhill switch. It provides variable output up to 14 volts, in steps of 2 volts, plus a maximum terminal of 20 volts. It is, therefore, nearly equivalent to a series of three filament transformers. If you have such a transformer well and good, but the filament units are electrically equivalent and much easier to mount in the box.

When switching ac voltage, it is preferable to rotate the switch to the desired value before connecting the load. The switch handles 5 amps continuously but is rated to break much less current. For easy manipulation and good appearance you may wish to mark each voltage tap as I did. The ac output is led to insulated pin jacks on the front of the box. Green jacks were chosen to color-code the ac.

Regular dc circuit
When converting ac to dc at high current, we are faced with two problems: rectification and filtration. The first is solved by using low-voltage bridge rectifiers. The second problem is partly solved by a large capacitance (C1) across the output terminals. Good filtering is difficult without a choke coil capable of carrying high currents. Such coils are not regular radio components and do not even appear in radio catalogs, other than those issued by a few firms specializing in battery chargers, eliminators and other high-current supplies. For this reason we settled for 5% ripple.

The ac voltage (selected by the rotary switch) is fed to selenium rectifiers. The diagram shows a single bridge but actually three are used, in parallel, to increase current capacity. Each bridge may be a Federal 1017 or Sarkes-Tarzian 604-B. Either can deliver 600 ma continuously. A total of at least 1.8 amps may be drawn continuously when three bridges are connected in parallel. For shorter periods,
Superior's
New Model
TD-55
EMISSION TYPE

The Experimenter or Part-time Serviceman, who has delayed purchasing a higher priced Tube Tester.

The Professional Serviceman, who needs an extra Tube Tester for outside calls.

The busy Service Organization, which needs extra Tube Testers for its field men.

Speedy, yet efficient operation is accomplished by:
1. Simplification of all switching and controls.
2. Elimination of old style sockets used for testing obsolete tubes (26, 27, 57, 59, etc.) and providing sockets and circuits for efficiently testing the new Noval and Sub-Mini types.

You can't insert a tube in wrong socket. It is impossible to insert the tube in the wrong socket when using the new Model TD-55. Separate sockets are used, one for each type of tube base. If the tube fits in the socket it can be tested.

"Free-point" element switching system. The Model TD-55 incorporates a newly designed element selector switch system which reduces the possibility of obtrusiveness of the absolute minimum. Any pin may be used as a filament pin and the voltage applied between that pin and any other pin or even the "top-cap." Checks for shorts and leakages between various sections.

The Model TD-55 provides a super sensitive method of checking for shorts and leakages up to 5 Megohms between any and all of the terminals. Continuity between various sections is individually indicated. This is important, especially in the case of an element terminating more than one pin. In such cases the element or internal connection often completes a circuit.

Elemental switches are numbered in strict accordance with R.M.A. specification.

One of the most important improvements, we believe, is the fact that the 4 position fast-action snap switches are all numbered in exact accordance with the standard R.M.A. numbering system. Thus, if the element terminating in pin No. 7 of a tube is under test, button No. 7 is used for that test.

Complete with carrying case...

Superior's New Model TV-40
PICTURE TUBE TESTER

Not a Gadget—Not a Make-Shift Adapter, but a Wired Picture Tube Tester With A Meter for Measuring Degree of Emissions—at Only $15.85

Of course you can buy an adapter for about $5—which theoretically will convert your standard tube tester into a picture-tube tester; or a neon type instrument which sells for a little more and is supposed to be "as good as" a metered instrument. Superior does not make nor do they recommend use of C.R.T. adapt-ers or neon gadgets because a Cathode Ray Tube is a very complex device, and to properly test it, you need an instrument designed exclusively to test C.R.T. tubes and nothing else.

Tests all magnetically deflected tubes . . . in the set . . . out of the set . . . in the cartridge.

Tests all magnetically deflected picture tubes from 7 inch to 30 inch types.

Tests for quality by the well established emission method. All readings on "Good-Bad" scale.

Tests for inter-element shorts and leakages up to 5 megohms.

Tests for open elements.

EASY TO USE: Simply insert line cord into any 110 volt A.C. outlet, then attach tester socket to tube base (can trap need not be on tube). Throw switch up for quality test . . . read direct on Good-Bad scale. Throw switch down for all leakage tests.

Superior's New
Model TV-12
TRANS-CONDUCTANCE
TUBE TESTER

Testing Tubes

- Employs improved TRANS-CONDUCTANCE circuit, an in-phase signal is impressed on the input section of a tube and the resultant plate current change is measured. This provides the calibration of the most suitable method of simulating the manner in which tubes actually operate in Radio & TV receivers, amplifiers and other circuits. Amplification factor, plate resistance and cathode emission are all correlated in one meter reading.

- NEW LINE VOLTAGE ADJUSTING SYSTEM. A tapped transformer makes it possible to compensate for line voltage variations to a tolerance of better than 7%.

- SAFETY BUTTON—protects both the tube under test and the instrument meter against damage due to overload or other form of improper switching.

- NEWLY DESIGNED FIVE POSITION LEVER SWITCH ASSEMBLY. Permits application of separate voltages as required for both plate and grid of tube under test, resulting in improved Trans-Conductance circuit.

Extra Feature

Model TV-12 Also Tests Transistors! A transistor can be safely and adequately tested only under dynamic conditions. The Model TV-12 will test all transistors in that approved manner, and quality is read directly on a special "transistor only" meter scale.

This Model TV-12 will accommodate all transistors, including NPN's, PNP's, Photo and Tetrodes, whether made of Germanium or Silicon, either point contact or junction contact types.

Housed in hand-rubbed oak cabinet...

$72.50

SUPERIOR'S
STANDARD PROFESSIONAL
TUBE TESTER

- Tests all tubes including 4, 5, 6, 7, Octal, Lock-in, Hearing Aid, Thyatron, Miniatures, Sub-miniatures, Novals, Sub-mini, Proximity fuse types, etc.

- Uses the new self-cleaning Lever-Angle Switches for individual element testing. Because all elements are numbered according to pin-number in the RMA base numbering system, the user can instantly identify which element is under test. Tubes having tapped filaments and tubes with filaments terminating in more than one pin are truly tested with the Model TV-12 as any of the pins may be placed in the neutral position when necessary.

- The Model TW-11 does not use any combination type sockets. Instead individual sockets are used for each type of tube. Thus it is impossible to damage a tube by inserting it in the wrong socket.

- Free-moving built-in roll chart provides complete data for all tubes. All tube listings printed in large easy-to-read type.

NOISE TEST: Phone-jack on front panel for plugging in either phones or external amplifier will detect microphonic tubes or noise due to faulty elements and local internal connections.

EXTRAORDINARY FEATURE: SEPARATE SCALE FOR LOW-CURRENT TUBES. Previously, on emission-type tube testers, it has been standard practice to use one scale for all tubes. At a result, the test 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. Housed in hand-rubbed oak cabinet...

$475.00

USE APPROVAL FORM ON NEXT PAGE

www.americanradiohistory.com
TRY FOR 10 DAYS
before you buy!
then if satisfactory pay in easy, interest free, monthly payments. See coupon below.

Superior's New
Model TV-50
7 Signal Generators in One!
R.F. Signal Generator for A.M.
R.F. Signal Generator for F.M.
Audio Frequency Generator
R.F. SIGNAL GENERATOR: 100 Kilocycles to 60 Megacycles on fundamentals and from 60 Megacycles to 180 Megacycles on powerful harmonics.

SUPER - METER: A Combination VOLT-OHM MILLIAMMETER PLUS Capacity, Reactance, Inductance and Decibel Measurements.

MOSS ELECTRONIC DISTRIBUTING CO., INC.
Dept. D-391, 3849 Tenth Ave., New York 34, N. Y.
Please send me the units checked. I agree to pay down payment within 10 days and to pay the monthly balance as shown. It is understood there will be no finance or interest charges added. It is further understood that should I fail to make payment when due, the full unpaid balance shall become immediately due and payable.

Model TV-50 — Terms: $11.50 after 10 day trial then $6.00 per month for 6 months.

Model 76 — Terms: $6.95 after 10 day trial then $5.00 per month for 4 months.

Model 670-A — Terms: $7.40 after 10 day trial then $3.50 per month for 6 months.

SUCCESSOR'S NEW
MODEL 770-A
IT'S A CONDENSER BRIDGE
IT'S A RESISTANCE BRIDGE
IT'S A SIGNAL TRACER
IT'S A TV ANTENNA TESTER

SPECIFICATIONS
CAPACITY BRIDGE SECTION 4 Ranges: 0.0001 Microfarad to .005 Microfarad; .001 Microfarad to .5 Microfarad; .1 Microfarad to 50 Microfarads; 20 Microfarads to 1000 Microfarads. Will also measure the power factor of all condensers from .1 to 1000 Microfarads.

RESISTANCE BRIDGE SECTION 2 Ranges: 100 ohms to 50,000 ohms; 10,000 ohms to 5 megohms.

SIGNAL TRACER SECTION With the use of the R.F. and A.F. Probes included with the Model 76, you can make stage gain measurements, locate signal loss in R.F. and Audio stages, localize faulty stages, locate distortion and hum, etc.

TV ANTENNA TESTER SECTION Loss of sync., snow and instability are only a few of the faults which may be due to a break in the antenna, so why not check the TV antenna first? Locates a break in any TV antenna and measures the location of the break in feet from the set terminals.

Complete with R.F. and A.F. Probes and test leads...

SUPERIOR'S NEW
MODEL 770-A POCKET-SIZED VOLT-OHM MILLIAMMETER

USING THE NEW "FULL VIEW" METER 71", MORE SCALE AREA—Occupies exactly the same space used by the older standard 2 1/4". Model 770-A provides 71% more scale area. As a result, all calibrations are printed in large easy-to-read type and for the first time it is now possible to obtain measurements instead of approximations.

Compact—measures 3 3/4" x 5 1/2" x 2 1/8".

Use "Full View" 2% accurate 850 Micro-micromhos D'Arsonval type meter.

Housed in round-cornered, molded case.

Beautiful black etched panel.

SPECIFICATIONS: 6 A.C. VOLTAGE RANGES: 0.15/15/150/1500/15000 Volts, 6 D.C. VOLTAGE RANGES: 0.75/15/75/150/1500/15000 Volts, 6 D.C. RANGES: 0 to 1000 Ohms, 0.1 Megohms, 3 D.C. CURRENT RANGES: 0.5/150 Mils, 0.5 Amps, 3 DECIBEL RANGES: +34 db to +18 db, 34 db to 58 db.

Complete with test leads...

SUPERIOR'S NEW
MODEL 76 SUPER - METER

Bar Generator
Cross Hatch Generator
Color Dot Pattern Generator
Marker Generator
Bar Generator: Pattern consists of 4 to 16 horizontal bars or 7 to 20 vertical bars for easy, instant color and pattern recognition.

CROSS HATCH GENERATOR: Pattern consists of non-shifting horizontal and vertical lines interlaced to provide a stable cross-hatch effect.

DOT PATTERN GENERATOR (FOR COLOR TV): The Dot Pattern projected on any color TV Receiver tube by the Model TV-50 will enable you to adjust for proper color convergence.

MARKER GENERATOR: The following markers are provided: 30 kHz, 262.5 kHz, 456 kHz, 500 kHz, 1000 kHz, 1400 kHz, 2000 kHz, 2500 kHz, 3579 kHz, 4.5 Mc, 5 Mc, 10.7 Mc, (3597 kHz is the color burst frequency.) Complete with shielded leads...

$11.50

$6.95

$7.40

$47.50

$28.40

$15.85 NET

$28.40

$7.40

$28.40

$3.50 per month for 6 months.

$4.00 per month for 6 months.

$4.00 per month for 6 months.

$4.00 per month for 6 months.
network that easily eliminates much of the ripple (since current is low in this circuit). The load is connected in the emitter return. Measurement shows approximately 800-mv peak-to-peak ripple between points A and B. Yet with full load, output ripple is less than 10 mv peak to peak, almost too small to detect on a sensitive scope.

It is unlikely that the transistors you use will be matched perfectly, so one will tend to do more than its share in handling the current. For this reason a resistor is needed in series with the base of the more efficient transistor. This resistor (R3) is shown as 33 ohms, but you may wish to experiment to find the correct value for your own transistors. To do so, plug a meter into J6 to measure total current. Also, temporarily cut the lead to one emitter (at C) and insert another ammeter here. This meter will measure the total dc drawn from the unit.

No line switch has been used in this device but you can quickly shut off its output without removing the cord. If you are using the dc terminals, switch (S2) to ac. Conversely if you are using ac, switch (S2) to dc. A line switch may be installed in the line cord, of course.

The 5% ripple compares favorably with outputs of commercial dc power supplies used for battery charging, energizing solenoids, etc. It is even suitable for powering transistor radios and other circuits where slight hum modulation is not serious.

**Pure dc output**

Generally we rely on some L-C combination to do a good filtering job. At low voltages, capacitance is no problem. For example, a 1,000 uf 25-volt unit for C1 is small and cheap. Coils are another story. A coil to handle 1.5 amps or more is a special item. It would be bulky and expensive, for it must be wound with heavy wire. You are probably aware that a transistor saturates when supplied with sufficiently high collector voltage at rather low base current. For example, increasing collector voltage from 6 to 8 (33%) may produce a rise in current from 0.5 to 0.92 amps (4%). If the bias is nearly pure dc, the output will also be pure dc, despite considerable ripple in the collector supply voltage.

Fig. 2 shows the circuit for obtaining pure dc from regular dc. For unregulated (and variable) voltages switch S3 is thrown to UNREG.

Two RCA 2N301 transistors are used to filter the output. The bases of V1 and V2 are fed through an R-C measure input to only one transistor, so it should indicate approximately half the total current shown by the other ammeter. R3 is placed in series with the base of the transistor supplying more than its share of power (V2 in this case). This R3 so that V1 and V2 divide the load equally. This should be done while nearly maximum current (for example, 1.5 amps) is drawn.

The bias filter network R1, R2, C2 is not critical. R1 affects output and ripple to some extent. If reduced in value, it provides greater output but tends to raise the ripple. R2 controls regulation and output. If its value is decreased, the output drops while regulation (and overall current) improves slightly. The values for R1 and R2 shown in Fig. 2 were found to be optimum. A 1.5-amp fuse protects the transistors.

The photos show how the transistors mount directly to the chassis. The metal conducts heat from the transistors, keeping their temperature to a minimum. Each 2N301 is mounted with a pair of 6-32 machine screws. The

Flange (collector connection) of each transistor thus returns to negative potential, and the metal case serves as a heat sink. On the inside of the box, a nine-pin miniature socket plugs onto the transistor pins. Use pin 5 for the base and pin 2 for the emitter of each transistor. For convenience, each socket may also be screwed down to the box from the inside. In this way you may remove either transistor at any time (for test or temporary use elsewhere) merely by removing the machine screws and unplugging the 2N301. The transistor can always be returned by screwing it back to the box.

**Using the power supply**

When operated near maximum output, the transistors will become warm to the touch, but they should never be too hot to hold. Both should be at nearly the same temperature if they are sharing the load equally. At a flange temperature of 80°C, a 2N301 can dissipate up to 7.5 watts so it is ideal for the application described here.

**Regulated dc**

The unregulated supply provides nearly 18 watts of pure dc, and since the output is variable it can be adjusted for the load. Sometimes, however, load fluctuations considerably, yet it is desired that the voltage remain nearly constant. A Class-B amplifier is such a load. When switched to REG, the circuit of Fig. 2 delivers a regulated voltage. Greater silicon reference diodes, Texas Instruments 6525C, are connected in series. These are rated at 6.3 volts each, so the total regulated voltage will be approximately 12.6. Actually, Texas Instrument diodes are available in steps of 0.1 volt so you can use any type that regulates close to 6 volts

R4 controls current through the diodes and may need careful selection. With the load terminals open, maxi-
CORRECTION

In the parts list for the TV sound tuner (June, 1957, page 46) the dimensions of the forms for L1 and L2 are erroneous. The forms (Cambridge Thermionic Corp. type LS9 or equivalent) are ¾ inch in diameter and 1½ inches long. The number of turns and the winding lengths are correct as given in the parts list.

END

Spectacular...new Tape System Components

PENTRON

Select the Tape units to meet your needs

Pentron combines professional features and custom styling with build-in-block flexibility. You buy what you want and add to your system when you desire—from the simplest monaural system to the all inclusive stereo systems.

PENTRON LEADERSHIP FEATURES

Precision made and tested professional head assembly with Azmurb-X spring loaded screw adjustment.

Simple single rotary control.

Four outputs plus two AC convenience outlets.

Mounts VERTICALLY, horizontally, or at any angle.

Speed change lever at front panel.

Removable pole pieces in heads, as easy to change as a phono needle.

Automatic self-energizing differential braking.

Basic Specifications

TM Series mechanisms

Combination Head:
Frequency response: 40-14,000 cps with proper equalization. Signal to Noise: 55 db with CA units. Track width: 0.25" gap width: 1/4 mil; impendance of record section: 6000 ohms; inductance of erase rod: 60 mH.] STACKED HEAD: 1/2" track width: 0.080" gap width: 0.25 mil; impedance: 5500 ohms • FLUTTER: under 0.4% at 20,000 cps. under 1% at 3 ips. • CAPSTAN DRIVE: 200 rpm • MOTOR: 4 pole induction type. Inductance balanced. OUTPUTS: 6 standard pin jack outputs to accept shielded signal plus 4 convenience outlets: two auxiliary AC outlets controlled by mechanism power switch. Supplied with removable mounting brackets with shock mounts.

Preampifiers

CA-11 Tape Playback only. Response: 20-20,000 cts. Signal-to-Noise: 56 db


ALL CA UNITS HAVE SAME PHYSICAL DIMENSIONS AND REQUIRE SAME CUTOUT.

MEAR PENTAPE RECORDED TAPES—"GREATEST SOUND EVER FOUND"

Send brochure on tape components

PENTRON

779 S. Tripp Avenue
Chicago 24, Illinois

Canada: Atlas Radio Ltd. Toronto

Name

Address

City & State

OCTOBER, 1957
PUBLIC attention has been focused sharply on the hazards of transformerless electronic equipment by the electrocution of a 6-year-old boy, Howard Erenstein Jr., of Skokie, Ill. He apparently brushed his bare leg or other part of his body against the metal stand of a 17-inch portable TV while reaching for a knife in the drawer of a sink cabinet.

The danger is not confined to TV receivers. On the same day a musician, Wm. Sennett of London, England, was killed by his own electric guitar. Nor is it rare. Within the last few months another small child—a 4-year-old boy—was killed while crawling under a TV set stand. Appearing in a local paper the event did not receive the burst that followed the accident in a Chicago suburb. Local papers continually carry stories of people being killed by wire antennas attached to ac-de receivers, by receivers falling into bathtubs, etc. A compilation of the annual deaths caused by household electronic and electric equipment would produce what might truly be called a shocking total.

What's it all about?

What causes the danger and why is transformerless or portable equipment so often mentioned? Equipment with transformers, it is true, can become defective and cause accidents, but the danger is not as great.

In the home, electricity is usually brought in on two conductors, at about 117 volts. One of the two conductors is grounded close to the point the electric lines enter the house. This is in itself a safety measure, but has one drawback. The ungrounded or hot wire can form a circuit with any object connected to earth (Fig. 1). Your radiators, washstands, sinks, furnaces, water and steam pipes and even such small objects as the switch plates on the walls can become—with the hot lead—part of an electric circuit.

Probably the world's most dangerous piece of electronic equipment is a small hot-chassis type ac-de radio removed from its case. If the attachment plug is inserted in the wall receptacle in one direction, there is a difference of 117 volts between the chassis and any grounded object. If the plug is turned around, the chassis is at ground voltage and quite harmless (Fig. 2). But if the chassis is hot, any person who touches it and any grounded object at the same time is across the electric line. The part of the body in the circuit and the amount of moisture on the skin determine that person's chances of survival.

If the path is through vital organs—as from one hand to the other or (as in the Skokie case) from a leg through the body to the one arm—the result is likely to be fatal. Very dry skin may act as a partial insulator, but damp skin lowers resistance dangerously.

In transformerless TV and radio equipment, one side of the circuit is directly connected to one side of the electric line. In much of such equipment, the metal chassis on which the components are mounted is part of that circuit—in some others a single lead or bus—usually forming the negative-de lead of the circuit as well—is connected directly to the ac line. This bus is often connected to the chassis through a small capacitor shunted by a large resistance, to increase operational stability. In

(Continued on page 109)
Build the Best—Build ALLIED knight®-kits

the finest electronic equipment in money-saving kit form

LOWEST COST
ALLIED'S giant buying power passes biggest savings on to you—you do the easy assembly and your finished instrument equals the performance and appearance of equipment selling for several times the low KNIGHT-KIT cost. Your savings are BIG.

EASIEST TO BUILD
KNIGHT-KIT "Step-and-Check" instruction manuals with wall-sized picture diagrams are marvells of clarity—it's like having a good instructor at your side. No experience required—you can easily build any KNIGHT-KIT and get professional results.

LATEST DESIGN
Each ALLIED KNIGHT-KIT incorporates the very latest circuitry for top-quality performance. Tried and proved professional design and the use of premium quality parts throughout help insure your building success to bring you quality results.

MONEYBACK GUARANTEE. When properly assembled, KNIGHT-KITS fully meet published specifications or we refund your money in full.

High Fidelity Everyone Can Afford

- World's Finest Hi-Fi Kits
- Custom-Styled
- Easiest to Build Hi-Fi
- Money-Saving

Knights-kit High Fidelity FM-AM Tuner Kit

Model Y-77
$49.95

Only $4.99 down

The best-looking, best-performing FM-AM tuner kit your money can buy! Carefully designed for quick, easy construction—a tuner you'll enjoy assembling and be proud to own, both for its amazing musical performance and outstanding beauty. Covers the full AM broadcast band and 88 to 108 mc FM. On FM, sensitivity is a remarkable 2.6 microvolts for 20 db of quieting; hum and noise, -60 db; IF bandwidth, 200 kc at 50% down on curve; response, ± 0.5 db, 20-20,000 cps. On AM, sensitivity is 3 microvolts for 10 db signal-to-noise ratio; IF bandwidth, 8 kc at 50% down on curve; response, 20-8000 cps. Outstanding features include: Inertia Flywheel Tuning for effortless, accurate tuning; Automatic Frequency Control (plus AFC disabling) to "lock-in" FM stations; printed circuit board (with most of the kit wiring already done for you) assures time-saving, error-free assembly; pre-aligned RF and IF coils; tuned RF stage on FM; drift-compensated oscillator; neon glow tuning pointer; cathode follower output; two output jacks—one for recorder, one for amplifier; rotatable built-in ferrite antenna for AM. Includes beautiful French-gray case with chrome-finished tapered feet, 4 x 13 x 8". Ideal for use with 18, 20 or 20 watt KNIGHT-KIT amplifiers. Ready for easy assembly. Shpg. wt., 12 lbs.

Model Y-77T. FM-AM Tuner Kit. Net only.................$49.95

Our 37th Year

Order from ALLIED RADIO

100 N. Western Ave. • Chicago 80, Ill.

Easy Terms to Fit Your Budget. ALLIED KNIGHT-KITS may be purchased under our Easy Payment Plan. Your order must total only $45.00 or more—only 10% down, small monthly payments thereafter. No red tape—fast handling assured.
**knights-kit 30-Watt Complete Hi-Fi Amplifier Kit**

**Model Y-762**

- $76.95
- Only $7.69 down

Comparable to the best in Hi-Fi—at far less cost! Deluxe features include: Linear-deluxe Williamson-type circuit for flawless response; equalization for all records within ½ db of recommended accuracy; 2 exclusive new printed circuit switches in preamp section (no complex wiring to do); 3 printed circuit boards for time-saving, error-free assembly; separate, continuously variable Level and Loudness controls; use of premium 12AY7 tube for low noise and hum; DC on all filaments of preamp tubes; exclusive A-AB-B speaker selector switch (use speakers of mixed impedances without mismatch). 8 inputs: Tape Head direct; G.E. and Pickering cartridges; Ceramic cartridge; Microphone; Auxiliary; Tape Preamp; Tuner (with separate Level Set control). Power amplifier response, ± ½ db, 15-100,000 cps at full 30 watt level; distortion—harmonic, 0.55% at 30 watts—1M, 0.74% at 20 watts. Separate Bass and Treble controls; rumble filter switch; variable damping. Output, 8 and 16 ohms. With smart French-gray cabinet, 4 x 15 x 15”. Ready for easy, money-saving assembly.

Model Y-762, 30-Watt Hi-Fi Amplifier Kit. Net only .................. $76.95

---

**knights-kit High Fidelity FM Tuner Kit**

**Model Y-751**

- $38.95
- Only $3.69 down

Here is top value in creative engineering, impressive hi-fi performance and distinctive design—a tuner you'll be proud to build and own. Covers the full FM band, 88 to 108 mc. Features Automatic Frequency Control (with disabling feature) to “lock-in” stations and prevent drift; Inertia Flywheel Tuning for velvety-smooth, accurate station selection; pre-adjusted RF coils; pre-aligned IF's; cascade broad-band RF amplifier; drift-compensated oscillator; needle bath pointer. All critical wiring is already done for you in the form of a printed circuit board—assembly is simple. Sensitivity is 4 microvolts for 20 db of quieting across entire band; output, 2 volts at 1000 microvolts input; IF bandwidth, 200 kc; response, 20-20,000 cps. with only 0.6% distortion. Output jacks for amplifier and tape recorder; cathode follower output. Ideal for use with the KNIGHT-KIT amplifiers, or any amplifier with phono-tuner switch. Features custom-styled case in French-gray, with tapered chrome-finished feet, 4 x 13 x 8”. Includes all parts, tubes and step-by-step instructions for easy assembly. Shpg. wt., 12 lbs.

Model Y-751, Hi-Fi FM Tuner Kit. Net only .................. $38.95

---

**knights-kit Deluxe 3-Way Speaker System Kit**

**Model Y-337**

- $89.50
- Only $8.95 down

Deluxe quality high fidelity speaker system at a money-saving low price. Easy to assemble—all you need is a screwdriver. System includes KNIGHT “Quik-Craft” corner-type folded-horn enclosure kit, and the famous-value KNIGHT 3-Way 12-inch speaker. Just assemble the enclosure—no finishing required—all surfaces are finished in hand-rubbed Korina blonde, mahogany or walnut. The speaker is the new 3-way type: 12” woofer cone for bass (full 1¼ pound woofer magnet), conical radiator for mid-frequencies, built-in compression-type tweeter (with wired level control and calibrated dial) for highest frequencies. Unexcelled enclosure efficiency and superb speaker performance combine to cover the whole spectrum of audible sound for true hi-fi response from 35 to 15,000 cps, ± 3 db. Kit includes 12” 3-Way speaker, prefinished enclosure panels, grille cloth, hardware and instructions. Specify Korina blonde, mahogany or walnut when ordering. Shpg. wt., 44 lbs.

Model Y-937, 3-Way Speaker System Kit. Net only .................. $89.50

---

**knights-kit 10-Watt Hi-Fi Amplifier Kit**

**Model Y-753**

- $23.50
- Low-cost, authentic hi-fi amplifier. Response, ± 1 db, 50-20,000 cps. Input for crystal phono or tuner; chrome-plated chassis is punched for preamp kit below, to permit use of magnetic phone. Only 0.5 volt drives amplifier to full output. Separate bass and treble controls. Only ½% harmonic distortion. Matches 8-ohm speaker. 7 x 13 x 6”. With all parts, tubes and instructions. Shpg. wt., 13 lbs.

Model Y-753. Net only .................. $23.50

Model Y-753A, Deluxe Kit. Net only .................. $3.10

Model Y-757, Metal Cover .................. $3.95

---

**Allied Radio**

America's Pioneer in Electronic Kits
THE VERY FINEST MUSICAL QUALITY—SO EASY TO BUILD
MONEY-SAVING HI-FI EVERYONE CAN AFFORD

So Easy To Build
Anyone can build KNOTT-KIT Hi-Fi.
No experience required to get top results!

**knight-kit High Fidelity Preampifier Kit**

Model Y-754

$39.95

* Exclusive Printed Circuit Switches and Boards
* Equalization ± 0.5 db of Recommended Accuracy
* 8 Inputs including Tape Head + Self-Powered
* DC on All Tube Filaments + Custom-Styled

Sensational Hi-Fi design at amazing low cost. Provides precise record equalization guaranteed within 0.5 db of recommended accuracy!—more accurate than all but the most expensive factory-built preamps.

Includes exclusive new 1/24 Yt printed circuit switches for easy, error-free assembly; 2 printed circuit boards eliminate all other wiring, except for power supply and control leads—so easy to build. Has built-in power supply; includes premium 12AQ7 and ECC82 tubes.

Frequency response: ± 0.5 db; 10-50,000 cps. Has 8 inputs: Tape Head; G.E. Phone; Pickering Phone; Ceramic; Microphone; Auxiliary; Tape Preamp; Tuner. Level adjustment for tuner input. Includes separate Bass and Treble controls; separate Level and Loudness controls; Rumble Filter switch; DC on all tube filaments; cathode follower output; 2 extra AC outlets. You get every advanced hi-fi feature in this easy-to-build preampifier at the lowest possible cost.

Includes beautiful custom-styled French-gray case, with tapered chrome-finished legs, 4 x 13 x 8 1/2". With all parts, tubes, step-by-step instructions; ready for easy assembly. Shpg. wt., 12 1/2 lbs.

Model Y-754. Hi-Fi Preamp Kit. Net only...$39.95

**knight-kit 25-Watt Hi-Fi Basic Amplifier Kit**

Model Y-755

$44.50

* Hi-Fi Response, ± 0.5 db, 10 to 120,000 cps
* Only 0.15% Distortion at 30 Watts Output
* Printed Circuit Wiring Board + Chrome-Plated Chassis
* Williamson-Type Circuit with OVER 25 Watts Output

Here's superb Hi-Fi performance at less than half the cost of a comparable commercially-assembled unit. Williamson-type linear-deluxe circuit delivers over 25 watts of virtually undistorted reproduction. Ideal for use with the KNIGHT-KIT preamp at left. Includes printed circuit board for simplified, error-free assembly. Remarkable hi-fi response: ± 0.5 db, 10-120,000 cps at 20 watts. Harmonic distortion, 0.15% at 30 watts; 1.14% at 20 watts. Hum level, 5 db below 25 watts output. Output impedances, 4, 8, and 16 ohms; output tubes, 25881. Includes balance control for precise matching of the output tubes; variable damping control for maximum performance with any speaker system—prevents low-frequency distortion from overdamping or underdamping. Very attractive black and chrome styling, 8 1/2 x 14 x 9". An outstanding engineering achievement in a basic hi-fi amplifier, delivering performance equal to the finest commercially-assembled units. Includes all parts and tubes; with step-by-step instructions, ready for easy assembly. Shpg. wt., 25 lbs.

Model Y-755. 25-Watt Amplifier Kit. Net only...$44.50

Y-759. Metal Cover for above; black finish. 5 lbs. Net...$4.25

**knight-kit 2-Way Hi-Fi Speaker System Kit**

Model Y-789

$49.95

* Easy to Assemble—Pre-Finished Enclosure
* High Fidelity Response, 45 to 14,000 cps
* 12" Woofer and Horn-Type Tweeter
* A Wonderful Money-Saving Speaker Value

BIG SAVINGS—assemble your own quality knight-kit 2-way speaker system—it's quick and easy! The cabinet is pre-finished in full-grained, high luster blonde or mahogany—you just assemble 7 pieces, mount the speaker components and enjoy rich, thrilling hi-fi sound—at incomparably low cost. Special Jensen-engineered baffle features "ducted port" construction to bring out the full beauty of bass notes, perfectly matching the Jensen woofer and compression tweeter; genuine L-pad control is rear-mounted to permit adjustment of tweeter for best tonal balance. Impedance, 8 ohms. The assembled unit delivers a frequency response of 45 to 14,000 cps. Enclosure measures 26 x 10 x 14". Beautifully styled to blend in any room. Kit includes Jensen 12" woofer, Jensen compression-type tweeter, prefinished wood parts (with grille cloth installed), acoustic material, glue, hardware and step-by-step instructions. Absolutely no furniture finishing required. Specify blonde or mahogany finish when ordering. Shpg. wt., 110 lbs.

