Have 310 • Will Travel...

- Hand size, but with the features of a full-size V-O-M.
- 20,000 ohms per volt DC; 5,000 AC.
- EXCLUSIVE SELECTOR SWITCH speeds circuit and range settings. The first miniature V-O-M with this exclusive feature for quick, fool-proof selection of all ranges.
- SELF-SHIELDED Bar-Ring Instrument; permits checking in Strong Magnetic Fields.
- Fitting interchangeable test prod tip into top of tester makes it the common probe, thereby freeing one hand.
- Unbreakable plastic meter window.
- BANANA-TYPE JACKS—positive connection and long life.

MODEL 100

The most comprehensive test set in the Triplett line is Model 100 V-O-M Clamp-On-Ammeter Kit, now available at distributors. The world's most versatile instrument—a complete accurate V-O-M plus a clamp-on-ammeter with which you can take measurements without stripping the wires. Handsome, triple-purpose carton holds and displays all the components: Model 310 miniaturized V-C-M, Model 10 Clamp-On-Ammeter, Model 1D Line Separator, No. 311 extension leads and a Leather Carrying-Case, which neatly accommodates all the components. Model 101 literally makes it possible to separate the two sides of the line when using Model 10. Extension leads permit use of Model 10 at a distance from the V-O-M. Complete Model 100 is only $59.50.

For full information see your Triplett distributor

TRIPLETT ELECTRICAL INSTRUMENT COMPANY • BLUFFTON, OHIO

PANEL METERS / AND A VOM FOR EVERY PURPOSE AND EVERY PURSE
If you have some knowledge of Radio or Television or Electronics now and want to **BECOME A PROFESSIONAL SERVICE TECHNICIAN**

you will want to investigate the special **ALL-PRACTICE TRAINING PLAN** developed for men like you by the **OLDEST AND LARGEST** home study Radio-Television school

**MAIL THIS TO NRI NOW**
National Radio Institute, Dept.OKFT, Washington 16, D.C.
Accredited Member National Home Study Council

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

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

(Note: This training is NOT for beginners)

Over 40 years ago, J. E. Smith, founder of the National Radio Institute, pioneered in teaching Radio by the home study method. Today, this magnificent building is completely devoted to NRI's Radio-TV Electronics training. Here up-to-date laboratory and research facilities are constantly testing new developments and improved methods of training men for Radio-TV Electronics careers.

**All-Practice Method**

NRI's Professional TV Servicing Training is practical, complete. You make tests and experiments to help thoroughly understand TV problems. You get equipment to build a 5" Oscilloscope, a 17" picture tube and all components for building a TV receiver. Comprehensive Color TV manuals also included. You learn how experts diagnose TV defects, get knowledge of professional techniques. Mail the coupon for free catalog now. NATIONAL RADIO INSTITUTE, Washington 16, D.C.
EDITORIAL
33 Instructive Electronic Devices—Hugo Gernsback

AUDIO-HIGH FIDELITY
34 Build a High-Power Twin-Coupled Amplifier (Cover Feature) —Norman H. Crowhurst
45 Add a Third Speaker the Easy Way—Herman Burstein
48 New Stereo Pickups, Part II—Julian D. Hirsch
78 Sound at the Cocktail Party

ELECTRONICS
38 How Live Is Your Nickel-Cadmium Battery?—Nathaniel Rhits
39 Better Photos With a Transistor Slave Flash You Can Make—Franklin T. Merkler
51 Duo-junction—I. Queen
54 Build a Transistor-Capacitance Relay—Rufus P. Turner
55 Winding a Transistor-Power-Supply Transformer—B. L. Winklepleck
58 The Tunnel Diode Really Works . . . Try These Circuits—I. Queen

RADIO
52 Assemble a One-Transistor Radio That Powers an 8-Inch Speaker—William H. Grace, Jr.
82 Radio Control With Oomph—Make a 30-Watt Transmitter—J. H. Thomas

INDUSTRIAL ELECTRONICS
68 Understanding Magnetrons, Industrial Power Generators—Tom Jaski
80 Injec-Check Industrial Equipment With This Home-Built Unit—Wm. F. Kernin

TELEVISION
40 Troubleshooting the Vertical Oscillator and Output Stages—R. D. Jacques
60 TV Service Clinic—Conducted by Jack Darr
84 Tube-Changing the Tough Ones—Jack Darr
92 TV Antennas Invite Lightning to Strike

TEST INSTRUMENTS
46 Construct This Practical Tester for Electrolytics—H. B. Conant
76 Make Your Own Transistor Field-Strength Meter for the Citizens Band—Lyman E. Greenlee

125 Business and People 6 News Briefs
21 Correspondence 112 Noteworthy Circuits
130 New Books 114 Technician's News
128 New Literature 110 Techniques
117 New Patents 120 Try This One
98 New Products 124 50 Years Ago
96 New Tubes and Semiconductors

ON THE COVER
(Story on page 34)
The printed-circuit heart of the new RADIO-ELECTRONICS Twin-Coupled Amplifier described in this issue. The printed board was designed and executed by Electro-Technik Co., Detroit, Mich.

Color original by Habershaw Studios

Hugo Gernsback Editor and Publisher
M. Harvey Gernsback Editorial Director
Fred Shunaman Managing Editor
Robert F. Scott WPWG, Technical Editor
Larry Stockler Associate Editor
I. Queen Editorial Associate
Elizabeth Stalcup Production Manager
Fernando Martinez Art Director
Wm. Lyon McLaughlin Tech. Illustration Director
Fred Neinast Staff Artist
Lee Robinson Director, Advertising Sales
John J. Lamson Eastern Sales Manager
G. Aliquo Circulation Manager
Adam J. Smith Director, Newsstand Sales
Robert Fallath Promotion Manager

Average Paid Circulation Over 163,000

RADIO-ELECTRONICS is indexed in Applied Science & Technology Index (Formerly Industrial Arts Index)


SUBSCRIPTION RATES: U.S., U.K., possessions and Canada, $4.99 for one year, $7.99 for two years; $10.00 for three years. Pan-American countries $5.00 for one year; $9.00 for two years; $12.00 for three years. All other countries $5.50 a year; $10.00 for two years; $14.00 for three years.

SUBSCRIPTIONS: Address correspondence to Radio-Electronics, Subscriber Service, 154 West 14th St., New York 11, N.Y. When requesting a change of address, please furnish your old address label from a recent issue. Allow one month for change of address.

GERSHBACK PUBLICATIONS, INC. Executive, Editorial and Advertising Offices, 154 West 14th St., New York 11, N.Y. Telephone Astoria 5-7755. Hugo Gernsback, Executive Editor; M. Harvey Gernsback, President; G. Aliquo, Secretary. Advertising Representatives and Foreign Agents Listed on Page 111.

POSTMASTER: If undeliverable, send Form 3579 to: RADIO-ELECTRONICS, 154 West 14th St., New York 11, N.Y.

*Roadmark registered U. S. Pat. Off.

50 YEARS OF ELECTRONIC PUBLISHING

OCTOBER, 1960

Radio-Electronics
MAKE MORE MONEY in TELEVISION

Better...more complete...lower cost...with National Schools Shop-Method
Home training!

Better...Training that is proved and tested in Resident School shops and laboratories, by a school that is
the oldest and largest of its kind in the world.

More complete...You learn all phases of Television-Radio-Electronics.

Lower cost...Other schools make several courses out of the material in our one
master course...and you pay more for less training than you get in our course at one
low tuition!

Top pay...unlimited opportunities
Lifetime security can be yours!

You are needed in the television, radio, and electronics industry! Trained technicians are in growing demand at excellent pay—in all phases, including servicing, manufacturing, broadcasting and communications, automation, radar, government missile projects.

National schools shop-method home training, with newly added lessons and equipment, trains you in your spare time at home, for these unlimited opportunities, including many technical jobs leading to supervisory positions.

You learn by building equipment with kits and parts we send you. Your National School's course includes thorough practical training—YOU LEARN BY DOING! We send you complete standard equipment of professional quality for building various experimental and test units. You advance step by step, perform more than 100 experiments, and you build a complete TV set from the ground up, that is yours to keep! A big, new TV picture tube is included at no extra charge.

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

Lessons and instruction material are up-to-date, practical, interesting. Every National Schools Shop-Method lesson is made easy to understand by numerous illustrations and diagrams. All instruction material has been developed and tested in our own Resident School Shops, Laboratories and Studios.

Send for information today...it can mean the difference between success and failure for you! Send for your free book, 'Your Future in Television-Radio-Electronics' and free sample lesson. Do it today, while you are thinking about your future. It doesn't cost you anything to investigate!

Get the benefits of our over 50 years experience

Approved for GI Training

Mail now to National Technical Schools, Dept. RG100
4000 S. Figueroa St., Los Angeles 37, Calif.

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

Check if interested only in resident school training at Los Angeles

Veterans: Give date of discharge

National Schools
Los Angeles 37, Calif.

October, 1960
Echo Satellite Opens Way  
To New Communications System

The successful transcontinental telephone conversations via the Echo satellite may be only the beginning of a complete system of telephone and TV relay communications via satellites. This is the opinion of scientists both of the National Aeronautics and Space Administration (NASA) and of the Bell Telephone Laboratories, who collaborated to put Echo into space.

The first satellite is a sphere 100 feet in diameter, making a circuit around the earth in a little over 2 hours, and traveling roughly 1,000 miles above the earth on a course angled 47° from the equator. Two tiny transmitters 180° apart on the sphere's equator help the ground stations to track it. Otherwise Echo is a complete passive reflector.

A number of satellites, either three or four at great heights, as proposed by Hugo Gernsback in RADIO-ELECTRONICS, March, 1958, or a system of 50 traveling at about the same height as Echo, could carry a fantastic number of messages and provide reliable communication at all hours of the day.

As a rehearsal for Echo, phone messages were exchanged between Holmdel, N. J., and Goldstone, Calif., using the moon for a reflector. Reception, as witnessed by a large group of reporters, was completely intelligible, though much more noisy than the later Echo transmissions. The same receiving equipment was used later to track and receive Echo.

In transmissions between the Bell station at Holmdel and Jet Propulsion Laboratories at Goldstone, power in the order of 10 kw for the transmitters was used at both ends, the West Coast station operating at 2390 mc and the Bell Labs transmitter at Holmdel using 960 mc. The receiver is a ruby maser type, which, in conjunction with the special horn antenna, reduces noise to a negligible level.

Hams Bounce Signals Off Moon

The first amateur radio moon-bounce contact was made July 21 between the Eimac Radio Club in San Carlos, Calif., and Sam Harris of the Rhododendron Swamp VHF Society, Medfield, Mass. The frequency used was 1,296 mc. At both ends of the circuit, a 1,000-watt (maximum allowable power) klystron was used in the transmitter and a sensitive Microwave Associates MA2-1000 parametric amplifier in the receiver.

The contact took place between 7:30 and 8:00 am, PDT.

The photograph shows some of the members of the Eimac Radio Club who participated in the moon-bounce project. They are, left to right, standing: W6OUV, Robert Sutherland; W6HB, O. H. Brown; W6UP, Bill Eitel; W6RXW, George Badger; W6MUC, Al Clark; K6GJF, Bob Morwood; sitting, W6KEV, Ray Rinaudo; W6IVZ, Charles Anderson and K6GSO, Allan Beer. Not shown are Bill Orr, W6SAI, and Mike Krivohlavak, K6AXN.

Underground Radio

A teletyped radio message has been sent through 41/2 miles of the earth's substrata by Developmental Engineering Corp. The message was sent on a frequency of 150 kc, but anything between 30 kc to 3 megacycles is suitable.

The transmitter was placed 1,000 feet below the surface in a mine near Carlsbad, N. M. The receiving equipment was in a second mine 41/2 miles away.

The Lithocom system is not suitable for general broadcasting as the (Continued on page 10)
The Man who works with His Hands...

Has a Real Advantage When Preparing for
MONEY! EXCITEMENT! JOBS!
in
Electronics

FROM RADAR—TV ... TO GUIDED MISSILE CONTROL ETC.

You run a punch press, drive a tractor, work at a gas station. Or, maybe you can make home repairs, wire an electric appliance, or tune your car. You work with your hands. So did Thomas Edison and many other famous men. Artists, engineers, surgeons—all "work with their hands"—and so do Electronics Technicians! So, by all means, be proud of your "hand skills!"

DeVry Tech readily prepares men who use their hands for good-paying careers in the fast-growing Electronics field by sending 16 shipments of quality parts for building their own valuable test equipment. They work over 300 projects with these parts while they learn important basic theory. They learn in spare time at home, or in our well-equipped training centers in Chicago or Toronto. Many earn money part time repairing TV and radio sets while still training! When they finish, we help them get started.

DeVry Covers What You'll Need to Know

If you can understand clearly-written instructions, work with equipment, run training movies in your home, you surely can train for a profitable future in Electronics. ACT NOW to find out. Send for two fact-filled booklets that have helped so many men get started toward the kind of careers they wanted.

DeVRY TECHNICAL INSTITUTE
4141 Belmont Ave., Chicago 41, III., Dept. RE10Q

Please give me your two FREE booklets, "Pocket Guide to Real Earnings" and "Electronics in Space Travel." Also, include details on how to prepare for a career in one or more branches of Electronics.

Name__________________________ Pleas Print Age__________

Street__________________________ Apt__________

City__________________________ Zone State__________

☐ Check here if you face military service.

Canadian residents address: DeVry Tech of Canada, Ltd., 978 Lawrence Avenue West, Toronto 10, Ontario

2 FREE Booklets
Send coupon TODAY!
Then Sell the Complete ROHN Line for Bigger-By-Far Profits!

In addition to one-stop shopping, the full line of ROHN Towers and accessories mean more sales! Check and see!

The Full Line of ROHN Towers Fills Your Every Need!

ROHN TV TOWERS—The finest available for television reception. Install the No. 25 (illustrated) with amazing “zig-zag” design, self-supporting to 50 feet or, when properly guyed, to 280 feet. Or sell the popular No. 6 tower with the famous “Magic Triangle.” Both are fully HOT-DIPPED GALVANIZED THROUGHOUT AFTERT FABRICATION and come in handy 10 foot sections.

ROHN "FOLD-OVER" TOWERS—Specially designed to “fold-over” so the amateur radio operator can do his work on the ground. In sizes to handle all amateur antenna needs, ROHN "Fold-Over" Towers have won highest acclaim for design, performance and dependability.

ROHN COMMUNICATION TOWERS—Rugged, sturdy towers to meet EVERY communication requirement. Illustrated is the new and now available No. 55. Available are self-supporting towers to 150 feet, 7 full lines of towers in all, for guyed heights up to 630 feet! All are HOT-DIPPED GALVANIZED after fabrication.

The Finest in Masts, Tubing & Accessories

Tubing—Just what you need. Six-inch expanded or swaged end, both 1/8" taper to form a solid locking joint. High carbon steel. The 1½" tubing is available in 16 or 18 gauge, and in 5 and 10 ft. lengths. In 16 gauge, with expanded or plain end, and 10 ft. lengths.

Telescoping Masts—Unexcelled in design, structure and sales appeal. All popular sizes, heights and weights—in the exact specifications that are demanded today.