Model Y-789. 2-Way Speaker System Kit. Net only...$49.95

www.americanradiohistory.com
Fascinating ALLIED knight-kits
FOR EXPERIMENTERS AND HOBBYISTS

** knight-kit 2-Transistor Pocket Radio Receiver Kit**
Model Y-162
- Price: $14.65
- Loud, Clear Local Reception
- Lowest Printed Circuit Board
- Built-in Loop Antenna
- Complete Kit—Nothing Else To Buy

It's fun to build this pocket-size two-transistor radio — and you'll enjoy its crystal-clear local broadcast-band reception wherever you go! Fits in your pocket, or with its button-down flap, can be worn from your belt. Completely self-contained with built-in ferrite loopstick antenna — no external antenna needed. Extremely efficient, this kit is Type 2-transistor circuit actually does the work of 3 transistors! Printed circuit board reduces building time to about one hour. Has air-dielectric variable capacitor for easy, accurate station tuning. Operates for months and months on long-life alkaline battery supplied. Sensitive miniature earpiece provides crystal-clear tone. Handsome tan carrying case, plastic-impregnated, is styled to resemble leather; only 4½ x 3½ x ⅛”. Kit includes all parts, transistors, earpiece, battery and case. Shpg. wt., 1¾ lbs.
Model Y-262. Not only $14.65

** knight-kit "Trans-Midge" Transistor Receiver Kit**
Model Y-167
- Price: $2.45
- Tiny, cigarette-puck-size one-transistor radio kit—fascinating to build — so low-priced. This novel miniature receiver will provide endless listening pleasure the moment assembly is completed. Covers the local AM broadcast band with exceptional sensitivity and selectivity. Special features include: Efficient, slug-tuned coil for excellent station separation; external knob for easy station tuning; low-drain transistor; operating for months from single penlight cell supplied; hinged-back, red plastic case. Kit includes all parts, transistor, battery, complete case and easy-to-follow instructions for quick assembly. (External antenna and headphones required.)
Model Y-167. Net only $2.45
J-149, 4000 Ohm Headphones. 1 lb. $2.15
C-100, Antenna Kit. 1½ lbs. $1.03

** knight-kit 10-Circuit Transistor Lab Kit**
Model Y-239
- Price: $15.75
- Sensational experimenters' transistor kit—an electronic marvel! Perfect for experimenter, student or hobbyist. Assemble basic parts once, then complete project after project (10 in all), by simply plugging leads into proper jacks on printed circuit board—no wiring changes needed. You learn how transistors operate by "plugging in" to make any one of the following circuits: AM radio for strong headphone reception; built-in audio amplifier; wireless broadcast; code practice oscillator; electronic timer; electronic switch; electronic flasher; photoelectric relay; voice-operated relay; capacity-operated relay. Includes all parts, 2 transistors, battery, headphones, circuit leads, relay, photocell, special guide cards for each project, explanation of each circuit. 3 lbs.
Model Y-299. Net only $15.75

** knight-kit 5-Transistor Superhet Personal Portable Radio Kit**
Model Y-166
- Price: $29.95
- Stylish to Equal the Finest
- Push-Pull Audio Drives 3½" Speaker
- Printed Circuit for Easy Building
- 200 Hour Battery Playing Life

Beautiful, easy-to-build transistorized personal portable with every ultra-modern design feature: 5 Texas Instrument Co. transistors; latest printed circuit chassis for easy, error-free assembly; bigger-than-average 3½" speaker; class B push-pull audio output; built-in high-gain ferrite loopstick antenna; plus phone jack output for private listening. Provides sensitive reception of the AM broadcast band with exceptional tone quality. Ultra-smart high-impact ivory plastic case has handsome gold trim with ebony accents; includes pull-out handle; only 7½ x 3½ x 1¼". With all parts, transistors, 9 volt transistor radio battery, carrying case and instructions anyone can easily follow. Shpg. wt., 2 lbs.
Model Y-166. Not only $29.95

**1-Transistor Radio Kit**
- Price: $3.95
- Offers excellent AM local broadcast headphone reception. Printed circuit board for easy assembly. Operates from single penlight cell for months. Complete with all parts, transistor and penlight cell. (Antenna and headphones required.)
Model Y-765. Net only $3.95

**"10-In-One" Electronic Lab Kit**
- Price: $12.65
- "10-In-One" Electronic Lab Kit
$12.65 Famous experimenters' kit. Builds any of 10 fascinating projects, including broadcast receiver, wireless phone oscillator, code practice oscillator, signal tracer, relay, etc. Shpg. wt., 5 lbs.
Model Y-265. Not only $12.65

**"6-In-One" Electronic Lab Kit**
- Price: $8.45
- "6-In-One" Electronic Lab Kit
$8.45 A favorite with beginners. After basic wiring is completed, you make circuit changes without soldering. Builds any of six favorite projects, including radio, wireless broadcast, etc. Shpg. wt., 3 lbs.
Model Y-770. Not only $8.45

**Crystal Set Hobby Kit**
- Price: $2.15
- Entertaining, educational
Delivers clear headphone reception of local broadcast stations. With all parts, ready for easy assembly. (Antenna and headphones required.)
Model Y-261. Not only $2.15

**Wireless Broadcaster Kit**
- Price: $9.50
- Play music or make announcements through your radio set — no connection to set required! Loads of fun—easy to build. Works up to 50 feet from set.
Model Y-705. Not only $9.50

ORDER FROM ALLIED RADIO
100 N. WESTERN AVE. • CHICAGO 80, ILL.
FUND TO BUILD...INSTRUCTIVE... LATEST CIRCUITS FOR TOP PERFORMANCE

WIDEST CHOICE OF QUALITY HOBBYIST KITS

**Knight-kit Photoelectric Relay Kit**

Model Y-702

Advanced-design, ultra-sensitive photoelectric relay—build it yourself and save! Dozens of uses: for automatic control of lights, door announceur, burglar alarm, counting devices, etc. Provides dependable operation up to 250 feet with white light, up to 125 feet with "unseen" light (red filter) from Light Source Kit listed below. Selectable operation, with "trip" for burglar alarm to provide continuous ringing of alarm; and "auto" if relay is to operate each time beam is broken (for chimes, counting devices, etc.). Has SPST relay operated by thyratron. 6-3 v. terminals provide power for accessories. For 105-120 v. 50-60 cy. AC use, 6 lbs.

Model Y-702, Relay Kit. Net only...$13.50

Model Y-703, Light Source Kit. With bulb and red filter. Shpg. wt., 0.15 lbs. Net...$6.75

**Knight-kit "Ocean Hopper" All-Wave Radio Kit**

Model Y-740

This top-performing regenerative receiver puts a world of listening pleasure at your finger-tips. Tuning range (using coils listed below) is virtually world-wide; covers 155 ke to 35 mc, including every type of radio transmission: AM broadcast, marine aircraft, distress channels, direction-finding. Amateur, frequency standard, foreign broadcast, and police. With hand-tuned tuning. For use with headphones or 3-4 ohm PM speaker. Kit is supplied with standard broadcast band coil and all tubes and parts. \( \text{Net: } \$$11.95 \) Y-746, Cabinet for above. \( \$$2.90 \)

Extra coils available: Long Wave Coil (1.25-410 kcs). \( \$$11.50 \).

Model Y-740. Not only...\( \$$11.95 \)

Model Y-747. Cabinet for above. \( \$$2.90 \)

Model Y-746. Net only...$14.75

Model Y-747. Cabinet for above. Shpg. wt., 0.8 lbs. Net...$2.90

**Knight-kit "Space-Spanner" Bandswitching World-Wide Radio Kit**

Model Y-243

Broadcast or Short Wave Reception

Sensitive Regenerative Circuit

Convenient Bandspread Tuning

Built-In Loudspeaker

Imagine the thrill of hearing overseas broadcasts on a precision receiver you've built yourself—and then, at the flip of a switch, being able to tune to your favorite local broadcast station! Bandswitch selects exciting short wave, including foreign broadcasts, amateur calls, aircraft, police, and marine radio on the 6.5 to 17 mc range, as well as standard 340-1700 kc broadcasts. Features highly sensitive regenerative circuit. Includes built-in 4" PM speaker and beam-power tube for strong volume and clear tone. Headphone connectors are available for private listening; switch cuts out speaker. Controls: Bandspread, Main Tuning, Antenna Trimmer, Bandswitch, Regeneration, Volume. \( \times10 \)

Easy to build from step-by-step instruction manual. For 110-120 v., 50-60 cy. AC or DC. \( \$$5.85 \)

Model Y-243. Not only...\( \$$15.95 \)

Model Y-247. Cabinet for above. Shpg. wt., 0.8 lbs. Net...$2.90

**"Ranger II" Superhet Receiver Kit**

Model Y-255

Low Cost—Easy to Assemble

High Gain—Clear Tone

Handsome Metal Cabinets

Includes 50-Foot Cable

Easy to build at lowest cost—ideal for home, office, shop or school. Consists of Master unit and Remote unit. Remote unit may be left "open" for answering calls from a distance, for "baby sitting", etc. Remotes also may be set for "private" operation—cannot be "listened-in" on, but it can be called and can originate calls. Master unit includes high-gain 3-stage amplifier, combination volume control and on-off switch, plus pilot light. Each unit has 4" PM dynamic speaker. System responds to a whisper. Handsome Antique white cabinets, each 4% x 15% x 4%". With all parts, tubes and 50-ft. cable (up to 200-ft. may be added). For 110-120 v., 50-60 cy. AC or DC. \( \$$5.85 \)

Model Y-255, Master and one Remote. Not only...$14.75

Model Y-256. Extra Remote Station Kit. 3 lbs. ...$3.75

**Phono Amplifier Kit**

Model Y-790

Build it yourself—and save! Ideal for use in a portable phonograph—just add record player and 3-4 ohm speaker. 15a watts output. Inverse feedback circuit. Easy to assemble. Shpg. wt., 3 lbs. \( \$$9.45 \)

Model Y-790. Not only...$9.45

**Electronic Photoflash Kit**

Model Y-244

Ideal for color or black and white photography.

1,700Rohm of a second flash; 50 watt/second output. Synchronizes with any camera with X or O shutter. \( \$$28.50 \)

Model Y-244. Not only...$28.50

**Code Practice Oscillator Kit**

Model Y-239

Ideal for beginners learning the code. Transformatoried circuit. Operates for months from single penlight cell supplied. Clear crisp 500 cycle tone. Jacks for headphones; screw terminals for key. \( \$$3.95 \)

Model Y-239. Not only...$3.95

**Phono Oscillator Kit**

Model Y-760

"Broadcasts" recorded music through any standard radio set up to 50 feet away. No direct connection to set required. Easy to build—fun to use. Shpg. wt., 2 lbs. \( \$$5.85 \)

Model Y-760. Not only...$5.85
Better By Far— ALLIED knight-kit QUALITY TEST INSTRUMENTS

**knight-kit Low-Cost Tube Tester Kit**

Model Y-143

$29.75

- With 16 Filament Voltages
- 600 Latest Tube Types Listed
- Easy-to-Read 4½" Meter
- Tests Series-String TV Tubes

Expertly designed for complete, up-to-date coverage of tube types. Tests series-string TV tubes; tests 4, 5, 6 and 7 pin large, regular and miniature types, octals, octalas, 9-pin miniatures and pilot lamps. Tests for open, short, leakage, haster continuity and performance (by amount of cathode emission). Big 4½" square meter has clear "GOOD-? REPLACE" scale. With line-voltage indicator and line-adjust control. Choice of 16 filament voltages from 0.63 to 117 volts to check virtually all receiving tubes; blank socket for future type tubes. Universal-type selector switches permit selection of any combination of pin connections. Single-unit, pre-assembled 10-level function switch simplifies and speeds assembly. Up-to-date illuminated roll chart lists over 600 tube types. Counter model case. 5 x 14 x 10". Easy to build. 14 lbs.

Model Y-143. Not only...

Y-142. Portable Case model. 15 lbs. Net...

Y-141. Picture Tube Adapter. 1 lb. Net...

$4.25

**knight-kit RF Signal Generator Kit**

Model Y-145

$19.75

Build this wide-range, extremely stable RF signal generator—save two-thirds of the cost of a comparable wired instrument! Large, semi-regular dial is clearly calibrated; range is covered in 5 separate bands for close accuracy in setting individual frequencies. Ideal for aligning RF and IF stages in radio and TV sets and for troubleshooting audio equipment. Delivers output on fundamentals from 160 kc all the way out to 112 mc; useful harmonics to 224 mc. Has built-in 400-cycle sine-wave audio oscillator for modulating RF; audio is also available externally. Features high-stability Colpitts circuit. Convenient jack for external modulation. Maximum audio output 10 volts; RF output over 0.1 volt on all ranges. Stop and continuous-type attenuator controls. Supplied with precision-wound coils that require no adjustment.

7 x 10 x 5". Shpg. wt., 11 lbs.

Model Y-145. Not only...

$19.75

**knight-kit Vacuum Tube Voltmeter Kit**

Model Y-125

$24.95

- 200 Jt Movement, 4½" Meter
- Includes AC, Peak-to-Peak
- Balanced-Bridge, Push-Pull Circuit
- ½ Film-Type Resistors

Top buy in an extremely stable, highly accurate VTVM. Easy to assemble—entire chassis is printed circuit board. Perfect for radio-TV service work, lab and Amateur use. Features low-leakage type switches; ½ film-type precision resistors; balanced-bridge, push-pull circuit (switch to any range without readjusting zero set); zero center scale and direct-reading db scale; polarity reversing switch. Ranges: Input Resistance, 11 mega; DC and AC rms, 0-5-15-50-150-500-1500; AC Peak-to-Peak, 0-4-14-40-140-400-4000; Response, 30 cycles to 1 mc; Ohms, 0-1000-10K-100K-1M; db, -10 to 0; -10 to -45. Includes all parts, tubes, battery, test leads and portable case. 7½ x 5½ x 4½". Easy to assemble. Shpg. wt., 6 lbs.

Model Y-125. Net only...

$24.95

Y-126. Hi Voltage Probe; extends DC to 50,000 volts...

$4.75

Y-127. Hi-Frequency Probe; extends AC to 250 mc...

$3.45

**Transistor Checker Kit**

$8.50

Checks gain ratio of all types of transistors; checks germanium and silicon diodes; checks for continuity and shorts. A valuable instrument at very low cost. Easy to assemble. Shpg. wt., 2½ lbs.

Model Y-149. Not only...

$8.50

**Flyback Checker Kit**

$19.50

Checks condition of all types of horizontal output transformers and deflection yokes, as well as TV linearity and width coils. 4½" meter; widest range in its field. Shpg. wt., 6 lbs.

Model Y-118. Not only...

$19.50

**Sweep Generator Kit**

$43.75

Extreme linearity on a par with costly lab instruments; fundamentals to 250 mc; output flat within 1 db; electronic blanking. Easy, money-saving assembly. Shpg. wt., 16 lbs.

Model Y-123. Not only...

$43.75

**Capacitor Checker Kit**

$12.50

Tests capacitors while in the circuit! Has widest range—20 mmf to 2000 mfd. Exclusive circuit for cancelling lead capacity. "Magic Eye" indicator. Save 60% over factory-wired units. 5 lbs.

Model Y-119. Not only...

$12.50

**6V-12V Battery Eliminator Kit**

$32.50

High current rating; continuously variable filtered output; delivers 15 amps at 6 volts, 10 amps at 12 volts. May be used as battery charger. Two meters provide simultaneous current and voltage readings. Shpg. wt., 18 lbs.

Model Y-129. Not only...

$32.50

**1000 Ohms/Volt VOM Kit**

Model Y-128

Exceptional accuracy and versatility at amazing low cost. Ideal for service shop, lab or Amateur use. Large 4½", 400 micromper meter with separate scales for AC and DC voltage and current, decibels and resistance. Uses 1½ precision resistors; has 3-position function switch and 12-position range switch. 88 ranges include: AC, DC and output volts, 0-1-5-10-50-500-500 (1000 ohms/volt sensitivity); Resistance, 0-1000-10,000 ohms and 0-1 meg (center scale readings of 60, 150 and 1500 ohms); Current: AC or DC, 0-1-10 100 ma and 0-1 amp. Decibels, -20 to +40 in 6 ranges. Precision resistors are used as shunts and multipliers to assure exceptional accuracy of measurements. With all parts, battery, test leads and black leatherette case with convenient carrying handle, 6½ x 5½ x 3½". A great value in an easy-to-build quality instrument. Shpg. wt., 2½ lbs.

Model Y-128. Not only...

$16.95

ORDER FROM

ALLIED RADIO

100 N. WESTERN AVE. • CHICAGO 80, ILL.

www.americanradiohistory.com
ADVANCED-DESIGN INSTRUMENTS FOR SERVICE, INDUSTRIAL AND RESEARCH USE IN EASIEST-TO-BUILD, MONEY-SAVING KIT FORM

**Knight-kit 20,000 Ohms/Volt VOM Kit**

Model Y-140  
Outstanding quality and performance at money-saving low price. Features 1% precision multipliers; 4½" meter accurate within 2% of full scale deflection; 50 microamp sensitivity for 20,000 ohms/volt input resistance on DC; front panel "Zero adjust"; single switch to select function and range; 32 ranges; AC, DC and output volts, 0-2.5, 10-20, 50-10000, 50000; Resistance, 0-2000-200,000 ohms and 0-20 meg.; DC ma. 0-0.1-10, 00; DC amps, 0-1-10; Decibels, 30 to ± 6.5 in six ranges. Moisture-resistant film-type resistors for extreme accuracy. Carefully designed circuit design achieves high sensitivity and extremely versatile application. Kit includes all parts, battery, test leads and black Bakelite case with highly legible white markings: size 6¾ x 5¾ x 3½". Easy to assemble. Shpg. wt., 5 lbs.  
Model Y-140. Net only.  
$29.50

**Knight-kit High-Gain Signal Tracer Kit**

Model Y-125  
A remarkable value in an easy-to-build instrument which permits visual and aural signal tracing of RF, IF, video and audio circuits. Has highest gain in its price class. Traces signal from antenna to speaker. Reproduces signal at plate or grid connection of any stage. Identifies and isolates "cloud" stages. Features: usable gain of 91,000; "magic eye" with calibrated attenuators for signal presence indication and stage-by-stage gain measurements; built-in 4" PM speaker; combination 2-position probe, one for RF (6 mv. input). The other for audio. Provides noise test: built-in watt-meter calibrated from 25 to 1000 watts; provision for external scope or VTVM. Binding posts provide output transformer and speaker substitution test, plus external 280 volts B+. With all parts, tubes and probe.  
Model Y-125. Net only.  
$26.50

**Knight-kit 5" General-Purpose Scope Kit**

Model Y-146  
- Phantastron Linear Sweep  
- 25 mv./inch Sensitivity  
- Printed Circuit Board  
- Retrace Blanking Circuit  

Feature for feature the world's best oscilloscope kit value. A stand-out in its class with all these fine features: Printed Circuit wiring board and laced harness for quick, error-free assembly. Phantastron Sweep Circuit for high linearity of sweep from 15 to 150,000 cps. 25 Millivolts Per Inch Sensitivity—3 times that of similarly priced scope kits. Calibration Voltage—1 volt peak-to-peak square wave, fully regulated. Vertical Amplifier—frequency response ± 3 db, 3 cps to 1.5 mc (± 0.6 db to 2.5 me). Includes: Directly coupled positioning controls; retrace blanking circuit; frequency-compensated vertical input attenuator; positive damping circuit; high 2nd-anode voltage for high-intensity trace; input capacity, 45 mmf. kit includes CRT. 91/4 x 131/2 x 171/4". 26 lbs.  
Model Y-146. Net only.  
$42.00

**Resistance Substitution Box**

Easily determines resistor values required in a circuit. Makes available 30 standard 1-watt resistance values in 2 ranges between 15 ohms and 10 megohms, with 10% accuracy. Slide switch selects range; 18-position switch for value selection. Shpg. wt., 2 lbs.  
Model Y-139. Not only.  
$5.95

**Capacitance Substitution Box**

Makes it easy to find capacitor values needed in a circuit. Provides 18 standard values from .001 mfd to .22 mfd, ± 20%. All values are 600 volt, except 15 and 22, which are 400 volt. 18-position selector switch. Shpg. wt., 2 lbs.  
Model Y-138. Not only.  
$5.95

**Audio Generator Kit**

Model Y-137  
Excellent design; range, 20 cps to 1 mc; less than .20% distortion; 600 ohm output. Ideal for hi-fi testing; offers the flat response of a lab standard. Shpg. wt., 16 lbs.  
Model Y-137. Not only.  
$31.50

**R/C Tester Kit**

Model Y-124  
Measures capacitance and resistance. Balanced-bridge circuit; indicates power factor, total capacitors at rated voltage. Large, easy-to-read dial and "magic eye. Shpg. wt., 10 lbs.  
Model Y-124. Not only.  
$19.50

Take advantage of the most liberal Easy Pay plans in electronics. On Knight-Kit orders totaling $45 or more—just 15% down, small monthly payments thereafter. Low carrying charges—no "red tape."
knight-kits FOR THE RADIO AMATEUR

knight-kit 50-Watt CW Transmitter Kit

Model Y-255

$38.95

Ideal for the Novice
PI Antenna Coupler
Bandswitching—80 to 10 Meters

There's an exceptional value in this very popular bandswitching transmitter kit. Compact and versatile, it's the perfect low-power rig for the beginning novice as well as the seasoned veteran. Has bandswitching coverage of 80, 40, 20, 15 and 10 meters. Rated at 50 watts—actually operates up to 60 watts on 80 and 40 meters. Oscillator is efficient 6AG7; final is reliable 807. Crisp, clean, cathode keying of oscillator and final. Built-in pi coupler permits use with random length antennas. Has highly effective TVI suppression. Other features not usually found in transmitter kits at this low price include: Ceramic-insulated final tank capacitor; pre-assembled switches; pre-wound parasitic chokes; ceramic coil forms; coax connector; crystal and VFO socket on front panel; power take-off jack for accessory equipment. Meter reads either plate or grid current of final. Takes crystal or VFO without circuit changes. Cabinet interior and chassis are copper-finished. Size, 9.5 x 105 x 8.5". With tubes and all parts for easy assembly. (Less crystal and key.) Shpg wt., 19 lbs.

Model Y-255. 50-Watt Transmitter Kit. Net only...$38.95

knight-kit Self-Powered VFO Kit

Model Y-725

$28.50

With built-in power supply! Careful design and voltage regulation assure high stability. Excellent oscillator keying characteristics for fast break-in without clicks or chirps. Full TVI suppression. Has plenty of bandspread; separate calibrated scales for 80, 40, 20, 15, 11 and 10 meters; vernier drive mechanism. 2-chassis construction keeps heat from frequency determining circuits. Output plugs into crystal socket of transmitter. Output: 40v on 80, 20v on 40. With Spot-Off-Transmit switch for spot frequency tuning. Extra switch contacts for operating relays and other equipment. Attractive metal cabinet, 9.5 x 6 x 6". Ready for easy assembly. Shpg wt., 8 lbs.

Model Y-725. VFO Kit. Net only...$28.50

knight-kit 100 Kc Crystal Calibrator Kit

Model Y-256

$10.50

Crystal frequency standard at very low cost. Gives marker every 100 kc up to 35mz. A "must" for marking band-edges. Mounting flanges for installation in or back of receiver cabinet. Size only 11 3/4 x 7 1/2". Requires 6.3 v. at 0.15 amp and 150-300 v. DC at 3.6 ma. Trimmer for zero-beating with WWV; Off-ON switch. Complete with tube, crystal, all parts and easy-to-follow instructions. Shpg wt., 1 lb.

Model Y-256. 100 Kc Crystal Calibrator Kit. Net only...$10.50

ALLIED RADIO

ALLIED RADIO, Dept. PF, 100 N. Western Ave., Chicago 80, Ill.

Ship me the following KNIGHT-KITS:

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Description</th>
<th>Model No.</th>
<th>Price</th>
</tr>
</thead>
</table>

$... enclosed. (For parcel post, include postage — express is shipped collect).

☐ My Down Payment in the amount of $... is enclosed. Send Time Payment form.

Name...

Address...

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

ALL PRICES NET F. O. B. CHICAGO.

FREE 1958 404-PAGE ALLIED CATALOG

See the 1958 ALLIED 404-Page Catalog for complete listings of more than 50 KNIGHT-KITS, covering Ams, Ham, and other Radios, Amateur Radio, SWR, and other Electronic Kits. The 1958 ALLIED Catalog is your complete Buying Guide to the world's largest stocks of everything in Electronic Kits. Send FREE 404-Page 1958 ALLIED Catalog.
What to do about it

A number of ways to make electronic household equipment completely safe have been proposed. The Chicago authorities have suggested making a three-wire system (Fig. 5) mandatory for transformerless sets. It is standard practice for small hand-held tools and appliances, and window air conditioners. A third wire is attached to the metal shell of the appliance and runs to a pin on a three-prong plug. It has been urged that the three-wire attachment lead presents a new hazard. Most householders do not hesitate to replace or splice line cords, even of they will not touch anything else electrical. With a three-wire cord, confusion and the possibility of wrong or dangerous connections might result. In spite of that, the three-wire line seems the surest approach to safety in home electronic and electrical equipment. The plan has one weakness. Practically no homes have the necessary three-wire receptacles and though a municipality could no doubt enforce a ruling that no equipment be sold unless fitted with three-wire plugs, it could not as easily compel homeowners to install the necessary three-prong receptacles.

This should not prevent the individual life-loving home owner from having receptacles installed for his own electronic and electrical equipment. It is comparatively simple to run a three-wire line for the average TV set. The third (grounding) wire may be attached firmly under a screwhead on the cabinet.

Some cheaper homes have been wired with a two-conductor flexible cable which makes no provision for grounding, and some older houses may be wired in the ancient knob-and-tube style, with the wires widely separated and run on porcelain standoff or through porcelain tubes. These systems do not normally have a ground lead and installing one is likely to be costly. Even worse are the cases where houses are provided with ungrounded armored cable. This happens and is the reason why all three-wire receptacles should be checked after installation to make sure the grounds are actually grounded.

An apparently safer proposal is to use two-prong polarized plugs. You may not be aware of it, but the chances are 10 to 1 that the receptacle on the wall nearest you is polarized—one slot is wider than the other. The wider is connected to the grounded wire of the electric system (or should be). Used with a polarized plug (one prong larger than the other) this would seem to mean that a TV or radio set could be so hooked up that the chassis would stay at ground potential. But one serious drawback stands in the way of this easy-looking solution.

The polarized plug would make a chassis safe if it were connected to the grounded side of the line at all times. Unfortunately, many pieces of equipment, including most small radio receivers and some TV sets, have the line switch between the set or chassis ground and the line. When the switch is opened, the connection to earth is broken and the whole set becomes hot (see Fig. 6). If this is done in the other side of the line (Fig. 6-b) so that the hot lead is disconnected when the switch is turned off, the equipment remains connected to ground and is safe.

Another suggestion is that an isolation transformer be used. This would presumably make the set safe, but in an awkward and expensive way. The suggestion presumes that the sets are inherently unsafe, which is not the case. The weight and bulk of an isolation transformer destroy the portability of a portable TV and the cost of a large isolation transformer is high ($15–$20).

TELEVISION

The technician's role

A more fruitful immediate solution is to insure that nothing in done to a TV set (or other piece of electronic equipment) that will make it dangerous. When the sets come from the factory, they are presumably safe. How do they become otherwise?

Two things can make a hitherto normal piece of equipment dangerous. One is internal breakdown, such as the shorting of a capacitor between a hot chassis and cabinet. The other is external damage or incorrect servicing. A cabinet can be dropped so that items that should be separated come into contact or the same result may be produced by careless servicing or inexpert tinkering by unqualified repairmen. The metal-cabinet sets, in general, have a hot chassis carefully separated from the cabinet by insulating washers or strips. A capacitor shunted by a high-ohmage resistor is usually installed between...
Draw to a Straight success with...
Fig. 6—Why a set can be safe turned on and dangerous turned off.

between the negative terminal of the circuitry (normally the chassis) and the cabinet, to prevent static charges, as pointed out previously. The antenna leads may be entirely isolated from the rest of the circuitry, or may have a pair of capacitors or capacitors shunted by resistors. In the General Electric M3—presumably the chassis involved in the Skokie accident—the arrangement is as shown in Fig. 7. Shorting of any of the capacitors can cause a hot cabinet.

More serious is the possibility of mechanical contacts. Where the chassis is held to the cabinet with screws inserted through tapped nylon inserts, a long screw may make contact with hot metal. Shorts may actually be introduced by tampering with antenna isolating networks.

One manufacturer recognized the problems of metal cabinets as long ago as the introduction of the 8-inch portable. Instructions to the service technician for replacing the chassis in the cabinet include:

Make sure the insulating boards have been placed in their proper positions. The boards are provided to prevent any thin metal object, which may fall or be inserted through the louvers, from coming in contact with high-voltage circuits or from causing a short circuit to cabinet. [Italics ours.]

More recent instructions—on current 17-inch portables—say:

The three insulating boards—one between the lower chassis and the printed circuit, another fastened to the bottom of the cabinet back and the third the disc around the fine tuning shaft must be replaced if removed for any reason. A final check should be made when servicing the receiver, to insure that no loose metal object is shorting between the receiver chassis and the cabinet. (RCA Service Data, 1957 No. 71.)

No similar warnings (other than the usual hot-chassis notice) have been found in other service data so far in—

Cause of the Skokie electrocution was a short through insulation to the 135-volt B plus lead of the television chassis, a jury of experts reported after examining the set. The cause was a combination of direct current and the 120-volt ac found to be present behind the inside cabinet and ground, the jury stated. Probable cause of the short was stated: "The jury believes that during the factory assembly the 135-volt direct current bus was accidentally wedged between the mounting bracket and the vertical holding control. The probability is very great that the deceased died of shock from simultaneously contacting the TV set and the grounded metal trim of the kitchen counter top."

OCTOBER, 1957

UNI-DIRECTIONAL

“MONOPLEX”

MODEL 737A

SEMI-DIRECTIONAL

“SONODYNE”

MODEL 51

You have your choice of three

SHURE moderated priced general-purpose microphones

BI-DIRECTIONAL

“GRADIENT”

MODEL 315

Where quality is essential, yet cost is a factor—you can rely on these SHURE Microphones

FOR PUBLIC ADDRESS • HOME RECORDING-COMMUNICATIONS • PAGING AND INTERCOM SYSTEMS

MODEL 737A "MONOPLEX": Uni-directional, moisture-proofed crystal microphone—reduces feedback by 67%. Can be used under adverse conditions of background noise where conventional microphones would be practically useless. "Humi-seal" Crystal for trouble-free operation even in humid climates. High impedance unit with excellent response to 10,000 cps. Output -54.0 db.

LIST PRICE $46.00

MODEL 51 "SONODYNE": Semi-directional, dynamic microphone. Switch for low, medium, or high impedance makes it three microphones in one! Ideal for recording and "close-talking" applications. Frequency response is 60-10,000 cps, Output -52.5 db. Unusually rugged microphone; can be used in any climate, indoors or outdoors.

LIST PRICE $49.50

MODEL 315 "GRADIENT": Bi-directional high fidelity microphone with multi-impedance switch. Picks up sound equally from front and rear; is "dead" at sides. Ideal for interview broadcasting or group recording. Frequency response 50-12,000 cps. Provides exceptional voice and music reproduction. Particularly useful in installations where feedback is a problem. Output -57 db.

LIST PRICE $85.00

All three units have rugged, die-cast metal cases and are finished in a rich satin chrome.

SHURE BROTHERS, INC.

Microphones ~ Electronic Components
212 HARTREY AVENUE • EVANSTON, ILLINOIS
"In Electronics Since 1925"

www.americanradiohistory.com
Some replacement capacitors may be physically larger, or slightly more costly, than the original capacitors used in a piece of equipment. Still it may be preferable to use these replacement capacitors which are not "exact", rather than obsolete the equipment because "exact replacements" are not available.

For example, one or more sections of a multiple unit can be left unconnected, if not needed, without affecting or impairing the capacity or useful life of the remainder of the units.

A separate tubular capacitor can be paralleled with any section of a multiple capacitor to create a capacity section not available in stock multiple units. The lowest voltage rating of the paralleled sections must not be exceeded!

Regardless of the circuit—you can count on Mallory capacitors to do any service job—right. See your Mallory Distributor, today, and lay in a working replacement stock.

TELEVISION

Expected, but there is little doubt that most service manuals printed in the future will carry very definite warnings and information on proper precautions to be taken when servicing such sets.

Summary

It is possible and necessary to increase the TV and radio safety factor greatly by following a few simple precautions:

Make sure that the insulating medium provided by the manufacturer is not removed or damaged during servicing. If it is damaged, replace it.

After the set is installed in the cabinet, make a visual check, then finally a check from cabinet to a known ground with an ac voltmeter, with the plug in both positions in the receptacle and with the power switch in both on and off positions.

Make sure that isolating networks, especially in antenna circuits where they are more likely to be disturbed, are intact. The cabinet-ground test will check the capacitors in these networks.

The service technician or technical set owner may under some circumstances take further steps to insure safety:

![Diagram](Fig. 7—Isolating networks in the General Electric M-3 chassis.)

If the power switch is found to be in the hot side of the line, a two-prong polarized plug may be attached, making sure, of course, that the large prong is on the chassis side; if three-prong receptacles can be installed, a three-wire lead may be used to ground the cabinet.

Sets may be placed well away from grounded objects like radiators, bathtubs or pipes. They can also be situated well away from windows, where rain may drive in the back and temporarily short insulating boards.

Sets should be inspected immediately after any damage, such as may be caused by tipping over a portable TV stand.

Obviously, the usual procedures, such
as checking for frayed line cords, should be observed and the fire hazard should not be ignored. Check for, and replace, oversize fuses and warn against installations in poorly ventilated places.