Roof Towers—A big profit item—very popular and easily shipped. Heights of 10, 5, 3, and 2½ feet, ideal to use ALL HOT-DIPPED GALVANIZED.

ROHN Manufacturing Company
6718 West Plank Rd.
Peoria, Illinois

BE SURE TO MAIL THIS COUPON NOW
ANNOUNCING A $3.05 PRE-PUBLICATION SAVING ON THIS LONG-NEEDED...

INTERNATIONAL DICTIONARY OF APPLIED MATHEMATICS

AT LAST! OVER 8,000 MATH APPLICATIONS, METHODS, TERMS, NOW IN ONE 1,215-PAGE, QUICK-REFERENCE BOOK!

HERE'S AN IMPORTANT ACHIEVEMENT: A BOOK THAT BRINGS TOGETHER FOR EVERY USE, DEFINED AND EXPLAINED, THE TERMS AND METHODS OF APPLIED MATHEMATICS TO TWO GREAT FIELDS OF SCIENCE AND ENGINEERING.

This massive International Dictionary of Applied Mathematics contains 8,165 entries. All those basic definitions and methods from pure mathematics, as well as from science and engineering, are clearly defined and explained. Each entry is carefully presented so that it serves both as a reference and as a source of understanding.

Mathematics to Engineering, and Methods to Applications, are included. Each term is so carefully defined that many listings take up half a column, some require a page or more. Equations are included and their derivations explained.

WORLD-FOAM Specialists in Their Fields Make This Book Unique as a Reference

From the United States and abroad, noted mathematicians, physicists, chemists and engineers have prepared each entry to ensure authoritative selection and most careful presentation covering these fields:

Acoustical Engineering
Acoustics
Astronomy
Automatic Control
Differential Geometry
Electromagnetic Theory
Mechanics
Network Topology
Nuclear Science
Optics
Quantum Mechanics
Relativity
Spectroscopy and Interpretation of Spectra
Strength of Materials
Chemical and Physical Thermodynamics
Vector Analysis
Aerodynamics and Hydrodynamics
Atomic Structure
Chemistry
Elasticity
General Mathematics
Molecular Structure
Nuclear Engineering
Nonlinear Analysis
Probability and Statistics
Relativistic Quantum Mechanics
Solid State Physics and Chemistry
Statistical Mechanics

Structural Analysis and Design
Engineering Thermodynamics
Tensor Analysis
Visco-Elasticity and Plasticity

In this dictionary you will find those concepts and approaches which are most widely used in applied mathematics and which prove most fruitful in their results. Every article is cross-referenced, the section on "Hole Theory," for example, mentions Dirac equation. This is in bold type to refer you to its listing for a more complete understanding of the entire subject.

A number of the articles in applied mathematics, especially in numerical analysis, refer you to the great 4-page entry on methods of computing eigenvalues and eigenvectors of matrices.

Important Foreign Language Indices

You bridge language barriers to pursue original reading by means of the four—German, Russian, French, Spanish—foreign language indices in this big book. Helpfully lists all terms with their English equivalents.

Every scientist, every engineer, every student, teacher, researcher needs this book. Whether you're checking data, looking for methods of application, interpolating an equation, writing a paper, clarifying technical articles—this book will give you the answers you need quickly, correctly, without wasted time or effort.

PRE-PUBLICATION OFFER

A work of this scope (1,215 pages, 315 illustrations) would ordinarily sell for $35 or more. However, the publishers plan an unusually large first printing to bring the retail price down to $25.00. To build up this first printing, we are accepting advance reservations now. In return for helping us increase this printing's size, we will send you the Dictionary at the special pre-publication price of only $21.95.

SEND NO MONEY

When the International Dictionary of Applied Mathematics comes off the press, a copy will be sent to you at the pre-publication price of only $21.95. Simply fill out and mail reservation certificate at right. Browse through it, use it for ten days free. Then, if you're not convinced it will be the most used reference work on your desk, return it and owe nothing. Mail certificate today to: D. Van Nostrand Company, Inc., Dept. 1810A, 120 Alexander Street, Princeton, N. J. (Established 1848).

TAX DEDUCTIBLE if used in your work!

OCTOBER, 1960
signals do not go above ground. The main value of the system lies in the fact that it is very difficult to jam. It can be used as an emergency means of communications. In a war, the enemy could not listen in (the expected maximum range is 100 miles).

**Russian Artificial Hand**

A man with an artificial hand "powered by bioelectricity generated in his own arm muscles" was presented to delegates of the First International Congress for Automatic Control, held in Moscow. The man wrote: "Welcome Congress Delegates" on a conference room blackboard in legible handwriting.

A paper presented on the subject by Soviet Professor Abram Kobrinski gave credit to Professor Norbert Wiener's work on bioelectrics 12 years ago. Dr. Wiener, of the Massachusetts Institute of Technology, said he was pleased that the Russians had developed "a bioelectrical artificial limb based on transistorized amplification of currents generated by the human body."

**Reflecting Ring to Orbit Earth?**

A plan to ring the earth with billions of tiny antennas is to be tested by the Air Force. Each antenna will be about half as thick as a human hair; their length will depend on the frequencies to be used.

The ring will be used to relay signals from point to point by reflecting them off the ring in a manner similar to bouncing signals off the Project Echo balloon.

It is planned to place a small number of antennas in orbit by a vehicle with a different main mission. The vehicle may be launched within a month or two.

One objection to the plan is that the ring might block signals used in other space projects.

The ring would not be as likely to be damaged by meteorites or space debris as would balloons or "active" (receiver-amplifier) satellites.

**Electronic Elevators**

"Talking elevators" installed at the Hess department store in Allentown, Pa., not only tell customers what they may find on the various floors, but also give instructions to help the passengers preserve their own safety and improve elevator service.

Completely electronic in operation, down to the pushbutton that summons the car, the elevators have a capacitance-operated door-safety device that detects a person in the way and opens the doors again to let him get in. If the passenger lingers, the elevator addresses him: "Kindly step back in the car, so that service may continue." After repeating the message a few times, if the passenger is still obstructing the entrance,
do you know what an FCC License Really Can do for you in electronics

1. If you want to get into electronics . . . ?

2. If you are now employed in electronics . . . ?

See what this leading employer Burroughs Corporation has to say:

"An FCC License is a job asset . . .

to any man looking to enhance his career in the field of electronics. At Burroughs Corporation, a licensed man is well regarded because an FCC license attests to his knowledge of electronic theory. The licensed man at Burroughs will be called upon to handle many challenging assignments."

Employers are good judges of the value of an FCC License.

Cleveland Institute announces a New and Dynamic Technician Training Program in Computers, Servo Mechanisms, Magnetic Amplifiers and others

Other advanced fields covered include Basic Math, A. C. Circuit Analysis, Pulse Circuitry, Color TV, Radar, Advanced Measuring Techniques, Industrial Electronics, Instrumentation, Automation, Radio Telemetry. Send for information today.

Accredited by the National Home Study Council

Cleveland Institute of Electronics
Desk RE-46B, 4900 Euclid Avenue, Cleveland 3, Ohio

GET ALL 3 VALUABLE BOOKLETS

free!

JUST MAIL THE COUPON BELOW
BRIGHT NEW VIEW
for Multi-set TV-FM Home Operation...

...and a Bright Profit Outlook for YOU with NEW JERROLD HSA-43 Amplified 3 SET COUPLER

Here's a new precision-perfected amplifier that provides 5 DB min. gain across all TV-FM channels on two outputs and no loss in the third output. Housed in a rugged, compact and handsome case. The HSA-43 features single tube operation (6DJ8), A.C. interlock and no-strip twin lead terminals. Its excellent isolation and match prevents set interaction and ghosting. IDEAL FOR FEEDING ONE FM AND TWO TV SETS FROM THE SAME ANTENNA.

$29.95 list

Write Jerrold today for full details on this new Profit Outlook!

ELECTRONICS CORPORATION, Distributor Sales Division
Dept. IDS-33, Philadelphia 32, Pa.
Jerrold Electronics (Canada) Limited, Toronto

LEADER AND LARGEST MANUFACTURER OF TV DISTRIBUTION SYSTEM EQUIPMENT

NEWS BRIEFS (Continued)

the elevator registers mild annoyance by starting a buzzer while continuing to urge the obstructor out of the way, and the doors close slowly but politely, nudging the customer into (or out of) the car. This capacitance system is considered superior to photocell methods of controlling doors, since it acts only if the customer is close to the door's edge. It also protects the smallest child, since the whole edge of the door, from ankle to shoulder height, forms part of the sensing element.

FM Increasing

FM stations are developing faster than AM stations, according to the latest count. Of course, AM stations still outnumber the FM's (3,484 AM's, 741 FM's), but percentage-wise, FM is ahead.

From 1958 to 1959, the number of operating FM stations increased from 571 to 677 (19% based on 1958 figures), while in the same period AM stations increased from 3,318 to 3,456 (4%).

In the period from Jan. 1 to June 30 of this year, 64 new FM stations went on the air (an increase of approximately 10% in just half a year), while 28 AM stations went on the air (approximately 1% in half a year).

And Now—Underwater Stereo

Submerged stereo in a swimming pool was heard for the first time in a joint demonstration by three audio companies at the famed Grossinger resort in New York State. Records were played through a dual 65-watt stereo amplifier to two specially designed underwater speakers. Bathers reported that the sound could be heard underwater across the whole pool.

Three companies took part in the demonstration of stereo sound, which was also carried on in more conventional style in a special listening room at the resort. Bogen-Presto supplied the amplifiers, University the special MM2-UW underwater speakers and United Audio the Duni stereo record changer.

Underwater Distance Record

Underwater explosions set off near Australia were picked up by Columbia University's Seismic and SOFAV (Sound Fixing And Ranging) station in Bermuda. The sound waves traveled 12,000 miles in 3 hours and 43 minutes.

The shots—weighing 50 pounds—were fired in a deep channel off southern Australia by the Vema, Columbia's research vessel. There were three of them, spaced 5 minutes apart.

John J. Ewing (staff member and brother of Dr. Maurice Ewing, director of Columbia's Lamont Geological Observatory, Palisades, N. Y.) said recording the shots was remarkable (Continued on page 16)
ALLIED value-packed 1961
444-PAGE ELECTRONICS CATALOG
including products available only from Allied

BUY ON EASIEST TERMS
ONLY $2 DOWN

Yes, only $2 down on orders up to $50; only $5 down on orders up to $200; only $10 down over $200. Up to 24 months to pay.

ALLIED Exclusives:

MONEY-SAVING KNIGHT-KITS®—truly the very best in build-your-own electronic equipment—designed to save you money, easiest to assemble—the only kits offered with Free Inspection Privilege. See the complete selection of Stereo hi-fi kits, Hobbyist kits, Test Instrument and Amateur kits. KNIGHT-KITS are an exclusive ALLIED product.

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

ALLIED RADIO
our 40th year
Satisfaction Guaranteed
Or Your Money Back

World’s Largest Electronic Supply House

ALLIED Exclusives:

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

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

FREE the most complete electronics catalog!

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

☐ Send FREE 1961 ALLIED Catalog.

Name

Address

City Zone State
Sprague Black Beauty tubulars are missile-type capacitors. Actually, they are low cost versions of the famous Sprague capacitors now being used in every modern military missile. Where positive reliability is important, make no mistake, use Black Beauty Difilm Molded Capacitors! You get the most for the least with Black Beauties!

Difilm Black Beauties are engineered to withstand the hottest temperatures to be found in TV or auto radio sets—in the most humid climates. Further, unlike straight polyester film tubulars, these capacitors operate in a 105°C environment—without derating!

Black Beauty tubulars are tough units, too—no fragile shell to break—you can’t damage them in soldering. For your convenience, every capacitor is marked twice... no need to twist capacitor around to read rating.

±10% CAPACITANCE TOLERANCE IS STANDARD AT NO EXTRA COST

Difilm Black Beauty and Difilm Orange Drops are packaged in sturdy, reusable rigid plastic Kleer-Pak® boxes. Your distributor is stocked in all the popular ratings. Order some today. You can count on Difilm.
Grantham training is the easy way to learn more quickly—to prepare more thoroughly—for F.C.C. examinations. And your first class license is the quick, easy way to prove to your employer that you are worth more money.

This correspondence course is directed toward two major objectives—(1) to teach you a great deal about electronics, and (2) to prepare you to pass all of the F.C.C. examinations required for a first class commercial operator’s license. We teach you step by step and have you practice with FCC-type tests which you send to the school for grading and comment. You prepare for your F.C.C. examinations under the watchful direction of an instructor who is especially qualified in this field.

Grantham resident schools are located in four major cities—Hollywood, Seattle, Kansas City, and Washington, D.C. Regularly scheduled classes in F.C.C. license preparation are offered at all locations. New day classes begin every three months, and new evening classes begin four times a year. The day classes meet 5 days a week and prepare you for a first class F.C.C. license in 12 weeks. The evening classes meet 3 nights a week and prepare you for a first class license in 20 weeks. For more information about the Grantham resident schools, indicate in the coupon the city of your choice and then mail the coupon to the School’s home office in Hollywood, Calif. Free details will be mailed to you promptly.

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

GRANTHAM SCHOOL OF ELECTRONICS

HOLLYWOOD SEATTLE KANSAS CITY WASHINGTON

This booklet FREE! This free booklet gives details of our training and explains what an F.C.C. license can do for your future. Send for your copy today.

To: GRANTHAM SCHOOL OF ELECTRONICS
1505 N. Western Ave., Hollywood 27, Calif.

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

Name ___________________________ Age ________

Address __________________________

City ___________________________ State ______

I am interested in: [ ] Home Study, [ ] Kansas City classes, [ ] Hollywood classes, [ ] Seattle classes, [ ] Washington classes
NOW! One Britener for ALL series string heaters

New Perma-Power unit guards against picture tube damage caused by excessive power boost

When you're trying to brighten a 110° button base picture tube, watch those series heaters! Many of the newer sets have controlled warm-up filaments with ratings of 2.34 and 2.68 volts. (Older sets are usually rated at 6.3 volts.)

These new tubes use finer heater wire and closer element spacings—which makes them more efficient, but more fragile. Too much power boost will "blow" these low voltage filaments!

On these newer tubes, you can not safely use a Britener made for older sets. But you can use the new Perma-Power Model C412 on these and older style tubes. For the first time, here's one Britener for all 110° button base series string heaters—the only Britener that works properly for 2.34, 2.68, 4.70, 6.3 and 8.4 volt filaments! No switching necessary—no adjustments required.

The Model C412 Vu-Brite is one of four new Perma-Power Briteners, all engineered to fit properly and work properly. Without excessive inventory, Perma-Power—and only Perma-Power—can now assure you of complete coverage—a Britener that's right for every picture tube in general use today.

Perma-Power COMPANY
3106 NORTH ELSTON AVENUE • CHICAGO 18, ILLINOIS

LOOK what's coming along in Radio-Electronics future issues

- Build a 6DJ7 Amplifier
- Servicing TV Distribution Systems
- Zener Diodes Simplified
- Simple Transistor Gain Checker
- Professional Picture Tube Testers
- Electronic Timer for Guns
- Technicians—Avoid Legal Pitfalls!

On sale September 27
Last chance to subscribe now at these low rates

1 year $4  2 years $7  3 years $10
On October 31st rates go up to
1 year $5  2 years $9  3 years $12

154 West 14th Street  New York 11, N.Y.

NEWS BRIEFS (Continued from page 12)
both because of the distance and the small probability that there is a clear path between the flying point and Bermuda.

"Sound waves traveling through the water between those two points may have to feel their way around islands and through shallow areas," he said. The sound traveled near the surface in the south and then dropped to depths of around 2,600 feet near the Equator. It followed a Great-Circle path past the Cape of Good Hope.

The instruments in Bermuda are located in water about 2,600 feet deep. Scientists believe that an underwater atomic blast could be picked up if it was fired near the sound channel.

Party Lines Next?
Two widely separated computers can now exchange information with each other over a telephone system at the rate of 160 characters or numbers per second, the International Business Machines Corp. reported recently. The system requires a pair of IBM 1009 data-transmission units, one at each end of the line.

Information from a core storage unit, punched cards or magnetic tape may be sent.

Language Labs for Schools
The Board of Education plans to install language laboratories in 38 schools in New York City beginning this fall. The labs will be placed in 27 high schools, 7 junior high schools and 4 elementary schools.

In a language laboratory, the student listens to model speech through a pair of headphones and replies to or imitates it. His reply (and the master) are recorded on tape. By playing back the tape, the student can compare his answers with the master and see how well he is doing. Each student is in an acoustically treated booth. The instructor can monitor any of the booths (for more details, see "Electronic Labs Help Teach Languages," RADIO-ELECTRONICS, June, 1960, page 95).

Telephone Service Expanded
Two-way air-to-ground telephone service is now available in the New York, Washington and Pittsburgh areas. The service was previously available only on an experimental basis in the air corridor between Chicago and Detroit.

In making an air-to-ground call, a passenger pushes a button on the phone. An "aviation" switchboard operator answers via the nearest base station. The customer gives the operator the number he wants and she makes the connection.

Ground-to-air calls are made by dialing the telephone company and asking for the aviation operator in the area where the plane is known to be flying.

Equipment will be furnished to
Another factor in "Integrity in Music"

Does your amplifier change the music?

For Integrity in Music...

When your amplifier adds or subtracts not one nuance of sound... you enjoy Integrity in Music. This concept of pure, unadulterated reproduction has been manifested most recently in Stromberg-Carlson’s 8-80 stereo amplifier. Its combination of features, performance and price—its control versatility and listening quality—make it the most unusual value ever offered in high fidelity.

ASR-8-80 Specifications: Power: 64 watts (2-32-watt channels); Response: 20-20,000 cps ±0.9 db; Distortion: Harmonic: less than 0.6% at full output; IM: less than 1% at program level; Hum & Noise: down 70 db. A plus B output for center speaker system; Price: $199.95, Zone 1, gold and white finish, top cover extra.

Another amplifier featuring Stromberg-Carlson integrity is the dual channel ASR-433. Each channel provides 12 watts of exceptionally clean, balanced power. The control and performance are excellent.

The deliberately conservative specifications include: frequency response 20-20,000 cps; harmonic distortion less than 1% at full output; IM distortion less than 1% at program level; hum and noise 63 db down. Top cover available in gold and white or black and brushed chrome. ASR-433... $129.95.*

Stromberg-Carlson now offers 16 equipment cabinets in a wide variety of styles and finishes. They are designed to house complete Stromberg-Carlson stereo component systems and are factory assembled. They reproduce as faithfully as separately mounted components because of a unique mounting method that isolates the speaker systems from the other sensitive components.

See your dealer (in Yellow Pages) or write for a complete component and cabinet catalog to: 1478-010 North Goodman St., Rochester 3, New York.

*Prices audiophile net, Zone 1, less base, subject to change.

"There is nothing finer than a Stromberg-Carlson"

Stromberg-Carlson
A Division of General Dynamics
The invention of radio was still a military secret when Dr. Otto Halley was awarded the Department of Defense medal for outstanding public service for planning and carrying out the details of an invention that was a rubbathetile material. This invention is a rubberlike material containing metallic flakes that absorb radar waves. 2400 paces were used in the development of this invention.

The Government has released the details of the invention to the public, who are now using it for various purposes. The invention is called the "rubberband."
Learn RADIO, TELEVISION AND ELECTRONICS by Practicing at Home in Your Spare Time

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

Increasing Demand for Trained Men

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

High Pay, Prestige, Bright Future

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

Train With the Leader

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

Start Soon to Earn More

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

NRI Has Trained Thousands for Success

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

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

"Averaged $150 a month spare time before I graduated. Now have my own full time business and employ 3 men." F. W. COX, Hollywood, Cal.

NEW COURSE IN ELECTRONICS

Cut Out and Mail—No Stamp Needed

64-PAGE CATALOG FREE

No Salesman will call. (Please PRINT) 

Name ___________________ Age ________

Address __________________________

City __________________ Zene State __________

NATIONAL RADIO INSTITUTE

WALSHINGTON 16, D. C.

ACREDITED MEMBER NATIONAL HOME STUDY COUNCIL

www.americanradiohistory.com
NEW Home Study Course in ELECTRONICS
Principles-Practices-Maintenance
NOW READY

This is the Electronic Age. Electronic equipment is already being used to count and control flow of liquids, solids, gases. Electronics is employed to search for oil, make surveys, control traffic, machine complex parts and in atomic installations. Military uses of Electronics are great and expanding rapidly. In business, Automation with Electronics plays an important part, prepares payrolls, calculates engineering formulas.

Learn More to Earn More

Now, to meet the growing demand for trained Electronic Technicians NRI has developed a comprehensive, complete course in Electronics Principles, Practices, Maintenance. This training stresses fundamentals. It is a course specially prepared for beginners and for Technicians. You get both theory and practical experience in an interesting, exciting way.

Ten Special Training Kits
Give Practical Experience

You get practical experience with Thyratron Tube circuits, Multivibrators, build a D'Arsonval type Vacuum Tube Voltmeter (Kit 2); work and experiment with pentode tubes, selenium resistors, oscillators, transistors, magnetic amplifiers; and get practical experience in telemetry circuits as used in earth satellites, digital and analog computers (Kit 9).

NRI—Oldest and Largest School


NATIONAL RADIO INSTITUTE, Washington 16, D.C.
SUPPRESSORS NEEDED

Dear Editor:

With regard to the article by F. H. Frantz, "Interference—Causes, Remedies and Locations," in the July issue, several points should be clarified.

The reactance alone of a capacitor at a given frequency will not establish its attenuation characteristics. The degree of attenuation can be made to vary 12 to 15 db by adjusting the capacitor's lead length.

With regard to automotive suppression, it will almost invariably be necessary to install 10,000-ohm suppressors in series with each spark plug. Further, it should be noted that the generator can be suppressed at the armature. Bypassing the field coil may prove quite costly.

L. G. JAKUBEC, JR.
Reseda, Calif.

WHERE TO GET THEM

Dear Editor:

In at least two issues of Radio-Electronics within the past year, the question has been raised as to the availability of spare parts for Natco projectors. Parts are available from several sources: First of all, Natco, 4401 W. North Ave., Chicago 39, Ill. Also parts for some models are available from Sears, Roebuck. Some models were marketed under the Sears Tower brand.

If the drive chain needs replacing, it is available from DeVry Corp., 4141 Belmont Ave., Chicago 41, Ill. DeVry's projector uses a drive chain that is almost identical with Natco's. If gears are needed, they can be cut or ground by Boston Gear Works, Quincy 71, Mass. LaVezzi Machine Works, 4635 W. Lake St., Chicago 44, Ill., is a good bet for reproduction of parts for almost all projectors.

The only electrical trouble that is likely to occur would be the 6V6 oscillator coil (for the excitor lamp) burning out. Simply use a universal oscillator coil available from most parts houses.

HERSHEL D. PARKER
Gadsden, Ala.

IMPROVING DETECTOR

Dear Editor:

Looking over the July issue of Radio-Electronics, I came across the article "Underwater Metal Detector" by Mr. Richardson. This looks like a good thing for the small-boat people. It seems to me that R2 could be eliminated and, at the same time, increase the sensitivity. Since R2 is in parallel with the battery, it is also an extra drain. Remove R2.

(Continued on page 26)
"Without speculation there is no good and original observation"

—Charles Darwin, naturalist

Man's search for scientific knowledge and understanding has its taproots in the above thought expressed by Darwin in a letter to his distinguished contemporary, Alfred Russel Wallace, in 1857.

Speculation—intuitive contemplation guided by past discoveries—led Darwin to his famous observations set forth in *Origin of Species*. Similarly, it led Alexander Graham Bell to the invention of the telephone—and has since led to many major advances in electrical communications.

At Bell Telephone Laboratories, the puzzling flow of current in semiconductors provoked speculation which yielded the transistor—and a Nobel Prize. Speculation about the behavior of the electron led to experimental proof of its wave nature—and another Nobel Prize. “Brains” capable of guiding missiles and space probes first took form in the bold speculations of Bell Laboratories scientists.

Today, Bell Laboratories scientists and engineers are more keenly aware than ever of the importance of speculative thinking. The far-reaching scientific and technological developments of tomorrow are already the subject of advanced research. Among them are radically new materials and devices—basically new switching systems, transmission via satellites, and waveguide networks able to carry hundreds of thousands of voices simultaneously.

Through informed speculation about Nature's laws, Bell Laboratories will continue to search for the “good and original observations” which are so vital to the ever-improving Bell Telephone System.
The greatest beauty of Thorens famous quality... you can afford it!

No need to hesitate, you can afford Thorens famous quality. You can have music as it's meant to be heard. You can relax with Thorens unique one year guarantee. There's a Thorens model that fits handily into any budget. Whether you know a lot or a little about high-fidelity equipment, you'll particularly enjoy the courteous and knowledgeable way a Thorens franchised dealer earns your confidence. Each Thorens dealer is carefully selected for knowledge, ability and integrity. They'll make buying your Thorens almost as much fun as owning it. Shop around this page for a few of the outstanding features and then stop in and see all of them for yourself.

Guaranteed for one full year. Sold only through carefully selected franchised dealers.

MATCHLESS!
TD-124. All four speeds. Plays any record. Easy-to-use lighted strobe sets exact speed for best musical reproduction. Completely silent. Many more exclusive features... only $99.95 net.

TD-124

MARVELOUS!
TD-184. Includes tone arm and simple dialing system that lets you select records and start turntable. All 4 speeds. Save $20 on turntable, up to $30 on tone arm. Look at TD-184... only $75.00 net.

TD-184

MORE ECONOMICAL!
TD-134. The finest 4-speed manual turntable you can buy. Includes tone arm. Elimination of semi-automatic feature saves you another $15. You can also save up to $30 on the tone arm. Look at TD-134... only $59.95 net.

TD-134

MOST ECONOMICAL!
TDK-101. You can assemble this Thorens turntable yourself. The superb quality of the components makes all your work worthwhile. Look at Thorens TDK-101... only $47.50 net.

TDK-101
“Over and above the details of design and performance, we felt that the Citation group bore eloquent witness to the one vital aspect of audio that for so many of us has elevated high fidelity from a casual hobby to a lifelong interest: the earnest attempt to reach an ideal—not for the sake of technical showmanship—but for the sake of music and our demanding love of it.”

A truly remarkable commentary about a truly remarkable group of products—the Citation Kits by Harman-Kardon. Mr. Reid’s eloquent tribute to Citation is one of many extraordinary reviews of these magnificent instruments. We are proud to present a brief collection of excerpts from Citation reviews written by outstanding audio critics.

“When we first heard the Citations our immediate reaction was that one listened through the amplifier system clear back to the original performance, and that the finer nuances of tone shading stood out clearly and distinctly for the first time... bass is clear and firm, and for the first time we noted that the low frequency end appeared to be present even at low volumes without the need for the usual bass boost... The kit is a joy to construct.” C. G. McProud, Editor, Audio Magazine

“The unit which we checked after having built the kit, is the best of all power amplifiers that we have tested over the past years... none have had distortion that was quite as low as we found in this new Citation II... the amplifier should provide the very finest in hi-fi stereo reproduction...”

William Stocklin, Editor, Electronics World

PRESENTING THE 1961 CITATION LINE FEATURING

The CITATION I
Stereophonic Preamplifier Control Center
Here is the first brilliant expression of the advanced design concepts which sparked the new Citation Kit line—the incomparable Citation I, Stereophonic Preamplifier Control Center. The Citation I consists essentially of a group of circuit blocks formed “active” and “passive” networks. The “active” networks are treated as one or two stage amplification units, flat over an extremely wide frequency range and each is surrounded with a feedback loop. This results in levels of distortion so low as to prove unmeasurable. The “passive” networks provide precise equalization with no phase shift. The use of professional step type tone controls overcome the limitations of continuously variable potentiometers. Each position on a step control is engineered to perform a specific function—which is absolutely repeatable when necessary. The many professional features and philosophy of design expressed in Citation I permit the development of a preamplifier that provides absolute control over any program material without impairing any coloration of its own. Citation I—$159.95. Factory Wired—$249.95. Walnut Enclosure, Model WCI, $29.95.

The CITATION II
120 Watt Stereophonic Power Amplifier
This remarkable instrument has a peak power output of 260 watts and will reproduce frequencies as low as 5 cycles virtually without phase shift, and frequencies as high as 100,000 cycles without any evidence of instability or ringing. At normal listening levels the only measurable distortion comes from the laboratory test equipment. Video output pentodes are used in all low level stages for exceptional wide frequency response and low distortion. Multiple feedback loops for increased degree of usable feedback (30 db overall) result in lower distortion without sacrificing stability. The power supply consists of four silicon diode rectifiers, choke, heavy duty electrolytics and potted power transformer for precise regulation and long life. The use of rigid component boards, heavy duty components, special Cable Harness assure the kit builder that the unit he constructs will be the exact duplicate of the factory built instrument. Because of its absolute reliability and exceptional specifications the Citation II has gained widespread acceptance among professionals as a laboratory standard. The Citation II—$159.95. Factory Wired—$229.95. Metal Enclosure, Model ACII—$7.95.

The CITATION III
Professional FM Tuner
Citation III is the world's most sensitive tuner. But more important—it offers sound quality never before achieved in an FM tuner. Now, for the first time Harman-Kardon has made it possible for the kit builder to construct a completely professional tuner without reliance upon external equipment. To meet the special requirements of Citation III, a new FM cartridge was developed which embodies most of the critical tuner elements in one compact unit. The cartridge is completely assembled at the factory, totally shielded and perfectly aligned—eliminating the difficult problems of RF alignment, oscillator adjustment and lead definition.