The technician may also perform another service of considerable psychological value. On completing work on a receiver, he can give the owner a statement that the equipment has been tested and found free from shock hazard. This may be typed out on the bill. At the present time, such a statement will carry considerable reassurance to the owner and may even be of value to the technician if an accident should occur some time after the equipment has been serviced.

END

REFERENCES


A BRUSH WITH DEATH

The greatest occupational hazard in TV servicing is the ever-present danger of a picture-tube implosion. Although it doesn't happen too often, most technicians know the hair-raising sensation when the neck of a tube cracks or snaps off.

This may happen while a chassis is being carried and the protruding neck is carelessly bumped against a door frame or in some cases during the installation or removal of a tube from a tight-fitting yoke.

In any event, the technician is usually in a precarious position and for several seconds can do little more than hold his breath and hope... as he listens to the tell-tale hiss of rushing air.

On one occasion, a near-victim was driving in a coupe with a 21-inch chassis and tube on the seat beside him. The speaker was resting directly behind him, near the rear window. At a sudden traffic stop the speaker fell forward and struck the picture tube.

Of course it was all over in a split second and the driver remembers nothing more than the boom of the implosion and the awareness of flying glass. When I saw him emerge from his car a few minutes later, his head was dripping blood and he staggered dazedly.

The inside of car was a shambles with broken glass everywhere, no one piece much larger than a half-dollar. The material damage was extensive: one yoke, one flyback transformer, eight tubes, one speaker, several items on the car's instrument panel and two windows. The latter, one on each side, were apparently shattered by the impact of the flying pieces of the ½-inch faceplate.

The remarkable thing is that the driver wasn't seriously injured. Within this area of bombardment he escaped with only a few superficial cuts, one being on the chin, only a fraction of an inch from the throat.—Charles G. Budsonbe
How Far Can You Go in Electronics Without a Degree?

Fred Gunther has no degree. Yet, today, at IBM, Fred is a Technical Engineer working on America’s biggest electronics project. His story is significant to every technician who feels that lack of formal training is blocking his road to the top.

Let’s go back to 1950 and watch Fred Gunther, at 18, as he goes about the business of determining his life’s work. Fred spent almost a year trying his hand at various jobs. None of these turned out to be the one that Fred wanted to devote his life to. So, still undecided about his career, Fred entered the Navy for a four-year hitch.

Fred learned something very valuable in the Service, as have many other men who eventually discover the electronics field. His aptitude tests revealed him as an excellent electronics prospect, and he received ten months’ training in electronics fundamentals and radar. Upon his discharge in 1955, he was an Electronics Technician, First Class.

Something even more important to Fred’s career occurred during his Service hitch. He began to hear such terms as “automation”... “data processing”... “electronic computer.” “Then, one evening, while glancing through the paper,” he recalls, “I spotted a story about Project SAGE.”
What is Project SAGE?
SAGE—Semi-Automatic Ground Environment—is part of America's radar warning system—a chain of defense that will ultimately ring our country's entire perimeter. At the heart of this system are giant electronic computers, which digest data filtered in from Texas towers, picture ships, reconnaissance planes, ground observers. The computers analyze this information for action by the Strategic Air Command and other defense units. These computers are the largest in the world. Each contains perhaps a million parts—occupies an entire city block. They are built for the Project by IBM.

Fred Gunther joined IBM
SAGE fascinated Fred, for it embodies the most advanced electronic concepts in giant computer work. And, when he learned that IBM would train him at full salary, plus a living allowance, to become a Computer Units Field Engineer, he seized the opportunity. Fred started his new electronics career in the IBM school, with twenty other technicians. He attended classes 8 hours a day. Courses consisted of some 20 subjects—computer circuitry and units, maintenance techniques—everything he would need to become a full-fledged Computer Units Field Engineer.

Assigned to McGuire AFB
His training completed, Fred was assigned in May, 1956, to McGuire Field, where the first of the giant SAGE computers is located. Here he assisted in the cable installation for this vastly complicated electronic giant. He helped to set up the computer, interconnect its many sections, check it out and make it ready for operation. Fred spent five months at McGuire Air Force Base, but his education was not yet completed.

Becoming a Computer Systems Engineer
"I like to think it was due to my interest and grade of work," Fred says, "but at any rate, last October I was invited to return to Kingston for further training—to become, in fact, a Computer Systems Engineer. Naturally, I was proud and pleased, for this training would give me a much greater range of understanding ... make me more valuable to the company and myself ... and give me a chance to assume actual engineering responsibility." Fred completed the Computer Systems course. After several months of outstanding work in his new capacity, he received a third promotion—to Technical Engineer—in a field engineering liaison group.

What does the future hold?
What does the future hold for Fred Gunther, now that he has become a Technical Engineer? "It's hard to even set a goal in a field as rapidly moving as this," Fred says, "but with my IBM training back of me, the future sure looks good. I've advanced from Radar Technician to Computer Units Field Engineer to Computer Systems Engineer to Technical Engineer in two years—and received a valuable electronics education besides!"

How about YOU?
Since Fred Gunther joined IBM Military Products and the Project SAGE program, opportunities are more promising than ever. This long-range program is destined for increasing national importance, and IBM will invest thousands of dollars in the right men to insure its success.

If you have 2 years' technical schooling—or equivalent experience—IBM will train you for 20 weeks as a Computer Units Field Engineer.

This intensive training leads to positions of unusual responsibility. Thousands of IBM electronic engineers, graduates of this course, can vouch for its effectiveness.

After training, you will be assigned to an area of your choice within the United States. You receive salary, not wages, plus overtime pay. In addition, every channel of advancement in the entire company is open, and IBM is a leader in a field that is sky-rocketing in growth. And, of course, you receive the famous IBM company-paid benefits that set standards for industry.

WHY NOT WRITE—today—to:
Mr. N. H. Heyer, Room 3110
Military Products Division
IBM Corp., Kingston, N. Y.?

You'll receive a prompt reply. Personal interviews arranged in all areas of the United States if your résumé of experience and education indicates you have the qualifications.

OMER, 1957

MILITARY PRODUCTS

- DATA PROCESSING
- ELECTRIC TYPEWRITERS
- MILITARY PRODUCTS
- SPECIAL ENGINEERING PRODUCTS
- SUPPLIES
- TIME EQUIPMENT

www.americanradiohistory.com
NOW, before we get back to this degaussing routine, remarked Fuzzball, "which do you do first, purity or convergence?"

"From a practical standpoint, you should make up your mind right away which you are going to do," Red observed.

"So, how do I make up my mind?" asked Fuzzball helplessly.

"Maddening, isn't it?" Red grinned. "All you do is to start on the one that is out the farthest."

"That makes sense," Fuzzball admitted, "but it gets confusing. One service manual I remember tells you to make good static convergence before and during purity adjustments — another tells you to make all the purity adjustments before going to the convergence controls."

Red stuck his tongue in his cheek. "If you listen to too many guys at the same time, you'll just make more business for the head-shrinker. In this racket you ought to try to get the general idea of what it's all about."

"The way I understand it, then, is like this," Fuzzball mused, "if the convergence looks pretty decent but the purity is for the birds, I start to bring in the purity first. Then I touch up the convergence and ought to have it made."

"You're so right," agreed Red. "And of course, sometimes vice is versa. If the purity happens to look about right but convergence is cruddy, then you work on convergence to start with, and end with purity touchup, in case it seems like there is room for improvement."

"Likewise and furthermore," suggested Fuzz, "if they are both out quite a ways, you might have to work back and forth several times between them."

"Sometimes I feel like there is really some hope for you," Red remarked admiringly.

"OK, never mind the compliments," Fuzz muttered; "let's get back to degaussing."

Red inhaled a thoughtful swig of java. "Well," he said, "first you got to get a degaussing coil. Some of the screwdriver mechanics tell me you can use the ac field from a soldering gun — personally I wouldn't know anything about that."

"You got me fogged," protested Fuzz. "What's a degaussing coil?"

"Just a large air-core coil that you plug into the 117-volt ac line," Red explained. "They are stocked by some jobbers, or you can make your own."

"Could I make a degaussing coil?"

"Sure thing. Any country boy can do it. Just wind 300 or 400 turns of magnet wire — about No. 22 or 24 — on a 12- or 18-inch circle and tape it up like a doughnut. Connect 8 or 10 feet of zip cord to the coil and you got it made."

"So how do I use it, in case the purity is bad on the picture tube?"

"That falls in the class of easy problems for easy boys," Red grinned.

"To listen to you," Fuzz protested sourly, "I would figure that I belong to the new generation of idiots."

"It's only one man's opinion," Red replied soothingly. "But seriously, the first thing you do is to remove the rim magnets from around the picture tube. In a Motorola set, you unsnap the magnets from their clips, and lay them aside while the tube is being degaussed. In an Admiral, you find the other type of rim-magnet arrangement — the rim magnets can be pulled back into iron cups or magnetic shunts. When the magnets are inside the shunts, there is no danger of demagnetizing them with the field of the degaussing coil."

"Suppose somebody forgets about the rim magnets?"

Red made a weak gesture. "As Confucius say, 'You have had it.' You will take so much magnetism out of the rim magnets that they won't do a job anymore."

"OK," agreed Fuzz, "I'll remember about the rim magnets. So how do I use the coil?"

"First try degaussing the tube from the front. Plug the coil into an outlet and hold it up in front of the screen for 20 or 30 seconds. Then back off slowly. When you are 6 or 8 feet away from the receiver, you can unplug the coil."

"Why this slow backing away before the coil is unplugged?" asked Fuzz with a puzzled look.

"Well, when you unplug the coil, there's going to be a spark at the contacts and a surge through the coil. It could leave the tube magnetized worse than when you started. You have to get far enough away that the surge won't affect the tube."

"Should the set be turned off?" asked Fuzz.

"Doesn't have to," replied Red, "although it could be called good practice. If you have the set on, you'll get a color pattern on the screen that's out of this world, in case you're the curious type."

"Then I recheck the purity?"

"Yep. Usually, the first treatment does it. In some cases, the tube or the tube shield or the chassis itself gets magnetized in a spot where the first treatment doesn't get it."

"What do I do when the ball bounces in that direction?"

"Well, then you have to get the degaussing coil down around the sides of the tube, and maybe under the chassis, too. But when you are working back on the tube, be sure to remove the beam magnets, lateral corrector magnet and purity magnets while you're using the coil. If you demagnetize them and have to come back to the shop for replacements, the boss will chew you out but good."

"I see where you got to use the coil with discretion," Fuzz admitted.

"You said a mouthful," Red agreed. "Just get careless once and lay the coil..."
TRANSMIT PICTURE and SOUND
AT ANY TIME—TO ANY TV SETS
Displays any pattern, picture, or message for TV servicing or for closed-circuit telecasting

Provides crystal-controlled, full color rainbow display for complete color TV testing

Provides FM sound carrier. Has built-in audio tone generator plus input for tape, tuner, mike

THE FLYING SPOT SCANNER produces a composite video and sync signal that operates any standard black & white or color TV receiver, at any VHF television frequency. Reproduces your own test pattern or picture on the TV screen with high definition, anytime, anywhere, from any slide transparency—or transmits messages typed or written on clear acetate. Can be used with one or more TV sets or fed into a master or community antenna system. Maximum resolution capability is well in excess of 450 lines at video.

BUILT-IN COLOR-SCAN provides crystal-controlled, full color rainbow display of orange, red, magenta, blue, cyan, green. Enables you to test color sync circuits—check range of hue control—align color demodulators, etc.

BUILT-IN AUDIO-SCAN provides FM sound transmission exactly like a TV station, 4.5 megacycles above video carrier, with modulation from any available audio source. Enables you to combine speech or music with the video display. Can be modulated with built-in 400 cycle tone generator for test signal or from external signal source such as microphone, tape recorder, FM-AM tuner, or from audio oscillator. Has built-in audio amplifier and volume control.

Facilitates servicing, installation or demonstration of black & white and color TV receivers. Provides closed-circuit TV system with both video and audio for commercial, industrial, and educational applications. Allows convenient stand-by and break-in, or distribution line check, for community antenna system operation.

Model 1050 DYNASE-SCAN complete portable video and audio generator, with built-in Color-Scan and Audio-Scan. Includes 3 test pattern slide transparencies, one clear acetate and slide holder. Comes with 6 ft. r.f. cable. Size 16½ x 10½ x 9½ in. Net, $259.95

Model 1000 DYNASE-SCAN picture and pattern video generator. Has all the features of the Model 1050 above, except without the Color-Scan and Audio-Scan sections. Net, $199.95

Color-Scan or Audio-Scan or both can easily be added to the Model 1000 at any time.

Model C15 COLOR-SCAN for Model 1000. Net, $19.95
Model S16 AUDIO-SCAN for Model 1000. Net, $29.95

Available from most Electronic Parts Distributors on easy time-pay plan.

See your B&K Distributor, or write for Bulletin 1050-E

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

OCTOBER, 1957
PHAOSTRON INSTRUMENT AND ELECTRONIC COMPANY
151 Pasadena Avenue, South Pasadena, California

TELEVISION

near a meter, and you're in hot water. That meter will read low and can't be used until it goes back to the factory for repair."

"How does a picture tube get magnetized, anyhow?" Fuzz asked.

"Lots of ways. Some guys forget and use magnetized tools around a color set. If you get screwdriver-happy, you'll have a degaussing job right away. Sometimes a guy forgets and lets a PM speaker get close to the picture tube. Some meters have an external field that causes trouble if the meter is rested on the tube or shield. Then, there are cases that you just can't tie down—the set has been running OK but the purity gradually gets out and can't be adjusted unless a degaussing job is done."

"I reckon I ain't too sharp, but I'm hep," Fubb remarked. "Then what comes after the purity adjustments?"

"Can't figure whether you're bragging or complaining," Red replied. "But we ain't quite through with this purity deal yet. In most cases, the green and blue fields will come in OK after you get good red purity. You will find cases though where you may have to compromise a little in purity adjustments for the three fields."

"How do you compromise?"

"Well, you work back and forth between the three fields and always favor the red as much as possible. The customer will be most critical of the flesh tones because the actors carry the action and their faces are the center of attention. That's why you should balance the purity in favor of the red field, when necessary."

Fuzz pulled a bottle of aspirins out of his pocket and handed it to Red. "Have two," he offered; "they're small."

"It isn't really that bad," Red replied. "There's headaches all right, at the start, but when you get enough practical experience this color setup is a breeze."

"What else should I know about the purity adjustments?" asked Fuzz.

"That's about it. As a final check, balance up the three screen controls for a neutral gray raster and see if there is any tinting anywhere on the screen. If you see any you will know that you slipped a little somewhere along the line. Sometimes, when the tinting is very minor at this point, you can make the final purity touchup on the gray raster without going back to the individual color fields."

"Then we get with the convergence," Fuzzball suggested.

"Well, this is where you come to the pièce de résistance, as you might say. For the first few days, you're going to figure that color TV is a comedy of errors, and wonder if you have all your buttons."

"I'm listening."

"OK. It's easy enough to get good convergence in the center of the screen by adjusting the three beam magnets and the lateral corrector. Getting convergence at the top and bottom and
We hit the target again... with this new, modern version of the most wanted service-test instrument.

Pyramid introduces the CRA-2 Capacitor-Resistor Analyzer, a versatile, up-to-date, moderately priced test instrument. The CRA-2 is the perfect multi-purpose analyzer for the technician, serviceman and engineer, in industrial and military electronics, black and white, and color television, and all related fields.

The guesswork has been removed from circuit trouble shooting. When making leakage-current measurements, the values are read directly from the meter while the rated operating voltage is applied to the capacitor. A vacuum-tube ohmmeter circuit displays accurate insulation-resistance values on the meter for many types of capacitors. The extended range calibrated power factor control permits power factor measurements of electrolytic capacitors rated as low as 6 volts DC working and as high as 600 volts DC working. This special "QUICK CHECK" circuit performs rapid "IN CIRCUIT" test for short, open, intermittent high RF impedance and high power factor without removing or disconnecting the component from its operating circuit.

**FEATURES**

- "Quick Check" in circuit test for Open Circuits, Short Circuits, Intermittents, High RF Impedance, High Power Factor.
- Precision meter for accurate readings of leakage current, applied voltage and insulation resistance.
- Combination Wien and Wheatstone bridge. Accurate vacuum-tube meter circuit.
- Parts of the highest quality are used. Wire and wiring meet military specifications.

Examine it today
Being introduced by leading Electronic Parts Distributors
TELEVISION

Using the degaussing coil on a color TV installation.

sides of the screen is a horse from a different garage—this is where the dynamic convergence controls come in."

"So I turn on the white dot generator now."

"Reet. And make blame sure that the generator is synced in at 15,750 cycles."

"Why is that so important yet?" Fuzz asked.

"Simply because the horizontal phasing coils are turned to resonance with the horizontal sweep frequency, as I will explain. Obviously, if your white dot generator is locking in a hundred cycles or so off frequency, you will mis-tune the horizontal phasing coils—you can converge the picture tube but, when you tune in a black-and-white program, the tube will be out of con-vergence on the left- and right-hand sides and the customer will complain about rainbow fringing."

"I see what you mean. Then I'll go bats doing the dynamic convergence all over again."

"That's it," Red agreed. "A guy could end up in a padded cell."

"So how can I be sure the white dot generator isn't a white elephant gen-erator?"

"Well," said Red, "there are several ways. Some generators have hori-zontal sync and some don't. If the generator doesn't have sync, you have got to supply sync from a black-and-white station transmission—the instruc-tion book for a generator of this type explains how to do this."

"But," suggested Fuzz, "if the dot generator has its own sync, I have nothing to worry about."

"Not if you use your head for some-thing besides a hat rack," agreed Red.

"You will find that some generators provide a crystal-controlled sync oscil-lator and you have nothing to check out. Other dot generators use a vfo sync oscillator with a control on the instrument panel for setting the sync frequency."

"Is it a job to set the sync to the right frequency?" asked Fuzz.

"It's easy enough," Red replied, "if you watch the screen pattern while you're adjusting the sync frequency. All sets have at least a trace of 60-cycle hum in the circuits and when the ver-tical sync is zero-beat with the power line, there is no writhing or movement in the dot pattern. But, if the ver-tical sync is not zero-beat with the power-line frequency, you'll see more or less snaking in the pattern."

"Clue me in here," Fuzz protested. "We started talking about setting the horizontal sync frequency in the gen-erator and now you talk about the ver-tical sync rate."

"It's simple enough," Red explained. "The horizontal sync and vertical sync in this type of generator are locked together—if one is right, the other is correct too."

"I got you now, Red. The station operates its own vertical sync in step with the power-line frequency, I heard somewhere."

"You heard right," he agreed.

"What size dots are best?" Fuzz asked next.

"Frankly, I can't answer that one," Red admitted. "So much depends upon the particular situation and personal preferences. On some of these color sets, you have to make some or all of the convergence adjustments from the rear, using a mirror in front on the screen."

"That's where large dots will come in handy," Fuzz suggested.

"As a matter of fact, you may not be able to see small dots at all in a mir-ror, unless you darken the room like the inside of a cow. You better have a pretty good mirror, too."

"Guess though, if I had a helper along in a case like that, he could tell me how the pattern looks from in front," Fuzz remarked.

"Only after you have both had plenty of experience," Red shot back. "Other-wise you will find out quick that you are not talking each other's language."

"Small dots would give you a more accurate check on convergence, wouldn't they?"

"They'd tend to," Red agreed. "Don't forget too, that it will be a cold day in July when you get a picture tube 100% converged. The trick is to know when to stop."

"When would that be?" Fuzz asked.

"Well, as a general rule, if you can't see any misconvergence when you are 5 feet back from the screen, you prob-ably have convergence about as close as you are going to get it."

"Suppose the customer complains, though, about not having 100% con-vergence?"

"We have an almost irresistible urge to shoot him right at the beginning," Red advised him. "I generally put his name on the stink list, and tell him I'm all booked up the next time he calls."

"Not to get off this fascinating sub-ject of customer beefs," Fuzz said, "but I been hearing a lot about white crosshatch for convergence. What's the scoop?"

"Well, I like it for at least certain parts of the job," Red replied. "How-ever, I can get along very nicely with white dots only. Seems to be partly a matter of opinion, I would say."

"I know that we have juggled with at least a dozen dynamic convergence controls," Fuzz remarked. "Where do I start?"

"We covered the beam magnets and the lateral corrector for center-screen convergence,", Red replied, "and the main thing to keep in mind here is that these static convergence controls, as they are called, produce exactly the same motion of a color dot at any point over the entire screen."

"Then the dynamic controls cause nonuniform dot motions," Fuzz sug-gested.

"That's what they do. The first rule is to keep the three color dots converged at all times in center screen while work-ing the dynamic controls to bring in the dots around the edges of the screen."

"I smell something here," Fuzz an-ounced. "Do you mean that the dy-namic adjustments will interact with the static adjustments and throw the convergence out at center screen?"

"You are so right," Red replied. "Con-vergence is a matter of continual back-and-forth adjustments. That's one of the reasons why it eats up so much time."

"Clue me in a little more on these dynamic controls."

"Well, you have the dynamic group for vertical—usually six controls. Then you have the dynamic group for hori-zontal—again usually six controls. In some cases you may also have a couple of yoke balancers for final touchup."
FINCO announces

MODELS UNLIMITED!

NOW...you can sell a TV Antenna designed for your area

<table>
<thead>
<tr>
<th>Area</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>BUFFALO SPECIAL</td>
<td>B-6</td>
</tr>
<tr>
<td>SYRACUSE-ROCHESTER SPECIAL</td>
<td></td>
</tr>
<tr>
<td>DUO-DIRECTIONAL SPECIALS</td>
<td></td>
</tr>
<tr>
<td>SAN DIEGO B-6</td>
<td></td>
</tr>
<tr>
<td>CHICAGO SPECIALS</td>
<td></td>
</tr>
<tr>
<td>PITTSBURGH SPECIAL</td>
<td></td>
</tr>
<tr>
<td>LONGVIEW, TEXAS SPECIAL</td>
<td></td>
</tr>
<tr>
<td>VICKSBURG SPECIAL</td>
<td></td>
</tr>
<tr>
<td>FLORIDA, WEST COAST SPECIAL</td>
<td></td>
</tr>
<tr>
<td>GEOMATIC SPECIALS</td>
<td></td>
</tr>
<tr>
<td>PATENDED FIDELITY PHASING</td>
<td></td>
</tr>
<tr>
<td>DETROIT-TOLEDO SPECIAL</td>
<td></td>
</tr>
<tr>
<td>MODEL B-8</td>
<td></td>
</tr>
<tr>
<td>UHF-VHF SPECIALS</td>
<td>B-66</td>
</tr>
<tr>
<td>MODEL B-7</td>
<td>FRONT-TO-BACK SPECIALS</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

• IN SOLVING UNUSUAL, LOCALIZED RECEPTION PROBLEMS, FINCO has proved that the only positive way to develop the most efficient and economical TV Antenna is by actual MOBILE RESEARCH LABORATORY TESTS combined with Expert Topology and Channel Power Plotting.

If a distributor qualifies, Finco's research department assumes the task of studying the specific, local reception problems. If the problems can possibly be solved the result is an exclusive Red-Hot, High-Performance Antenna For Your Area —

Hundreds of FINCO research projects are now in process or already completed, giving dealers and servicemen a big jump on their competition. The total cost to your Jobber IS HIS COOPERATION...urge Your Jobber to write, wire or call FINCO TODAY!

THE FINNEY COMPANY • 34 West Interstate Street • BEDFORD, OHIO • Telephone: BEford 2-6161

Copyright 1957, The Finney Co.
SNOWY PICTURE?

TRY THE BENC
LOW NOISE SUPER '20' MAST-MOUNTED BOOSTER

- Very Low Noise Cascade Circuit Brings Weak Snowy Pictures to Entertainment Level.
- Automatic ON-OFF from TV Receiver
- Easily mounted on Mast
- Supplied Complete with all Connectors (Solderless)
- 20 DB Gain
- Contains separate 3-tube Amplifiers for High and Low Bands (3 Dual Triodes).
- Amazing Low Price

$45.00 Suggested User Net

TELEVISION

“Which do I start in with first?”

“IT’s customary to start vertical dynamic convergence first. You pick out a column of dots down the center of the screen and start making vertical dynamic adjustments to converge this column of dots—forget the others.”

“Why do we work on just the center column of dots?”

“Simply because convergence at the left- and right-hand sides of the screen is affected much more by the horizontal controls, and you will go all around the mulberry bush if you pay any attention to them at this point in the procedure.”

“IF see,” said Fuzz. “How about filling me in on the vertical controls?”

“Well, we have them grouped into red, green and blue controls. We have a tilt and an amplitude control for each color—total of six.”

“They interact with each other?”

“Unfortunately, yes. You will seldom be able to make a final adjustment once and for all on any one of these controls,” Red observed.

“Now, judging from the names, I guess the tilt controls will make the column of color dots slant one way or the other.”

“You’re partly right,” Red agreed, “but you’re partly wrong, too. The red and green tilt controls produce some starting or tilting of the dot column, but the dot motions are complex and there is more than tilt in the movement. Moreover, the blue tilt control has no tilting action whatsoever—it changes only the relative spacing of the blue dots.”

“This is intriguing,” Fuzz commented.

“Do you figure that color TV will ever get off the ground?”

“It is off the ground, buddy,” Red replied somewhat sharply. “I can play the violin, too. You and I are up against the maintenance of color sets in the field right now.”

“I ain’t giving you any static, Red,” Fuzz apologized. “I’m confused.”

“Everybody gets confused in this racket until they get some practical experience. You remember the first black-and-white set you worked on.”

“Amen, Fuzz grunted.

“Now to get back, the amplitude controls adjust the amount of parabolic current flowing through the convergence coils, and the tilt controls adjust the amount of sawtooth current in the coils.”

“What does that mean in English?”

“Practically, what you do is to work back and forth on the amplitude and tilt controls to get the red and green dots in parallel columns, because they can then be brought into a straight single vertical column with the beam magnets.”

“What about the blue dots?” asked Fuzz.

“We don’t have to even look at them, if we don’t want to, while we are lining up the red and green dots. In fact, some techs cut off the blue gun during this time.”

“You mean that the blue dots will come in OK once the red and blue dots are straightened up?”

“Right. The blue dots always line up straight in a vertical column because of the mounting of the convergence pole pieces. And since the green and red dots must line up straight in a vertical column when they are adjusted to be parallel, we don’t have to worry about the blue dots to start with.”

Fuzz scratched his head a moment.

“So it looks like the final adjustment will be work with the blue vertical amplitude and tilt controls to bring them into convergence with the yellow dots.”

“That’s the general idea,” Red agreed.

“Remember, you have to touch up the beam magnet adjustments while you are doing this. You will also find that every time you make a considerable adjustment of the blue controls, you will probably have to go back and make a little touchup on the red and green controls.”

“I’m kind of shook up,” Fuzz announced, “but I’m still game. What next?”

“That pretty much ties down the vertical convergence until after the horizontal convergence has been made. Then you will probably have to retouch the vertical controls.”

“Before we go ahead,” Fuzz suggested, “I think we owe ourselves another coffee.”

Red held up two fingers. “Garon, draw two.”

Vertical dynamic convergence of one line of dots: a—pattern when starting; b—red, blue and green dots lined up in parallel columns; c—convergence completed, only white dots can be seen.

come in OK once the red and blue dots are straightened up.”

www.americanradiohistory.com
for the Right 'LYTIC replacement ...use an exact SPRAGUE replacement

YOU GET EVERYTHING IN A SPRAGUE TVL! Every TVL for every voltage rating is made with the more expensive high-purity etched-foil anode construction using ultra-stable film formation techniques. Cathodes are etched to meet high ripple requirements. Sprague TVL's give maximum trouble-free service—NO HUM—as well as long shelf life. And they perform just as well in the cold North as they do in the sub-Tropics. Yet this premium quality costs you no more!

That's why Sprague Twist-Lok® electrolytic capacitors are the first choice of leading radio-TV set makers and independent service technicians alike. Insist on TVL's for more exact ratings ... quality that meets original equipment specifications ... and all the latest results of capacitor research.
Write for catalog C-612.

SPRAGUE RESEARCH IS CONSTANTLY PRODUCING NEW AND BETTER CAPACITORS FOR YOU
Sprague Products Company • Distributors' Division of the Sprague Electric Company • North Adams, Massachusetts

OCTOBER, 1957
PICTURE analysis is one of the most useful tools in troubleshooting color TV receivers. Every distortion in picture reproduction has a reason behind it and, if you are on your toes, a lot of time which would otherwise be wasted in hit-and-miss approaches can be saved.

Here are some of the more basic elements of color picture analysis:

**Horizontal rainbows**

Each rainbow shows that the color subcarrier oscillator is 60 cycles off frequency. Thus, a picture with one horizontal rainbow shows that the color subcarrier oscillator is running 60 cycles above or below 3.58 mc.

A picture with two horizontal rainbows shows that the oscillator is running 120 cycles above or below 3.58 mc. Let's consider the single horizontal rainbow. If the oscillator is exactly 60 cycles off frequency, the rainbow will stand still. But if the oscillator frequency is slightly less than 60 cycles, the rainbow drifts downward. On the other hand, if the oscillator frequency is slightly higher than 60 cycles, the rainbow drifts upward. Here's why:

When the oscillator is exactly 60 cycles off frequency, the oscillator returns to its starting phase at the beginning of each vertical scan. In other words, the rainbow repeats itself exactly at the beginning of each vertical scan—the rainbow stands still.

But when the oscillator frequency is slightly lower than 60 cycles, the rainbow is a bit incomplete at the end of the vertical scan and is completed only after a portion of the next scan has been completed—the rainbow thus drifts down the face of the picture tube.

If the oscillator frequency is slightly greater than 60 cycles, the rainbow develops faster, and more than completes itself in one vertical scan. For this reason, the rainbow drifts up the screen.

As the oscillator frequency goes up, the rainbow drifts up faster and faster until we cannot see it any more and the color seems to have dropped out of the picture—when red, green and blue flash past our eyes at a speed greater than the persistence of vision, the colors blend into a gray.

When the oscillator frequency becomes still higher and approaches 120 cycles, we see two rainbows drifting down the screen. At exactly 120 cycles above 3.58 mc, the two rainbows stand still. A slight increase in oscillator frequency, and they start to drift upward.

Thus, by counting rainbows and observing their drift, we can quickly determine how many cycles the oscillator is off frequency, and whether it is higher or lower than burst frequency.

**Match Gonset line**

What is the best way to match 300-ohm Gonset line to 300-ohm ribbon? One manual says to split the Gonset line, tapering it down to the 300-ohm line over a span of 30 inches or more. This is difficult and slow.—R. L. B., Bluefield, W. Va.

This is a good question (and we like 'em!) because it brings out some of the practical considerations in impedance matching which are sometimes overlooked. In the first place, you are working with a SWR (standing-wave ratio) of 1.5 to 1, on the basis of nominal impedance ratings. This is splitting the old hair a bit thin, for the following reasons:

1. Some 300-ohm ribbon line does have a characteristic impedance very close to 300 ohms. But, on the other hand, some of the stuff measures much higher or much lower. If you want to be sure of what you are trying to match to what, better get a really good sweep generator and check the lines.

For complete catalog see your local dealer or write:

MADISON FIELDING CORPORATION
Creators of Distinctive Audio Instruments
361 Madison Street, Brooklyn 21, New York
New Transcription-Type Tone Arm Makes Collaro World's First True High Fidelity Changer

The Turntable That Changes Records

From Collaro, Ltd., world's largest manufacturer of record playing equipment—comes the most significant development in the field in years—the new transcription-type tone arm.

This arm, exclusive with Collaro, literally changes the conventional record changer into a brand new instrument—a TRANSCRIPTION CHANGER—with features of the finest professional equipment.

The arm is a one-piece, spring-damped, counter-balanced unit which will take any standard high fidelity cartridge. It is free of any audio spectrum resonances. It permits the last record to be played with the same low stylus pressure as the first. Between the top and bottom of a stack of records there is a difference of less than a gram in tracking pressure as compared with 4 to 8 grams on conventional changers. Vertical and horizontal friction are reduced to the lowest possible level. These qualities, found only in the Collaro Transcription Changer, insure better performance and longer life for records and styli.

In its superb performance, the new Collaro Continental, Model TC-540, meets the rigid requirements for high fidelity equipment. Here, for the first time in a changer is professional quality at a record changer price. The Continental is $46.50. Other Collaro changers are priced from $37.50 up. (Prices slightly higher west of the Mississippi.)

In addition to the new tone arm, the Collaro Continental features include: 4 speeds, manual switch for turntable operation; wow and flutter specifications—0.25% RMS at 33 1/3 RPM—superior to any changer in the world; automatic intermix; automatic shut-off after last record; heavy duty 4-pole, shaded pole induction motor; heavy rim-weighted balanced turntable; muting switch and pop-click filter for elimination of extraneous noises; jam proof machinery; pre-wiring for easy installation; attractive two-tone color scheme to fit any decor; tropicalization to operate under adverse weather and humidity conditions; easy mounting on pre-cut board or base; custom testing at the factory for wow, flutter, stylus pressure and correct set down position.

FREE: Colorful new catalog describes complete Collaro line. Includes helpful guide on building record collection.

WRITE TO
ROCKBAR CORPORATION
Dept. D-010
650 Halstead, Mamaroneck, N.Y.

Rockbar is the American sales agent for Collaro and other fine companies.
sturdy, steel PERMA-TUBE lasts three times longer than galvanized TV masting

Resistance to bending in Perma-Tube TV masts is greater than in galvanized masting. Perma-Tube's extra resistance to bending and damage by wind-force protects your reputation and improves TV reception.

Machine-fitted joints speed field assembly, insure close tolerance. Perma-Tube joints are stronger than the tubing itself.

Perma-Tube is corrosion-proof. It is treated with vinsynite—then coated with a metallic vinyl resin base both inside and outside. It successfully passes ASTM's 500-hour minimum salt spray test—which guarantees longer life under corrosive conditions.

Five diameters of fitted joint Perma-Tube are available, ranging from 2 1/4" OD to 1 1/4" OD. Telescoping masts can also be erected up to 50 feet high, using 10 foot lengths of high strength J&L 16-gage Perma-Tube.

For complete details on easy-to-sell Perma-Tube TV masting, write to the Jones & Laughlin Steel Corporation, Dept. 496, 3 Gateway Center, Pittsburgh 30, Pennsylvania.

TELEVISION

with a series demodulator probe (see Fig. 1) against precision (1%) carbon resistors. You may possibly be surprised when you find out what you are trying to match to what.

2. Even if you find that you are really concerned with matching 300 ohms to 450 ohms, how about the SWR in the rest of the system? That is, if you sweep each terminated section of the system, do you find SWR’s in the order of 1.2 to 1, or perhaps more like 3 to 1 or 5 to 1? It is only logical to make certain that we are not swallowing a camel, while gagging at a gnat. Fig. 2 shows the extremes of patterns encountered in SWR tests. When the trace touches the zero-reference line, as in Fig. 2-b, the SWR is infinite. That is, any peak voltage divided by zero is infinite.

You will obtain this pattern when the end of the line is open or when it is dead shorted. However, the phase of the null shifts, of course, along the base line for a short, as compared with an open.

To measure SWR, we divide the maximum voltage (or current) by its minimum value, as shown in Fig. 3, taken from the AARL Handbook. When the minimum is zero, we have an infinite SWR.

When you are working on a very long section of line, the loss is appreciable. This can also be measured. Short the end of the line and then note the voltage by which the pattern fails to touch the zero-volt reference line. This amount is double the line loss.

On short lines, such as 20 or 30 feet, we can’t even see the loss, and we forget about it. The pattern is given purely in terms of VSWR (voltage standing-wave ratio).

A dc scope is as useful as a zero-volt reference line from a scope because the resting position of the beam with no signal applied shows us the zero-signal level, which can be drawn on the screen with a wax pencil.

Fig. 2—a. Rectangular pattern shows perfect match of line to load; b. sine-wave pattern touching base line shows complete mismatch—dead short or wide open.

Fig. 3—Measuring SWR: I_{max} is 1.5 and I_{min} is 0.5, so SWR equals I_{max}/I_{min} = 1.5/0.5 = 3 to 1.
thousands of servicemen have happily discovered

TOBE

QUALITY

SERVICE

CAPACITORS

have you?

Specify TOBE Capacitors • Pioneers since 1922

OCTOBER, 1957
COMPLETE RADIO-TV SERVICE TRAINING  

at a price you can easily afford!

This famous Ghirardi Service Library

TELLS YOU HOW - SHOWS YOU HOW!

If broken into "lessons" and sent to you as a course, you'd recant three great books as a bargain at $100.00 or more! Instead, you get them both for only $13.00 - with 3 months to pay! Almost 1800 pages and over 800 how-to-do-it charts, diagrams, and pictures show step-by-step how to handle every phase of troubleshooting and servicing.

Radio & TV TROUBLESHOOTING & REPAIR

Here, in one giant, 822-page book is absolutely complete, fully modern training in professional service methods.

Radio & Television TROUBLESHOOTING AND REPAIR teaches you to handle ANY trouble in AV TV - Radio, Communications Receiver or Record Playing Equipment. No meaningless theory. Instead, it gets right down to brass tacks in guiding you through service procedures... from locating troubles quickly to fixing them fast and right. Block diagrams, oscilloscope patterns, quick summaries of problems and other features speed your work... make every step doubly clear.

Handy troubleshooting charts save you loads of time!

Every experienced serviceman will find there's big bonus in time-saving, easily-understood troubleshooting charts like TV Trouble Symptoms and Their Causes; General Troubleshooting; Car Receivers; Radio Front End, IF and Tuning Circuits, Amplifier & Loadwinder Sections; FM & AM Receivers; Amplifiers; Component Troubleshooting... and others.

Radio & TV CIRCUITRY & OPERATION

Learn circuits... and watch service headaches vanish!

It's amazing how much easier and quicker you can repair radio and TV sets and even special electronic equipment when you know all about the circuits that are used. That's where this big 860-page book, RADIO & TV CIRCUITRY AND OPERATION is worth its weight in gold to servicemen who want to forge ahead.

You know more in less time... because you know exactly what to look for and where. You make repairs better and faster... because you eliminate useless testing and guesswork. You qualify for additional jobs... because you have the correct "know how" that really pays off.

There's a wealth of modern equipment plus many puzzling circuit variations: teaches you to understand their peculiarities and fully troubleshoots. Over 4000 charts explain Troubleshooting from scanning to detail of each of the sectional receiver circuits. Price $8.75... or see MONEY-SAVING OFFER.  

TELEVISION

The center frequency of test depends on the frequency you are interested in. It might be channel 2 or 13 or 75. The sweep width of the generator should be sufficient to throw a maximum and a minimum on the screen. Otherwise, the tuning dial of the sweep generator can be rocked a little back and forth, to run both onto the pattern.

If we find that this 1.5-to-1 mismatch is our goal, it is quite possible to bag the beast. The method of matching the 450-ohm line to the 300-ohm line depends upon the particular channel or channels to be accommodated.

In case several channels are to be received, the instruction to split the Gosset wire line and to graduate the spacing down to that of the 300-ohm ribbon is the most practical solution. However, if only one channel is to be received, you can make up a quarter-wave matching section which is mechanically more convenient than a tapped line.

The impedance of the matching section should be 365 ohms, which can be obtained by using No. 12 wire spaced 1 inch between centers. The length of the matching section must be equal to a quarter wavelength of the picture carrier on the desired channel.

For general tests, I have found the RCA WR-59 sweep generator hard to beat. The output is acceptably flat, the output cable is terminated with a center-tapped load which greatly facilitates use of the double-ended demodulator probe, and there is enough output voltage on the high channels that you can really work with it.

SWR and impedance-matching tests are difficult or impossible with many sweep generators which are highly touted by their manufacturers. One of the hidden faults to be guarded against is the presence of spurious frequencies in the output which can vitiate the test. For example, if you are changing an rf tuner for match on channel 7, and the sweep generator has strong spurious outputs on channels 2 and 13, our test is little more than a farce.

Few technicians seem to realize how essential a really good sweep generator is for the accomplishment of any serious test work.

High B plus

I replaced the focus-coil circuit in an Olympic 766 with an equivalent resistor and PM, focus control to overcome a condition of too high voltage from the B-plus power supply. This did not have any effect on the voltage, which still remains about 70 volts too high. The resistor is a variable wirewound type, and no matter what the slider is set, the voltage remains the same.

Lifting the B-plus lines off the bleeder also has no effect on the B-plus voltage. Is the trouble in the power supply?—A. J. K., Milwaukee, Wisc.

The fact that you can lift the B-plus lines off the bleeder with no effect on the supply voltage suggests that the bleeder is open. If the bleeder has...
TELEVISION

Continuity and normal resistance, there must be some change (at least a little drop) in the voltage value when the bleeder draws current from the supply. I would suggest that you check the bleeder for an open circuit before proceeding further.

Long-range reception

My problem is I am trying to receive channels 9 and 11 at a distance of 105 miles from New York. Here in Philadelphia we have a powerful station on channel 10. I can receive 10 without any antenna at all. Hence, the chief problem is to keep channel 10 from interfering with the weak signals on 9 and 11. Should I use a double-stacked traveling wave or a 10-element Yagi cut to 9 and 11? Also, is a booster really helpful, or does it just boost the noise?—V. D., Philadelphia, Pa.

You may find that you will have difficulty in trying to receive channels 9 and 11 from New York with any type of antenna since you are receiving 10 without an antenna. Adjacent-channel traps may be insufficient in this case, and you may have to enclose the chassis in a screen box.

Any unbalance in the lead-in can also be very troublesome in a case like this, and you may find it advisable to use shielded 300-ohm ribbon lead. The outer braid of the lead-in is grounded to the screen box.

A double-stacked traveling-wave antenna would ordinarily be a good choice, although in this particular situation its high gain on channel 10 could work against you. The fact that 10 is not in line with 9 and 11 in your location does give you a certain advantage in the front-to-back ratio of the traveling-wave antenna. An experimental installation would be required to determine if the available rejection would be adequate.

A Yagi cut to 9 and 11 can be designed to have a deep dip through 10 and, if used with shielded ribbon lead and possibly a screened chassis, would seem to be the most conservative selection in your particular situation.

A booster will give you a definite advantage if it is installed at the antenna and if the booster itself has a low noise figure. The cascade type of booster is one of the types with low noise. Any booster installed at the receiver end of a long down lead will have to contend with the line noise, which may be appreciable. To make certain that you are getting the maximum signal-to-noise boost, it is advisable to make the installation at the antenna terminals.

Vertical nonlinearity

I have a Crosley model H-21ICOWH receiver that has a bright horizontal stripe moving up across the picture. It is almost 1/2 inch wide and other than this the entire picture is fine. I have replaced the vertical linearity control but this did not help. All capacitors and resistors have been checked.

NOW! A TRUE COAXIAL SPEAKER SYSTEM: ONLY $79.50

The Sonotone "110" Loudspeaker System

Only system in this price range to give you all these big-cabinet features:

True 2-speaker coaxial... 2 separate drivers... inductor-capacitor dividing network... full frequency range.

"Rectilinear" vent enables startlingly vivid low-frequency performance equal to many larger-cabinet systems.

Speakers radiate directly for wide dispersion, true "presence"... cabinet can be placed anywhere in room.

Hand-rubbed cabinet in choice of 3 fine finishes... ideal size for most homes (and for true 2-system stereo).

Interested? Wait till you hear it! Ask your dealer to demonstrate the "110." Send in the coupon below for full details!

Cabinet: 30" x 14" x 20"—Available in mahogany, blond or walnut-hand-rubbed finish on birch. Shipped with CA-12 installed. Shipping weight: Approx. 50 lbs.

Price: $79.50 Slightly higher in the West

SONOTONE® CORPORATION
Electronic Applications Division
Dept. LE-107
Elmsford, N.Y.

Sirs: Please send me full details on the "110" loudspeaker system.

Name________
Address________
City________ Zone________ State________
Excitingly new!

DX-16 Super Deluxe TV Kit

For the CUSTOM-BUILT CHASSIS that even a high school student can build.

The DX-16 Super Deluxe TV Kit is a worthy successor to the famous 930 TV Kit. It's a product in which we feel a pride from our years of experience and knowledge. This NEW KIT is used in the DX-16, a standard of comparison for the LESS-TUBE Deluxe Kit. It results in a better DX-16 chassis, both in performance and with even greater versatility.

NEW IN DESIGN

Mounts Horizontally, Vertically or Sideways
- Produces a 16-Tube Chassis with 30-Tube performance.
- Latest Interchannel Circuity and Multi-section Tubes.
- Standard Cascode Tuner for Selectivity and Fine Definition.
- 10KV—Operates 21" and other size 79 Tube Pictures.
- 5 Microvolts Sensitivity (20Y peak to peak at CRT grid).
- Fast Action AGC for Drift Free, Steady and Clear Pictures.
- 3 Main Inputs Video I.F. Stages for fine Contrast and Details.
- AGC Level Control, for adjusting reception to signal area.
- All Video and I.F. Coils factory pre-aligned and tuned.
- Latest Horizontal Biaxial Vertical Alignment.
- Large 256ms Power Transformer for dependable service.
- Large 12" Concert-tone Speaker.

Dimensions 17 1/2" W x 16" D Shipping weight 52 lbs.

COMPLETE KIT with LIFE-SIZE step-by-step Assembling Instructions (less tubes & CRT) $69.97

COMPLETE KIT with SET of WESTINGHOUSE TUBES (less CRT) $79.97

COMPLETE KIT with SET of WESTINGHOUSE TUBES and WESTINGHOUSE 21YP4A Aluminized CRT $99.97

BUILD YOUR OWN TV CABINET

Comparable to the top Tipsix, use on their high priced TV Sets, Prefabricated for you—in the FRONT PANEL as pictured with mask and safety glass (knob panel supplied undrilled) and TOP and SIDES cut to size, all in satin finish in mahogany, walnut and blond extra for any finish. Included is an amazing booklet of easy to follow step-by-step instructions. FRONT PANEL sold separately for TV Wall Mounting or for use in modernizing old TV Cabinets that used round or smaller CRT's.

21" TV CABINET FRONTAL 25" W x 28" H $17.45
TOP and SIDES... 7.50
54.95

24" or 27" TV CABINET FRONTAL 281/2" W x 30" H $22.97
TOP and SIDES... 9.50
32.47

TV CRYSTAL CLEAR LIQUID MASKS

Framed in Rich Goldleaf Finish

Tube Size Over-all Dimensions

21"—Rectangular 13/8 x 13/8... $4.56
21"—Rectangular 13/8 x 13/8... $6.92
24"—Rectangular 20/2 x 20/2... $11.84
27"—Rectangular 21/2 x 21/2... $12.10

On 17" and 21" specify type number of CRT used

TV PLASTIC OPEN MASKS

Used in conjunction with safety glass

17"—Rectangular 13/8 x 13/8... $5.49
21"—Rectangular 13/8 x 13/8... $3.38
24"—Rectangular 20/2 x 20/2... $4.93
27"—Rectangular 21/2 x 21/2... $4.93

On 17" and 21" specify type number of CRT used

TV SAFETY GLASS in HANDY SIZES

16 1/2" x 20 7/8... $5.94
16 1/2" x 20 7/8... $5.94
16 1/2" x 20 7/8... $5.87

Available in new lined grey 50c extra

TELEVISION

and none are bad. I also replaced the vertical output transformer but this gave no improvement in the linearity. Varying the linearity control changed the width of the horizontal line a little, but not nearly enough. The output of the vertical oscillator looks good on my oscilloscope and so it appears that the problem is in the vertical output stage. But I am at a loss as to what the trouble might be.—T. F., Orlando, Fla.

The symptoms you describe point very strongly to 60-cycle interference in the vertical output stage. I assume that you have replaced the 12BH7 output tube and we can most likely eliminate heater-cathode leakage as the cause of the compressed lines or nonlinearity. The vertical movement of the bright horizontal line is due to the fact that your local power line is not synchronized with that of the transmitted sync pulses. This trouble is not unusual in this chassis, and in a synchronous area the horizontal bar will remain stationary.

Next Month's TV Clinic

That First Color Service Call

End
NEW...UNIVERSITY DUAL-RANGE MLC
Weatherproof Super-Compact Speaker System for Voice and Music

Now...real high fidelity never before available in a rugged, small size, weatherproof speaker system. Unique wide-angle, dual folded horn design with separate low and high frequency drivers. Dependable, easy to install, low in cost, the MLC offers these outstanding features:

**BETTER LOWS:** Balanced "compression" folded horn, starting with 6" throat and energized by top quality woofer driver provides more lows than other designs.

**BETTER HIGHS:** Driver unit tweeter with wide angle horn transmits more highs with greater uniformity...high frequency response that you can hear!

**BETTER EFFICIENCY:** Dual range theater type system permits uncompromising design of the woofer and tweeter sections for greatest efficiency. Penetrates noise with remarkable fidelity and intelligibility.

**LESS DISTORTION:** Separate low and high frequency driver systems reduce intermodulation and acoustic phase distortion found in other systems which use two different horns on a single diaphragm.

**MORE DEPENDABLE:** Experienced mechanical engineering and careful electrical design meet the challenge of diversified application and environmental hazards. Rugged and conservatively rated—you can rely on the MLC.

**SPECIFICATIONS:**
- Power Capacity: 15 watts
- Frequency Response: 150-15,000 cps
- Impedance: 8 ohms
- Dispersion: 120°
- Sound Pressure Level: 117 dB taken at 4 ft. 750-1250 cps with 1 cps sweep
- Dimensions: Bell Mouth 12 3/4" W x 9 1/2" H, Overall Depth 10 1/2";
- Shipping Weight: 10 lbs.; $54.50 List.

**FOR HEAVY DUTY APPLICATION...**

**MODEL BLC** employs same design principles as the MLC except for heavy duty 8" woofer with uniform response from 70 cps.

**MODEL WLC** employs same design principles as the MLC except for heavy duty 12" woofer with uniform response from 50 cps.

**LISTEN**

UNIVERSITY LOUDSPEAKERS INC. 80 SOUTH KENWOOD AVENUE, WHITE PLAINS, N.Y.

OCTOBER, 1957
MODERN FLYBACK CIRCUITS

A better knowledge of how the three main types operate can simplify some of your service problems and eliminate others.

THE several variations of high-voltage and horizontal deflection systems used in TV receivers include the rf, isolation-transformer, autotransformer and direct-drive arrangements. All of these (except the rf) perform the same basic functions—production of sawtooth sweep current for the horizontal output and other stages, high voltage for the second anode of the picture tube, filament voltage for the high-voltage rectifier. Flyback systems may also be designed to provide any, or a combination, of the following: age pulses, afc pulses, horizontal blanking pulses, horizontal linearity control, picture width control, horizontal centering. All functions of the system occur simultaneously.

The rf supply (high-voltage system) was used extensively with 10- and 12-inch picture tubes prior to the advent of the 630 chassis. In this system an rf oscillator supplies energy to a separate transformer which produces the high voltage for the picture-tube second anode. The disadvantages of this system are the interference created (due to oscillator radiation) and the relatively great number of component parts. This led to its early extinction.

Isolation type flyback

This circuit (Fig. 1) made its appearance with the 630 chassis and is still used in some of the very newest TV sets. The horizontal output tube supplies voltage pulses to the flyback transformer. The flyback transformer matches the relatively high impedance of the horizontal output tube with the low impedance of the horizontal yoke and provides additional windings and taps to connect other components such as the width coil. Pulses appearing across the 1–3 winding are rectified by the high-voltage rectifier tube which supplies a high dc voltage for the picture tube. The horizontal yoke provides sweep current for deflection. Spurious oscillations which occur in the yoke circuit are removed by the damper tube. The width and linearity coils control picture width and horizontal linearity, respectively.

*Author Servicing TV Sweep Systems (H. Sams).
ANODIZED
...it lasts forever

The new magnificent
GOLDEN
topliner

Completely anodized to lock out corrosive fumes and weather elements...

Designed to outperform any antenna, dollar-for-dollar, or size-for-size...

Designed to make your installation look better...

This is the new Taco Golden Topliner, the antenna you've been waiting for...

Install a Golden Topliner. You'll marvel at its performance.

TACO
TECHNICAL APPLIANCE CORPORATION
SHERBURN, N.Y.
In Canada: Hockbusch Electronics, Ltd., Toronto 4, Ont.
C1–R1 form the input coupling network and C2–R2 the cathode bias network for the horizontal output tube. C3–R3 are the screen grid coupling capacitor and dropping resistor, respectively. C4, C5, and C6 are the yoke de-blocking resonant (with linearity coil) and boost capacitors, respectively. C7–R4 form the filter network for the rectifier tube.

During the latter two-thirds of the sweep portion of the input to the horizontal output tube, the tube conducts and current I flows in the primary of the flyback transformer. The sawtooth yoke current I, develops due to transformer action. The negative spike of the input signal cuts off the horizontal output tube sharply and the entire flyback circuit, since it is not being loaded down now by the tube's conduction, breaks into oscillation at 70–90 kc. The first negative half-cycle of oscillation appears across the secondary and is transferred back to the 1–3 winding; it is rectified and used to obtain the high-voltage output of the system.

The next positive half-cycle of oscillation (as well as all other positive halves) appearing across the secondary causes the damper tube to conduct (I1), charging boost capacitor C6 with the indicated polarity. In about one-third of the trace time C6 charges to the peak voltage appearing across the secondary. The damper cathode becomes positive enough, with respect to its plate, to cut the tube off. After one-third of the horizontal trace the horizontal output tube conducts and the cycle repeats.

The boost voltage which appears from pin 1 of the flyback to ground results from the charge across C6 and the B-plus voltage in series with it.

The linearity coil and C6 resonate at about 16,750 cycles. This alters the instantaneous plate voltage of the horizontal output tube which, in turn, affects the horizontal linearity of the picture. The width coil is a power-absorbing device. That is, its inductance (variable) changes its impedance and the current flowing through it. The greater the current flow through it, the less the current available for the flyback system the narrower the picture width; the converse is also true.

**Autotransformer flyback**

The basic circuit is shown in Fig. 2. In comparing this with the isolation type it is seen that both circuits are practically identical. (The same symbols and pin numbers are used for the corresponding component parts.) In fact, it would appear at first glance that the only difference is that the 4–7 secondary winding in Fig. 1 has simply been repositioned so that it lies directly below the primary winding. However, the basic difference is that in the autotransformer the B plus is applied to the damper tube plate instead of directly to the secondary winding. (This is necessary to permit I1 flow through the damper tube, as shown.)

C9 is added in the circuit to permit the ac conduction of I1 and to prevent dc from being applied directly to the 4–7 winding of the flyback. Boost capacitor C6 charges as shown. The boost voltage appears from the damper cathode to ground, which includes the charges across C6 and the B-plus supply (and C-9) added to each other.

Current I, flows from pin 7 to 4 of the flyback and in Fig. 1 (the isolation type circuit) it flows from 4 to 7, making the polarity across the winding opposite for both types of circuits. This does not alter the operation of the flyback circuit, as was explained previously, but merely makes the waveforms and polarity of the autotransformer secondary winding 180° different from that of the isolation type.

The advantage of the autotransformer sweep circuit over the isolation type is its greater operating efficiency, by virtue of the closer coupling between windings and the increased turns ratio between primary and secondary (for the same given number of transformer turns). For this reason, practically all

---

**Fig. 3—Schematic diagram of the little-used direct-drive arrangement.**

*Air-core flyback transformer.*

*Deflection yokes: above—90° type; below—70°. Note the considerable difference in the angle of flare.*

---

www.americanradiohistory.com
FULL COLOR TV
demands reliable

**MODEL U-98**—first and finest fully automatic rotator. Eye-appealing decorator colors—Ivory, Forest Green and Standard Mahogany Grain. Retail . . . . . . $44.25

**MODEL T-12**—with exclusive Tenna-Teller Pointer—highly accurate. Striking, modern design. Forest Green, Ivory or Standard Mahogany. Retail . . . $34.25

Decorator Colors priced $2.00 extra.

**DON'T ASK VIEWERS TO PUT UP WITH A 'STAY-PUT' ANTENNA!**

- TV authorities admit the higher sensitivity of color.*
- Viewers won't tolerate weak, washed out color!
- Maximum directivity with ALLIANCE TENNA-ROTOR is the best insurance for top antenna performance—for FULL COLOR!

*Many TV authorities agree that color is more sensitive than black and white. "Chromatic gradation" with color that's ghosty, is harder on the eyes than black and white. Many recommend properly installed outdoor antennas with rotators, to improve directivity of the antenna, to help overcome interference and reduce annoying effects caused by the higher sensitivity of color, and the normal characteristic of color to "drop out" quicker.

Wherever you find Color TV, it will pay you to recommend Alliance!

- Every color TV buyer is a potential Tenna-Rotor sale . . . even in metropolitan areas. Because the "fringe" area for color is closer to the transmitter!

Viewers who might tolerate black and white TV that's "so-so", will not put up with irritating, "ghosty" color. And independent interviews at point of sale show that color TV customers find it easy to say Yes to Alliance Tenna-Rotor!

Meet the Constant Changes in Television!

Alliance Tenna-Rotor makes any good outside antenna more directional. New stations, channel changes, new towers, more power, UHF-VHF . . . AND NOW COLOR! They all add up to Alliance Tenna-Rotor!

**THE ALLIANCE MANUFACTURING COMPANY, INC.**
(Division of Consolidated Electronics Industries Corp.)
ALLIANCE, OHIO
In Canada—ALLIANCE MOTORS, Schell Avenue, Toronto 10

OCTOBER, 1957

135
optimum efficiency while using a minimum number of component parts.

A typical direct-drive circuit, used in Emerson chassis 120124, is shown in Fig. 3. The most distinguishing feature of the circuit is that the flyback transformer has only three terminals and one tap point. The horizontal yoke winding, since it is in series with the 1-2-3 flyback winding, takes the place of an additional secondary winding. In other words, it is equivalent to the 4-5-6-7 secondary winding shown in Fig. 2, making the direct-drive circuit equivalent to an autotransformer type flyback circuit. In Fig. 3, the damper tube is effectively connected across the yoke and the width coil, in series with the yoke.

The conduction of the damper tube is indicated to show how the .022-µf boost capacitor develops its 290-volt charge. The 520-volt boost, thus, is formed by the charge across the boost capacitor and the 230 volts of B plus.

The horizontal yoke inductance of this system is very high (30 mh) since it actually takes the place of the flyback transformer winding which normally also has a high inductance. The inductance value is the same as that of winding 1-2. Thus, winding 1-2 provides approximately 2.5 kv peak-to-peak across it, as well as the yoke. From terminal 2 of the flyback to ground, there is developed, therefore, 2 x 2.5 or 5 kv, voltage needed to develop 11-14 kv at the output of the high-voltage supply.

The flyback transformer used in this particular system is an air-core type. This is one of the first direct-drive flybacks used. Later types employ a circular ceramic core, permitting its overall size to be reduced considerably. The air-core type requires many more winding turns from terminals 1 to 2 to obtain the necessary impedance and, therefore, its dc resistance is much greater than for ceramic-cores.

The direct-drive system is highly efficient. Its design is based upon its inherent distributed and stray capacitances. Thus, lead dress must not be disturbed when servicing such a circuit. The circuit is designed so that the retrace time (about 5-6 µsec) is very low, thus helping to achieve its high efficiency.

The 90° flyback circuit

This designation refers to the deflection angle of the picture tube. The sweep components must be designed to work with such a picture tube. Originally, 90° tubes were 24 and 27 inches. However, some 10-, 15- and 21-inch tubes have been included recently.

There are no noticeable mechanical distinctions between 70° and 90° flybacks whether they be isolation or autotransformer types. As a matter of fact, they may even be interchanged, provided they meet all other design requirements. Electrically, more winding turns are used for the 90° flyback to obtain a greater high-voltage output and thus its dc resistance is higher than those of the 70° flyback. However, there are exceptions to this rule.

The winding flare of the 90° yoke is much greater than that of the 70° unit. The greater flare is necessary to provide sufficient deflection to cover the entire picture-tube screen with good edge-to-edge focusing. Also, the horizontal inductance of the 90° yoke (over 20 mh) is much greater than that of the 70° type (usually less than 20 mh, except for direct-drive systems). Although the magnetic field of the 90° yoke is used to better advantage because of its flare, the field has less effect on the gun beam since the distance between field and beam is much greater. To compensate for this and, at the same time, to obtain more magnetic energy the yoke inductance is made greater. (The energy of an inductor is directly proportional to its inductance.)

The width and linearity coils used in the 90° system are the same as those used for 70°. However, the former more often uses horizontal output tubes such as the 6CD6 and 6CU6 and damper tubes such as the 6AX4 and 6AU5 to

---

**Horizontal output transformers (flybacks):** above—90°; below 70°

of the newer flyback circuits contain an autotransformer.

**Direct-drive circuit**

Several years ago, the direct-drive system was employed in the chassis of many set manufacturers. Although many TV sets contain such a circuit it is practically extinct in the newer sets because of its tendency to break down. This circuit was designed to produce...
WIRE
FOR EVERY
ELECTRONIC
PRODUCT

TV CAMERA CABLE
MAGNET WIRE—
HOOK-UP WIRE
TV STUDIO CABLE
BROADCAST AUDIO CABLES
MICROPHONE CABLE
INTERCOM CABLE
SOUND SYSTEM CABLES

Belden
WIREMAKER FOR INDUSTRY
SINCE 1902
CHICAGO

OCTOBER, 1957
137
The RCA general-purpose model 211D1 70° cosine deflection yoke.

withstand the greater currents and peak voltages which prevail in this system.

In practically every case the 90° system uses an autotransformer flyback. A typical A-15 unit, used in the RCA chassis KCS89, is shown in Fig. 4. Unlike the 70° autotransformer circuit in Fig. 2, the flyback transformer is one continuous winding and the linearity coil is connected to the bottom of the flyback instead of in between a split winding. This does not alter the circuit operation (as was explained previously) since the linearity coil serves the same function — to vary the instantaneous plate voltage to the horizontal output tube plate. The advantage of the linearity coil arrangement in Fig. 4 is that it is not subjected to the high peak voltage which appears across the damper cathode, thus making it less susceptible to breakdown.

The damper current I is indicated in Fig. 3. It charges the 0.047-μF boost capacitor which is in its path. The boost voltage, therefore, appears from pin 1 to ground, which is the average charge across the boost capacitor (290 volts) plus the 500-volt B-plus supply. The boost voltage is fed to the C-E tube first anode to obtain proper focusing. The 15,750-cycle filter is, therefore, inserted between the boost voltage supply and the first anode to prevent 15,750 cycles from causing intensity modulation of the electron beam.

The linearity coil does not have a resonant capacitor (C5 in Fig. 2) since the stray distributed capacitances of the coil as well as the other capacitances in the circuit provide the needed capacitance. A 1.5-μF bale and a 270-μF capacitor, connected in the 6AU4 plate circuit, form an antiparasitic filter to prevent the higher harmonics developed in the flyback circuit from entering the 300-volt B-plus supply.

High-voltage circuits

Many of the early TV sets used multiple high-voltage rectifier systems, doublers in particular. A few of the newer sets, such as Sylvania chassis 1-387, also use doublers. Tripler, quadrupler and even quintupler circuits are used in projection sets to obtain very high voltages, in the order of 30 kv. However, since these are limited in their use, only the operation of the doubler circuit is discussed.

The basic doubler circuit is shown in Fig. 5. The operation of V1, R1, C1 and C2 is that of a single rectifier. When positive pulses appear at the plate of V1, it conducts (I), charging up C2 as shown. Between positive pulses C2 discharges (I) as indicated and charges C1, R1, in series with C1, prevents the latter from losing too much of its accumulated charge. After several cycles, C1 and C2 are charged to the full value of E. From point X to ground (between flyback transformer pulses) E exists, by virtue of the charge across C1. When the positive pulses from the flyback appear, another E voltage is superimposed on the already-existing one across C1, thus making the voltage from point, X to ground approximately 2E. The voltage has thus been doubled. V2 and C3 operate in the following manner: The V2 filament is effectively connected to point X since the plate resistance of V2 is very small when it conducts during positive pulses. Therefore, C3 charges (I) as shown and after many pulses it is charged to the full 2E value. The charge of C3 discharges C1 (since it lies in the I current path). However, C1 once again regains its E charge between positive pulses. Actually, the high-voltage output is about 2 kV less than 2E, due to the inherent losses (such as loss in voltage by the drop across V1 and V2 during their conduction and the voltage drop across R1) in the circuit.

Stancor's A-8234 flyback transformer.

The RCA 228T1 70° horizontal output transformer, for voltages to 15 kv.

RCA's 232T1 universal 70° horizontal output transformer.

Fig. 5 — A conventional voltage doubler.
new Devices

Abraham Marcus, co-author of famous best-seller
"Elements of Radio" makes amazing offer!

Here it is! The most amazing guarantee ever offered on any radio-TV course anywhere! We'll send you Abraham Marcus' course to use free for one full month! If in that time you haven't actually made $100 fixing radios and TV sets, just return the books to us and pay not a penny!

Why do we make this sensational offer? First, because these books are so easy to use. They are written in the same clear, easy-to-understand language that made the author's "Elements of Radio" a 1,000,000-copy best-seller. Second, because these books get right to the point—tell you exactly what to do in 1-2-3 fashion. For example, once you master the first few chapters of the TV book you are ready for business—ready to do service jobs in the field—jobs that account for over 80% of all service calls.

DON'T WAIT! You risk nothing when you send the coupon at right. You don't have to keep the books and pay for them unless you actually make extra money fixing radios and TV sets. Even when you decide to keep them, they pay on easy terms. Mail the coupon now.

WHAT YOU GET IN THESE 3 GIANT VOLUMES

ELEMENTS OF TELEVISION SERVICING. Analyzes and illustrates more TV defects than any other book, and provides complete step-by-step procedure for correcting each. You can actually see what to do by looking at the pictures. Reveals for the first time all details, theory and servicing procedures for the RCA 28-tube color television receiver, the CBS-Columbia Model 205 color set, and the Motorola 19-inch color receiver.