The Citation III's front end employs the revolutionary NuVistor tube which furnishes the lowest noise figure and highest sensitivity permitted by the state of the art. A two-stage audio circuit patterned after the Citation II is employed. By utilizing a high degree of feedback and providing a frequency response three octaves above and below the range of normal hearing, the Citation sound quality is maintained and phase shift is eliminated. The Citation III is styled in charcoal brown and gold to match all the other Citation instruments. Citation III—$149.95. Factory Wired—$229.95. Walnut Enclosure, Model WCI—$29.95.
"Its listening quality is superb, and not easily described in terms of laboratory measurements. Listening is the ultimate test and a required one for full appreciation of Citation...there is a solidity, combined with a total ease and lack of irritation which sets this amplifier apart...The more one listens to the Citation II, the more pleasing its sound becomes...Anyone who will settle for nothing less than the finest will be well advised to look into the Citation II."

Hirsch-Houck Labs, High Fidelity Magazine

"At this writing, the most impressive of amplifier kits is without doubt the new Citation line of Harman-Kardon...their design, circuitry, acoustic results and even the manner of their packaging set a new high in amplifier construction and performance, kit or no."

Norman Eisenberg, Saturday Review

"Specifications published by the manufacturer are so astonishing that our sister publication, Electronics World, has subjected them to critical examination and found performance wholly consistent with claims...Nothing can faze it...we have heard this particular amplifier loaded with four big speaker systems glide over the steepest orchestral hurdles without the slightest trace of strain...The realism of the virtually distortion-free music was nothing less than startling. Our initial amazement soon gave way to an easy, relaxed enjoyment that was sustained for hours without a trace of that tension known as "listening fatigue." Here was a sound system that fulfilled the most difficult of all high fidelity requirements: to provide an awareness only of music, and oblivion of technicalities."

Herbert Reid—Hi Fi Stereo Review
PRESENTING THE FINEST CERAMIC STEREO CARTRIDGE EVER PERFECTION BY SONOTONE

STereo Quality Soars to New Heights...

Now, the ceramic cartridge proved in independent A-B listening tests to perform as well as the highest-priced "professional" types. It's Sonotone's revolutionary new 9T. So superior, you can expect faithful reproduction from the most robust musical passages to the most subtle overtones. Sonotone's new 9T series stereo cartridge:

GUARANTEES performance equal to cartridges costing up to 3 times as much— as proven in A-B listening tests.

GUARANTEES highest compliance—allows major reduction of tracking force.

GUARANTEES more than adequate channel separation.

GUARANTEES crisp definition.

GUARANTEES superior, more compact mechanical design—including revolutionary new needle design with instant "snap-in, snap-out" replacement needle feature and built-in jewel tip protector. ELIMINATES distortion—increasingly flat response of = 1 db from 20 to 17,000 cps—cuts listening fatigue. ELIMINATES dust pile-up—at recent trade show the 9T ran 4 straight hours, collected no dust. ELIMINATES most record groove noise or hiss—no "needle talk".

Imagine, the 9T boasts all these "professional" features... yet sells for less than half the price of the least expensive "professional" cartridge. Simplify your inventory...cut call-backs—increase sales and profits—with Sonotone's great new 9T cartridge...unsurpassed for performance—and for value.

LIST PRICE: 9T-S $16.50 (0.7-mil and 3 mil sapphires) 9T-S77 $16.50 (Two 0.7-mil saphires) 9T-SD $19.50 (Sapphire Diamond)

Sonotone

ELECTRONIC APPLICATIONS DIVISION, ELMSFORD, N. Y., DEPT. C2, TOBACCO
IN CANADA, CONTACT ATLAS RADIO CORP., LTD., TORONTO

LEADING MAKERS OF

BATTERIES • CARTRIDGES • SPEAKERS • TAPE HEADS • MIKES • ELECTRONIC TUBES

METER LIMITATIONS

Dear Editor:

In the August issue, Robert G. Casey described a method of making an audio wattmeter from a vtvm. His method appears simple, but there are two limitations to be kept in mind when using the meter.

First, the method is good when working with sine waves only. This is a rarely encountered waveform in audio work (except when using a sin-wave generator for testing). Most vtvm's respond to either peak-to-peak voltage or to the average value of the waveform. The indicated rms voltage is correct only when the waveform is sinusoidal. For all other waveforms, the meter reading will probably be too high or too low. When the erroneous reading is squared to get the power, the error becomes relatively much greater.

Second, the suggested circuit makes use of the meter's 0- to 3 volt range. Here, most of the simple peak-responding meters become relatively inaccurate. For example, two Heath V-7A meters were calibrated to read correctly on sine waves above 0volts. Both read about 14% low on a 1.4 volt rms sine wave and 14% high on a 2-volt (peak-to-peak) square wave.

Considering the above points, Mr. Casey's system will be quite satisfactory if it is restricted to sine-wave measurements and if a vtvm that is accurate on the low ranges is used. (The latter restriction will eliminate most of the simple peak-responding meters.)

KENNETH F. STONE

Iselin, N. J.

ELECTROSTATICS

Dear Editor:

In Norman Crowhurst's article "More Bass From Smaller Loudspeakers" (August, 1966), he makes certain statements concerning wide-range electrostatics which I believe are not completely fair.

"This new field is only beginning." The truth of the matter is that Quad full-range units have been publicly demonstrated for more than 5 years and have been available for more than 3. It is true, of course, that competitive units will be introduced only this fall, but that does not subtract from the fact that the Quad has been available for some time.

"One way to use it is to just stand it by the wall, in which case the whole unit acts as its own air coupler." Actually, the Quad works heat away from walls and other room divisions which tend to upset frequency relationships, no matter what kind of speaker is used. The walls are no part of the
OCTOBER, 1960

RADIO-TV and ELECTRONICS TRAINING

... AT A PRICE YOU CAN AFFORD!

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

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

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

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

We Want Many More Shops This Year

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

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

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

CUT OUT AND MAIL — TODAY!

RADIO-TELEVISION TRAINING SCHOOL
415 EAST ROSECRANS AVENUE Dept. RE100
LOS ANGELES 59, CALIFORNIA

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

[ ] Radio-Television [ ] Industrial Electronics

[ ] Automation

Name
Address
City & State

Mail This Coupon Now—No Salesman Will Call
Correspondence (Continued)

Quad transmission system. Indeed, the response, out of doors and
hung in the air, is flat to at least 40 cycles—the only
known speaker that does not require room reinforcement
for flat bass.

"dramatically different impedance—high and capacitive."

The Quad impedance curve is essentially resistive—actually
lying between 15 and 30 ohms between 40 and 8,000
cycles (falling above that frequency).

"something will have to be done about its directional
effects."

If you will read Mr. Briggs’ chapters on electrostatic loud-
 speakers (in Loudspeakers, the most recent edition), he
points out that directionality is the same problem with elec-
 trostatics as with dynamics, no move, no less. The follow-
ing generalizations must apply (no matter what kind the speaker)
and may mean that the electrostatic is the answer.

An electrostatic can be designed with any dispersion angle
required. Design parameters are infinitely variable. Any
design is completely predictable, whereas the design of
dynamic spakers must be a bit more empirical since masses
and interactions are much less precise.

More important than the actual dispersion angle (theor-
orists vary on the requirements) is what speaker engineers
call "acoustic ratio"—the congruence of dispersion angles
at all frequencies from deep bass to high treble. It can be
shown, analytically, that only a full-range electrostatic can
be designed for a "proper" loudspeaker-room relationship.

Interested parties can read about these matters in Mr.
Peter Walker’s articles on electrostatics in Wireless World,
1955.

Irving M. Fried, president
Electronics of City Line Center, Inc.

Mr. Crowhurst Comments

Mr. Crowhurst was asked to comment on the above. His
remarks follow:

When I wrote the article, I anticipated that some manufac-
turer might write in and complain that I had not been
fair. After all, one cannot find good reason to pronounce
every competitive product better than the rest! But Mr.
Fried’s letter, about the wide-range electrostatic came as
a surprise.

He complains of my remark that this is a new field, just
beginning, yet acknowledges that there has been only the
QUAD so far. The rest of my remarks, about change in
proportions, as compared with dynamic, about different im-
pedance (where he quotes only part of my sentence—the
rest of it refers to adaptation to integration techniques, for
which the electrostatic is basically well suited) and about
tailoring the directional response, only serve to confirm this
first remark to which he takes exception.

On placement, I did not recommend placing it against a
wall. I am well aware that an open-backed unit such as the
electrostatic is least likely to suffer interference effects if
it is away from walls. But if Mr. Fried insists on his cus-
tomers hanging QUADS in the air or leaving them in the
middle of the room, I don’t think he’ll sell many. Far more
people need to place the speaker against a wall. My com-
ment was that it can be used that way.

Unfortunately some makers of dynamic units act as if
wide-range electrostatics are a joke—they’ll never work!
It seems as if Mr. Fried adopts the reverse attitude and
ignores any comparison with dynamics. Trying to convey
the impression that his speaker—of whichever type—is the
only one that works, does not help anyone. Articles like
mine try to put things in perspective to enable the pur-
chaser to judge realistically.

There is no disagreement between Mr. Briggs and myself
on this subject. In particular, Mr. Briggs conducts thorough
investigations and makes realistic observations, letting
"the chips fall where they may." Doubtless Mr. Briggs,
too, gets accused occasionally of being “unfair.”—Norman
H. Crowhurst

End

Stancor. n.
Synonym for quality and dependability in coils and transformers

It makes good sense for you to choose replacement parts from the manufacturer who is the
world’s largest supplier of electronic transformers to the original equipment market. The complete
Stancor line includes the unit you need, at the fine performance level you expect. For quality
and dependability in transformers and coils, always specify Stancor.

The Stancor TV Guide
gives you always up-to-date replacement information—through regular mailings of loose-leaf
pages direct to you from Stancor. Register with your distributor to get the Stancor TV Guide.

Stancor

Chicago Standard Transformer Corporation
3501 West Addison Street • Chicago 18, Illinois

www.americanradiohistory.com
this is Photofact Set No. 500

truly a milestone in the history of the Electronic Servicing Industry

over 20,000,000 Photofact Sets are now in use the world over

over 50,000 listings of TV, Radio and allied equipment are covered

over 23,000 Service Technicians subscribe to every new Photofact Set

over 75,000 Service Technicians refer to Photofact daily

Plain Facts: Photofact owes its universal acceptance and success to its unquestioned ability to help earn more money for any Service Technician. The man who owns a Photofact Service Data Library knows his customers' sets best.

He earns more... HE RATES with the public because he's Photofact-equipped.

Write today for valuable information

Be among the first in your community to display this powerful symbol

If you now own a Photofact Library or plan to own one, you can apply for membership in "PEET"—the first industry program to build truly effective public acceptance for the Service Technician who qualifies. Membership helps you win public respect and confidence, builds more business for you. Benefits cost you absolutely nothing if you qualify. Ask your Sams Distributor for the "PEET" details, or mail coupon today.

Howard W. Sams & Co., Inc.

October, 1960
SELECT THE BLONDER-TONGUE TV/FM SYSTEM DESIGNED TO BRING IN THE BEST RECEPTION IN YOUR AREA

NEW BLONDER-TONGUE ALL-CHANNEL TV/FM AMPLIFIER MODEL HAB

Provides high gain (23 db ± 1 db) on all VHF channels including the FM band. Ideal amplifier for home systems or pre-amplifier for large or small master systems. 69.50 list.

NEW BLONDER-TONGUE SINGLE-CHANNEL ANTENNA MOUNTED TV AMPLIFIER MODEL CB

Enclosed in a weather-proof housing, this versatile performer can be used in the home as a pre-amp or booster to increase signal strength for a single weak channel, or in conjunction with other CB amplifiers to make an economical and powerful multi-channel system. 17 db gain, CH. 2-6; 15 db, CH. 7-13. 52.50 list.

NEW BLONDER-TONGUE B-24 POW-R BOOSTER

Powerful booster or amplified coupler provides sharp, clear pictures on 1, 2 or more TV sets with only one antenna. 10 db gain as 1-set booster, 5 db gain per set as amplified 2-set coupler. No-loss 4-set distribution system with B-T A-104 4-set coupler. 24.95 list.

Available at parts distributors. For further information write Dept. RE-10

BLONDER-TONGUE LABORATORIES, INC.
9 Alling St., Newark 2, N. J.
Expert: Morhan Export Corp., N. Y. 13, N. Y.
hi-fi components • UHF converters • master TV systems • industrial TV cameras • FM-AM radios

www.americanradiohistory.com
IN STOCK — Compare, then take home any EICO equipment — right "off the shelf" — from 1500 neighborhood EICO dealers throughout the U. S. & Canada, most of whom offer budget terms.


EICO Stereo Preamplifier: Complete master stereo preamplifier-control unit, self-powered. Distortion borders on unmeasurable. Level, bass, & treble controls independent for each channel or ganged for both channels. Inputs for phonos, tape head, mike, FM, & FM-multiplex. One each auxiliary A & B input in each channel. "Extremely flexible...a bargain." — HI-FI REVIEW. Kit $39.95. Wired $64.95. Incl. cover.

New EICO 100-Watt Stereo Power Amplifier: Dual 50W highest quality power amplifiers. 200W peak power output. Uses supertwinline ultra-linear connected output transformers for unstressed reproduction across the entire audio range at full power, assuring utmost clarity on full orchestra A average 60 db channel separation. 1% distortion 0.5% at 100W, harmonic distortion less than 1% from 20-20,000 cps within 1 db of 100W. Kit $99.50. Wired $139.50.

EICO 70-Watt Stereo Power Amplifier: Dual 35W highest quality power amplifiers identical circuit-wise to the superb HF9S, differing only in rating of the output transformers. 1% distortion 1% at 70W, harmonic distortion less than 1% from 20-20,000 cps within 1 db of 70W. Kit $74.95. Wired $114.95.

FM Tuner HFT90: Prewired, prealigned, temperature-compensated "front end" is drift-free. Prewired exclusive precision eye-triangl traveling tuning indicator, Sensitivity: 1.0V for 20 db quieting, 3.5 mV for 30 db quieting, full limiting from 25 uV. If bandwidth 250 kc at 6 db points. Both cathode follower & FM-multiplex stereo outputs, prevent obsolescence, very low distortion, "One of the best buys in high fidelity kits."—AUDIO 25: Kit $39.95. Wired $65.95. Cover $3.95. "Less cover, F.E.T. incl." AM Tuner HFT95: Matches HFT100 selects "Hi-Fi" wide (20-5000 cps) or 3 db) or weak-station narrow (20-5000 cps @ 3 db bandwidth). Tuned RF stage for maximum selectivity, Precision eye-triangl tuning. "One of the best available." —HI-FI SYSTEMS. Kit $39.95. Wired $65.95. Incl. cover & F.E.T. FM/AM Tuner HFT92 combines renowned EICO HFT90 FM Tuner with excellent AM tuning facilities. Kit $59.95. Wired $94.95. Incl. cover & F.E.T.

EAF Economy Stereo Integrated Amplifier provides clean 4W per channel or 8W total output. Kit $28.95. Wired $65.95. Incl. cover & F.E.T.

HFT12 Mono Integrated Amplifier (not illus.): Complete "front end" facilities & true hi-fi performance. 15W continuous, 25W peak. Kit $34.95. Wired $57.95. Incl. cover.