RADIO PROJECTS. Build your own receivers! Gives you 10 easy-to-follow projects, including crystal detector receiver—diode detector receiver—regenerative receiver—audio-frequency amplifier—tuned-radio-frequency tuner—AC-DC superheterodyne receiver—etc.

TRY MY TV and RADIO COURSE FREE FOR 1 MONTH

"If you haven't earned at least $100 in spare time during that period you pay not a cent."

RADIO SERVICING Theory and Practice. Here is everything you need to know about radio repair, replacement, and readjustment. Easy—step-by-step self-training handbook shows you how to locate and remedy defects quickly. Covers TRF receivers; superheterodyne receivers; Shortwave, portable, automobile receivers, etc. Explains how to use testing instruments such as meter, vacuum-tube voltmeters, tube checkers, etc., etc.

MAIL THIS COUPON

[Address]

[City, State]

139

www.americanradiohistory.com
Oeti

designed
color

Mg®

COLOJRTE

U.S.
PATENT No.
2,772,413

CANADIAN
PATENT
No. 541,670

rerommeaded/or
doíá

color

aid

hack

mrred/

reception

áreaslormerly

usiny

coaled and
eoaieal
-yaafi

úntallatioas

small and compact

for easier installation and improved outside appearance.

flat frequency response

a necessity for good color reception

for the ultimate in color reception

magna chrome

element system

The Magni-Chrome element system consists of an EXTENDED WING DIPOLE accurately coupled with a precision V'd dipole. This combination is designed to magnify the chromatic characteristics of the incoming color signal to assure true, full-color reception. The folded dipole is V'd at the exact angle that gives greatest gain and band width when used in conjunction with the EXTENDED WING DIPOLE. Extremely flat frequency response across the entire VHF band is obtained together with improved gain.

TRIO

COLOR-ROYAL

high forward gain

Sharper, Clearer Pictures High Signal-to-Noise Ratio

flat frequency response

Improved Contrast on Black & White -

Perfect Reproduction of the Color Signal

highest front-to-back ratio

For Freedom From Co-channel Interference

tri-stop reflectors

Used in combination with the "Wing" and Collinear directors give exceptionally high front-to-back ratio while maintaining optimum gain on all channels.

THE LINE WITH PROTECTION

U.S. PATENT No. 2,772,413

CANADIAN PATENT No. 541,670

Export Sales Div., Scheel International Inc., 5909 N. Lincoln Ave., Chicago, U.S.A. Cable Address: HARESHEEL

140

RADIO-ELECTRONICS

www.americanradiohistory.com
Get This Valuable Book FREE!


At Last! Money-Making “Know-How” on Transistors, Color TV and Servicing

Coyne’s great 7-volume set gives you all the answers to servicing problems—quickly! For basic “know-how” that’s easy to understand you’ll find everything you want in Volumes 1 to 5 on over 5000 practical facts and data. Every step from fundamentals to installing, servicing and trouble-shooting all types of radio and TV sets. Up-to-date it covers COLOR TV. UHF and the latest on TRANSISTOR TELEVISION plus Volume 6—NEW Coyne TECHNICAL DICTIONARY with over 4000 definitions of the latest terms, symbols and abbreviations in radio-TV, electronics and electricity.

EXTRA! 900-Page Television Cyclopedia Included

And then, for speedy on-the-job use, you get volume 7—the famous Coyne TELEVISION CYCLOPEDIA. It answers today’s television problems on servicing, alignment, installation, etc. In easy-to-find ABC order, cross-indexed. Use this 7-volume TV-RADIO LIBRARY FREE for 7 days; get the Servicing Book ABSOLUTELY FREE!

Get This Valuable Book FREE

just for examining Coyne’s new set

“Applied Practical Radio-Television” on 7 day free trial!

Send no money! Just mail coupon for 7-volume set on 7 days free trial. We’ll include book of 150 TV-Radio Patterns & Diagrams. If you keep the set, pay $2 in 7 days and $2 per month until $24.50 plus postage is paid. (Cash price, only $34.95.) Or you can return the library at our expense in 7 days and owe nothing. YOU DECIDE THE JUDGE. Either way, the book of TV-Radio Patterns is yours FREE to keep! Offer is limited. Act now!

FREE BOOK—FREE TRIAL COUPON!

Educational Book Publishing Division Coyne Electrical School, Dept. A7-T1 500 S. Paulina St., Chicago 12, Ill.

YES! Send me 7-Volume “Applied Practical Radio-Television” for 7 days free trial in your offer. Include TV-Radio Patterns & Diagram Book FREE.

Name

Address

City Zone State

Where Employed

$22.95 plus C.O.D. postage or delivery. 7-day money-back guarantee.

Now with an Instantaneous Readout.

New 12SN7 Tube-Testers Available

Available for standard or high-temperature use.

"Applied Practical Radio-Television"

For 7 days free trial the famous Coyne 7-volume set on radio, television, color, and transistors will be yours for you to examine. All you have to do is mail this coupon and you will receive the complete set of 7 volumes. The only charge is $2 in 7 days and $2 per month until $24.50 plus postage is paid. Whether you keep the set or not you will have your money back. Offer is limited. Act now!
NEW DEVICES (Continued)

DEPOSITED-CARBON RESISTORS. Dalohm MC type. Molded plastic coating. 3 sizes: 1/4, 1 and 2 watts. — Dale Products Inc., Box 136, Columbus, Neb.


TAPE RECORDER, model 1900. 2 speeds, 3½ and 7½ inches per second. Dual-track recording. Fast forward and rewind. Weights less than 15 pounds. — Teletronsonic Corp., 32-16 37th St., Long Island City, N.Y.

CASES. Model 400 ( illustrated) holds any Viking tape deck and can be used vertically or horizontally. Model 601 for amplifier or pramp. — Viking of Minneapolis, 8600 Albright Ave. So., Minneapolis 20, Minn.

MAGNETIC TAPE. Scotch brand no. 111 Low-Print. Reduces print level by 8 db and increases high-frequency response. — Minnesota Mining & Mfg. Co., Dept. A7-226, St. Paul, Minn.


PHONO CARTRIDGE, twin-lever ceramic. 30-15,000 cycles. Dual needles. 1-mil stylus for 33½ and 45 rpm, 3-mil for 78 rpm. —Shure Brothers Inc., 222 Hartrey Ave., Evanston, III.


REMOTE-CONTROL UNIT, Duo-Master, for TV sets can also be used for monitoring tape recordings. Single-wire hookup. Provides remote tuning of picture, sound and station selection. — Tech-Master Corp., 75 Front St., Brooklyn, N.Y.

WIDE-ANGLE PROJECTOR, model CLH. Omnidirectional swivel mounting enables projector to be rotated 360°. Air column length 4 ½ feet. Horn cutoff 120 cycles. — University

suddenly stereophonic sound comes "alive"

the new binaural dynamic earspeakers
DIMENSI-FONES

For the first time, enjoy the full, exciting realism of binaural sound. New DIMENSI-FONES create the feeling of true stereophonic depth and direction. Each ear hears a separate sound channel...exactly as picked-up by each recording or broadcast microphone. Amazing frequency response reproduces the full orchestral scale within human hearing. Perfect for private hi-fi, AM-FM radio, TV, and short-wave listening. Used and recommended by leading performers and engineers. Equipped with comfortable ear cushions to eliminate all external noise. Monaural headset models also available. Sold at high fidelity and radio parts dealers.

FREE! Write for booklet "16 Ways to Hook-up DIMENSI-FONES" and information on Permoflux high fidelity speakers, systems, and components.

Permoflux PRODUCTS COMPANY
4101 San Fernando Road • Glendale 4, Calif. • CHapman 5-5111

RADIO-ELECTRONICS
Loudspeakers, Inc., 80 S. Ken- me Ave., White Plains, N.Y.

TRANSISTORIZED MICRO-

with factory-mounted com-

ponents. Dec flaments. Fre-

cuency response +0.5 db, 6-

60,000 cycles. 6 inputs. Feed-

dback type tone control. Dyna

Co. 617 No. 41 St., Philadel-

phia, 4, Pa.

PREMAPIFER. Includes dip-
soldered printed-circuit board

BINAURAL PREAMP. Model

K-45 kit or factory-wired. Dual-

channel preamp drives its own

25-watt amplifier in conjunction

with any present ampli-

er. Response 20 - 20,000 cycles. 

Equalization controls. 2-

position low-cut and high-cut

selectors. - Arkay, 120 Cedar 

St., New York, N.Y.

Loudspeakers, Inc., 80 S. Ken-

cisco Ave., White Plains, N.Y.

TRANSISTORIZED MICRO-

with factory-mounted com-

ponents. Dec flaments. Fre-

cuency response +0.5 db, 6-

60,000 cycles. 6 inputs. Feed-

dback type tone control. Dyna

Co. 617 No. 41 St., Philadel-

phia, 4, Pa.

PREMAPIFER. Includes dip-
soldered printed-circuit board

BINAURAL PREAMP. Model

K-45 kit or factory-wired. Dual-

channel preamp drives its own

25-watt amplifier in conjunction

with any present ampli-
er. Response 20 - 20,000 cycles. 

Equalization controls. 2-

position low-cut and high-cut

selectors. - Arkay, 120 Cedar 

St., New York, N.Y.

Loudspeakers, Inc., 80 S. Ken-
cisco Ave., White Plains, N.Y.

TRANSISTORIZED MICRO-

with factory-mounted com-

ponents. Dec flaments. Fre-

cuency response +0.5 db, 6-

60,000 cycles. 6 inputs. Feed-

dback type tone control. Dyna

Co. 617 No. 41 St., Philadel-

phia, 4, Pa.

PREMAPIFER. Includes dip-
soldered printed-circuit board

BINAURAL PREAMP. Model

K-45 kit or factory-wired. Dual-

channel preamp drives its own

25-watt amplifier in conjunction

with any present ampli-
er. Response 20 - 20,000 cycles. 

Equalization controls. 2-

position low-cut and high-cut

selectors. - Arkay, 120 Cedar 

St., New York, N.Y.

Loudspeakers, Inc., 80 S. Ken-
cisco Ave., White Plains, N.Y.

TRANSISTORIZED MICRO-

with factory-mounted com-

ponents. Dec flaments. Fre-

cuency response +0.5 db, 6-

60,000 cycles. 6 inputs. Feed-

dback type tone control. Dyna

Co. 617 No. 41 St., Philadel-

phia, 4, Pa.

PREMAPIFER. Includes dip-
soldered printed-circuit board

BINAURAL PREAMP. Model

K-45 kit or factory-wired. Dual-

channel preamp drives its own

25-watt amplifier in conjunction

with any present ampli-
er. Response 20 - 20,000 cycles. 

Equalization controls. 2-

position low-cut and high-cut

selectors. - Arkay, 120 Cedar 

St., New York, N.Y.

Loudspeakers, Inc., 80 S. Ken-
cisco Ave., White Plains, N.Y.

TRANSISTORIZED MICRO-

with factory-mounted com-

ponents. Dec flaments. Fre-

cuency response +0.5 db, 6-

60,000 cycles. 6 inputs. Feed-

dback type tone control. Dyna

Co. 617 No. 41 St., Philadel-

phia, 4, Pa.

PREMAPIFER. Includes dip-
soldered printed-circuit board

BINAURAL PREAMP. Model

K-45 kit or factory-wired. Dual-

channel preamp drives its own

25-watt amplifier in conjunction

with any present ampli-
er. Response 20 - 20,000 cycles. 

Equalization controls. 2-

position low-cut and high-cut

selectors. - Arkay, 120 Cedar 

St., New York, N.Y.

Loudspeakers, Inc., 80 S. Ken-
cisco Ave., White Plains, N.Y.
strip type recorder used for controlling and recording wide variety of processes. Universal for 5-500 C. but may be changed for other applications. Automatic bridge principle using CA alignment method. Original coil several times more sensitive than any other brand. Need for demagnetized equipment not necessary. Bonded ceramic used, or guaranteed, or money back if not satisfied. Wired for A, B, or C.

$179.50 ea.

M-1 SERVO UNIT FOR BEAM REGULATOR

Unit has self-contained hydraulic pump moving arm 19.5 -11 amp. 15/8 hp. ideal mounting for radio. Bull type carrying handle. Cost $4.25 ea.

$1.00 ea.

Brand new, ready to operate by connecting to your DC source. Spare parts included with ample supply of ink and paper. Transmits and receives pictures, signatures, and copies. Ideal for loan offices, banks, or other businesses where signatures must be verified, etc. Use two sets together with 2 wires telephone line or radio carrier between. Cost Gymn. approx. $60.00. Your choice, in original packing, only $30.60 ea. Ship. wt. approx. 300 lbs.

$9.50 ea.

Brand New
12 V. Dynamotor

DM-40. Indoct: 12-14 V 3.4 A. Output: 172 V. -128 3.4. An ideal dynamotor to adapt to mobile users on the new 12 V. cars. Don't pass up this line even if your intended use are not correct plate. Size 4 1/4 x L. x 2 1/4. dia. 4". lead with 5 pin Jones plug. Ship. wt. 7 lb. $7.75

We are not going out of business or losing our lease—but compare this list of prices & items anywhere

Due to lower prices on these items we cannot accept orders unless total amount is $5.00 or more

g. BC-601 Transmitter—10 tube 20-27.9 MC. F3 converts easily to 10 meter. For 12 or 24 V. DC use (no dynamotor supplied) complete with tubes. Size 18"x12".10'. Excellent condition. Shipping wt. 100 lbs. ea. Price $6.95 ea.
c. Receiver R1/ARR:—two stage RF range. 235 to 248 MC. Ideal for conversion to preselectors, ham 220 MC converter, etc. Complete with tubes in compact aluminum case 12 1/2"x4 1/2"x 5". No radiation on input coil has been blocked by Arm for diminishment. Easily repaired with cement or replacement. Shipping wt. 4 lbs. New. $1.25 ea.
d. Coach relay—operates on 12 or 24 V. Ideal for your mobile transmitter receiver equipment. Ship. wt. 2 lbs. New $1.25 ea.
e. 9 S. T. set—telephone type switch in handle. Ideal for your mobile equipment. $2.95 ea.

$4.50 ea.

e. 115 V. 400 cycle inverters $4.95 ea. New. 24 V. DC input-115V 400 cycle output inverters for numerous ADF, radar, and other electronic items. Size 9 x 4 x 2.5". Ship. wt. 4. New. $1.25 ea.
f. 115V Plate Transformer—$8.95. Brand new—Arm II X 115 V. Contains two 400 volt. $5.95 ea.

$1.25 ea.

g. Amplifier—A. Dual Target Transmitter—$3.95 dual transmitter one on 5.5-meter band for 67.5 MC built. into a 6 ft. x 30 H. plastic sheet. Shipped in original case. Original box. wt. approx. 11 lbs. Ship. wt. 5 lbs.

$4.50 ea.

h. Torque Amplifier 120 V. AC—$7.50. Works like the power steering on a car. Takes movement of input wheels and turns the motor shaft with ratio where by being added by 110 V. 1/40 H.P. motor which is part of unit. Size 12 x 5 x 7 1/2". Shipped in original box. Ship. wt. 3 lbs. New. $3.50 ea.

$10.00 ea.

i. 30 Amp. DC Ammeter—$1.00 New. 3 round panel type 0-30 Amps. DC. With scale. Black. Mfg. by Hoyt. Ship. wt. 2 lbs. ea.

$10.00 ea.

j. DM-52 Dynamotor—15-16 V. DC input-15/30V output 240 and more. Continuous. Size 1/2"x 2" x 7". Ship. wt. 30 lbs.

$5.00 ea.

k. 110V to 28V Transformer—$5.00. 110V, 60 c. per second. 28V, 5 amp. secondary transformer for building your 24 volt charger or DC supply. Ship. wt. 1 lb.

$7.00 ea.

l. RSS-54-C. 34A Battery—$1.95. New. Plastic case storage battery, size 5 1/2"x4 1/2"x 3 1/2". Shipped dry charged. Ship. wt. 5 lbs.

$1.25 ea.


$10.00 ea.

n. Golf Car Motor—$4.50. Storage battery operated reversible motor—1 1/4 H.P.—12 to 24 V. DC. Speed to 4400 RPM. 4 1/8" dia. x 9 1/2 long shaft. NEW. Ship. wt. 12 lbs.

$10.00 ea.

o. 100 amp. 6V. Leece-Neville Alternator and Rectifier for police car or other automobile or boat use where high charging currents are needed. Used but guaranteed. Ship. wt. approx. 110 lbs. $80.00 ea.

$1.25 ea.

p. OIL CAPACITORS: All New

2 mfd. 600V. Aerovox 20C16 $2.50/dozen
2 mfd. 600V. Sprague 20C16 $2.50/dozen
3 mfd. 600V. Tube 30C16 $7.50/dozen
4 mfd. 1500V. GE 30C16 $30 each

$1.25 ea.

q. Mechanical Varicables: All New

1/2" spindle variable. Built RC 125 Reg. $2.45 price—Special $1.00 ea. boyfriend.

$1.25 ea.

RADIO-ELECTRONICS
NEW DEVICES (Continued)

TRIC CONTROL. A variety of combinations. P. H. Mallory & Co., Inc., 3029 E. Washington St., Indianapolis, Ind.

LONG-NOSE PLIERS, no. 200-6-VC. For wiring by cut, hook and crimp method. Replaceable cutting blade. Self-opening coil spring.—Mathias Klein & Sons, 7200 McCormick Rd., Chicago 45, III.

TAPE TENSION GAUGE. Imported from West Germany, this precision-built instrument measures the tension of tapes in tape recorders. All movable parts are mounted on ball-bearings—American Elite Inc., 7 Park Ave., New York, N. Y.

VARIABLE INDUCTORS. Supported in 45, 60, 75, 100, and 150,000 combinations.—P. H. Mallory & Co., Inc., 3029 E. Washington St., Indianapolis, Ind.

NEW SUBMINIATURE TUBE RECORDERS. 207A-210, 207A-211. For wiring troubles on models using tubes that may be the nearest out of Color TV—a Fully illustrated, covers basic color television transmission and reception, the color signal, color tubes. Helps each individual this profitable new field.

TELEPHONE PICKUP COIL, model HP-61. Transforms telephones conversations with recorder or makes messages audible with amplifier. 9/16-inch diameter, 2 3/4 inches long. With 6-pin shielded cable terminated in standard phone plug.—Microtron Co., Inc., 145 E. Madison Ave., Valley Stream, N. Y.

ANTENNA-MATCHING COILS, for RCA TV sets. No. 1213 (center) replaces coils with voltage regulation from zero to 115 volts at 100 ma. Recommended for manufactured applications.

27-255 crystal and tube; F-208 matching receiver. 3 1/8 x 2 1/4 x 3/4 inch; F-208; motor-driven, single-channel transmitter 1-mile range, with power input of 500 watts.

Power output of 150 watts.


TV TROUBLE SHOOTING METHOD. New Edition. November TV servicing method enables anyone to diagnose TV troubles as rapidly as an expert. No knowledge of TV servicing required. Thousands of TV troubles are solved. Hundreds of TV troubles are solved.

RCA & ADMIRAL TROUBLE INDICATING TV TUBE LOCATION GUIDES. These two books contain the most complete compilation of RCA and Admiral TV troubles found in one place. These books contain the most complete compilation of RCA and Admiral TV troubles found in one place. RCA Guide—No. A1. 50¢. Admiral Guide—No. A2. 50¢.

LEARN MORE! EARN MORE! WITH H. G. CISIN'S TV SERVICE BOOKS

NEW 1957 TV TROUBLE INDICATING TV TUBE LOCATION GUIDES. These two books contain the most complete compilation of RCA and Admiral TV tube location guides ever published. RCA Guide contains all TV models from the earliest TV models to the latest 1957 models. Admiral Guide contains all TV models from the earliest TV models to the latest 1957 models.

TV TROUBLE TRACING GEARS. No trouble tracing in TV tubes. This guide contains all TV models from the earliest TV models to the latest 1957 models.

IF JOBER IS OUT OF STOCK, MAIL THIS "WAN'S" TRIAL ORDER COUPON 5-day Money Back Guarantee

H. G. CISIN, Dept. E-43, AMAGANNSETT, N.Y.

Enclosed find $ RUSH POSTPAID following books:

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>K-S-1</td>
<td>50¢</td>
<td>$1.50</td>
</tr>
<tr>
<td>K-S-2</td>
<td>50¢</td>
<td>$1.50</td>
</tr>
<tr>
<td>K-S-3</td>
<td>50¢</td>
<td>$1.50</td>
</tr>
<tr>
<td>K-S-4</td>
<td>50¢</td>
<td>$1.50</td>
</tr>
<tr>
<td>K-S-5</td>
<td>50¢</td>
<td>$1.50</td>
</tr>
<tr>
<td>K-S-6</td>
<td>50¢</td>
<td>$1.50</td>
</tr>
<tr>
<td>K-S-7</td>
<td>50¢</td>
<td>$1.50</td>
</tr>
<tr>
<td>K-S-8</td>
<td>50¢</td>
<td>$1.50</td>
</tr>
<tr>
<td>K-S-9</td>
<td>50¢</td>
<td>$1.50</td>
</tr>
<tr>
<td>K-S-10</td>
<td>50¢</td>
<td>$1.50</td>
</tr>
</tbody>
</table>

Enclosed find $13.50 for entire CISIN TV LIBRARY of 17 valuable TV service books listed above. Regular Price $15.00—yours for only $13.50.

Name: ____________________________
Address: ____________________________
City: ____________________________
State: ____________________________

FREE $2 WORTH OF BOOKS—FREE—With every purchase of entire CISIN TV LIBRARY of 17 valuable TV service books listed above. Regular Price $13.50. Yours for only $13.50.

www.americanradiohistory.com
Marion McPartland makes her tape recordings on

Irish Ferro-Sheen Recording Tape.

That alone is not the reason why you should use

Irish Ferro-Sheen Recording Tape.

Here's why you should use

Irish Ferro-Sheen Recording Tape:

It's the best-engineered tape in the world...gives you better highs...better lows...better sound all around! Saves your tape recorder, too — because the Irish Ferro-Sheen process results in smoother tape...tape that can't sand down your magnetic heads or shed oxide powder into your machine. Price? Same as ordinary tape!

Available wherever quality tape is sold.

GRRadio Industries, Inc., Cetikka, Alabama

Note: Records below are 12-inch LP and play back with RIAA curve unless otherwise indicated.

Audio Follies
Bargain Sampler of Indecent Proportions

Cook LXX

If Emory Cook set out to produce a hi-fi sampler to end all samplers, he may well have succeeded. Certainly no previous sampler comes close to offering so complete a sampling of a catalogue or such a variety of sound.

There are 15 selections here from 15 Cook records, starting with very real trains, proceeding through steel bands, calliopes, carousels, a variety of unusual instruments such as the theremin, cimbalom and pedal harpsichord, the more familiar organ (but in Cook's awesome realism), the orchestra and finally calypso and hot jazz. Many of these I have reviewed previously, but this recording may well be superior to the originals because it is pressed by the new Microprocess.

The claimed superiority of this process seems to be realized. Surface noise is at a new low — though the material is not immune to electrostatic noise and, therefore, needs treatment for it. Cook claims, also, that the material is stiffer and, therefore, the high frequencies are not as likely to be wiped off. In any event the high highs are extremely sharp and the transient response very notable, indicating a wider and cleaner bandwidth. On all accounts, as a sampler of Cook's peculiar genius, hi-fi sounds and the new process, this is recommended without any reservations.

Fiesta in Hi-Fi
Hanson and Rochester Symphony Orchestra

Mercury ML-30134

Here are four pleasant and colorful works by four contemporary American composers all based on familiar folk songs: Mehnhir's Mexican Ranchers, Nelson's Savannah River Holiday, Mitchell's Kentucky Mountain Portraits and Vareld's Joe Clark Steps Out. The music is both melodic and rich in orchestral color with a spectacular bass, tremendous drums and a variety of high highs. The recording is truly Olympian with tremendous crescendo — so tremendous that in spots even the best pickups may be overdriven if track- in and pressure are not optimum. Thus, it provides a very real challenge and test. But on those systems that can take it and dish it out, the effect will be sufficient to pop vest buttons with pride.

Hi-Fi Fiedler
Fiedler and Boston Pops

RCA Victor LM-2100

A very felicitous combination of music most people — even newcomers to music — will enjoy and brilliant sound that will nicely prove the value of high fidelity. The works are Rimsky-Korsakov's Coq d'Or, Rossini's William Tell and Tchaikovsky's Manfrede Suite. Between them they provide a little of everything from sharp high highs to thundering tympani. The balance is exemplary, though the recording is live, definition is excellent, and with the best pickups there will be no noticeable distortion. It will sound good on any hi-fi, but on the best it should provide a complete illusion of listening to a live concert in a seat 75 or 100 feet from the stage.

Honegger: Pacific 231
Rugby and other works

Schuricht conducting Philharmonic Symphony of London

Westminster XWN-18486

Pacific 231 is the new famous musical impression of a locomotive which offers as fine fare for a first-rate (and test for poor-to-middlin') hi-fi as there is on records. This version is particularly outstanding for the good double bass, very low drums, definition, clarity and the overall awesomeness of the performance. Rugby is a rather similar musical impression of a Rugby game. Movement Symphonique has been described as Pacific 231 coming back. Prelude to the Tempest is even more awesome to my ear than 231 with its thunderous drums and buzzing strings. In the other shorter works are of an early period. Here is a pretty good anthology of Honegger music and, for those who can tolerate it, excellent material for system testings especially of definition and dynamic capability — as well as notably realistic samples of various instruments — particularly string bass and drum — and some remarkable tonal effects.

Tchaikovsky: Nutcracker
(Excerpts)

Fiedler and Boston Pops

RCA Victor LM-2052

This version contains not only those most familiar excerpts usually performed as the Nutcracker Suite, but other less familiar portions of the original ballet. The music provides fine show-off and demonstration material particularly rich in the high percussion. The recording is outstanding with a brilliant liveliness, realistic balance and very clean throughout.

Kabalevsky: Comedians' Suite
Colas Breugnon Suite

Hordik conducting Paris Conservatory Orchestra

Schuechter conducting Philharmonia of London

MGM-E3506

The Comedians' Galop from The Comedians by this contemporary Russian composer has become a great pop favorite. Here is the full suite of excerpts from the original ballet. While the other sections are not as exciting as the Galop, they are all interesting in tone coloration and pleasant to listen to. The less familiar Suite from Colas Breugnon, an opera, possesses equal interest and even more spectacular sound material, particularly a fine bass, heavy drumming and big climaxes. The recording is one of MGM's best with a fine balance, liveliness and exception- ally clean.

The Deutscheinschmuck Takes a Holiday
Deutschmeister Band conducted by Herrmann

Westminster WP-6044

There are bigger brass bands than the Deutschmeister and there are records of bands playing more demanding music, but no other band plays with such an authentically Viennese sentiment...
NOW YOU CAN ORDER
precise KITS BY MAIL...
from Your Local Parts Distributor!

Precise Engineered
QUICK-TEST TUBE TESTER
Only 3 Knobs for GM, EM, Short and Gas Tests.

This is the finest fast-check tube tester and dollar-earning traveling companion for a Serviceman... or for use in the factory. You can plug in 5 tubes of the same type and check each one individually by rotating the Tube Bank switch. It actually checks 5 tubes in 20 seconds... or 100 per hour. By rotating the function-switch, each tube of a diode-triple is checked individually, each diode and the triode of a diode-triple is separately tested and not lumped as in other testers... and a period is tested as a period—not a diode. Transistors, shorts, gas, life, mutual conductance and emission can be tested with this model. Includes a deeply etched, polished, Mahogany colored wood carrying case and cover. Easy to carry.

Precise Model 110K Kit Form $79.95
Precise Model 110W Factory Wired 139.95

Precise Engineered
POWER LAB
For all your electrical needs!

For the first time in the industry, one instrument takes the place of more than 11 pieces of equipment. Here's what you get:

- A BATTERY ELIMINATOR for 6v and 12v battery
- A BATTERY CHARGER up to 24 volts
- A HIGH CURRENT LINE VOLTAGE VARIAC—up to 10 amperes
- AN AC LINE VOLTAGE METER
- AN AC LINE AMMETER
- AN AC LINE WATTMETER
- AN AC LINE ISOLATION TRANSFORMER—100w or 300w
- A LOW VOLTAGE, HIGH CURRENT AC SUPPLY — 24v or 10 amperes
- A DC LINE VOLTAGE VARIABLE SUPPLY
- A DC HIGH CURRENT AMMETER
- AN AGC BIAS BOX

Precise Model Isolation
711K Kit Form $49.95 100w
711W Factory Wired 64.95 100w
713K Kit Form 62.95 300w
713W Factory Wired 79.95 300w

Mutual Conductance and Emission
TUBE TESTER

Here is a tester that actually checks a tube for its applications, not whether it is just good or bad. On the Model 111, GM and Emission are checked separately. It is the first and only device that measures 600-mil tubes on a meter. Switches from 0 through the normal testing range when making measurements, which gives an average evaluation for the tube over an extended range of operation. Connects test voltages to each tube element. Uses a single rotary switch to check each element against every other element for shorts, whether they're hot or cold. Measures tube bias directly on a meter. Features a no-backlash roll chart. Includes provisions for testing all rectifying types. Cathode-Ray tubes may also be checked with the use of an adapter. An exceptional instrument for the shop, one that has won an impartial independent scientific survey hands down.

Precise Model 311K Kit Form $79.95
Precise Model 311W Factory Wired 139.95

You benefit from faster delivery, lower price, postage savings, and the personal local service of your nearby parts distributor when you order by mail...if you are more than enough, drop by and see the top quality parts included in each kit. Here are 8 of the many PRECISE distributors who are ready to serve you. Use the handy coupon below to order your PRECISE kit by mail.

Graham Electronics
Supply, Inc.
102 S Pennsylvania St.
Indianapolis 4, Ind.
Mr. H. Thompson...Creative Engineering and quality components assure customer satisfaction with PRECISE equipment.

Leuck Radio Supply
2413 South 31st St.
Lincoln, Nebraska
L. H. Soderholm...We have found that the advanced engineering of PRECISE kits offers design features comparable with many laboratory instruments.

Radio Electric Service
CO. OF PENNA., INC.
N. W. Camer 7th & Arch Sts.
Philadelphia 6, Penna.
Henry A. Koss...For quality and precision, we always recommend PRECISE in test equipment.

Standard Parts
277 N. Franklin St.
Hempstead, N. Y.
William Hull...Refreshing original design built into every PRECISE kit.

Thriftty Electronic Supply Co.
3647 Burbank Blvd.
Van Nuys, California
Mr. H. Es...Precise engineered kits give you more value for your money.

Whole Sale Radio Parts
CO., INC.
308 West Redwood St.
Baltimore 1, Maryland
Frederick, v.p. We have found that PRECISE-Kit for giving quality and value—economically—goes hand-in-hand with our pursuits.

Winter Radio
Incorporated
1408 West 25th St.
Cleveland 13, Ohio
Edward J. Gorcey...Precise kit—a quality line that has no equal.

Precise Distributors:
Mr. Precise Distributor; I would like to order the following Precise kits:
5" Scope Powerlab Tube Tester
Model Kit [ ] Model 711K [ ] Model 111K
[ ] Model 311 Kit [ ] Model 711W [ ] Model 111W
[ ] 311W [ ] Model 311K [ ] Model 111k
[ ] Catalog [ ] Model 713K [ ] Model 116K
Please send kits COD [ ] Bill my account
Remittance Enclosed, Ship Prepaid [ ]

Print Name Clearly
Street Address
City & State

www.americanradiohistory.com
Transistorized Power Supply

Go modern. Build this transistorized mobile power supply using popular CBS 2N256. Compact combined inverter, rectifier and filter operates from automobile battery. Delivers up to 50 watts d-c output ... for example, 250 volts at 200 ma. Replaces troublesome vibrator pack or dynamotor. Has no moving parts and offers efficiencies up to 85%. Inverter output is square-wave... 0.1 mfd filters it. This easy-to-build supply is ideal for mobile ...transmitter, receiver, sound system, etc.

CBS 2N256 (6-volt) and 2N256 (12-volt) power transistors are useful in many other economical amplifier ... fixed or mobile. Write for CBS Power Transistor Applications, PA-16, for complete details on 15 practical circuits, including this power supply. Or pick up Bulletin PA-16 along with your 2N255 and 2N256 transistors at your CBS Tube distributor's.

NEW RECORDS (Continued)

SURLINCH: Second Symphony TURINA: Rhapsody Sinfonica Winograd conducting Philharmonia of Hamburg With Sandra Bianca, piano MGM E-3510

Somehow or other the blend of modern and Spanish is far more palatable than straight modern. In any event it produces in these works some interesting sound, well punctuated with percussion and accentuated by some big peaks. Surlinchi is more modern than Turina, yet sounds more Spanish in this particular work. Even those who ordinarily dislike modern music may find both these works engaging. The recording is one of the best of this orchestra and presents the music to very good advantage.

HOVANES: Anahid Alileinai and Fugue Tower Music Surlinchi conducting MGM Orchestra MGM E-3504

I have previously reviewed several recordings of this very individual American composer. This one gives a fittingly good review of his three pieces: Alileina and Fugue goes back to his more conventional early days. Anahid is from his Armenian period and Tower Music from his more recent neo-Archaic period. The three works are fairly representative though not the most remarkable of his unique style. There are plenty of unusual effects, including a bass solo and considerable percussion. I do not know why some of it was cut so high, however, with the result that in spots even solo trumpets are ragged.

BRAMHS: Symphony No. 1 Munch and Boston Symphony RCA Victor LM-2097

The first movement of this great symphony is almost a concerto for tympani, and a very fine showing they make in this recording. No comment is necessary about the music and everybody has his own preference as to its interpretation. The recording is clean, spacious and live enough to yield all appropriately romantic quality. Definition is good enough and the overall sound at a moderately loud level yields a fine presence. Not at all spectacular from a hi-fi point of view but an outstanding example of the way a fine hi-fi recording can enhance great music and yield an experience of it almost as good as a live performance.

LECLAIR: Concerto for Flute, Strings and Harpsichord HAYDN: Concerto for Flute and Strings PERGOLESI: Concerto for Flute Traverso Camillo Wanauack, Flute Pro Musica Chamber Orchestra of Vienna Vox PL-10-150

The flute is one of the most felicitous of all instruments on a fine hi-fi system and this recording provides three very fine examples of music written especially for it, beautifully and very cleanly recorded. Incidentally, if you live in an area where there are lots of birds, play this next spring when they are in their best voice and you'll attract a choir of flute-lovers and imitators.

SHUBERT: Death of Lazarus Winograd conducting Philharmonia of Hamburg With vocal soloists MGM E-3526

This was intended to be the first act of a full-length opera, but the first act was finished. It was not performed until very recently and...
NEW RECORDS (Continued)

won some acclaim not only for its intrinsic musical values but for its Wagnerian effects as well. This recording presents it complete and is the first performance on American records.

BACH, K.P.E.: Concerto for Four Viols
MASCHERA: La Capriola
GABRIELLI: Canzone
TOMOSINI: Suite for Violetta
Ensemble Marius Casadesus
Westminster XWN-181-30

Four composers of the 18th, 17th and 18th centuries are represented here with chamber works performed on ancient string instruments by a group which has specialized in recreating this music as authenticly as possible. Especially interesting to me was the way four viols in the Bach concerto's second movement manage to sound like an organ. Thanks to the fine recording, the contrast of the viols to our modern violins is well and flatteringly presented. You don't have to be a musical antiquarian to enjoy this music either.

VIVALDI: Concerto for Two Trumpets in C
Concerto for Two Trumpets in E Flat
Concerto for Oboe and Strings in D Minor
Concerto for Oboe and Strings in F
Winterthur Symphony Orchestra
Concert Hall CHS-1242

Except in brass band music, the trumpet is seldom allowed to take the spotlight. Here a pair of them is given the opportunity to show off both the capability of the instrument and the virtuosity of its players in very pleasant music and a very fine recording which presents the trumpets at their best in a very fine test of mid-range and treble coloration. Assuming the pickup tracking is good, the tone should be clean and sweet throughout, brassy but without stridency. The oboe is about a half octave higher in range and offers a contrast in tone. This one is unusually sweet and mellow.

COPLAND: Piano Concerto 1926
Leo Smit, piano; Radio Rome Symphony conducted by the composer
BLACK: Four Episodes for Chamber Orchestra
Scherman conducting
Radio Zurich Symphony Orchestra
Concert Hall Society CHS-1238

This is an early Copland, seldom heard nowadays, in which he employed jazz idiom. It will be especially interesting because it is conducted by its composer and because it shows only traces of the style so characteristic of his later works. The Block Episodes are very interesting chamber music, with an oriental flavor in spots—modern but most people would find the modernisms unobjectionable. The recording is excellent except that it is overfed in spots and will drive some pickups into distortion.

VERNON DUKE: Souvenir de Monte Carlo
ROBERT CORERT: Mediterranean Suite
Surinach conducting
MGM Chamber Orchestra
MGM E-3497

An opportunity to savor hitherto unperformed music. Duke is a Russian-born contemporary American composer who has scored Broadway shows and some popular songs, including April in Paris. He has also written serious music (at first under his patronymic Dukelsky) which shows very few traces of Broadway or pop music. Souvenir de Monte Carlo is a ballet composed about ten years ago but never produced. Cobert is a clearly promising young American composer who here receives the first performance of his works. Neither of these is at all hard to listen to. Both have some excellent percussion. The recording is excellent.

Name and address of any manufacturer of records mentioned in this column may be obtained by writing Records, Radio-Electronics, 351 West 14th St., New York 11, N.Y.

OCTOBER, 1957
another
TABS
quality engineered product

all channel UHF converter
Model 99 is your best buy in a UHF converter. Features include tuned input, precise impedance match, UL approval, one-knob tuning and drift-free performance. Largest selling UHF converter in the country at $22.95 list. ...In difficult reception areas use the BTU-2 only $39.95

another
TABS
quality engineered product

2-set coupler
Model TV-42 a 2-set coupler approved for color, UHF, VHF and FM. Matched resistive circuit with 12db interset isolation and flat response—0-900 megacycles. Another quality TV accessory engineered by B-T Labs. $2.95 list
Sold by electronic parts distributors for further information use coupon below

BLONDER-TONGUE LABS, INC., RE-10
925 Alling Street, Newark 2, N. J.
Please send me literature covering — B-T TV Accessories
Name
Address
City Zone State

RCA TRANSISTOR PORTABLE
In model 7-BT-10K a 33,000-ohm resistor R28 has been added from the collector of the driver to the collector of one of the output transistors as shown in the diagram. This introduces negative feedback, improving audio response and cutting distortion.

CROSLEY AT-10M
Complaint: excessive buzz, most pronounced on strong and medium signals.
The set employs a gated beam tube as FM detector, limiter and first audio amplifier. For minimum buzz the alignment of the preceding 4.5-icf if coils must be on the button. A high hiss developed whenever alignment was attempted, showing that the stage was oscillating at an ultrasonic rate.

DUMMY TUBE
As a cure, the secondary of the if transformer feeding the 3BN6 was shunted with a resistor as shown in the partial schematic. The highest value that would permit alignment was 68,000 ohms. To insure a permanent cure, a 47,000-ohm resistor was installed with no noticeable loss of volume. (The added resistor acts as a damper to kill the oscillation.) — J. R. Vought

FRONT-END FAULT
We were demonstrating a new color bar generator on an early Sylvania 15-inch receiver. The receiver gave good results on color TV programs. The generator looked very bad with incorrect hues for all bars except black and white. No setting of the color phasing control served to produce correct hues.

We then considered the possibility of the tuner having poor response on the channel for which the generator was set (channel 3). There was no possibil-
TECHNOTES (Continued)

ity of switching channels, since the generator was fix-tuned. Another color receiver was not available for a cross check.

We did have a spare tuner and wired it into the receiver. This solved the problem, all colors came through properly both on a channel-5 program and on channel 3 with the generator. Another example of the fact that tuned-circuit response is considerably more important for color reception that for black-and-white.—Robert G. Middleton

COMPRESSION

A Truetone TV model 2D1530B showed compression of scanning lines at the top of the picture. Tube changes and linearity-control manipulation would not remove the bunching.

The condition was remedied by feedback to the vertical peaking resistor from the vertical output transformer. As the diagram shows, a 33,000-ohm resistor was connected from the hot side of the peaking resistor (R315) to the plate (pin 9) of the vertical output tube. Value of the resistor may have to be a little higher or lower for different sets of the same model.—Peter Miliano

ADMIRAL TUNERS

Poor performance in Admiral all-channel tuners may be due to improper lead dress. The lead between the uhf antenna terminals and the uhf tuner doubles as a quarter-wave trap at the mean frequency of the low vhf channels and a three-quarter-wave trap at the mean frequency of the high vhf channels. The lead must be dressed away from any metal, particularly the metal brackets of the rear kinescope mount. If the lead is found doubled up or looped it should be straightened out.

—Warren J. Smith

END

8 NEW PRODUCTS
...just a few of the many new B-T precision engineered products

FIELD STRENGTH METER Model FSM-1
A portable precision instrument for acurate measurement of RF signals. Continuous tuning from 54 MC to 216 MC covering VHF-TV, FM, mobile, aircraft, ham, industrial and CD. Use of B-T UHF converter extends range to entire UHF band, $310 net

3 MASTERLINE CRYSTAL-CONTROLLED CONVERTERS
Model MVC: Hi-to-Lo channel VHF converter.
Model MLC: Lo-to-Lo channel VHF converter.
Model MUC: UHF to VHF converter.
Extremely stable, self-powered with two matched 75 ohm outputs. All channel VHF mixing network. Flat within 1/2 db over full 6 mc output. For color and black and white TV.

4 INDOOR TV SYSTEM TAPOFFS
Easy to install, matched low cost taps Model TO1-75: single isolated tapoff for recessed mounting. For RG-11/U or RG-59/U, with 75 ohm jack.
Model TO1-300: has 300 ohm terminals.
Model TO2-75: two 75 ohm outlets from RG-11/U or RG-59/U cable.
Model TO2-300: two 300 ohm isolated outlets from RG-11/U or RG-59/U cable.
sold by electronic parts distributors for further information use coupon below

BLONDER-TONGUE LABS, INC.
9-25 Alling Street, Newark 2, N. J. Dept.
Please send me literature covering:
□ Field Strength Meter □ Masterline Converters □ Indoor TV System Tapoffs
Name:
Address:
City________ Zone State

151
NOW—
Get it from
your Parts
Jobber!
Admiral®
4-Speed Record Changer
Hi-Fidelity

Admiral—
rated by servicemen as the most foolproof and trouble-free of all changers!

Admiral—
built into more phono and combinations than any other changer in the world!

Now—
Admiral®
phono-tip
connection into
AMPLIFIER
reproduction,
sapphire
separate
"jump"
shut
arm to
ords; intermixes
position. Changes
33 1/2,
pickup
Positive
sign.

NOW—
ATTACHED
DIAMOND
FEATHERWEIGHT
RUBBER
PLAYS ALL FOUR SPEEDS—
45, and 78

PLAYS ALL FOUR SPEEDS—
33 1/2, 45, and 78 plus "talking
book" 16 2/3 r.p.m. Has neutral
position. Changes 12 to 14 rec-
cords; intermixes those of same
speed. Automatic 2-way shut-off
after last record. Returns tone
arm to rest, stops turntable motor
completely. NOTE: Can be wired to
shut-off radio or amplifier chassis.

RUBBER TURNTABLE MAT
FEATHERWEIGHT TONE ARM—new resonance-free de-
sign. Less than 1/2 oz. pressure.
Positive tracking ... no "skip" or
"jump" on loud passages.

DIAMOND LP STYLUS—sep-
eterminate LP diamond and 78 r.p.m.
sapphire needles for finest sound
reproduction, long record life.

ATTACHED 40" SHIELDED
AMPLIFIER CABLE—eliminates
pickup of unwanted noise. Cable
has phono tip plug for quick easy
connection into standard input
phono-tip jack.

HEAVY DUTY MOTOR—powerful 4-pole
constant speed shaded pole induction type
motor. Operates without hum, rumble
or "wows" (as little as 0.15 db). Maintains even
speed even if line voltage varies. Six foot
line cord attached.

Admiral®
SPECIAL PRODUCTS DIVISION
3600 West Cortland Street
Chicago 47, Illinois

Texas Electronic Fair
The Texas Electronics Association
(TEA) held its fifth annual clinic and
Fair on Aug. 2, 3 and 4, at the Texas
Hotel in Fort Worth, Tex. Total attend-
cence was more than 450, out of a total
registered membership of over 500.

The opening night was highlighted
by a banquet. After the invocation, the
guests were addressed by Tommy
Thompson, of the Fort Worth City
Council, representing the Mayor; Bill
Inman, president of TEA, and the
Honorable Robert S. Calvert, Com-
troller of the State of Texas. Keynote
speaker of the evening was Hal F.
Bersche, of RCA, who spoke on "The
Future of Independent Service in Elec-
tronics."

The second day's features included
addresses by John Bennett, general
manager of Philco's factory-supervised
service program, and J. A. Milling,
President of Howard W. Sams, Inc. Mr.
Bennett's talk dealt with "Etiquette for
Servicemen" and Mr. Milling discussed
"Selling Service."

After a coffee break the technicians
heard talks by Cecil Lightfoot, of
Texas Instruments Co. on "Transistors
and Their Effect in the Service Indus-
try" and on the "TV Orphan," by Irv
Tjomsland (see RADIO-ELECTRONICS,
July, page 102) of Triad Transformer
Corp. Then the group was addressed
by Robert K. Cannell, service manager
of V-M Corp., on "Servicing Tape Re-
corders." After lunch John Thompson
of G-E Distributor Sales Tube Division
spoke on "Service Can Be Profitable."
"Color Alignment and Convergence"
was discussed by Verne Ray, editor of
Howard Sams' PP Reporter.

Management seminars during this
period covered "Independent vs Captive
Service" by Dick Fenick of Tung-Sol
Tube Co. and "Basic Needs of the Mod-
ern TV Shop" by E. W. Merriam, of
Sylvania, followed by an open discus-
sion period.

On the closing day the first address
was by Ed Meagher of CBS-Hytron on
"An Eye to the Future." Technical
personnel heard talks by Al Coumont
of Sprague on "Ceramic Capacitors and
Their Application" and the day was
ended with a panel discussion of var-
ious technical problems. James Palmer
of TEA moderated the panel consisting
of Bill Renner, Ed Meagher, Irv Tjoms-
land, Bob Hodges, Cecil Lightfoot,
Gordon Gow, Al Coumont and Clint
Walter.

During the talks several interesting
facts were brought out, including the
successful effort by TEA and its members to kill a licensing bill brought up in the Texas Legislature during the past session, but whose principles were considered incorrect by TEA members.

The business sessions closed with talks on "Advertising and Promotional Aids" by Wm. J. Nagy of Philco; "Accident Reduction Made Effective" by Bill Leonard of the National Safety Council and "Developing a Store's Personality" by Al Robertson of Oklahoma City.

NEW GUILD FORMED

A state organization of independent radio-television service groups was created at a recent meeting held in Cambridge by delegates from six Massachusetts cities. The group is chartered as the Electronic Technicians Guild of Massachusetts (ETGM).

Elected president of the new group was Nicholas A. Averinos, Colonial Radio & Appliance Co., South Weymouth; vice president, Gilbert P. Clark, Centronics Co., Newton; secretary, Lawrence J. McEvoy, technician, West Newton; treasurer, Albert N. Giddis, TV service manager, Lowell; assistant to the president, Remo DiNicola, South Shore Television Services, Quincy.

LETTER TO THE FTC

The following letter was sent by the National Alliance of Television & Electronic Service Associations (NATESA) to the Federal Trade Commission:

"Gentlemen:

"We note with growing concern the tremendous pressure being exerted upon your commission to authorize 'Pay-as-you-see TV.' It appears that those who are pushing the hardest are huge, interlocking combines which would profit immensely from authorization of captive broadcasting. It appears that exclusive rights to movies, sporting events, etc., are tied up by these people and that manufacturing facilities are also already within these combines."

"With such potential monopoly so evident in other phases touching upon 'Pay-as-you-see TV' and in view of the fact that should authorization be forthcoming, control of the operation of all sets would become vital to the operators, it becomes crystal clear that the monopoly would be extended to include service and maintenance of TV sets.

"The independent TV service people, of whom there are roughly 120,000, have pioneered and developed the service business at great cost and sacrifice. They are little, little businessmen and cannot easily afford the cost of defending their rights against huge corporations. Further, they have learned from many years of contact with set owners that by and large, the public is happy with TV broadcasting as now practiced, even though they may not be completely satisfied."
for LOWEST hum...noise... microphonics
in a high-µ dual triode . . .

Amperex®
ECC83 A PLUG-IN REPLACEMENT FOR THE 12AX7

MICROPHONICS:
Negligible in amplifiers requiring an input voltage of at least 50 mV for an output of 5 watts. No special precautions against microphonics necessary even though the tube is mounted in the near vicinity of a loud-speaker with 5% acoustical efficiency.

HUM AND NOISE LEVEL:
Better than — 60 db relative to 50 mV when the grid circuit impedance is no greater than 0.5 megohms (at 60 cps), the center tap of the heater is grounded and the cathode resistor is by-passed by a capacitor of at least 100 mfd.

OTHER Amperex TUBES FOR HIGH-FIDELITY AUDIO APPLICATIONS:

EL84/6BQ5 9-pin power pentode; 17 W PP
6CA7/EL34 High-power pentode, 100 W PP
6EH7/6E27 Low-noise high-µ pentode
EC8B/12AT7 Low-noise medium-µ dual triode
EC8B/12AU7 Low-noise low-µ dual triode
EC8B/6AQ8 High-µ dual triode for FM tuners
GZ34/5AR4 Cathode-type rectifiers; 250 ma.
EZ80/5V4 9-pin rectifier; cathode; 90 ma.
EZ81/6CA4 9-pin rectifier; cathode; 150 ma.

At All Leading Electronic Parts Distributors

Amperex ELECTRONIC CORP. 230 Duffy Ave., Hicksville, Long Island, N.Y.

TECHNICIANS’ NEWS (Continued)

“Small service businesses are good for the American economy in both peace and war. With the rapid development of bigness in all phases of business, we believe service is the last frontier of free enterprise and that it must be preserved.

Sincerely,
Frank J. Moch
Executive Director

ASSOCIATION MAGAZINE

The first issue of the SRTT IPET has appeared. It will be produced and distributed monthly as the official publication of the Society of Radio and Television Technicians, Inc. of California (SRTT). IPET means for the Independent Professional Electronic Technician. The magazine is mailed free each month to members of SRTT and nonmember radio and TV dealers in the San Fernando Valley and the adjoining territory.

GUILD HITS DISTRICT

Long Island, N.Y., electronic parts distributors were blasted for indiscriminate consumer sales by the Radio & Television Guild of Long Island (RTG). A report in the Guild News, the association’s monthly journal, listed distributors accuses by the guild of indiscriminate sales. Also listed were distributors who would not sell to a consumer under any circumstances.

This action was taken after persistent reports from members indicated that existing guild shopping policies required strengthening. Long Island service dealers have strongly objected to the number of parts jobbers selling to defense plant employees.

The Guild News noted that, if the more than 200,000 defense workers of the region make an average annual purchase of $5 in parts from distributors, more than $1,000,000 in retail sales would be routed from normal retail outlets.

RTA-PASADENA NEWS

Recent meetings of the Pasadena Radio Television Technicians Association (RTA) have seen a group of informative speakers, due to the efforts of Cecil Parker and Bill Yatty, program chairman.

Bernard H. Linden, of the Los Angeles FCC office, presented a full discussion on interference problems with a description of the makeup and activities of the Cooperative Interference Committee, and the local FCC office.

At another meeting Miss Lillian Dionne, representing the Pasadena Office of the Social Security Administrations, covered all aspects of social security from both employer and employee viewpoints with special reference to the problems of service technicians and dealers.

Another interesting talk was given by W. W. Cotie of the Hickok Instrument Corp. Mr. Cotie discussed tube testers and answered questions concerning his firm’s test instruments. END

STAN-BURN CATHODE RAY TUBE SPECIALS

ONE YEAR GUARANTEE

G.E. Type STAN G.E. Type STAN

510B8 $19.50 510A8 $19.50
18.75 18.75 18.75 18.75
375.70 375.70 375.70 375.70
$8.95 $8.95 $8.95 $8.95

WHY PAY MORE?

Hi-Fi COMPONENTS • KITS • REPRO PLAYERS • TAPE RECORDER • TUNERS • AMPLIFIERS • SPEAKERS • ELECTRONIC PARTS & TUBES, ETC.

Top brand nationally advertised in this and other Radio & TV Magazines. Send for full information. Send your order to: Dprodol Globe Mfg. Co., Dept. 37, 195 East 67th Street, New York 21, N.Y.

WHILE THEY LAST!!

BRAND NEW IMPORTED TAPE RECORDER

Clear, sharp music and clean reproduction. Dual track, 5, 7½, 8 ¾, 10, 12 ½, 15 tape recorders. AMAREX VALVE, single speed (5%), dual speed (5% & 17%).

$64.95 $44.95

FREE reel of tape with each order.

HIF DIAMOND NEEDLES—1 Yr. Guar.

GLOBE TANGLES (dual needles) $49.49 ea.

$119.49 ea.

RECORD CHANGERS

Columbia RC-455, 4-speed changer $35.91

Garrard RC-88, 1-speed changer $34.31

Garrard RC-30, 4-speed changer $66.15

FREE wood mounting base, record cleaning cloth and 54 RPM spindle with all orders for Columbia and Garrard changers, with this ad.

Vic 4 speed Hi-Fi CHANGER—Model 1210 with Rotette or Astoria Diamond cartridge.

MONARCH Model UABU 4 SPEED AUTO. INTER- NIX CHANGER less crystal turret $19.95

RONETTE (phono fluid) cartridge flip-over type $2.98

SOUNDTOE cartridge, flip-over $2.98

General Electric Hi-Fi Variable Reltance cartridge.

INTER-MIX Diamond head, full range, high sensitivity (in short supply). Four gram tracking force. Minimum record side

$25.95

4500—Dual Sapphire needles, 33-1/3, 45, $18.95

(GO2)-Diamond, Sapphire needles, $8.77

KITS!

We stock the following manufacturer’s parts listed in our reference catalogs. Send us your list, Dept. X-23, or see page 16 for complete listings.

$18.00 and up. Send for free catalog.

RECORDING TAPE

Excellent reproduction qualities.

1600 Ft. Master $2.59

1200 Ft. Acetate $1.99

FREE! 32-page illustrated booklet—

"Speaking of Loudspeakers" by University Co. Projects, Inc., a book on the history and mysteries of speakers. Write today to Dept. RE-10

YOU NAME IT—WE HAVE IT

Complete line of "X"- and "Y"- radiation products, gaiters, cloth, cord, antennas & accessories—Mini- mium order—DEALER'S BROCHURE—DEALER'S CATALOG—GIVES THE BEST DEAL POSSIBLE. Export inquiries and orders invited. Terms: 20% down, Balance G.O.B. 30 days. Price list on request.

Write for our latest price list and Hi-Fi Catalog RE-10. All prices subject to change without notice.
A Box Is Not A Musical Instrument!
your present speaker
in a
KARLSON TRANSDUCER

CAN GIVE YOU
10x THE EFFICIENCY
2x the dispersion!
2 more octaves bass!
Flatter response — Less distortion!
Unexcelled transient response!

IN EASY-TO-ASSEMBLE KITS
Hardwood exteriors - capable of fine furniture finish - from $18.60 to $57 net.
Also assembled models from $26.70 to $174.
See Your Dealer or Write:
KARLSON ASSOCIATES INC.
Send for your free catalog Dept. RE-8
1610 Neck Rd., Bklyn. 29, N.Y.

New Tubes & Semiconductors

Among the month's releases are two transistors. One of these is accompanied by a diagram showing its use in a neon indicator circuit. A tube-based silicon rectifier, a multunit seven-pin miniature and a stacked rectifier also appear.

2N398
A germanium alloy-junction transistor of the p-n-p type. Made by RCA and specifically designed for use in high-voltage, on-off control applications, particularly neon indicator, relay puller, incandescent-lamp driver and direct-indicating counter circuits of electronic computers.

A typical neon indicator circuit is shown in the diagram. An input of -6 volts lights the lamp by overcoming the transistor's cutoff bias and causing the 2N398 to conduct heavily (saturate), grounding the lamp through the low collector-to-emitter resistance. With 0-volt input, the 2N398 is cut off by the base bias circuit (V_b, R2, R1) and acts like an open switch due to the high collector-to-emitter resistance.

Maximum ratings in switching service are:

- \( V_{ce} \) (ma) - 100
- \( I_b \) (ma) - 50
- Dissipation at 25°C (mw) - 10
- Ambient temperature operating °C - 55

2N274
A drift transistor of germanium p-n-p type. Specifically designed for use as a rf amplifier in very compact military and commercial equipment and in entertainment type receivers operating at frequencies covering the AM broadcast band and up into the short-wave bands. An important design feature is the use of shielding to minimize interlead capacitance and coupling to adjacent circuit components. It is provided by a fourth lead situated between the collector and emitter leads and internally connected to the insulated metal envelope. The RCA 2N274 is

Tubes & Semiconductors

KARLSON ASSOCIATES INC.
Send for your free catalog Dept. RE-8
1610 Neck Rd., Bklyn. 29, N.Y.
**OXFORD HI-FIDELITY SPEAKERS**

Optimum Range at Minimum Cost!

Engineered for finest performance at minimum cost, OXFORD HI-FI SPEAKERS have a flat response throughout the audible range and are capable of handling the range of power inputs necessary for finest high fidelity reproduction.

![Diagram of OXFORD SPEAKERS](image)

**COAXIAL SPEAKERS**

C11406 & 11"  
Frequency response: 10-15,000 cps.

C151608 & 15"  
Frequency response: 20-15,000 cps.

**FULL RANGE SPEAKERS**

F11406 & 8"  
Frequency response: 50-12,000 cps.

F112408 & 12"  
Frequency response: 50-12,000 cps.

F121608 & 16"  
Frequency response: 20-15,000 cps.

**EXTENDED RANGE SPEAKERS**

HF1018 & 10"  
Frequency response: 1,000-15,000 cps.

HF1021 & 21"  
Frequency response: 1,000-15,000 cps.

**TWEETERS**

TSC08 & 3"  
Frequency response: 1,800-20,000 cps.

**NEW TUBES & SEMICONDUCTORS (Contd.)**

A tube-base-mounted silicon replacement for the 6X4. Directly interchangeable with the 6X4, it has a maximum dc output of 85 mA, an input voltage of 400 rms and a maximum peak current of 225 mA. Maximum peak inverse voltage is 1250. Voltage drop at 70 mA is 6 volts. It is made by International Rectifier.

**1DNS**

This diode-remote-cutoff-pentode is a seven-pin miniature type with a 1.4-volt 0.5-amp coated filament. Designed for use in battery-operated portable sets, it performs the combined functions of AM detection and AF amplification. It is manufactured by RCA.

**CONVERT TO COLOR TV**

**COLORADAPTOR**—A simple 10-tube circuit and mounting case which converts any standard black-and-white TV, direct view or projection, to receive composite color TV. **COLORADAPTOR** is simply attached to TV set, does not affect normal operation and can be built from parts experiments have on hand. Complete specifications including theory of operation, assembly and construction instructions, schematic and sample color filters, are included in complete kit containing all special parts—cables, delay line, crystal, color filters. **COLORADAPTOR** is a complete kit for use with any color TV. **COLORADAPTOR** parts include color filters, trimmers, etc., available. Write for information and prices.

**STANLEY**

840 MAIN ST.  
PATERSON, N. J.
NEW TUBES & SEMICONDUCTORS (Contd.)

Rectifier stacks
A new line of 170°C silicon rectifier stacks has been announced by G-E. More than 200 standard models, completely wired for various uses, are included. A typical example is the 12-fin stack shown in the photo. This model is rated at 280 volts rms, input and 250 volts dc, output. Current rating at 25°C is 9 amps; at 170°C, 3 amps.

6BA8-A
A general-purpose multiunit tube of the nine-pin miniature type containing a medium-mu triode and sharp-cutoff pentode. The pentode unit is especially useful as a video amplifier tube. It may also be used as a reactance or ac amplifier tube. The triode unit can be used in low-frequency oscillator and phase-splitter circuits. Made by RCA, the 6BA8-A is designed with a 6.3-volt 600-ma heater having a controlled warmup time.

Its characteristics as a class-A1 amplifier are:

<table>
<thead>
<tr>
<th>Triode Unit</th>
<th>Pentode Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>V&lt;sub&gt;t&lt;/sub&gt;</td>
<td>200</td>
</tr>
<tr>
<td>V&lt;sub&gt;e&lt;/sub&gt;</td>
<td>150</td>
</tr>
<tr>
<td>V&lt;sub&gt;c&lt;/sub&gt;</td>
<td>-8</td>
</tr>
<tr>
<td>Cathode-bias resistor (ohms)</td>
<td>180</td>
</tr>
<tr>
<td>μ</td>
<td>18</td>
</tr>
<tr>
<td>R&lt;sub&gt;o&lt;/sub&gt; (k ohms)</td>
<td>6.7</td>
</tr>
<tr>
<td>g&lt;sub&gt;m&lt;/sub&gt; (µmhos)</td>
<td>2,700</td>
</tr>
<tr>
<td>L&lt;sub&gt;1&lt;/sub&gt; (ma)</td>
<td>8</td>
</tr>
<tr>
<td>L&lt;sub&gt;2&lt;/sub&gt; (ma)</td>
<td>3.5</td>
</tr>
</tbody>
</table>

Other types
A miniature twin-triode with separate cathodes has been released by Amperex. Type 7002 is designed as a plug-in replacement for the 5805.

A 6198-A Vidicon has been announced by RCA. It is a small camera tube intended primarily for industrial television applications.

A high-power high-vacuum diode has been introduced by IT&T. Designated the P-7030, it has a maximum peak inverse voltage rating of 25 kv.

Two uhf-beam-power tubes with ceramic metal seals have been announced by RCA. They are the 6816 and 6884.

OCTOBER, 1957

END

172 KING-SIZED PAGES
EVERYTHING IN RADIO TV AND ELECTRONICS
100'S OF NEW ITEMS LISTED HERE FOR 1ST TIME
21 PAGES OF BARGAINS NOT IN ANY OTHER CATALOG

BA CATALOG
A COMPLETE BUYING GUIDE FOR EVERYTHING IN
RADIO TV ELECTRONICS
Giant
ALL NEW 1958

BURSTEIN-APPLEBEE CO. Dept. M-1
1012-14 McGee St., Kansas City 6, Mo.

INDEX PAGE 1/2 OF COMPLETE 581 PAGES

RUSH COUPON TODAY!

ENGINEERING
Prepared for you... B.S. DEGREE
LIMITED OFFER: IN 27 MONTHS

Electronics Engineer

INDIANA TECHNICAL COLLEGE
1718 E. Washington Blvd., Fort Wayne 2, Indiana

Send for free information on B.S. ENGINEERING DEGREE IN 27 MONTHS as checked.


Name.
Address.

2 WAY PORTABLE RADIO SET
Send—Receives up to 10 miles as shown or hundreds of miles with outside antenna. 90 and 10 meter amateur radio bands (novice) and aircraft and overseas broadcasts. (On & RF) POWERED WITH SELF-CONTAINED PORTABLE RADIO BATTERIES. NO AC PLUGS INS NEEDED! Takes battery with you everywhere you go. Ideal in camp or in boat, house, etc. Has 1 way crystal controlled transmitter. Sensitivity is automatic. Generator. Send receiver switch. Wt. only 3 lbs. Size, only 4 1/2"x3"x1 1/2". TROUBLE-PROOF SUFFICIENT PRACTICAL. Full information given on order.

Send Only $3.00 (U.S. coin or note) and 50c postage, from 111 S. 85th St., Omaha, Nebr. 4001 B, for portable radio set designed for 12 volt battery. Inquire about complete model $7.05; prices $7.25. COMpletely WELDING AND DESIGN PORTABLE. 1958. A PORTABLE THAT TAKES CARE OF ITSELF! AVAILABLE IMMEDIATELY. WESTERN RADIO, INC. B-20, KERNERY, NEBR.
Telematic
CUSTOM HIGH FIDELITY KITS
AM/FM TUNER
2 ur for 20 DB quieting, AFC plus Defeat, Full Frequency Response, 330 Kc bandwidth
Model KC-400 Less Cage $34.95 (FED. EX.)
Wired and Tested 59.85 (TAX INC.)
20-WATT INTEGRATED AMPLIFIER
Power Response CONSTANT at 20 Watts, 1 to 0 DB Full Frequency Response, Infinite Equalization Bass Treble Controls; 3 Hi, I Low inputs.
Model KC-461 Less Cage $46.00
Wired and Tested 64.95
Exclusive! STEREOPHONIC KITS
AM/FM STEREOPHONIC TUNER WITH WIRED FM FRONT END
NEW DIMENSIONS IN SOUND—Each section used individually or together—0.9 ur for 20 DB quieting, 330 Kc bandwidth. 3 gang variable AM tuning. 15 ur per meter loop sensitivity.
Model KB-402 Less Cage $89.95 (FED. EX.)
Wired and Tested 99.50 (TAX INC.)
40-WATT STEREOPHONIC AMPLIFIER
NEWEST DEVELOPMENT IN STEREOPHONIC SOUND FOR THREE DIMENSIONAL LIFE-LIKE REALISM!
Twin 20-Watt Channels—Each with FULL PREAMP sections and Master Volume Control.
Model KB-403 Less Cage $82.50
Wired and Tested 99.50
For full details, see your local dealer or write
TELEMATIC INDUSTRIES, INC.
16 HOWARD AVENUE, BROOKLYN 21, N. Y.