HFS3 3-Way Speaker System Semi-Kit complete with factory-built 3½" veneered plywood (4 sides) cabinet. Bellows-suspension, full-inch excursion 12" woofers (210 sq. cm.) 8-midrange speaker with high internal damping cone for smooth response +5% response. 32°/2° cone tweeter, 1½ cu. ft. ducted-port enclosure. System Q of ½ for smoothest frequency & best transient response. 32-0000 cps clean, 16 ohm impedance. HFD: 26W x 13½" x 14½". Unfinished birch. Kit $72.50. Wired $86.50. Walnut or mahogany. Kit $87.50. Wired $99.50.

HFS2 2-Way Speaker System Semi-Kit complete with factory-built 3½" veneered plywood (4 sides) cabinet. Bellows-suspension, ¾" excursion, 8" woofer, 255 sq. cm. 1½ cu. ft. ducted-port enclosure. System Q of ½ for smoothest freq. & best transient resp. 45-14,000 cps clean, useful resp. 16 ohms.

HFD: 24" x 13½" x 10½". Unfinished birch. Kit $47.50. Wired $56.50. Walnut or mahogany. Kit $53.50. Wired $89.50.

HF51 Bookshelf Speaker System complete with factory-built cabinet. Jensen 8" woofers, matching Jensen compression-driver exponential horn tweeter. Smooth clean bass, crisp extended highs. 70-12,000 cps range, 8 ohms. HFD: 23" x 11" x 9". Kit $39.95. Wired $74.95.

HF52 Omni-Directional Speaker System (not illus.) HFD: 36" x 10½" x 15½". "Fine for stereo" — MODERN Hi-Fi. Completely factory-built. Mahogany or walnut $179.95. Blown $144.95.

New Stereo/Mono Automatic Changer/Player: Jam-proof 4-speed, all record sizes, automatic changer and auto/manual player. New extremely smooth, low distortion moisture-proof crystal cartridge designed integrally with tonearm to eliminate mid-range resonances. Constant 4½ grams stylus force is optimum to prevent groove flutter distortion. No hum, fluttering accents, acoustic feedback, center-hole enlargement. Only 10½" x 13½". 0.7 ml, 3 mili sapphire. $49.75. Incl. F.E.T. and "Magnadaptor."

EICO KITS are sold through all EICO Catalogs, Radio Showrooms, mail orders, & dealers. For full details, write to us. EICO, 33-00 N. Blvd., L. I. C. 1, N. Y.

EICO Stereo and Mono Hi-Fi...the experts say your Best Buy is EICO.
DESIGNED AS YOU WOULD DESIGN IF YOU WERE AN ELECTRONICS ENGINEER...

Praised by the experts as Best Buys...

A. By far the best professional VTVM value on electronics, nobody but EICO brings you such outstanding instrument performance for so low a price! Calibration without removing from cabinet. Measure directly p-p voltage of complex sine waves: 0.1, 0.4, 1.4, 4.0, 14.0, 42.00 DC/V/RMS sine volts: 0.1, 5, 15, 50, 150, 1500 (up to 20,000 volts with HP probe, & 250 mc with PPF probe). Ohms: 0.2 ohms to 1000 meg. 4½" meter, can't-tum-out circuit. 7 non-skid ranges on every function. Zero-center. Features EICO's exclusive UNI-PROBE: your terrific time-saver, performs all functions: a half turn of probe-tip selects DC or AC Ohms.

B. An engineering achievement unmatched in the industry! EICO-designed for laboratory precision and EICO-priced for lowest cost. Features DC amplifiers. Flat from DC to 4.5 mc usable to 10,000Rnd. Sine: 25 mv. in. input 2 dc; direct-coupled & push-pull throughout 600 frequency-compensated attenuator up to 1000. Sweep: perfectly linear 10 cps -100 kc (ext. cap for range to 1 cps). Preset TV & V. Auto sync limiter & amplifier Direct or C coupling; balanced, or unbalanced input. Edge-lit engraved Lucite scale with damper control.

C. More features and versatility, more range and accuracy than in generators costing three to four times as much 150 kc to 635 mc with ONE generator in 6 fundamental bands and entire harmonic band <1.5% frequency accuracy. Colpitts RF oscillator directly plate-modulated by x-follower for improved modulation. Variable depth of internal modulation 0-50% by 400 pas Colpitts oscillator. Variable gain external modulation amplifier: only 3 volts needed for 30% mod. Turret-mounted, slug-tuned coils for max. accuracy. Five & Coarse (3-step) RF attenuators. RF output 100,000 uv, AF output to 10 v.


E. Speedy, simple operation, unexcelled sensitivity and accuracy, superb electrical and mechanical design. Tests all receiving tubes (picture tubes with adapter), n-p-n and p-n-p transistors. Composite indication of gain, 60 & peak emission. Simultaneous selection of any one of 4 combinations of those plate voltages, 3 screen voltages, 3 ranges of continuously variable grid voltage (with 5% accuracy pot.). Sensitive 200 uA meter. 10 position lever switches: frequency and power reading of each tube pin. 10 fixed settings in leakage test circuit. Direct reading of inter-element leakage test circuit. New gear-driven rohlh chart. CRA Adapter $4.50.

EIC0 33-30 Northern Blvd.. L.I.C. 1, N.Y.

Show mc HOW TO SAVE 50% on Test Instruments

Hi-Fi  Ham Gear  Send free Stereo Hi-Fi Guide

Send me FREE Catalog. Name a neighborhood dealer. Send me free Short Course for Novice License.

C-10

Name

Address

City  Zone  State
INSTRUCTIVE ELECTRONIC DEVICES

... There Is a Big Market for Educational Devices Today ...

In an age when our survival as a nation depends upon the electronic progress of our next generation, the thoughtful observer is being continually shocked to note how little is being done today to strike a responsive spark in our youngsters and to awaken them to present-day electronic—scientific wonders.

More modernly, electronic engineers don't fall from the sky ready made. In some way they all are indoctrinated at a very early age, usually before they are 6. Some magnetic or electric toy usually catches the child's fancy, lighting the flame of scientific knowledge. Thereafter the youngster slowly progresses to more interesting devices, learning and absorbing the mysteries of the various branches of physics, few of which he ever forgets as he grows up.

The despair of the average father nowadays is how little is offered on the market to start off a youngster on the road to electronic adventures. Outside of a few interesting magnetic toys in our stores, there is a vast vacuum when it comes to simple, low-priced, electric instructive devices. At the turn of the century, the present writer was responsible for bringing to a previously nonexistent market dozens of simple, low-priced items, all of which found ready acceptance. Many were imported from Europe; others were made by his pioneering firm, the Electro Importing Co. (E. I. Co.); still others were manufactured at his behest by enterprising, far-seeing manufacturers.

Let us name only a few: telephone receivers (50¢); sturdy electric motors (from 60¢ up); household medical coils (weak electric induction shocking machine) (90¢); electric whistle ($1); electric luminous scarf pins (to operate from pocket battery) (45¢); 6-volt dynamo ($3.80); spark coils, giving a 1/4-inch spark ($2.20); dozens of types of fascinating colorful Geissler tubes to work from spark coils (from 38¢ up); static-electric machine (3-inch spark) ($3.50); 4-inch X-Ray tubes* ($4.30) that worked well with a fluoroscope ($3.75); Fun With Electricity set (static) (50¢) microvolt meter (compass with coil winding) mounted with binding posts (50¢); rheostats (60¢)—just a few items from a long list.

Where can you buy such devices today? Particularly educational devices that a young boy can operate himself before he can read—the critical age.

More important, some of the few items that can be bought in stores today are all too often shoddy and a goodly percentage do not work.

Item: For two of our grandchildren, below age 6, we bought a set of hand telephones (intercommunicating). Made of red plastic, the set looked attractive. It had, however, no binding posts or any device for clamping the connecting wires. Each handset instead had two metal strips with a tiny hole into which you stuck the wires—impossible to obtain a good contact. Upon testing the phones, they were found to be inoperative—dead. Since it was electromagnetic, no batteries were required to work the set, but there was an open circuit, so we returned the outfit. What about the complete frustration to the children? The less said the better. A week later, a new set arrived—also dead! Then the factory in New Jersey closed for vacation. Finally, a month later, an operable outfit arrived, but the functioning was so poor that the voices came through in whispers. Yet the shoddy set's cost was close to $8!

It has been our experience over the past 15 years that a large percentage of present-day instructive electronic devices sold in toy stores are so skimpy, so poorly engineered that it is a wonder they work at all. Mass-produced, they are often not properly tested or, if they are, they fail apart during shipping.

This usually is not the case with most of the similar European devices, which are much better made and far sturdier, a necessity for inquisitive and impatient little fingers.

In a number of cases, after ransacking toy stores to no purpose, we had to design and make a number of devices ourselves for the youngsters. One—a combination electric set mounted on a block of wood 8 1/2 x 5 1/2 inches—included: a sturdy standard buzzer, a small neon bulb, several colored flashlight bulbs, a few pushbuttons, two metal handles and several binding posts. The buzzer had its vibrator "blocked" in such a way that it became a high-frequency type. Its self-inductance built up sufficient voltage to light a neon bulb that normally required at least 40 volts, although we used only a 3-volt battery. The buzzer also had sufficient electric "kick" to operate as a miniature shocking coil when the metalic handle were connected to it. Everything worked by means of pushbuttons, all wiring being concealed under the base.

We constructed a number of other projects—all simple for youngsters to operate. One with a few electromagnets, springs and half-inch steel balls proved very successful. These examples are mentioned only to give some idea of the hundreds of devices that can be evolved with a bit of ingenuity and planning nor is a large capital investment necessary.

When mass-produced, with correct engineering and good workmanship, such devices can satisfy a huge market. The sales prices can be kept surprisingly low, even today. Plastics in countless shapes, electro- and permanent magnets, when produced in large quantities are still not expensive per unit, due to recent advances in mass production and automated machinery. Hence there is no reason why many instructive electronic devices should be out of reach of any youngster, even the ones in the most modest circumstances.

Parents, too, should learn that it is not always the most elaborate or costly outfit that makes the greatest hit with a given child. Often the very complexity proves frustrating because it's over his head—he's too young for it and cannot read and digest the technical instructions.

For example, such an outfit costing over $20 was given a 6-year-old boy. He turned away from it dejectedly after a few useless attempts to make some of the pieces work. He then played for hours with a device costing less than $2, which we assembled for his birthday: a small toy electric motor mounted vertically on a board. On top of the rotating shaft, you could place a number of specially colored disks, which were constantly changed into surprising color combinations if you interleaved them with other disks.

Another variety of devices, which are also mostly inexpensive and comfortably easy to make, can be created for older youngsters. They are electronic games and puzzles. Practically none of these are on the market. Yet none of them need to contain expensive parts—they use neither vacuum tubes nor transistors. Many of these devices are begging to be launched on the market by enterprising manufacturers looking for a steady, lucrative market.

We were happy to learn that for youngsters, age 8-14, one of our great electronic kit manufacturers is launching a new line this fall in the country's toy stores. The list includes broadcast wireless mikes, experimental board, transistor kits and others.

—H.G.

---

*For further information on this subject, see Electronic Puzzles and Games (Gernsback Library).

OCTOBER, 1960

Radio-Electronics

Hugo Gernsback, Editor
By NORMAN H. CROWHURST

MANY readers have asked, "How can we design a twin-coupled amplifier around the output tubes we like using?" This article answers that question by showing a high-power twin-coupled circuit you can build and how to design one to suit your own tubes, ideas or requirements.

The original twin-coupled circuit was designed to give high fidelity at low cost. It used EL34's in its output, and inexpensive output transformers wound in the simplest possible manner to get adequate performance. This, unfortunately, resulted in unequal resistance for the primary halves. While the inequality is not important in the plate-screen-coupled transformer, it does result in slightly different bias on each of the output tubes—because of the different dc drop across the cathode-connected primary.

Some readers have rectified this difference and increased output 1 or 2 watts, by inserting a 30-ohm equalizing resistance in series with the half primary that measures only 70 ohms, to make its total resistance equal to the other half (Fig. 1).

To design your own circuit, use the same configuration as the original, or the variation shown in Fig. 2. As far as possible, the same component numbering is used on both to avoid confusion. But don't look for R9 or R10 in Fig. 2, because they aren't there. Whichever circuit you use, keep the arrangement and wiring of V2, V3, V4, R15, R16, C4, C5, R17, R18, C6 and C7 physically compact. They carry high audio voltages that should be kept away from the input circuits.

To go about the design, first decide what output tubes (V3, V4) you want to use and the operating conditions. If you want to go to more than 20 watts, you should use the larger transformer—Chicago Standard A-8098. It has balanced primary halves, more handling capacity and better mixing for high-frequency response. Its primary impedance is 2,000 ohms center-tapped, intended for use with tubes having a normal plate-to-plate load requirement of 4,000 ohms.

With slight variations, almost any output tubes can be used, with the suitable output transformer. To show how to figure circuit values, we will take EL34's as an example. The Mullard tube manual lists a condition using 375 volts B-plus with cathode bias, to give 35 watts output. The plate-to-plate load is given as 3,500 ohms for this condition. With a 4,000-ohm plate-to-plate load (using two A-8098 output transformers), these tubes should give better than 30 watts, assuming we get the same voltage swing with the higher load value.

To deduce the available output volt-
Swing does not have sufficient margin.

The driver stage

Now we look for a driver stage. First let's try a 12AU7. The only way is by drawing the load line on the curves. First we put in the maximum voltage and dissipation (Fig. 3). If we use 10,000-ohm resistors in the plates (R15 and R16) and about 12 volts bias, the operating point is about 290 volts, 8.5 ma (from the 375-volt supply). For a 56-volt swing, measured grid to cathode of the output stage, the grid swings 206 volts. So this 10,000-ohm resistor has only 56 volts (audio) across it, although the plate is delivering 306 volts audio. This means the effective value of the 10,000-ohm resistor for plate coupling, in the dynamic sense, is multiplied by 56 or about 5.5, which makes it look like 55,000 ohms.

The grid resistors (R17, R18), which should not be higher than 470,000 ohms to satisfy operating requirements of the output tubes, do not get multiplied in this way because they have to be returned to ground. So the effective ac plate load is 55,000 ohms in parallel with 470,000 ohms, or about 49,000 ohms.

Laying a 49,000-ohm load line through the operating point and estimating a 24-volt swing (twice the bias voltage), plate swing is from 100 to 440, or 340 volts. To use this dynamic operating point, one tube passes 12 ma (at 100 volts) while the other passes 5 ma (at 440 volts). The total current is 17 ma on dynamic swing, or 18 ma in quiescent condition, and we require 12 volts bias. So the cathode resistor (unbypassed) must be 680 ohms.

This is just enough, but it allows too little margin for comfort. To be sure of getting enough swing, let's try a 12BH7-A (Fig. 4). Again using a 10,000-ohm plate resistor (R15, R16), this time with 15 volts dynamic bias, we get an operating point of 300 volts, 7.5 ma, which is within the rating of the tube.

With the same 49,000-ohm dynamic plate load, the swing is now from 55 volts, 12.5 ma to 495 volts, 3.5 ma. The voltage swing is much more adequate: 495 – 55 = 440 volts. The cathode resistor (R11) needs to give 15 volts bias with a total current of 12.5 + 3.5 = 16 ma. Probably 1,000 ohms is close enough, in view of the reserve.