Patents

CALIBRATION CIRCUIT FOR PEAK-READING VOLTOMETER
Patent No. 2,765,442
Maxon A. Logan, New Providence, N. J. (Assigned to Bell Telephone Labs., Inc., New York, N. Y.)
This is the preferred device for calibrating a peak-reading voltometer. The voltage source is one that has the same general waveform as that which the meter is to measure. Network R1-C1 (see diagram) has a time constant equal to that of the meter. Therefore, waveform distortion is eliminated.

To prepare the calibration circuit, a peak reading is first adjusted to cancel diode contact potential Ed.

THE MASTERCRAFT" IN AM-FM
Providing the ultimate in hi-fi stereo sound at a bargain price

E.B.E.
COMPUTERS, ROBOTS AUTOMATION
Finally out! Plans for ALLASOVER!
Inexpensive computer can be built from standard parts. Instruction and worked-out problems. Over 30 pages for $3.
200-page manual on robot construction and plans, only $5.

RELAYS, up-to-date manual. Explains types, uses, how to use logic etc. Contains projects for building special types.

SPECIAL—Courses in Mathematical Logic, includes Boolean Algebra, Binary counting, games. Only $12.50 as an introduction. This includes 350-page textbook and personal instruction.
Courses in computers for beginners, start at $12.50. No previous experience in simple algebra required.

ELECTRONICS, over 1000 pages of text and material. Time payments. Investigate today. Includes Radio, Radar, Computers, Servosystems, Television, Test equipment and more.

Send for FREE information send to
ELECTRONIC BRAIN ENTERPRISES, INC.
1015 Atkin Ave., Salt Lake City 6, Utah

For every price

E.B.E. ELECTRONICS COMPONENTS—ACCESSORIES
AMPLIFIERS
PRICED AS LOW AS $39.50
"QUADNAURAL" SPEAKER SYSTEMS

- RECORD COMPENSATORS
- RUMBLE FILTERS
- HI-PASS FILTERS
- LOW-PASS FILTERS
- SPEAKER SELECTORS
- TRI-SET COUPLERS
- MODLED-ON CONNECTORS
- DUO-JAF JACKS
- FILTER-TEENNA

SOLD BY BETTER DISTRIBUTORS EVERYWHERE
Send for Catalog Sheets on all Dynamic Products
"UNMISTAKABLY THE FINEST"

Manufactured By
DYNAMIC ELECTRONICS—NEW YORK, INC.
Forest Hills, Long Island, N. Y.
PATENTS (Continued)

Corona is something to be avoided in TV sets, but here it is the basis of operation. The ionic speaker is an efficient device for converting audio currents into sound. It does this by generating an intense stream of ions (corona) which cause the air to expand and contract in accordance with the audio currents. Having no mechanical parts, the ionophone is efficient and without resonant frequencies. This invention (see Fig. 1) is an improvement

IONIC SPEAKER
Patent No. 2,793,324
Michael N. Haller, Palo Alto, and Stanley W. Halcomb, Mountain View, Calif. (May be used by the U.S. Government without payment of royalties.)

Can you think faster than this Machine?

Central Panels of GENIAC set up to do a problem in check valve research.

Be careful before you answer. GENIAC the first electrical brain construction kit in an effort to show you how GENIAC makes it possible for 12 to 18 year olds to understand the principles of electricity as well as add, subtract, multiply and divide. Several students in a variety of fields will be using GENIAC as their first experience with electrical circuits. GENIAC is the answer to a problem of teaching electrical principles and encouraging the students to experiment. It is the most practical and efficient educational instrument and is designed to be used in educational institutions and for group purchase. GENIAC makes it possible to simplify and perfect the teaching of electricity in a way that no other means can be used. It is the first educational instrument that has been designed for use in educational institutions and for group purchase.

For your ionic speaker, you can get it at 157 High Street, Mansfield. It has been acclaimed by professional engineers as a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States. The ionic speaker is a high fidelity loudspeaker. It is made in the United States.

For his name and address, write to: James B. Lansing Sound, Inc. 3249 Casitas Ave., Los Angeles 39, Calif.
THE REACH IS RIGHT AND TIGHT
with KRAEUTER LONG NOSE PLIERS

You can depend on reachability and cutting power with Kraeuter's #1781 Long Chain Nose Pliers. And your reach will be tight and sure for those hard-to-get-at jobs with the extra long milled jaws of these pliers.

Buy the right line—Sell the right line. It's the Kraeuter line for electronic and electrical work. Kraeuter tools are unreservedly guaranteed.

Send for catalog #25 illustrating complete Kraeuter line.

BUY THE FINEST
BUY KRAEUTER
BUY AMERICAN

AS MODERN AS TOMORROW

kraeuter & co., inc
FOR 100 YEARS THE FINEST IN HAND TOOLS 1860-1960 • NEWARK, N. J.

DON'T REMOVE THAT CRT TUBE!

Snap it back to normal brilliance with new improved Kinecure. INSTANTLY and PERMANENTLY corrects 33 different CRT defects. Saves time, money, and irritation for both servicemen and customers. Thousands of TV servicemen now use new, improved Kinecure. New time tested and job proven on over 50,000 sets. There is just nothing else like patented Kinecure. It looks different — operates different — works like a charm! Ask your Jobber. Or write for free full information.

CIRCUIT MANUFACTURING CO., INC.
923 Shadeland Ave., Drexel Hill, Pa.

PATENTS (Continued)

over previous types. There are three elements: an emitter, a metallic rod with pointed end; collector, a circular metal ring with opening at its center; a control element wire (whose cross-section is shown as a small circle). A high voltage is impressed between emitter and collector to set up a corona discharge. The ion stream must not be too intense or an arc will occur.

Fig. 2 shows how to connect the ionic speaker to an audio output tube.

ANTI-SHOPLIFTER DEVICE
Patent No. 2,744,060
Thomas F. Thompson, Eugene, Ore. (Assigned to Richard B. Thompson, Dale Belford and Oliver D. Olson)

This invention protects against theft of merchandise from department stores and similar shops. A tiny resonant circuit is concealed within the price tag of each article. If the article is stolen and carried through an rf field generated for the purpose, it affects an oscillating circuit which sets off an alarm.

RAINEX VS RADAR?

Vatican City Latinists bemoan that Latin is continuously being pushed to the rear. They claim Latin is by no means dead and their scholars keep adding modern terms. Sample: Radioelectricum instrumentum exploratorium (radar).
TRANSPORT RECTIFIER

Everyone knows that a junction transistor is made up of two rectifiers, but few have tried it for rectification purposes. Actually, the base-collector junction is very efficient when used as an ac rectifier.

The circuit is shown in the diagram. The transistor is any high-power p-n-p transistor, such as a 2N256 or 2N301. Load currents and voltages are shown below. In these tests the transistor junction was compared with that of a low-voltage (25-volt) selenium rectifier.

<table>
<thead>
<tr>
<th>Ac</th>
<th>Load</th>
<th>Load Current (mA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>20</td>
<td>125</td>
</tr>
<tr>
<td>10</td>
<td>8</td>
<td>800</td>
</tr>
<tr>
<td>6</td>
<td>8</td>
<td>520</td>
</tr>
</tbody>
</table>

If you find yourself without a high-current rectifier for a sudden experiment, try a transistor. Even a damaged unit may still be suitable as a rectifier. For example, it is quite possible that a dead short may occur between emitter and base, without affecting the other junction. Under this condition, it is still possible to use the collector-base junction. —I. Queen

CUT CONTROL SHAFTS

New subminiature controls used in transistor equipment have ¼-inch-diameter shafts. These shafts can be cut to length in less than a second using an AMP type screw-cutting and terminal tool.

Insert the shaft into the 8-32 or 10-32 screw-cutting opening and squeeze. The shaft will cut off clean as a whistle without any burrs or distortion. —Eduard Bohr

PAINTING ETCHED PANELS

Repainting electronic equipment with control markings etched on the metal panel is quite a problem. Many shun this type of work because of the time spent in "picking" the recessed letterings, which are usually numerous. Here is a simplified method of repainting this type of panel with a minimum of effort and with simple and inexpensive equipment.

To start with, you will need a paint sprayer or a hand type insecticide sprayer with a good pump. This is imperative if you want a fine spray finish. You will also need a stiff brush, a few sticks of writing chalk, paint thinner

OCTOBER, 1957
TRY THIS ONE (Continued)
and of course quick-drying enamels of the desired shades.

In repainting etched panels, start with the etched letters. Give the inside of the letters a thin coat of the desired color using a stiff brush to apply the paint. Use jiggling strokes. Next, wipe off paint smears on the panel's surface with a rag wet with paint thinner. Do not use too much thinner or you will flood the etchings. Allow the paint to dry completely (this is absolutely necessary) before you tackle the whole panel surface. If quick-drying lacquer or enamel is used in the operation, the repainting can be completed the same day. Here's where the real problem comes in. How do you prevent paint from smearing the nice job you made on the etched lettering? Very simple!

NOVEL AUDIO SWITCHING
Many record players (both manual and automatic) have a switch that opens the line circuit at the end of the last record. By substituting an SPDT switch for the normal SPST line switch on your amplifier, radio or tuner this equipment can be automatically turned off at the end of the last record. The diagram shows the hookup.

The record player is controlled at all times by its on-off switch. When the independent of the switch on the record player. A three-conductor cable and polarized connectors are recommended for making connections between the record player and audio chassis.—John E. Mayer

SOLDERING VISE
Ever wish you had a third hand to hold small parts when soldering? Make a small vise for the purpose from a test clip and a woodscrew. Clip off the wire supports at the rear of the clip, remove the screw and pinch the rear projection flat. Hack saw the slot in the wood screw 1/25 inch deeper, insert the back of the clip into the slot and solder it in place. Screw the vise into a pilot hole drilled in a convenient spot on the top of your workbench.—John A. Comstock

CRYSTAL-PICKUP TEST
Checking crystal phono and microphone cartridges is quick and simple when a bridge type capacitor analyzer is used.

Disconnect the leads from the cartridge and clip test leads to the terminals. Set the capacitor checker's range selector switch to the 10-5,000-μF range and balance the bridge with the tuning eye or other indicator just as you would when checking a capacitor. Now, gently pluck the phono needle or thump the mike cartridge with a finger while watching the balance indicator on the tester.

If the crystal is good, the indicator flickers or deflects violently as the generated voltage and change in capacitance unbalance the bridge. On the other hand, little or no variation will be noticed if the crystal is defective.—Paul Mitnau

END
ENGINEERS: Boost your gain!

Up your income with Announcing and Sales! The demand NOW is for combo-engineers-announcers. Write NOW for details of our residence or correspondence course in announcing.

NATIONAL ACADEMY OF BROADCASTING, INC.
3338 16th St., N.W., Washington, D.C.

ENGINEERING DEGREES

E.E.

Earned through

HOME STUDY

Pacific International

University

5719-M, Sola Monica Blvd.,
Hollywood, Calif.

NOW!

Step ahead faster as an

INDUSTRIAL ELECTRONICS TECHNICIAN

Turn your experience into a big, new better-paying career!

Day by day Industrial plants are adding more electronic devices for sorting, counting, checking almost any control job you can name. Cash in on industry's great need for men who can keep those devices in top working order. Make more money, feel more secure.

Use your experience as a plant's troubleshooter. Turn to FREE TRIAL-EASY TERMS

PRACTICAL INDUSTRIAL ELECTRONICS LIBRARY

With your name in front of the practioners of America's largest electronic industry, your knowledge is your ladder to higher position. Send now for FREE sample copy. You will not be troubled unless you request it.

McGraw Hill Book Co., Dept. RC-10
321 W. 42nd St., New York 36

Please send FREE sample copy of Practical Industrial Electronics Library to:

Name______________________________
Address____________________________
City________________________State____

For price and terms write McGraw-Hill Book Co., New York 36, N.Y.
DYNAKIT
Amplifier Kits

A proven circuit of finest sound quality in a new deluxe 60 watt model and standard 50 watt model

MARK III 60 watts $79.95
4, 8, 16 ohm outputs net

The new Mark III includes all the sensational attributes of the popular Mark II plus these outstanding deluxe features
- 60 watts at less than 1% distortion. Instantaneous peak power of 140 watts. 1M less than 0.5% at average listening levels.
- Choke filtering and low noise circuitry reduce hum and noise to 96 db below 60 watts.
- New rugged KT-88 tubes and other heavy duty parts used conservatively.

MARK II 50 watts $69.75
8, 16 ohm outputs net

The Mark II is the best buy in high power high fidelity kits
- Ease of assembly due to uniquely simple circuitry and printed circuit construction with factory-mounted parts.
- Highest stability using patented stabilizing networks with minimum number of phase shifting stages. Suitable for all loudspeaker systems including electrostatic.
- Dyna Biass (patent pending) for simplified adjustment and complete freedom from effects of unbalanced components. No balancing adjustments required to meet published specifications.
- Dynaco Super-Fidelity output transformer with patented pan-coupled windings. This is the finest available transformer of its type for the most critical audio uses.

Available from leading Hifi dealers everywhere

Descriptive brochure available on request.

DYNA COMPANY
617 N. 41st Street, Philadelphia, Pa.
Slightly higher in West

radio-electronic Circuits

SIGNAL-POWERED SET

For years we have dreamed of erecting an antenna and using the energy it picks up to operate electrical appliances. Now, in a limited application, this dream can come true. We can rectify and filter the carrier of a broadcasting station and use it as "battery" power to operate a transistor amplifier. (See "Free-Power Receivers" in the April, 1957, issue.)

The diagram shows the circuit of my signal-powered transistor receiver. In the set shown in the photo the "battery" circuit is separate and is connected to the receiver through a cable. A strong local signal is picked up by tuned circuit L3-C3 and coupled to D2 and rectified to provide "battery" voltage for the transistor amplifier. L3-C3 should be tuned to the frequency that provides the maximum voltage across the 1-pf filter capacitor. On strong signals the voltage will be between 0.4 and 0.8. If the strongest signal is supposed to be about 800 kc, increase the value of C3 to 200 or 300 µpf.

The receiver portion of the circuit consists of tuned circuit C1-L1, diode D1 and a 2N107 transistor as an audio amplifier. C1 may be one of the 365-µµf midget tuning capacitors used in transistor circuits. C2 couples the detector to the 2N107 amplifier. The phones should have an impedance of at least 8,000 ohms to provide an acceptable match to the transistor.

Coils L1 and L3 are ferrite-core

New SPEAKER MODELS WITH A FREQUENCY RESPONSE FOR EVERY APPLICATION

Mid Range Model GM6J List Price $13.80
Woofers G15P List Price $42.65
Coaxial Model G12J List Price $39.75

FABULOUS "G" SERIES SOUND REPRODUCERS

Are ideal for single or multiple installations, additions in Hi Fi systems or for bi-narial applications. Their fabulous features of superb range, response and overall perfection of performance—and unbelievable low price—makes Utah's new "G" series your best buy in Hi Fi. The incomparable, precision combination of molded, seamless cones permanently welded with indestructible adhesive to rugged 6 ohm voice coils powered by oriented grain Alnico V magnets, assures you of full power handling capacities.

See the FABULOUS "G" at your dealers today.

UTAH RADIO PRODUCTS CORP.
HUNTINGTON, INDIANA
Export Dept. Rocke International, N. Y. C.

INVENTORS
Send for PATENT INFORMATION Book and INVENTORS RECORD without obligation GUSTAVE MILLER 107-RE WARNER BUILDING WASHINGTON 4, D. C.

REGISTERED PATENT ATTORNEY
ASSOCIATE EXAMINER U.S. PAT. OFF. 1922-1929
Patent Attorney & Advisor U.S. Navy Dept. 1930-1942
PATENT LAWYER

GARAGE DOOR OPENER
Actuator Mechanism $24.50
EASY TO INSTALL, SAFE, RELIABLE WRITE for interesting free information TODAY P. E. HAWKINS CO.
631 PROSPECT DEPT. R.E. KANSAS CITY 24, MO.
with ATLAS

high quality
low price

PAGING &
TALK-BACK SPEAKERS
6 sizes and types.
All impedances
from 4 to 45 ohms.
From 5 to 15 watts.
From $15.00 to $24.00 NET.

WEATHERPROOF LINE
MATCHING TRANSFORMERS
For constant impedance
or constant voltage systems.
$5.00 NET.

HIGH-POWERED
PUBLIC ADDRESS SPEAKERS
Four sizes from 21/2" to 6", all classes.
From $10.00 to $39.00 NET.

U-L APPROVED
EXPLOSION-PROOF SPEAKERS
For hazardous applications.
Several sizes, all classes.
From $66.00 to $75.00 NET.

MIKE STANDS & ACCESSORIES
All sizes and types:
bloom stands, desk stands,
adapters, fittings, etc.

NEW! MIKE SUPPORT
Adjustable 12' goose
neck. Use as desk support,
for dispatcher office,
desk, table, etc.
#5B1...$7.80 NET.

NEW! "CHESTY"
NECK-SUPPORTED MIKE STAND
Quick, easy 3-way
adjustment. Lightweight.
Multiple use.
#5S1...$2.00 NET.

NEW! MIKE FOOT SWITCH
Hand, foot or knee
operation—shielded,
grounded, noise-free,
dependable, damage-proof.
#FS1...$7.20 NET.

SEND FOR COMPLETE
FREE CATALOG

ATLAS SOUND CORP.
1443 39th St., Brooklyn 18, N. Y.
In Canada: Atlas Radio Corp.,
Ltd., Toronto, Ont.

OCTOBER, 1957

RADIO-ELECTRONIC CIRCUITS (Continued)

antenna coils. L2 consists of 50 turns
of fine wire wound close to the grounded
end of L1, and L4 has approximately
75 turns of fine wire wound close to
the grounded end of L3.

This set uses two antennas and a
common ground. The antenna for the
"battery" circuit should be at least
50 feet long and as high as practical.
In many areas the other antenna need
not be longer than 5-10 feet.—M. E.
Quisenberry

DYNA BIASSET

A novel method of obtaining an accu-
rate bias adjustment is incorporated in
all new Dynakits amplifiers. Called
Biaset, it insures top performance of
the completed amplifier and eliminates
the need of high-quality meters to make
accurate bias settings.

The bias adjustment using the Biaset
technique results in the same setting
that would be obtained by adjusting the
amplifier for minimum distortion.

The circuit is seen in the diagram.
When bias is correctly set, the total
cathode current of the 6CA7/EL3-34's
is 130 ma. This current, flowing through
the precision 12-ohm resistor R1, pro-
duces a voltage drop of exactly 1.56 dc.
As 1.56 volts is the voltage furnished
by a D type flashlight cell, any fresh
cell of this type acts as an accurate
reference standard for bias adjustment.

The method of setting the bias is to
measure the voltage output of a D type
cell and note the meter reading. Then
place the meter across R1. Plug in the
rectifier and almost immediately there
will be a current flow which will cause
a meter deflection.

As the rectifier warms up, the read-
ing rises. The bias control (R2)
should then be adjusted until the meter
reading is the same as that across the
dry cell. There may be some drifting as
the tubes heat, but this will stabilize in
15 to 30 minutes, after which no further
adjustment is necessary.

Although the setting is semiperman-

DYNAKIT
PREAMPLIFIER

An Outstanding Companion Kit
to the Famous Dynakit Amplifiers

This handsome new control unit
gives crystal clear, noise-free re-
production of any modern pro-
gram source. Its unique all feed-
back design by David Hailer
sets a new standard of preamplifier
performance. The design of the
Dynakit preamplifier is a synthesis
of outstanding features which
produce smoother, more natural
sound. Compare these features
with any other units regardless of
price.

* Unequaled performance
Actually less than .1% distortion
under all normal operating condi-
tions. Response +.5 db 6 cps to over
50 kc. Distortion and response unaf-
ected by settings or volume control.
superlative square wave performance,
and complete damping on any pulse
or transient test.

* Easiest assembly
All critical parts supplied factory-
mounted on XXP printed circuit
board. Eyedlet construction prevents
damage to printed wiring. This type
of construction eases wiring time by
50% and eliminates errors of assem-
bly. Open simplified layout offers com-
plete accessibility to all parts.

* Lowest noise
Internal de heater supply plus low
noise components and circuitry bring
noise to less than .3 microvolt equiv-
alent noise input on RIAA phono
position. This is better than 70 db be-
low level of 1 millivolt magnetic
cartridge.

* Finest parts
1% components in equalization cir-
cuits to insure accurate compensa-
tion of recording characteristics.
Long life electrolytic capacitors and
other premium grade components for
long trouble-free service.

* High Flexibility
35 inputs with option of extra phono,
tape head, or mike input. Four AC
outlets. Controls include tape
monitor switch, loudness with dis-
abling switch, full range feedback
tone controls. Takes power from
Dynakit, Heathkit, or any amplifier
with octal power socket.

* Outstanding appearance
Choice of bone white or charcoal
brown decorator trim to blend with
any decor. Finished in indestruc-
tible vinyl coating with solid brass es-
catchem.

* Best Buy
Available from your Hi-Fi dealer at
only $34.95 net (all values higher in
the West), and yet the quality of per-
formance and parts is unequaled at
any price.

Descriptive brochure available on
request.

DYNA CO., 617 N. 41st St., Phila., Pa.
Pat. Pending
A New Concept in Amplifier Kit Construction

The ERIE Audio-Amplifier Kit featuring "PAC" and an ERIE Embossed Wiring Board

With these Plug-in Components:
- ERIE "PAC" (Pre-Assembled Components)
- ERIE EMBOSSED BOARD
- OUTPUT TRANSFORMER
- FILTER CAPACITOR
- VOLUME CONTROL and SWITCH
- TUBE SOCKETS
- CAPACITORS
- TONE CONTROL
- TUBES

Specifications for ERIE Standard Audio-Amplifier
- Frequency Response: 30 cycles to 12,000 cycles -6.0 - 2.5 db.
- Sensitivity: 0.56 volt RMS (input at 1 KC) for 4 watt output.
- Power Output: 4 watts
- Input Impedance: 2 megohms.
- Output Impedance: 4 ohms
- AC Power Consumption: 17 watts.
- Overall Dimensions: 6.5" x 4.5" x .834" H
- Shipping Weight: 2 lbs.

Model PAC-AMP 1

See and hear it at your local distributor or Write for nearest source.

Coine Technologies Training at Lowest Cost

Television Radio - Color TV

Only from famous COYNE, do you get this modern up-to-the-minute TV Home Training. Easy to follow instructions—fully illustrated with 2150 photos and diagrams. Not an old Radio Course with Television tacked on. Includes UHF and COLOR TV. Personal guidance by ERIE Staff. Practical Tech Guides to help you EARN MONEY QUICKLY IN A TV-RADIO SALES AND SERVICE BUSINESS—part time or full time. COSTS MUCH LESS—pay only for training—no costly "put together kit."

Send Coupon for Free Book

SEND COUPON BELOW for Free Book and full details including EASY PAYMENT PLAN. NO COST OR OBLIGATION—NO SALESMAN WILL CALL.

R. W. Coine, Jr.
President
ERIE ELECTRICAL SCHOOL
A Technical Trade Institute Operated Not for Profit
52 E. Fourth St. Phone 1-7657 Chicago 17, Illinois

RADIO-ELECTRONIC CIRCUITS (Continued)

Simple Audio Oscillator

This easily built audio test oscillator uses a minimum of parts, has enough output to test speakers and can be connected to high or low impedance circuits.

The cathode of the oscillator tube connects to the center tap on the primary of an audio transformer and is bypassed to ground by a .001-mfd capacitor. The transformer has a 5,000-ohm center-tapped primary and 500-ohm secondary. I used a Stancor A-3800. The oscillator is capacitance-tuned by switching capacitors in the grid circuit. A 2-pf paper unit produces oscillations at around 20 cycles and a 500-pf unit changes the frequency to around 20 kc. The frequency selector switch may be a 12- or 17-position rotary type such as the Mallory 32112J or 32117J, respectively. Use a soft-iron sheet-metal shield between the oscillator and power supply if both are on the same chassis.

This oscillator can be calibrated with the aid of a calibrated generator and an audio amplifier. Connect both outputs to the amplifier input and trim the tuning capacitors for zero beat. For example, if you want 400 cycles at a particular switch position and a .05-pf capacitor produces a 450-cycle signal, bridge small capacitors across the large one until the frequency is correct.

W. M. Finley, Jr.

End

Shocking Error

On my first job Didn't use good sense or I'd never have touched That high-voltage condenser!—Phyllis Barlow

B. 165
Hi-Fidelity AM-FM Radio  
FAMOUS MAKE NO LICENSED  
Reg. Price $139.90  
For Radio Alone  
SALE PRICE $59.95

1958 Model - Ready to Play 
Here is a professionally engineered FM radio made for the modern manufacturer. This set is ready for your own 
kit. It features 'The Safe FM Method' for pushing the 
trade. 1.2 volt Hi-Fi output, AM and FM, complete with 
cathode follower output, monaural tuning of AM or FM is possible. 
Aarky 'Miracle Ear' sensitivity on AM gives 4 mc. for 20 db. 
quieting bandwith 200 KC, 2 db. down freq. resp. 6 db. 
for 20,000 cycles. Convol 6 db. at 1000 cycles. ARC, odi. 
cathode follower output, 75 microsecond de-emphasis network. 
Aarky 'Miracle Ear' sensitivity on AM gives 3 mc. for 20 db. 
0.5 db. down. Convol 6 db. for 20,000 cycles. ASC, odi. 
cathode follower output.

STereo HIFI 
KITS AND PREWIREd 

ST-11 - A binaural tuner designed to provide the listener with stereo Hi-Fi of exceptional quality. Because each section 
contains its own tuning condenser I.F. strip, detector, and cathode 
follower output, monaural tuning of AM or FM is possible. 
Aarky 'Miracle Ear' sensitivity on AM gives 4 mc. for 20 db. 
quieting bandwith 200 KC, 2 db. down freq. resp. 6 db. 
for 20,000 cycles. Convol 6 db. at 1000 cycles. ARC, odi. 
cathode follower output, 75 microsecond de-emphasis network. 
Aarky 'Miracle Ear' sensitivity on AM gives 3 mc. for 20 db. 
0.5 db. down. Convol 6 db. for 20,000 cycles. ASC, odi. 
cathode follower output.

MODEL SA-23 - dual channel preamp drives a monaural 25 
waatt Linber Williams amp, with your present amplifier for 
unsurpassable realism of Binaural sound. 
Channel 1 - 25 watt amp; freq. resp. ± 2 db @ 20 watts, 
20 to 20,000 cycles. sen. phone -4 mv. for 20 watts 
tuner nec. @ 7V for 25 watts. Loud. Control Volume Control 
- controls dual dials. Bass Control and Treble Control 2 pos. 
"Lo-Cut" and "Hi-Cut" filters. Equal. switch for all labels 
plus "NAKED" tape head. 
Channel 2 - 25 volt output - same as channel 1; some 
preamp features. Just add your present Hi-Fi amp to channel 2 
and prepare yourself to enjoy the sound reproduction only 
AARKY stereo can offer.

Kit $59.95 Wired $89.95

Get the new, big catalogue and specifications of the remarkable AARKY radio, Hi-Fi and TV line 
Now at your local dealer!

ARKAY 
120 CAROL STEREO CENTER NEW YORK 6, N. Y.

FREE! COMMERCIAL AD KIT

Accessories for your AARKY Stereo! 

TEAPE RECORDERS 

Rolls-Accessories 

UNUSUAL VALUES.

SAME FOR FREE CATALOG

MERITABE 
Low Cost, High Quality, High Value.

DRESSER 
52-29 RE: 174 St. 
Community 8, N. Y.
NEW AUTOMATION PUNCHED CARD TV TUBE TESTER PROVED! IN OVER 17 MILLION TUBE TESTS!

Smallest, lightest tube tester ever made!

Model DM456

Speed-test complete set of tubes in minutes with the new DynaMatic Tube Tester
- So simple to use—a customer can operate it!
- LIGHTTEST and SMALLEST Gm tester available. Take it on ALL house calls.
- Perforated plastic cards set up socket pin connections and test voltages.
- Permits full-complement tube testing.
- DynaMatic is a dynamic mutual conductance tester—NOT an emission checker.
- Accurately measures mutual conductance in micromhos on 2 ranges. 0-6000, 0-18000.
- Also checks battery tubes

IMMEDIATE DELIVERY!

136-10 31st Road, Flushing 54, N. Y.

SERVICE MEN KNOW THERE IS JUST ONE

HUSH

Chemically engineered for tuners and switching mechanism

Hush comes in a 6 oz. pressure can with sufficient pressure to reach all contacts to wash-away that dirt, leaving clean and positive contacts, protected with a lasting lubricant film.

$2.25 net

EVER-QUIET

Since 1949 the Original Volume Control and Contact Restorer

EVER-QUIET is a free-flowing liquid that leaves no powder residue. Scientifically designed to seep around the shaft and penetrate the control or potentiometer, cleaning and contacts and leaving a safe protecting film. Harmless to metals, wire or carbon. Will not affect inductance, capacitance or resistance.

2 oz. (Also available in 32 oz. containers and only 59c Net)

See your distributor or write to CHEMICAL ELECTRONIC ENGINEERING, INC. Matawan, New Jersey

168

RADIO-ELECTRONICS
NO TV PROBLEM IS TOO...
WHEN YOU OWN THIS NEW GERNSEBACK LIBRARY BOOK

Now solve the toughest TV problem faster with this new book—RAPID TV REPAIR—by G. Warren Heath. With this unique new book no problem will be too tough for you—no job too difficult. RAPID TV REPAIR lists alphabetically more than 500 problems. It gives you symptoms, causes and cures. It’s cross-referenced where necessary and thoroughly illustrated with helpful photos, diagrams and schematics. Theory is kept to an absolute minimum. Easy-to-use troubleshooting charts help you put your finger on trouble in minutes. With this handy book you’ll be able to cut troubleshooting time down—handle more jobs—and increase your income! Order your copy now.

These and Hundreds of Other Troubles Covered

Aeronautics • Barber pole effect • Borkhausen oscillations • Barret effect or screen • Bend in picture • Bivio pattern • Blinding • Dropouts • Extended overshoot • Faster than normal • Buzz on screen • Buzz • Interferent clicking • Hot chassis • Distortion • Double picture • Negative and Flash-in-in-pair • White lines • Squelching • Horizontal ripple • Change in type • Interference • Oscillator drift • Slow flicker • Horizontal falsecolor • Glare and ghost effect.

NOW—GET THIS $4.60 BOOK FOR ONLY $3.35!

The deluxe hard-cover edition of RAPID TV REPAIR is nationally advertised for $4.60—buy it if you join the G/L TECNICIANS' BOOK CLUB now...you can get it for only $3.35 post-paid—a discount of 27%!

THE G/L TECHNICIANS' BOOK CLUB was formed to help service technicians get the kinds of books they need to get along without paying high prices! By our print-run and selective discount pricing high pricing and production economics were put to the hammer and passed on to you as a healthy 27% discount.

HOW THE CLUB WORKS

The help you seek is sent to you ON APPROVAL—enabling you to judge it for yourself at your own leisure. You have 10 days—[or 30 if you're in the Middle east]—to decide whether to keep the book or return it. You can pick from 1000 books and are mailed about every three months. No matter which books you send back, you will always get the book that's right for you. So you're not stuck with a bad choice. That's why the book is sent to you ON APPROVAL. You can keep it or return it to the same no-risk approval plan.

Spend NO MONEY—you only pay for the books you keep.

These Books Already Published

Select RAPID TV REPAIR—or any one of these books.

TV'S IT'S A GINCH—By R. Alden. All about TV theory, hints, mostly in lively conversational style. The models are made to order from the trends of specially-drawn humorous sketches.

SERVICING RECORD CHANGERS—By Frank Millen. Male extra money servicing changers.

SERVICING COLOR TV—By Robert G. Middleton. Learn the techniques of electronic workhorse.

THE V.T.V.M.—By Bruce Morton. New methods of testing TV's by a world authority in this electronic problem solver.


THE OSCILLOSCOPE—By John E. Best. Learn to calibrate, test and repair standard oscilloscopes. Getting full use of one of your most useful tools. This book shows how you can do it.

PROBES—By Bruce Morton. New and improved circuit testing techniques.

FINISHING TOUCHES—By Jay M. Canfield. New procedures for polishing the edges of the TV picture. All you have to do is follow the directions.

SPEAK WITH THE SCOPE—By John E. Best. Demonstrates how to use the TVScope for finding the trouble fast.

BOOKS TO BE PUBLISHED SOON

Rapid TV Repair
TV and Radio Tube Troubles
Servicing Tape Recorders
Working with the Scope

SEND IN THIS COUPON TODAY.

GERNSEBACK LIBRARY, INC., Dept. 107 C
154 West 14th St., New York 11, N. Y.

Rapid TV Repair
Servicing Color TV
TV's It's a Ginch
Servicing Recorder Changers
Servicing Tape Recorders
Working with the Scope

CASH-IN ON THIS MONEY-SAVING PLAN NOW!!

Take advantage of this NO-RISK money-saving plan now. Don't take a chance with the future. Make more money—arrive faster by getting the information you need to keep in step with this fast-moving industry.