This will give close to the same quiescent operating point, because each tube passes 7.5 ma with 15 volts bias.

For the EL34 bias, the Mullard tube manual lists 260 ohms per tube. Each half primary of the A-8098 transformer measures 85 ohms, so an additional 205 ohms per tube is needed. For two tubes, this value is halved. A 100-ohm resistor (R19) is close enough.

Total maximum signal plate and screen current is 227 ma (2 X 55 + 2 X 19.5), which will give a 22.7-volt drop and dissipate 22.7 X 0.227 = 5.16 watts. A 10-watt resistor should be used.

The driver plate resistors (R15 and R16) drop 75 volts with 7.5 ma, a dissipation of a little more than 1/2 watt, so at least 1-watt resistors should be used here. A 1/2-watt resistor is plenty for the driver bias (R11) and other resistors in these stages.

Phase splitter and voltage amplifier

The driver stage will need 30 volts swing on each grid (twice the bias voltage). This a 12AX7 will do easily with either circuit (Fig. 5). Using the arrangement of Fig. 2, with 100,000 ohms in both cathode and plate of the phase-splitter section (R4, R5), the load line is 200,000 ohms. Supplying 300 volts B-plus to this point, the minimum tube drop is about 60 volts. With the dynamic load line, due to paralleling the following-stage grid resistors (R7, R13), the minimum tube drop is somewhat greater, so allow 75 volts. This will be the minimum bottom swing from the operating point, with 15 volts in each load, plate and cathode. So the tube operating voltage should be 105.

PRINTED CIRCUIT AVAILABLE

RADIO-ELECTRONICS is pleased to announce that the printed-circuit board used in the Twin-Coupled Amplifier can be purchased by the constructor. By special arrangement, you can get a Twin-Coupled Amplifier circuit board for $2, postpaid, from RADIO-ELECTRONICS, 154 W. 14 St., New York 11, N.Y., or Electro-Technik Co., 1456 Meyers Rd., Detroit 35, Mich. Both sides of the board you will receive are shown in Fig. 9 of this article. In future issues, printed-circuit boards for other construction projects will also be made available.
Make it 110 volts to give a slight margin. This leaves a 190-volt drop to the dc load resistor, 95 volts in the cathode and 95 in the plate.

Now the other half of the tube has to provide a direct-coupled grid voltage of 95 positive (strictly this should be less the bias of the second stage, which would make it 94.3 volts). Using a 220,000-ohm plate resistor (R3), this needs a bias of 0.6 volt with 0.9-ma plate current. So the input stage bias resistor (R2) must be about 680 ohms. This is also the bottom leg of the feedback network.

The phase splitter and voltage amplifier operate from a 300-volt source \((B + 1)\) so a series resistor is needed to reduce the available voltage \((B + 2)\) to this level. A 39,000-ohm \(\frac{1}{2}\)-watt resistor passing 1.85 ma will develop the required 75-volt drop.

The stage has a gain of about 70, so the 30-volt output swing needed for the phase-inverter input (the phase-inverter gain is very nearly unity from input to each output) is obtained with about 0.43 volt input. If we use 14 db of feedback, the input has to be about 5 times this, or 2.15 volts swing, which is 0.76 volt rms. To get this feedback, the voltage across R2 has to be about 4 \(\times\) 0.43, or 1.72 volts swing. The swing on V4’s cathode, from which this is derived, is 250 volts. So resistor R8 must be 680 \(\times\) 1.72 = 110,000.

Coupling capacitor values follow the original circuit. Also R12, R14 and R13 (with R7 made the same—270,000 ohms). If a 400- to 400-volt power transformer is used, total current is 257 ma for output tubes, 15 ma for the driver stage and almost 2 ma for the input stages: a total of 244 ma. A 5U4 with capacitor input filter will take care of power requirements. Using a 10-ohm input capacitor, the output voltage is about 470. So the smoothing resistor must drop about 95 volts at 244 ma, requiring 370 ohms at 23 watts. A 350-ohm 25-watt resistor will serve. C8 must be rated at 500 volts.

Those are the calculations. But after building the amplifier, check the operating voltages, both quiescent and with power. The plate voltage of the 12BH7 should be 300 (assuming the B-supply ends of R15 and R16 get 375 volts).

The cathode and plate of the second half of the 12AX7 should be 95 and 205 volts, respectively (again assuming the supply point is 300 volts). If not, the bias resistors (R11, R12) need changing to get the voltages right. Don’t forget, if you change R2, R8 needs changing in the same ratio to maintain correct feedback.

Network C1–R6, from V-1a’s cathode to ground, levels off the response to around 30 kc when working into an open circuit or a resistive load. If the speaker system includes an electrostatic tweeter, this R-C network produces a 6- to 8-db boost at around 20 kc. This boost can be minimized by eliminating C1 and R6 when using an electrostatic tweeter.

If you use the original first-stage circuit (See RADIO-ELECTRONICS, June, 1960, for full schematic, or November, 1957, for original article), adjust R9 and R10 with signal passing and feedback connected, until signal voltage on both driver grids is equal. This is more easily done experimentally than by calculation.

Transformer input

Another variation requested was a surprise to me—a circuit to use transformer input. To do this effectively, much more gain is needed from the driver stage, so two stages (drive and output) are sufficient. This is done by using a pentode driver and taking the bootstrap feedback a little further, to include the output stage grid resistors. Fig. 6 shows the circuit.

The output stage is the same as the one we have just worked through and requires a 306-volt swing per grid, of which 250 volts appears at the cathode. The driver uses two pentodes, which can be EP86’s. Using a 100,000-ohm plate resistor (R15, R16), coupled to a 470-000-ohm following grid resistor (R17, R18), and 3.3 volts bias, the gain is approximately 500 (using a dynamic
Fig. 8—Schematic of the complete 35-watt twin-coupled. B-plus voltage is adjusted by varying R21's slider.

load line of 5.5 x 80,000, or 440,000 ohms (Fig. 7). This means the grid input swing for the EF86's must be about 30 V. Inserting 2.4 volts (4 x 0.6) in the return of the input transformer's grid windings gives 14-db feedback. The input swing per grid winding must be 3 volts, or about 1.06 volts rms. One of the stock line/plate to push-pull grid transformers, with a stepup ratio of 2.5 or 3 overall, will permit driving this amplifier from a cathode follower output delivering 1 volt rms.

The feedback resistors can be 1,000 ohms (R1, R2) and 100,000 ohms (R4, R5), to provide the 100-to-1 reduction from 250 volts to 24 (approximate). The only remaining details are the bias and screen voltage arrangements and the output-stage decoupling, to permit bootstrapping the grid resistor.

The EF86's need 3.3 volts bias with a total plate current of 2 mA, plus about one-sixth of this as screen current. A 1,500-ohm resistor should be right for this. Screen voltage must be 140, to use the operating point on the curves. Estimating screen current (two tubes) as 0.4 mA (one-sixth plate current) and swapping it five times with the potentiometer feed, the top part (R6) has to drop 375 - 140 = 235 volts with 1.8 ma, requiring a resistance of 130,000 ohms. The bottom part (R7) needs to drop 140 volts with 1.5 ma, requiring 93,000 ohms. Preferred values of 120,000 and either 91,000 or 82,000 ohms should serve.

A large capacitor (C1) is needed to decouple the screen because of the high stage gain, which means the screen will be susceptible to the amplification of any hum voltage fed to it. Try a 100-µf 150-volt electrolytic.

The output-stage grid decoupling requires full cathode swing voltage to be coupled to the bottom end of the grid resistors. There is a dc voltage across the capacitors used for this (C4, C5) equal to the bias of the output stage (22.7 volts). So a 50-volt electrolytic can be used, say 100 µf.
(R8, R9) absorb a small portion of the output power (as do feedback resistors R4 and R5, which at each cathode "see" a 1,000-ohm load resistance (one-fourth the total plate to plate). Making them 100,000 ohms means that only 1% of the proportion of power coupled by the cathodes will be fed to these resistors. The total grid-circuit resistance is now about 600,000 ohms (470,000 + 100,000).

In setting this circuit up, as with the others, check all dc voltages and then see that the signal voltages are also what they should be.

A practical circuit
Following the design procedures outlined in this article, the staff of RADIO-ELECTRONICS developed the 35-watt twin-coupled amplifier shown in Fig. 8.

Top of the twin-coupled amplifier. Printed-circuit board makes all parts readily accessible.

Input filter resistor R21 has its adjustable slider connected to the positive end of C8-a. The slider is adjusted for 375 volts at the B-plus ends of R15 and R16 (blue and brown leads of T2).

Under-chassis view of the 35-watt twin-coupled amplifier.

HOW LIVE IS YOUR NICKEL-CADMIUM BATTERY?

By NATHANIEL RHITA

The voltage of a mercury or nickel-cadmium cell remains nearly constant throughout its life span; then the cell goes dead suddenly. At normal discharge rates, for example, NiCd cell voltage varies as follows:

<table>
<thead>
<tr>
<th>Discharge Voltage</th>
<th>Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>10%</td>
<td>1.28</td>
</tr>
<tr>
<td>40%</td>
<td>1.24</td>
</tr>
<tr>
<td>70%</td>
<td>1.19</td>
</tr>
<tr>
<td>95%</td>
<td>1.15</td>
</tr>
</tbody>
</table>

Thereafter, the voltage drops sharply. The small voltage variations during its useful life are not easy to measure on a 3- or even a 1.5-volt scale.

A better method is shown in the diagram. The NiCd cell under test is connected in series (opposing) with a mercury cell. The latter voltage is about 1.35. Thus the voltage difference between cells will vary between approximately zero and 0.2 volt.

Sensitive d.c. meters generally measure about 0.2 volt without multipliers.

For example, a 100-µa meter may have an internal resistance of 2,000 ohms, and thus measure 0.2 volt. My own meter is a 40-µa instrument with resistance of 5,000 ohms. When connected as shown, such a meter measures the voltage between the 1.35 volts of the mercury cell and 1.14 volts from the NiCd cell. To simulate actual conditions, add a load (R) across the measured battery. Select R to have about the same current drain as the equipment on which the cell is used.

This method can indicate whether a cell is fully charged, half-charged or exhausted so it can be put back on charge. It may prevent the embarrassment of trying to operate from a cell that has little life left.
Better Photos with a Transistor Slave Flash

The finished unit. A clamp stand is attached to the reflector so the remote unit can be mounted almost anywhere.

By FRANKLIN T. MERKLER

EACH year thousands of flash bulbs are fired to produce thousands of flat portraits to paste into the family album. The villain is the flash bulb anchored to the top, side or bottom of the camera. It is needed to provide enough light for a proper exposure, but the direction and quality of this light never varies—it is always head-on.

Twenty years ago, I went through this critical phase of picture taking and soon tired of the flat prints, the glassy-eyed look, the ash-white faces. The flash gun was taken off the camera and two or more flash bulbs were set off at the ends of extension cords. These pictures were excellent, but the dangling wires which would sometimes appear in the picture and the nuisance of carrying some 20 feet of wire soon ended this experiment. Slowly the camera fell into disuse, except for the usual birthday and Christmas shots.

What I needed was an extension flash synchronized with the flash bulb on the camera. Such units could be made with the help of vacuum- and photo-tube circuits, but the disadvantages of providing a high-voltage supply ruled them out. I needed a unit that would be small, mobile, self-contained and keyed by the flash of light originating at the camera-mounted gun. Transistors could make such a unit possible.

Circuit requirements

Before a design could be worked out, I had to find out how much voltage and current a flash bulb requires. A typical M-class bulb (No. 5, Press 25, etc.) could be fired with 3 volts or more, but the current requirement was critical—300 to 350 ma minimum. To do the job, I designed a transistor switch that applies 6 volts at 500 ma to the flash bulb. The sensing unit is an International Rectifier Co. solar battery. Its output is too low to trigger the transistor switch directly, so some dc amplification is needed.

The circuit worked, but stray light would key the unit and flash the bulb. To make the unit more reliable, I added a 10,000-ohm potentiometer to the dc amplifier's base circuit and made up a test light to fit the flash socket. When the added pot is set so the test lamp does not light, it is safe to plug in the flash lamp. Any setting that lights the test lamp will fire a flash bulb. So when room lighting is bright enough to light the test lamp, the pot is turned down until the test light goes out.

Now I had a practical circuit (see schematic), but would it fire a flash bulb in sync with the one on the camera? At this stage, a professional photographer friend, Mr. Dale Watson, was asked to test the unit. He used a Speed Graphic with a Compur Synchro shutter. My slave flash was set up 12 feet away and aimed directly at the camera. The shutter was set at 1/25 second for the first exposure, subsequent tests were made at 1/100 to 1/400 second. Each time the slave flash unit keyed and fired its bulb when the camera bulb fired.

The breadboard setup was run through its paces in other ways too. One test had the flash bulb at the camera completely shielded from the subject. The light from the camera-mounted flash could only hit the slave-flash unit which was aimed to light the subject. This test was a complete success, the picture was perfectly exposed.

Building and using the unit

The finished unit (see photos) was built around a surplus flash unit. The reflector, socket and plastic body were used, but all internal wiring and the mounting shoe were discarded. Four penlight cells were needed to power the slave unit and they wouldn't fit into the case. Instead they are wired in series to provide 6 volts and are taped to the plastic case under the reflector. The 10,000-ohm potentiometer and its ganged switch are mounted in a hole drilled in the side of the case. Parts layout is not critical. The only vital point is to make sure all components are fastened securely in place.

The slave flash makes an effective portrait light when placed off to one side and above the subject so its light falls at about a 45° angle on the subject. Use the electronic slave flash to light your way to lively color slides and flash pictures with quality and punch.
Much can be learned about the condition of the vertical stages just by observing the picture.

The vertical oscillator and output stages of a modern TV set shouldn’t be too hard to troubleshoot. You can get a good idea of what shape they are in just by looking at the picture! A test pattern is always helpful (either off the air or from a pattern generator). And you can use a scope in one place (checking vertical sync), but even here you can find out what’s going on just by watching the way the picture acts when you move the vertical hold control. You can get a pretty good idea of the condition of the whole circuit, in fact, by just checking the picture and raster (actually, you don’t even need the picture, but it’s easier!).

There are three things to check about the vertical circuit: height, linearity and “holding ability.” The first two can be checked out pretty quickly by looking at the picture. If it doesn’t fill the screen, find out why.

Height and linearity controls are used to compensate for tube aging. The first step should be to set up the picture correctly. Turn height and linearity controls down until you have a linear picture. If the picture doesn’t fill, center it with the centering magnets on the yoke until it is the same distance from both top and bottom, as in Fig. 1. Center it with the centering magnets on the yoke until it is the same distance from both top and bottom edge. Now, using both controls, see if you can pull it up (and down) until it fills the screen with about a 1/4-inch overscan at top and bottom. If the picture will not cover the screen or isn’t linear (crowded or stretched at the top), then you’ve found the first trouble.