OCTOBER, 1957

169
PROFITABLE COLOR SERVICING Starts Here!

WintronixX
COLOR CONVERGENCE DOT GENERATOR

A MUST for color jobs ... a real time-saver for black & white. Used by leading TV manufacturers. Incorporates complete standard sync chain with AFC for optimum white dots, cross hatch, vertical or horizontal bars. Enables fast, callback troubleshooting and adjustment of: Dynamic Convergence • D-C Convergence • Beam Magnets • Dynamic Amplitude & Tilt • Deflection Coil Positioning • White Balance & "Y" Matrix • Focus • Linearity & Pixel Size • etc. Ultra-stable, automatically-locked circuits guarantee "jitter-free" dot patterns regardless of pixel size. Preset r-f output, variable 30 db.

Color TV Correspondence Course for men with previous radio-TV training.

Charles M. Odorizzi, executive vice president—sales and services of RCA, was elected a member of the board of directors.

Sterling C. Spielman, director of electronic engineering for the Government and Industrial Div. of Philco Corp., Philadelphia, was appointed director of engineering for the division.

Albert Coumont (left) and Kenneth Price were named regional sales supervisors for Sprague Products Co., North Adams, Mass. Coumont was formerly assistant to the president and is well known in the industry having served for four years as service coordinator for RETMA (now ELA). Price was previously Midwestern field engineer for Sprague Products and before that on the engineering Staff of Radio Condenser Co.

Goodwin Mills, general manager of Knight Electronics Corp., Chicago, manufacturer of Knight Kits, was elected vice president of the company.

Bruce Fritz, sales manager of Lincoln Radio & Television Corp., Chicago, was elected vice president.

Jack W. Merritt (left), sales manager of the Photofact Div. of Howard W. Sams & Co., Indianapolis, was named sales manager of the new Electronic Distributor Div. Walton G. Wilson, who joined the company in 1955, has been promoted to sales manager of the Industrial Service Div., succeeding Joe H. Morin, who recently became general sales manager.

Richard W. Griffth was appointed director of sales for the Components Div. of Litton Industries following recent consolidation of the division and U. S. Engineering, a Litton subsidiary. Production, engineering, administration and sales functions are now centered in one Los Angeles location. He had been with Graybar Electric.

Alfred P. Petrusky, sales service manager of the Sylvania Radio Tube Div. in Williamsport, Pa., was promoted to manager of marketing, research—electronic products, with headquarters in New York.

Robert Black was appointed to the new position of Government contracts manager with Astron Corp., East Newark, N. J. He comes to the company from Servo Corp. of America.

George Mucher, Jr. joined the Distributor Sales Div. of Clarostat Manufacturing Co., Dover, N. H. He is the son of George Mucher, executive vice president—engineering activities.

Donald G. Haines, manager of the Chicago office of the Electronic Applications Div. of Sonotone Corp., was elected chairman of Chicago's IRE section.
Arthur M. Liebschtz joined RCA as administrator-planning and entertainment, Semiconductor Div., Somerville, N. J. He had been manager of sales in the Selenium Rectifier Div. of Federal Telephone & Radio Corp.

Richard Deutsch, sales engineer for Channel Master Corp., Ellenville, N. Y., was promoted to chief sales engineer.

Allen S. Johnson was appointed sales manager of Cletron Inc., a division of Cleveland Electronics, Cleveland, Ohio, for its line of loudspeakers, speaker kits, hi-fi enclosures and related equipment. He has been active in sales and management with Westinghouse, Colonial Radio, Thompson Products and Webcor.

Reginald G. Schuler joined Brush Electronics Co., Cleveland, Ohio, as general engineering manager. He comes to the company from Badger Meter Manufacturing Co.

Sprague Products Co., North Adams, Mass., recently received its fourth Friends of Service Management Award from NATESA at that group's conference in New Orleans. Sidney L. Cherstok (left), sales promotion manager for Sprague, is shown accepting the award from Harrol O. Eales, NATESA West Central vice president.

“Does it say how to get it back in the case?”

OCTOBER, 1957
TRANSFORMER GUIDE

Assembled with the technician in mind, Catalog TV-57 describes a comprehensive line of replacement transformers and coils for TV applications. An alphabetical listing indicates the correct replacements for many TV sets. Triad Transformer Corp., 4055 Redwood Ave., Venice, Calif.

ELECTRONIC ORGAN

A two-color 16-page illustrated booklet lets describe an electronic organ you can build and details the 24 kits that make up the complete organ. Schoen Organ Corp., 2248 Broadway, New York 24, N. Y.

REPLACEMENT GUIDE

This revised replacement guide for substitution of germanium for selenium rectifiers in TV sets lists all American-made sets built since 1955 in which selenium can be replaced by germanium rectifiers.

BEWARE OF ImitATIONS

There is Only One Original, Dependable

NO-NOISE Tuner-Tonic
with PERMA-FILM

The "golden ensemble..."

One of a complete line of advanced design high fidelity tuners, amplifiers and components...

hears those quality Rauland units of your Hi-Fi dealer or write for details...

Rauland-Borg Corporation
3513 W. Addison St., Dept. A, Chicago 18, Ill.

General Electric, Semiconductor Products Dept., Electronics Park, Syracuse, N. Y.

DECIMAL EQUIVALENTS

A three-color wall chart of decimal equivalents with decimals running down the center of each column with 64ths to the right and 32nds and 16ths to the left. Guide lines connect each decimal with its equivalent fraction. 16 x 23 inches and 4 x 4 inches.

John Hassall Inc., P.O. Box 2232, Westbury, N. Y. Attn: Mr. Brewer.

CAPACITORS

Illustrated 24-page Catalog 5701 offers a variety of ceramic, electrolytic, metallized paper and paper-oil replacement capacitors.

Tobe Deutschmann Corp., 2900 Columbia Ave., Indianapolis, Ind.

BAFFLES

A complete line of loudspeaker baffles and housings is described in an eight-page brochure, No. P-100. Included are wall, ceiling and portable models; hi-fi enclosures, accessories.

MEASURING TIME INTERVALS

Data File 112, Time Interval Measurements and How to Make Them, describes time-interval meters, the measurement of pulse width and elapsed time, and timing relay operations.

Beckman/Berkeley Div. 2200 Wright Ave., Richmond, Calif.

EIA STANDARDS


EIA, Engineering Dept., 650 Salmon Tower, 11 W. 42nd St., New York 36, N. Y. RS-189, 30c; RS-192, 50c; RS-193, 25c; RS-194, 40c; RS-195, 50c.

NEW PRODUCTS

What's New With the Electron... 1957, is a listing of this manufacturer's new products for 1957. Klustrom, ceramic tetodes, ceramic triodes and other special types are covered.

Eitel-McCullough, Inc., San Bruno, Calif.

BATTERY CONNECTORS

New 32-page catalog on batteries contains information on battery-power and heavy-duty connectors for industrial and allied applications. Cannon Electric Co., 3203 Humbolt St., Los Angeles 31, Calif.

KNOWS AND DIALS

A versatile line of standard instrument and control knobs, dial and assemblies made from thermosetting plastic is featured in Catalog 106. Kurz-Kasch Inc., Standard Parts Div., Dayton 1, Ohio.

PRECISION RESISTORS

Comprehensive data on construction, types, winding techniques, winding forms, impregnations, terminals and characteristics of wirewound precision resistors is presented in Illustrated Bulletin D-1b.

International Resistance Co., 401 N. Broad St., Philadelphia 8, Pa. END

Any or all of these catalogs, bulletins, or periodicals are available to you on request; direct to the manufacturer, whose addresses are listed at the end of such item. Use your letterhead—do not use postcards. To facilitate identification, mention the issue and page of RADIO-ELECTRONICS on which the item appears. UNLESS OTHERWISE STATED ALL ITEMS ARE GRAVITY. ALL LITERATURE OFFERS ARE VOID AFTER SIX MONTHS.

ONE DOLLAR buys

As much as $15 worth — Everything Brand New and sold to you with a money back guarantee.

SPECIAL THIS MONTH

DEDUCT 10% ON ANY ORDER

Plus a FREE SURPRISE PACKAGE

100 - ASSORTED 1/2 WATT RESISTORS... $1
70 - ASSORTED 1 WATT RESISTORS... $1
50 - ASSORTED 2 WATT RESISTORS... $1
100 - FUSES 1 AMP, 15-30 ma, 0.250"... $1
10 - Metric LINE-CORD SOCKETS... $1
5 - 6 FT. ELECTRIC LINE CORDS... $1
4 - 50' SPOOLS MOP-UP WIRE... $1
100 - TWIN LEAD-IN WIRE... $1
5 - 4-CONDUCTOR WIRE... $1
1 - 57 INDOOR TV ANTENNA... $1
1 - ASS'T. TV KNOBS, ESCUTCHEONS, ETC... $1
15 - ASSORTED ROTARY SWITCHES... $1
1 - 60' INDOOR TV ANTENNA... $1
100 - SELF TAPPELED SCREW... $1
50 - ASS'T. TUBULAR CONDENSORS... $1
5 - ELECTROLYTIC COND. 200-500-1000... $1
35 - ASS'T. RADIO KNOBS, screw and set-in... $1
100 - KNOB SPRINGS... $1
50 - ASS'T. TUBULAR CONDENSORS... $1
5 - ELECTROLYTIC, 200-500-1000... $1
400 - ASS'T. HYDRAULIC, screw, nuts, etc... $1
50 - ASS'T. SOCKETS... $1
50 - MICA CONDENSORS... $1
20 - TUBULAR CONDENSORS... $1
50 - TUBULAR CONDENSORS... $1
5 - ELECTROLYTIC COND. 200-500-1000... $1
5 - ELECTROLYTIC COND. 40-45-450... $1
10 - TUBULAR CONDENSORS... $1
50 - TUBULAR CONDENSORS... $1
10 - HV TUBULAR CONDENSORS... $1
50 - HV TUBULAR CONDENSORS... $1
10 - HV TUBULAR CONDENSORS... $1
10 - HV TUBULAR CONDENSORS... $1
50 - TUBULAR CONDENSORS... $1
35 - MICA COND. 20-100 mm & 15-250 mm... $1
35 - MICA COND. 20-110 mm & 25-1000 mm... $1
35 - MICA COND. 20-880 mm & 15-108 mm... $1
35 - CERAMIC COND. 20-25-35 mm & 15-45 mm... $1
50 - TUBULAR CONDENSORS... $1
35 - CERAMIC COND. 20-35-70 mm & 15-800 mm... $1
50 - TUBULAR CONDENSORS... $1
50 - 100% 1/2 WATT RESISTORS 5%... $1
75 - 68017 1/2 WATT RESISTORS 10%... $1
50 - 470017 1/2 WATT RESISTORS 10%... $1
50 - 2.211 1/2 WATT RESISTORS 10%... $1
50 - 15K11 1 WATT RESISTORS 10%... $1
50 - 15K11 1 WATT RESISTORS 10%... $1
50 - 2.211 2 WATT RESISTORS 5%... $1
50 - 2.211 2 WATT RESISTORS 5%... $1
50 - 100K 2 WATT RESISTORS 10%... $1
50 - ASS'T. WIREWOUND RES... $1
3 - AUDIO OUTPUT TRANSFORMERS... $1
3 - AUDIO OUTPUT TRANSFORMERS... $1
3 - I.F. COIL TRANSFORMERS... $1
3 - I.F. COIL TRANSFORMERS... $1
50 - OVAL LOOP ANTENNAS... $1
10 - LOOP STICK ANT... $1
10 - LOOP STICK ANT... $1
10 - 1/2 MEG VOLUME CONTROLS... $1
5 - 5 M SPECIAL SPEAKER PLUGS... $1
10 - SETS PHONOGRAPH PLUGS AND PHONES... $1
2 - 52.50 SAPPHIRE NEEDLES... $1
50 - DIODE CRYSTALS... $1
10 - 110 EC-21... $1
10 - TV VERT. OUTPUT TRANS., 10011 radio... $1
10 - TV CRT. SOCKETS... $1
10 - TV CRYSTAL TRANS., 11011 radio... $1
10 - TV CRYSTAL TRANS., 11011 radio... $1
10 - TV SYNCHROGRAPH TRANSFORMERS... $1
10 - TV SYNCHROGRAPH TRANSFORMERS... $1
10 - TV RADIO DETECTOR TRANS... $1
10 - SET TV KNOBS... $1
10 - TV TAPING... $1
10 - LE SPOOL ROSIN-CORE SOLDER... $1
4 - SPIN TIGHT SOCKET... $1
10 - TV ALIGNMENT TOOLS... $1
10 - TV ALIGNMENT TOOLS... $1
10 - HANDY WAY TO ORDER—Simply tear out advertisement and send with merchandise coupon. Enclose cash, money order or check. You will receive a new copy of this ad for new orders.

ON SMALL ORDERS—Include stamp for postage, express will be charged. Larger orders ship by surface.

BROOKS RADIO & TV CORP.
84 Vesey St., Dept. A, New York 7, N. Y.

Please send items checked

Name

Street

City State

173
brings the whole subject up-to-the-minute for technicians and engineers. The author explains his subject by frequent comparisons with electronics and mechanics. Analogies between the systems appear often.

The book covers basic principles of sound waves, radiators and vibrators. Detailed data and charts are provided for the various types of speakers, microphones and specialized transducers.

Calibration of microphones, testing of speakers, measurement of wow, absorption and noise are given detailed attention. Of course, there is an entire chapter on the nature of hearing. After all, it is the ear mechanism that decides what hi-fi is and distinguishes between sounds. — IQ


More than 100 articles are reprinted in their entirety, from past issues of Electronics magazine. Theoretical and practical subjects are included. Transistor ratings and tables also appear.

Articles are grouped into sections: circuit design, amplifiers, oscillators, broadcast applications, communications computers, etc. Among the devices are a video amplifier, binary counter, pocket-size FM transmitter, hearing aids and hi-fi equipment. Besides germanium transistors, there are articles on tetrodes, silicon transistors and special high-frequency units. This is a convenient and comprehensive source of transistor information.


A compilation of original manufacturers’ schematic diagrams and servicing data on the most popular late 1956 and early 1957 home and auto radios, phonographs and tube and transistor portables. Sets covered include several hundred models and chassis made by 33 manufacturers. END

"Well, he shouldn't give us too much competition."

OCTOBER, 1957
ORadio Industries, Inc. 146
Oxford Components, Inc. 156
Pentron Corp. 99
Periplus Corp. 142
Phonotron Instrument & Electronics Co. 94
Pickering & Co., Inc. 83
Premier Research Corp. 141
Prentice-Hall, Inc. 139
Progressive “Edu-Kits,” Inc. 169
Pyramid Electric Co. 119
Quality Electronics 177
Radiant Corp. 24
RCA Electron Tube Division 20
RCA Institutes 31
Radio Parts Sales Co. 174
Radio-Television Training Associates 25
Rayland Equip. Corp. 172
Raytheon Manufacturing Co. 30
Rek-O-Kut Co., Inc. 170
Rinehart & Co., Inc. 128, 171
Rockbar Corp. 125
Sams, (Howard W.) & Co., Inc. 172
Scott (Hermon Homer) Service Instruments Corp. 166, 175
Shure Brothers, Inc. 111
Simpson Electric Co. 149
Sonotone Corp. 129
Sprague Products Co. 123
Sprayberry Academy of Radio 127

BE QUALITY WISE . . . BUY QUAL-KITS!

HI-FI AMP. KIT
Complete 6 tube-10 watt amplifier Push-pull beam power output, built-in pre-ampl. 5 position record equalization, LP, RPM. Car. Response 1/2 db. 20-20,000 cps. Output 10 watts at less than 2% % low noise level and harmonic distortion.
Every kit complete with 28 page fully illustrated instruction and assembly manual. Cover and less. optional.

HI-FI AM-FM TUNER KIT
Advanced 7 tube circuit plus Rectifier for full sensitivity and selectivity. Distortion less than 1%. Sensitivity is 5 1/2 db for 30 db quieting on FM. 25 or AM Armstrong, FM Circuit with limiter. Foster-Sheely Discriminator 20-20,000 cps response. Full AFC control — $32.50
Write for FREE catalog and name of nearest dealer carrying these remarkable units.

QUALITY-ELECTRONICS 319 Church St. Dept. RD New York 13, N. Y.

TEST CONDENSERS IN THE SET!
Test Selenium Rectifiers!

CAPACITEST
Quickly, Accurately Checks:
• PAPER, CERAMIC, MICA CAPACITORS
• ELECTROLYTICS
• SELENIUM RECTIFIERS
• CONTINUITY
• AC/DC VOLTAGES
• FLASHBULBS

FREE SET OF LEADS with each CAPACITEST
Order direct from mfr., Send $2 deposit with COUPON for CPC leads. Send 20.95 and get: 6 LEADS

BARJAY The Barjay Co. 145 West 40 Street New York 18, N.Y.

SCHOOL DIRECTORY PAGE 163
Baltimore Technical Institute
Candler System Co.
Capitol Radio Engineering Institute
Indiana Technical College
Milwaukee School of Engineering
National Academy of Broadcasting, Inc.
Pacific International University
Tri-State College
Valparaiso Technical Institute

NEW Wintronix INTERMITTENT CONDITION ANALYZER

 Makes any TV or Radio Super-Sensitive to Intermittents & Noisy Components . . .

NO WAITING NO “COOKING” NO “FREEZING”

Save valuable time and bench space when troubleshooting intermitents. Just connect output of Model 828 to Radio or TV receiver antenna terminals, and use exclusive “Electro-Wand” (for tubes) or “Electro-Probe” (for components) to quickly pinpoint intermittent or noisy tubes, capacitors, resistors, coils, transformers, defective connections, etc. No direct circuit connection needed.

Special Wintronix circuit immediately makes any receiver super-sensitive to intermitents. Lets you hear intermitents through built-in speaker. Reduces callbacks by detecting borderline components before they fail.

See the Wintronix Model 828 at your local parts distributor or write for free literature,

WINSTON ELECTRONICS INC.
4312 Main St., Phila. 27, Pa.
NEW 180 PAGE ELECTRONIC CATALOG FEATURING THE BEST BUYS IN THE BUSINESS

The newest and largest assortment of Electronic, Radio and TV parts, Hi-Fi and Public Address Components and systems, Test Equipment, tubes, Transformer Kits and all trans- 

tured components for transistor circuitry, Ham Equipment, Builders Kits, Tools, Books, Microscopes, Binoculars, Telescopes, Cameras, and Drafting Equipment— ALL AT LOWEST PRICES— Catering to the economy minded dealer, serviceman, engineer, technician, experimenter and hobbyist. CRAMMED FULL OF MONEY SAVING BUYS. SEND FOR YOUR FREE COPY TODAY.

Introduces Hi-Fi Gems
... at prices everyone can afford

LAFAYETTE MASTER AUDIO CONTROL CENTER
with BINAURAL CHANNEL AND DUAL VOLUME CONTROL.
Years Ahead of Every Other Control Unit ... Ahead In Sound ... Ahead In Styling
Ahead in Design ... Ahead In Features ... Available in Kit and Wired Form
This is not only the finest hi-fi panel characterized by the usual features, but the LT-30 is a fully functional design to keep pace with the conversion of your present hi-fi system to binaural
(Stereophonic) sound. Incorporates an extra channel and dual volume control for binaural reproduction. Features include DC on all tube elements, negative feedback in every stage, dual cathode follower output stage and latest printed circuit construction. Less than 0.09% distortion at 1,000 cycles over entire audible spectrum. 7 inputs for every type of phone, tuner or tape. Tuneful brilliance, brilliantly executed, Size 12" x 9 1/2 x 3 3/4". Shpg. wt. 10 1/2 lbs.

LT-30 - Lafayette Master Audio Control Kit Complete with cage and detailed assembly instructions. Net 39.50

DELUXE 70 WATT BASIC AMPLIFIER
• Conservatively Rated At 70 Watts • Ultra-Stable • Variable Damping • Metered Balance And Bias Adjus Controls • Available In Kit And Wired Form
Here's ultra-stability in a 70 watt basic power amplifier employing highest quality components conservatively rated to insure performance and long life. Features matched pair KT-88's and wide range linear output transformer, variable damping control, meter for bias and balance and chrome plated chassis. Frequency response 10,000,000 cps ± 1db. Hum and noise 90db below full output. IM distortion less than 0.3% at 30 watts. Harmonic distortion less than 2% at 70 watts from 20 to 20,000,000 cps ± 1db. Output impedance 4, 8 and 16 ohms. Handwound heavy gauge transformer for proper ventilation. Size 14 1/2 x 10 x 7 3/4" including cage and knobs. Shpg. wt. 40 lbs.

KT-400 - Lafayette 70 watt Deluxe Basic Amplifier Kit complete with cage and detailed assembly instructions. Net 69.50

LAFAYETTE'S EXCLUSIVE FM-AM TUNER KIT
FM-AM Tuner with outstanding Specifications and outstanding Performance — All at a Budget Price — In easily assembled kit form.
Excellence of design and quality of components provide this compact hi-fi FM-AM tuner with superb characteristics normally found in most expensive tuners. Features Armstrong FM circuit with limiter and Foster — Seeley discriminator, grounded grid triode RF amplifier, AFC circuit combined with front panel tuning control and simplified tuning with slide rule dial and cushioned, quiet, smooth, easy freedom. Excellent sensitivity and selectivity at balanced output. Distortion less than 1% at rated output. Meets FCC requirements for radiation. Attractive etched copper-plated and covered finish. Supplied with simplified detailed Construction Manual with easy assembly instructions. Size 9 x 9 x 3 1/2" (excluding knobs) x 3 1/2" H. Less metal cage. Shpg. wt. 9 lbs.

KT-100 - FM-AM Tuner Kit, less Metal Cage. Net 34.95

ML-100 - Metal Cage for above. Shpg. wt. 3 lbs. Net 5.00

NEW! Lafayette Deluxe Hi-Fi FM Tuner COMPLETELY WIRED AND TESTED.

• Armstrong Circuit with Dual Limiters
• Temperature Compensated and AFC
• Custom Styled

Lafayette engineers bring to this discriminating music lovers who cannot broadcast listening to FM (the true hi-fi spectrum), a tuner giving the utmost in performance and quality. Features Armstrong circuit with Foster — Seeley discriminator, 3-stage, grounded grid triode RF amplifier, AFC circuit, and has 9 tubes plus silicon rectifier. Sensitivity 100,000 cycles ± 1db. Distortion less than 1%. Frequency response 20-200,000 cycles ± 0.5db. Cathode follower and high impedance outputs. Meets FCC requirements for radiation. Linearity, components, finish is Brushed all brass and maroon, for shelf or table top use. Completely self powered and wired, ready for operation. Size: 14" x 7" D 6 1/2" H. Complete with cover. Shpg. wt., 13 lbs.

LT-60 - FM Tuner. Net 49.95

HIGH FREQUENCY TWEETER WITH ACOUSTIC LENS

New! DIRECT IMPORTATION MAKES THIS PRICE POSSIBLE!

• FREQUENCY RESPONSE FROM 2000 CPS TO BEYOND AUDIBILITY
• LOUVERED ACOUSTIC LENS FOR UNIFORM SOUNDS
• HANDLES 25 WATTS OF POWER
• PRICED EXCEPTIONALLY LOW

New high frequency tweeter featuring a louvered acoustic lens for uniform sound dispersion and capable of handling up to 25 watts of distortion-free power. The directional tendency of high frequency noise is overcome by the natural wide dispersion of the louvered design which is effective in the high frequency range of the tweeter, 3 1/2" diameter. Complete with a separate mounting mechanism for external mounting where desired. Aluminum voice coil has 16 ohms impedance. Baffle 5 1/4" long x 5 3/8" diameter. Requires a crossover network, preferably one with a level control, such as the LN-2. With full instructions. Shpg. wt., 6 lbs.

Net 19.45
LAFLAYETTE SENSATIONAL VALUES!

LAFLAYETTE SIGNAL GENERATOR
NEVER BEFORE HAS A COMPLETELY WIRED AND TESTED INSTRUMENT OF SUCH ACCURACY AND QUALITY BEEN OFFERED AT SUCH A PRICE!

- FREQUENCY 120 KC TO 260 MC
- 120 KC TO 120 MC ON FUNDAMENTALS
- LABORATORY ACCURACY AND QUALITY

A completely wired and tested signal generator instrument is now available in all from of them at almost the same price, but with a guarantee of performance. The new Lafayette Signal Generator incorporates all of the latest design features and is completely self-contained. The generator provides accuracy and reliability that is unmatched by any other instrument in this price range. For audio testing the 400 cycle signal can be used to check the operation of RF, audio, and DC circuits. It is also useful in testing impedance of any external or internal filter. For audio testing the 400 cycle signal can be used to check the operation of RF, audio, and DC circuits. It is also useful in testing impedance of any external or internal filter.

Outputs are unmodulated RF, either RF or audio, and 500-CP in audio. The output is in excess of 100,000 Megohms. Large class 5 inch diameter plate and panel are protected by transparent plastic bezel. Common AF terminals for EXT-MOD input and INT-AF, for audio tests only. A special AF output connector, machine-machined panel lettering. Standard 5 inch etched panel with trim. Six inch etched panel with trim.

MODEL SG-10

22.50

NEW!

LAFLAYETTE CAPACITANCE-RESISTANCE TESTER
COMPLETELY WIRED AND TESTED

WITH "IN-SET QUICK CHECK"

- TWO INSTRUMENTS IN ONE
- CHECKS ELECTROLYTIC, ALUMINUM, PAPER, MICA AND CERAMIC CONDENSERS
- DIRECT READING CAPACITANCE SCALES FROM .0001 MFD TO 1000 MFD
- CHECK FOR OPEN SHORTS, LEAKAGE AND INTERMITTENTS
- 2 RESISTANCE RANGES FROM 100 TO 5 MEGOHM

Here is a "must" for servicemen and technics. A completely self-contained AC operated capacitance and resistance tester, plus a microammeter in the set. Each simple direct reading scale has 4 ranges of .0001-6 MFD, .001-1.5 MFD and 20-1000 MFD. Resistance ranges are 100-50,000 Ohms and 10,000 to 5 Megohms. Quick check feature enables you to check capacitance for shorts, open or intermittent within 10 seconds from the time you set the scale. You're sure they need replacement. Leakage test switch gives a direct reading on any AC circuit you test. Complete with test leads and battery. Shipping weight 19 lbs.

MODEL LC-15

34.50

LAFLAYETTE CAPACITANCE-RESISTANCE TESTER
COMPLETELY WIRED AND TESTED

NOT ONLY 17.95

LAFLAYETTE VISCOS DAMPED TRANSCRIPTION TONE ARM
NOW AT THE LOWEST PRICES ANYWHERE

A new combination tone arm that is compact and durable, yet offers excellent performance. It is specifically designed to work with high-compliance cartridges and is perfect for cleaning and maintaining your record collection. The arm features an adjustable headshell with a variety of adapters to accommodate most popular cartridges. It is also compatible with most popular turntables.

Net 11.95

LAFLAYETTE TRANSCRIPTION ARM
12" VISCOS DAMPED ARM 11.95

LICENSED UNDER CBS
U. S. PATENT NO. 2674806

PK-90—12" Transcription Arm. Net 11.95

16" VISCOS DAMPED TRANSCRIPTION TONE ARM

NOW ONLY 17.95

LICENSED UNDER CBS
U. S. PATENT NO. 2674804

A 16" viscous damped arm of an unbelievable low price. An automatic balancing unit eliminates possibility of silicon leakage. Features single point pivot mounting, precision pickup arm adjustment controls, and plug-in adapters for all popular carriages. Complete. Ships wt. 13 lbs. PK-175—16" Transcription Arm

17.95

LAFLAYETTE RADIO

165-08 Liberty Ave, Jamaica 33; N. Y. • Include postage with order.

TRANSCRIPTION-TYPE MANUAL PLAYER
WITH TONE ARM AND TWO PLUG-IN HEADS

- MAGNETIC BRAKE FOR FINE ADJUSTMENT OF EACH SPEED
- 4-POLE, HEAVY DUTY TYPE MOTOR
- ACCOMMODATES ALL POPULAR CARTRIDGES

PK-160

All the important features of professional transcription arms, yet priced for the discriminating hobbyist.

- STYLUS WEIGHT ADJUSTMENT SCREW ON TONE ARM
- WOOD BASE FOR PROTECTION OF CARTRIDGE AND TONE ARM

Wt. 12 lbs. Net 35.95

LAFAYETTE RADIO

165-08 Liberty Ave, Jamaica 33; N. Y. • Include postage with order.

DEPT:J-2

www.americanradiohistory.com
It's New! Send for this FREE booklet today!

see what the rapidly expanding field of ELECTRONICS offers you

• BETTER JOB
• BETTER PAY
• PROMOTION
• GREATER SECURITY
• GREATER CONFIDENCE
• BETTER LIVING FOR YOU AND YOUR FAMILY

All these benefits can be yours if you act now! Take that first big step this minute—No obligation whatsoever!

TAKE A MINUTE TO MAIL THIS COUPON FOR FREE BOOKLET!

CAPITOL RADIO ENGINEERING INSTITUTE
ECPD Accredited Technical Institute Curricula—Founded 1927
Dept. 1410-W, 3224 18th St., N.W., Washington 10, D.C.

Please send me your course outline and FREE Illustrated Booklet "Your Future in the New World of Electronics" describing opportunities and CREI home study courses in Practical Electronic Engineering Technology.

CHECK

FIELD OF

GREATEST INTEREST

• Electronic Engineering Technology
• Broadcast (AM, FM, TV) Engineering Technology
• Television Engineering Technology
• Aeronautical Electronic Engineering Technology

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

Street...........................................

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

CHECK: □ Home Study □ Residence School □ Korean Veteran

To help us answer your request intelligently, please give the following information:

EMPLOYED BY

TYPE OF PRESENT WORK

SCHOOL BACKGROUND

ELECTRONICS EXPERIENCE

IN WHAT BRANCH OF ELECTRONICS ARE YOU MOST INTERESTED?

www.americanradiohistory.com
Electro-Voice® Variable-D Cardioid Microphones
Record the Quality You Want ... and that's ALL!

You'll make professional-quality, high-fidelity tape recordings with an Electro-Voice microphone — the choice of broadcast and TV engineers!

The secret of success is the unique E-V Variable-D, which stops background sound you don't want, picks up the sounds you do want. Work close — you'll record no "boom." Pick up from a distance — the sound is clean and free from "roominess." The single moving element is E-V's exclusive, virtually indestructible Acoustalloy diaphragm.

NEW Model 951 Crystal Cardioid—Professional quality at a Modest Price

This newest addition to the E-V line uses the same Variable-D principle as E-V's broadcast cardioids to give you uniform directivity of pickup and high discrimination against unwanted sound. Response is 50 to 11,000 cps. Has chrome-finished pressure-cast case, On-Off switch. Just $49.50, list, less stand.

Model 664 Cardioid Dynamic—Finest of its Kind!

Without a doubt, Model 664 is the world's best general-purpose cardioid! It's guaranteed to outperform all others. Unidirectional high fidelity Model 664 gives you highly directional sound selectivity, reduces pickup due to ambient noise up to 50%, has smooth, peak-free response at all frequencies from 40 to 15,000 cps. Convenient on-off switch, chrome finish. List, $85, less stand.

Electro-Voice manufactures the most complete high-fidelity product family... speakers, speaker systems, speaker enclosures, amplifiers, preamps, tuners, phono cartridges, do-it-yourself enclosure kits and microphones. Available at leading high-fidelity distributors.

For the finest microphone, see your hi-fi dealer. For all the facts, write us for "The ABC's of Microphones," Booklet W-710

ELECTRO-VOICE, INC. BUCHANAN, MICHIGAN
Export: 13 East 40th Street, New York 16, U.S.A.
Cables: ARLAB

www.americanradiohistory.com
Have **YOU** Given Your Service Business Its **COLOR** Transfusion?

This TV service-dealer is "hep". He's getting ready now for healthy, wealthy business. "Doctor", of course, is his RCA Tube Distributor. And he'll give you your "booster shot", the new RCA PICT-O-GUIDE for COLOR-TV, with your order for RCA TUBES—free of extra charge!

Written by RCA's well-known TV-service authority John R. Meagher (who also wrote the famous RCA Pict-O-Guide series for black-and-white TV), this volume is profusely illustrated with full-color photos, packed with step-by-step alignment and trouble-shooting instructions, and loaded with labor- and time-saving short cuts for profitable color-TV servicing.

See for yourself what other service technicians have learned—color-TV servicing has been simplified! See your RCA TUBE DISTRIBUTOR with your order today!

**RCA COLOR-TV**
**PICT-O-GUIDE CONTAINS**
**SECTIONS ON:**
- Color Mixing
- RCA Compatible
- Color TV System
- Purity
- Convergence
- Gray-Scale Tracking
- Color Operating Controls
- Antenna Considerations
- RF-IF Bandpass Alignment
- Color Test Equipment
- Color-Bar Patterns
- Troubleshooting
- Signal Tracing
- Interference
- "Green Stripe" Test Signals

**RCA RECEIVING TUBES**
**RADIO CORPORATION OF AMERICA**
© Electron Tube Division Harrison, N.J.