Height lack is usually due to a weak tube or low B-plus voltage. In most cases, low B-plus will cause a narrow picture too. A weak tube in either oscillator or output stage will usually result in the picture being nonlinear at the same time. In any case, if the picture is too small, replace the tubes first; it’s the easiest! (Note:

Fig. 1—Picture set up for vertical adjustments. Height and linearity controls turned down to leave 1 to 2 inches of space at top and bottom.

Fig. 2—Compression at top of picture is example of nonlinearity.

Fig. 3—Another example of nonlinearity is stretching of picture top.
TROUBLESHOOTING the VERTICAL OSCILLATOR AND OUTPUT STAGES

By R. D. JACQUES

You won’t find a few cases where the picture will have enough height, but will be stubborn about being linear. Change the tubes first; this is often the cause!

While adjusting the height and linearity controls, check for noise and roughness. Carbon controls will develop dirty or worn spots and cause trouble. These carry some dc in most circuits and are prone to troubles like this. You may find that the picture suddenly disappears as you move either control, leaving a thin white line across the screen. If this happens, the control is bad; replace it before going any further.

Linearity check

To check the linearity of the picture, look at the scanning lines. If they're evenly spaced all the way from top to bottom, fine. If not, the linearity is bad. A quick check for linearity is to roll the picture slowly downward with the vertical hold control. Watch the blanking bar as it travels down the screen. If it stays the same width all the way, good; if it comes into view very wide, then shrinks as it comes down, bad linearity. The opposite is also true: if it comes into view narrow, then widens or if it changes in width at all as it goes down, the linearity is off and must be adjusted. Poor linearity will also show up in the picture: Fig. 2 shows compression at the top; Fig. 3, excessive stretch at the top.

Vertical oscillator

Now let’s look at a typical vertical oscillator output stage used in many TV receivers (Fig. 4). The older sets used blocking oscillators with a separate output stage, usually a pentode. However, the multivibrator has about taken over in sets made in the last few years. The first versions used two tubes (sometimes) as in one series of Bendix chassis, half of a 6SN7 and a 6W6. Later sets use a single specially designed triode. These tubes are double triodes, but the two “halves” are different. The oscillator section is a voltage-amplifying type with a fairly high mu; the output half is a power amplifier. The 6CM7, 6CY7 and 6DR7 are typical of this class.

The two tubes are connected as a simple multivibrator. There are variations of this circuit, of course, but each version can be traced out as a multivibrator. Note the feedback paths from the plate of each section to the grid of the other. These R-C networks determine the time constants of the circuit, so that it will operate near the correct frequency of 60 cycles per second when free-wheeling.

The height control (sometimes labeled VERT SIZE) is usually found in the plate supply of the oscillator section. It will be a large resistor, common values being from 3 to 8 megohms. The vertical linearity control is most often found in the cathode of the output section. It will be a smaller control, running from 250 to 2,000 ohms. In this location, it regulates the output-stage bias so that the tube operates on the most linear (straightest) portion of its curve. A variation of this is used in Westinghouse and other sets with the linearity control connected in the grid-return circuit of the first and second stages. It is part of the grid leaks of both and also part of the coupling network. A higher resistance control is used here, around 500,000 ohms (Fig. 4).

In almost all circuits, the vertical hold control will be found in the grid circuit of the oscillator section where it will be a part of the R-C network. By varying the resistance in the grid cir-

Fig. 4—Typical vertical multivibrator. Notice that sync is fed to plate of the first section of the oscillator and the control is in the common grid return.

Fig. 5—When cathode-to-B-boost capacitor (circled) is leaky or open, linearity troubles may develop.
cuit, we alter the time constants and change the operating frequency of the oscillator.

There is a sort of general rule that applies to these circuits: The height control affects the bottom half of the picture, while the linearity control works mainly on the top half. Like all generalizations, this one is false, as it won't work in all cases. But it is pretty close.

Common troubles

The most common defect is loss of height or linearity. Weak tubes cause most of the trouble (as in all other circuits), and low operating voltages are next. As you can see from the schematics, some multivibrators are supplied from B-plus, while some are fed from the boost voltage. A few feed the oscillator from B-plus and the output stage from B-boost. Check the schematic for the set you're working on to see just what comes from where.

You'll find some high-value resistors in the supply circuits. These should always be checked carefully. If the trouble seems to be thermal (showing up only after the set is thoroughly heated up) you can suspect a shift in the value of one of the resistors in the B-plus circuits. Connect an ohmmeter across the resistor (after disconnecting one end) and hold the tip of a soldering iron close to the resistor. Watch for any resistance rise. If it changes more than 5%, replace it. Incidentally, while we seldom suspect variable resistors—such as height controls—of varying in total resistance, this has happened! So, don't overlook them when you're hunting for the cause of a height loss.

If the oscillator is fed from the B-boost voltage, a drop in boost voltage (due to a weak damper tube and so on) can cause trouble. Check the boost voltage first to make sure it's up to snuff. If the boost voltage is OK but the voltage at the output tube's plate is suspiciously low, check the output transformer for a high-resistance joint in the winding. A leaky coupling capacitor between oscillator and output stage can also cause this trouble although this will usually upset the linearity badly, causing foldover at the bottom of the screen.

Linearity troubles

Linearity troubles are almost always found in the output stage. While it is theoretically possible for it to originate in the oscillator circuit, in practice it is seldom found there. If the vertical linearity control is in the cathode of the output stage, it will always be bypassed with a large low-voltage electrolytic capacitor, 100 µF or more. If this value falls off or the capacitor opens entirely, linearity will be very bad.

High power factor in this capacitor is usually the cause of the mysterious "wrinkle" that shows up about a quarter of the way down from the top of the screen. The best test for this is to disconnect the original and substitute a known good unit of equal or larger size. You can use a larger capacitor but never a smaller one than that shown in the schematic.

Electrolytic capacitors elsewhere in the power supply can be responsible for vertical troubles. Some sets use an electrolytic of about 10 to 20 µF connected from the boost voltage to the vertical output tube's cathode. Obviously trouble in this unit can give you all kinds of assorted headaches! Leakage through it upsets the output tube bias; an open will allow all sorts of wild waveforms to float around the circuit and so on. So, if all of the "standard" parts seem to be OK, look for a capacitor connected in this manner (Fig. 5).

In a few cases, the last filter capacitor in the boost circuit will cause the same kind of trouble. This will be connected from B-boost line to chassis and may be far removed, physically, from the vertical circuits. If it opens up, it may allow high-level horizontal pulses to leak into the vertical output circuits where they will cause trouble.

The last common cause of vertical nonlinearity is found in the output transformer. Short of substituting a new one, these transformers are hard to test unless a winding happens to be completely open, in which case even I could find the trouble pretty easily! However, if everything else in the circuit is OK as far as you can tell and the picture still refuses to be linear (or have sufficient height), then there is room for a logical suspicion that the output transformer has a shorted turn(s) somewhere. Substitution is about the only quick check for this.

A lot of technicians have a tendency to suspect the vertical section of the yoke when this happens. However, you'll find that very few of these troubles are actually caused by defective yokes. There is one sure sign of vertical yoke trouble: that well-known trapezoidal raster (much narrower at top than bottom, or vice versa) which you'll find in every book. If you see this, there is only one thing that can cause it, and that's a bad yoke. In case of doubt, reduce picture width and look at the edges of the raster. If they are trapezoidal, you'll see it then. There is one more possibility: If the vertical output transformer is not the original part, check up on the part number, just to be sure that whoever replaced it put in the right one. It has happened!

Instability, sync troubles

Poor vertical stability is about the most common customer complaint, it seems. (It's rolling!) This can be due to two things: weak vertical sync or trouble in the oscillator. A weak oscil-
A good check of the sync or holding action can be made from the front of the set. Simply roll the picture downward by turning the vertical hold control. This control can tell you a lot about the condition of the vertical stages. The picture should roll slowly downward when the control is turned one way, with the blanking bar rolling smoothly down until it gets to a point about 3 to 5 inches from the bottom in a large-screen set. It should then suddenly snap out of sight and the picture lock momentarily in place. When the control is turned in the other direction, the picture should remain stationary, then "break out," rolling upward very rapidly! If you can roll a picture slowly upward by turning the hold control, then there's something very definitely wrong with the sync or oscillator circuits!

The snap at the bottom of the picture is the point where the vertical sync pulse grabs the oscillator and forces it to lock in. On a scope, this looks like Fig. 6. Here, the picture has been rolled part way down so that the vertical sync pulse may be seen. It is the tiny notch just below the top of the waveform. This is about the minimum amplitude for the sync pulse. If it is smaller than the one shown, it won't be able to control the oscillator as it should. Low sync is usually caused by weak sync tubes, incorrect plate voltage on sync tubes or leaky capacitors in the vertical integrator network (Fig. 7). This is often a printed-circuit type (the parts values shown are the ones most commonly used) although there are others found in some sets that will differ from these. Zenith, for example, uses a small Rescap network which is actually only a single capacitor and resistor.

This is the one place where a scope can be used to real advantage. Connect it (through a low-capacitance probe) to the sync input of the vertical oscillator, roll the picture slowly down with the hold control and check the amplitude of the sync pulse. If you have hold trouble, the sync pulse may be so small that you can't see it at all or show up as a mere wiggle on the oscillator waveform. If there is any doubt, kill the vertical oscillator by removing the tube or grounding the grid (turn the brightness down to prevent burning the picture-tube screen) and check the amplitude of the sync pulse all by itself. In the multivibrator circuit of Fig. 4, the sync is fed into the plate of the vertical oscillator. This may appear strange to some hard-headed old-timers who insist that sync should always be applied to the grid.

Before checking for holding action, be sure that the picture is adjusted to normal height and linearity with the proper controls. If the picture is not set up right, there will be a change in the waveform which may make sync action improper. Too much stretch at the top, for instance, can flatten the top of the wave so much that the sync pulses will have a hard time locking the oscillator at the right instant.

**Foldover**

Foldover at the bottom of the picture is caused by the oscillator running too fast. The beam has reached the bottom of the screen and started back up again before the whole picture has been scanned. Therefore, the bottom part of the picture is folded up over itself, making a wide white line (customer's description) at the bottom. This is usually caused by leaky coupling capacitors, defective grid resistors or improper bias on the oscillator tube.

Another cause of foldover, this one quite different, is heater-cathode leakage in the oscillator tube. This results in a 60-cycle sinusoidal voltage being applied, in effect, to the grid instead of the sawtooth and results in a picture looking like that of Fig. 8. This is easy to cure: just replace the tube. Characteristic symptoms: very bad non-linearity and severe foldover so that the picture covers only about half the screen.
Some odd troubles crop up as in all other stages. If there are two full pictures on the screen and the hold control has very little effect, look for a shorted capacitor in one of the time-constant R-C networks. For instance a shorted capacitor may change the time constant to only half of what it should be, and you will be able to get a double picture on the set. For a reliable test, one end of the capacitor must be disconnected. You can see the numerous parallel paths in the circuit which would foul up any resistance measurements taken with parts still connected.

Some tubes will give trouble, even though they test OK. For example, the 12B4 used as vertical output amplifier in certain Zenith TV sets will cause poor linearity, even though the screen is completely filled. Replace the tube for a quick test. In a Bendix T17 (with half of a 6SN7 and 6W6), the picture would hold fairly well. The “stop” action was almost normal. But, as the picture stopped, it would bounce up and down with a peculiar, slow rubbery bounce, almost as if it were suspended on springs! The cure? Replace the 6W6 output: apparently this tube had a wee gas content.

In some sync circuits you’ll find parts values which might seem a bit strange, especially in a circuit handling 60-cycle pulses. An example of this is seen in Fig. 9. If you find vertical sync troubles in sets with similar values, try rebuilding the integrator. Reduce R3 to about 27,000 ohms and increase C1 to about .01 to .02 µf. This will increase the amplitude of the sync pulses applied to the oscillator and improve the hold action tremendously. Do not use too small a resistor for R3, or too large capacitor for C1. This will upset the time constant of the vertical oscillator, making the action jerky.

One final case history before we go. This was in a Zenith TV, using a multivibrator similar to Fig. 4. After replacing a leaky sync-coupling capacitor, the picture would roll up normally, lock in beautifully and was most exceedingly linear. There was only one small hitch: the point at which the picture locked so firmly in place was slightly off center (photo below). Try as we would, it would not lock where it was supposed to! (Remember, we just said that to some hard-headed old-timers all sync must be fed to the grid of a tube?) In desperation, we checked the circuit we should have checked first: the one we were working on. Sure enough, there was the sync-coupling capacitor, firmly soldered to the grid! (Fig. 10—Should have been on the plate!) Moral: when in doubt, always check the job you just did, before searching for more obscure troubles!

Both Sylvania and General Electric have recognized that the average TV service dealer is not likely to appear among the 10 best businessmen of the year. Mainly concerned with the electronics end of the business, he rarely pays as much attention as he might to the dollars-and-cents part.

For this reason the two electronics companies have decided to sponsor home-study courses in business management for the TV service technician. When combined with the fix-it knowledge the technician has already learned, these courses can help get more work and more dollars into the shop.


Both courses include questionnaires designed to test the technician on what he has learned. The answers are graded and returned.

The texts cover everything from taxes and business records to customer relations. They show how to handle and collect on bad debts, set up a result-getting advertising campaign (within the means of the shop), and how to make your business grow.

The General Electric course is listed at $22.50, the Sylvania at $25.
By HERMAN BURSTEIN

THREE-speaker stereo is gaining in popularity. A center speaker, driven by the combined signal of the left and right channels, is added to the left and right speakers. This is in contrast to three-channel stereo, not yet available for the home, in which the center speaker is fed by a separate channel.

Several reasons have been advanced in favor of a center speaker:
- If the left and right speakers are angled wide to the listener's left and right, the center speaker tends to fill the hole in the middle.
- Center sound is a combination of the left and right channels. Combining them and feeding them to a center speaker serves to re-create center sound.
- The listener's position has less effect upon the stereo illusion when a center speaker is used. That is, he may sit closer to or farther from the speakers, or he may sit more distant from the center line between the end speakers, without losing the stereo illusion, as contrasted with the optimum position when only two speakers are used.

Whether these arguments are good or not, the fact remains that many stereophiles are incorporating or at least experimenting with center speakers. To save the cost of a third power amplifier, they often connect the center speaker across the stereo power amplifiers as in Fig. 1.

Unfortunately, this setup feeds a difference signal instead of a sum signal to the center speaker. Sometimes the difference signal produces results just as satisfactory as those we get from a sum signal. Often, however, the difference signal is unsatisfactory. This is apt to happen when a center microphone is used in recording and its output is fed in equal amounts to the left and right channels. Then the difference signal cancels the center sound.

To circumvent this problem, a number of stereo power amplifiers are now wired as in Fig. 2. The 4-ohm taps of each output transformer are connected to ground. Electrically, the 4-ohm terminal is the center tap of the secondary winding, so the output transformer is operated as a push-pull device. By connecting the center speaker to the 16-ohm tap of one output transformer and the common tap of the other, we get a sum signal.

It is possible to rewire conventional power amplifiers to operate as in Fig. 2. However, the values of the feedback network have to be adjusted to maintain the same amount of feedback as before the rewiring. This must be done on the basis of keeping the amplifier's gain the same as it was prior to the changes. An audio oscillator and a VTVM are needed to measure gain.

For those using conventional power amplifiers for stereo, there is a much easier solution than rewiring the amplifiers, if their stereo preamplifier has a phase-reversal switch, as many do nowadays. This solution is illustrated in Fig. 3.

The phase reversal is only in one channel, let us assume the right one. When the phase switch is in its reverse position, the output of the right power amplifier is out of phase with that of the left. Therefore a sum signal is obtained when the center speaker is connected to like terminals on the two power amplifiers (for example, to the 8-ohm taps).

Because the right amplifier is out of phase, the leads to the right speaker must be reversed, as shown in Fig. 3.

If the left and right speakers are connected to the 16-ohm terminals, it is advisable to connect the center speaker to the 8-ohm taps to get reduced output from the center speaker. If all three speakers have the same efficiency, the center one will have 3 dB less output than the others, which is just about right for three-speaker operation. Operating the center speaker at a slightly lower level than the end ones maintains sound at the left and at the right, instead of tending to focus it all toward the center.

In a similar fashion, if the end speakers are operated from the 8-ohm taps, connect the center speaker across the 4-ohm taps.

If the center speaker's efficiency is not the same as that of the end speaker's, adjust the relative volume of the center speaker by operating it through an L-pad or T-pad.

The "easy solution" presented here requires only a few minutes to hook up a center speaker. Quite possibly you have an extra speaker in the house. Or you may be able to borrow a bookshelf type speaker for several hours from a friend. With this speaker, a few feet of wire and an investment of a little time, you can find out for yourself whether three-speaker stereo enhances your enjoyment.

---

Fig. 1—Connecting center speaker to conventional power amplifiers can result in difference signal.

Fig. 2—Wiring a stereo power amplifier to produce a sum signal for the center speaker.

Fig. 3—An easy way to get a sum signal from conventional power amplifiers.
The best test for any product is one which evaluates its ability to do the job for which it was intended. Therefore any good test method must simulate some typical operating condition of the product under test.

In its most common function as a power supply filter, the electrolytic capacitor receives current pulses from a rectifier. It stores these for delivery to the dc load circuits during the intervals between rectifier pulses. The rectified ac is thus smoothed to a continuous direct current—if the capacitance is large enough, or if several filter sections are used.

If there is too little capacitance, some of the rectifier pulses remain superimposed upon the dc output of the filter and produce what is known as “ripple.” (Ripple is proportional to current drawn by the dc load and inversely proportional to the capacitance of the filter capacitors.)

The test circuit shown places the capacitor under test in typical service where it receives current pulses through the 1N2090 silicon rectifier. Between pulses it partly discharges through the 30,000-ohm load resistor or through about 1,400 ohms when the 1,500-ohm resistor is switched in parallel. With no capacitance connected to the test terminals, ripple voltage is 100% so the meter is set to 100% or full scale with potentiometer R4.

Any capacitance across the test terminals will tend to filter the rectifier output, thereby reducing the ripple voltage and the meter reading.

The 30,000-ohm load resistance provides a range of .03 to 6 µf and with the 1,500-ohm load in parallel, the range is 0.3 to 60 µf. Obviously, an open capacitor will not drop the meter reading; with a shorted capacitor, the meter will read zero. The reading will also be zero if an electrolytic is connected backward. The capacitor can also be damaged. Therefore mark the test terminals prominently to indicate polarity.

Circuit considerations

The meter circuit shown is a full-wave bridge rectifier type ac voltmeter fed through a .04-µf capacitor so that it reads only the ripple voltage. A 100-µa meter was used although any meter up to 1 ma can be used by changing values of capacitance and resistance to suit. The meter rectifier is a Conant catalog No. 1101 selenium bridge, selected both for economy and relative freedom from temperature effects, plus its suitability to this kind of circuit.

Transformer T is principally used for isolation from the line to avoid “fireworks.” It is a small power transformer, rated at 117 volt primary and 125 or 150 volts secondary, and is attached with the secondary to the line. Its secondary (original primary) may deliver anything between 75 and 125 volts and should be rated 50 ma or more. If secondary voltage is greater than 75, the silicon rectifier should be a 1N2070.

Control R4 should be of the lowest resistance which in combination with fixed resistor R5 will permit setting the meter to full-scale on either range and on all line voltages likely to be present. As a suggestion, a 1,000-ohm control may be tried, with 1,000 ohms for the value of R5. If the meter won’t come up to full scale, increase the value of R5. Reduce it if the meter can’t be brought down to full scale. [Note that .01 µf was used for C and 470 ohms for R5 in making the measurements for the table shown here.—Editor]

Calibrating the meter

Calibration will be simplified if the meter scale is calibrated 0–100, representing for calibration purposes 0–100% ripple. As there is a broad capacitance tolerance in commercial electrolytic capacitors, they cannot be used to give precise calibration, but may be close enough for practical use. Exact percentage of ripple depends upon the exact values of the load resistors.

After the tester is built, if possible, borrow a pair of precision capacitance standards, say 1 and 10 µf, and find where they read on the two respective ranges. Assuming that each reads 30%
ripple on their respective ranges, then 0.5 µf and 5 µf will read 60%, 4 and 40 µf will read 74%. Doubling the capacitance halves the ripple voltage. The response of the ac meter is essentially linear except at the extreme low end of the scale, so calibrations at the very low end will be only approximate.

Quality control
While this tester measures capacitance in terms of ripple voltage, its indications do tell whether a given capacitor is good or bad. For example, let us say an 8 µf capacitor reads 4 µf. Obviously it does not reduce the ripple voltage as well as 8 µf should, so it should be replaced.

Subject to small errors introduced by associated circuitry, this tester is practical for in-circuit testing. But don't try testing capacitors rated at less than 150 volts. And don't put it into transistor gear unless you want to ruin low-voltage components.

The above readings were made by Mr. Queen of the Radio-Electronics staff. C was .01 µf and R5 470 ohms in his setup.

Specifications: Checks all capacitors from approximately .05 to 60 µf. Can be used for in-circuit testing in many circuits.
Performance data: Tested by a RADIO-ELECTRONICS staff member, this capacitance checker was found to work reliably, and to be a simple, accurate and useful instrument.
Part II—The Grado Master, Neumann DST
Dynaco TA-12, G-E VR-22, London-Scott 1000

By JULIAN D. HIRSCH

In pre-stereo days, many of the finest phonograph cartridges used a moving coil as their generating element. Although moving-coil cartridges in general have lower output voltages and tend to be more fragile than other types, their lower impedance makes them relatively immune to induced hum (from nearby phono motors or power transformers) as well as to the shunting effects of cable capacitance at high frequencies.

At present, there are few moving-coil stereo cartridges. Two of these, both of very high quality, are the Grado and the Neumann.

Grado

The original Grado stereo cartridge (now called the Master) was described in Radio-Electronics (November, 1958, page 88). Current production models of the Grado Master, though similar in construction to the unit described in the earlier article, have been further refined. The two coils, each of 1,000 turns of extremely fine wire, are wound on a hollow plastic tube approximately 1/16 inch square, which is molded in one piece with the stylus arm (Fig. 1). The coil assembly is mounted in a special rubber grommet which provides uniform compliance in all planes.

The coils are located in a uniform field supplied by a powerful permanent magnet. When the coil structure rotates, a voltage is generated in each coil (proportional to the recorded velocity in the corresponding channel).

The new Master cartridge has an output of 6 mv at 10 cm/sec. The effective stylus mass has been cut in half, from 0.8 to 0.4 milligram, which, in turn, extends the high-frequency response of the cartridge. The manufacturer's specifications for frequency response are 10-50,000 cycles (with no tolerance specified).

In other respects, the present Grado Master cartridge is identical to the earlier models. The two outputs are balanced to within 0.5 db over the audio range. Recommended tracking force is 3 grams and the load resistance is non-critical so long as it is greater than 5,000 ohms. Channel separation is greater than 25 db. A tiny radioactive element embedded in the case of the cartridge behind the stylus ionizes the air in the vicinity of the record surface. Static charges are reduced and so is the amount of dust that accumulates on the record.

The Grado Custom stereo cartridge is a less expensive version of the Master for use in record changers. Its coils are wound with more turns of slightly heavier wire. The output, therefore, is greater than that of the Master series—approximately 7 mv at 10 cm/sec.

The Grado Custom stereo cartridge is a less expensive version of the Master for use in record changers. Its coils are wound with more turns of slightly heavier wire. The output, therefore, is greater than that of the Master series—approximately 7 mv at 10 cm/sec.

The Grado Master cartridge is designed for professional use, but can be used in domestic equipment. It has an excellent output and is immune to induced hum and shunting effects. The stylus arm is made of thin rubber membrane and provides a slight amount of stylus damping. The stylus itself is a sturdy, rounded jewel which protrudes from the rubber membrane.

The impedance of the Grado cartridge is extremely low—about 18 ohms—and it will work satisfactorily into any load impedance greater than 50 ohms. The output is correspondingly low, 1.05 mv at 7 cm/sec. This makes a stepup input transformer virtual necessity. Gothen offers the Beyer TR-147C transformer which has a 15-to-1 stepup ratio and a response from 30 to 20,000 cycles within 1 db. Two are needed for stereo operation.

The frequency response of the Neumann DST cartridge is 30 to 15,000 cycles ±2 db. Channel separation exceeds 30 db at mid-frequencies (1,000 to 3,000 cycles) and is better than 12 db at 10 kc. The stylus-system compliance is 3.6 × 10⁻⁴ cm/dyne. The recommended tracking force is 4 grams and the stylus is a diamond with a 0.6-mil tip radius.

The Grado Master cartridge is priced at $49.50 and the Custom at $32.50.

Neumann DST

The Neumann DST stereo cartridge is the product of a West German manufacturer of professional-quality microphones (sold in this country under the names of Telefunken and Neumann). It is imported by Gotham Audio Sales Co., 2 W. 46 St., New York 36, N. Y.

The Neumann cartridge is a moving-coil type with a tubular torsion bar mounting the stylus at one end and the two generating coils at the other end. The entire stylus bar is covered by a thin rubber membrane (visible in the photo). This membrane serves a triple purpose: It keeps dust and foreign matter from entering the cartridge, protects the delicate moving system from damage and provides a slight amount of stylus damping. Only the stylus jewel protrudes from the rubber membrane.

The frequency response of the Neumann DST cartridge is extremely low—about 18 ohms—and it will work satisfactorily into any load impedance greater than 50 ohms. The output is correspondingly low, 1.05 mv at 7 cm/sec. This makes a stepup input transformer virtual necessity. Gothen offers the Beyer TR-147C transformer which has a 15-to-1 stepup ratio and a response from 30 to 20,000 cycles within 1 db. Two are needed for stereo operation.

The frequency response of the Neumann DST cartridge is 30 to 15,000 cycles ±2 db. Channel separation exceeds 30 db at mid-frequencies (1,000 to 3,000 cycles) and is better than 12 db at 10 kc. The stylus-system compliance is 3.6 × 10⁻⁴ cm/dyne. The recommended tracking force is 4 grams and the stylus is a diamond with a 0.6-mil tip radius.

The DST is designed to fit arms having the plug-in connection used on some professional European equipment. Typical arms are the Neumann TA-2 or the Danish Ortofon (known in this country as the ESL Professional).
The price of the Neumann DST stereo cartridge is $69 and the TA-2 transcription arm is an additional $105. The Beyer TR147C transformers are $15.56 each.

**Variable reluctance**

The variable-reluctance principle (pioneered by General Electric in its early monophonic pickups) is still widely used in stereo cartridges. In a variable-reluctance cartridge, a fixed magnet supplies a magnetic field which links two or more fixed coils (in a stereo cartridge). An air gap is built into the magnetic circuit and the stylus moves an iron armature to vary gap width. This causes a change in reluctance (the magnetic equivalent of electrical resistance). The flux variation through the coils generates a voltage proportional to the stylus velocity. Thus, the name—variable reluctance.

**Dynaco TA-12**

The Dynaco B&O Stereodyne II cartridge is virtually identical to the one described in RADIO-ELECTRONICS, March, 1959, page 85. It has four coils and four pole pieces arranged to form a square (Fig. 2). The stylus moves an X-shaped armature, varying the flux to the two coil sets.

The chief changes in the present Stereodyne models have been to improve the stylus-system damping. The same basic cartridge, however, has been incorporated into an interesting integrated pickup design known as the TA-12.

The arm is tubular with the front portion angled downward and inward to place the stylus in contact with the record at the proper angle. The cartridge, identical internally to the regular Stereodyne II, plugs into the end of the arm. Together they make a strange-looking combination.

The pivot design of the Dynaco arm resembles the gimbal used to support the rotor of a gyroscope. The inner ring is pivoted at top and bottom to allow lateral arm motion while the arm itself is pivoted from the sides of the inner ring for vertical motion.

The counterweight at the rear of the arm exactly balances the cartridge and is offset to the side opposite the head offset. As a result, the arm (being fully balanced) is not affected by a turntable that is jarred or is not level. The downward tracking force is derived from a spring whose tension is adjusted by sliding a plastic collar along the arm. Calibration lines indicate stylus force (from 1 to 4 grams). The manufacturer recommends a force of 2 to 3 grams, which is enough for most installations.

The cartridge leads run through the pillar supporting the pivot assembly and are fully shielded. Since the cartridge is encased in Mu-metal, the result is a very low hum level.

The frequency response of the Dynaco TA-12 is rated at 30 to 15,000 cycles ±3 db. The output voltage is 7 mv per channel at 5 cm/sec. The compliance is 5 x 10^-4 cm/dyne in all directions due to the symmetrical design of the cartridge. The moving mass is less than 3 milligrams. Recommended load resistance is 47,000 ohms.

**Fig. 2—Exploded view of Stereodyne II.**

Price of the Dynaco TA-12 integrated stereo pickup is $49.95.

**G-E VR-22**

The VR-22 is the improved version of the G-E model GC-5 and GC-7 stereo pickups (RADIO-ELECTRONICS, October, 1958, page 49). In all fundamental respects, the new cartridge is identical to the original version.

The VR-22 series is available in two models, the VR-225 with a 0.5-mil diamond stylus for quality pickup arms and the VR-227 with a 0.7-mil stylus for record-changer operation.

The stylus assembly of the VR-22 cartridge has been improved—a new damping-block design improves tracking of high-level passages. Mu-metal shields around the top and front of the cartridge, as well as the coil assembly, minimize hum pickup.

Most of the performance specifications of the VR-22 are identical to those of the original Golden Classic cart- rides. A notable improvement has been made in channel separation (which is as great as 30 db at mid-frequencies) and in channel balance. The outputs of the two channels are within 1 db of each other at 1,000 cycles and are closely matched over the entire frequency range.

The response of the VR-225 is rated at 20 to 20,000 cycles ±5 db, and the VR-227 at 20 to 17,000 cycles ±3 db. The output of both cartridges is 6 mv per channel at 5 cm/sec. The lateral and vertical compliances of the VR-225 are 4 x 10^-4 cm/dyne and 2.5 x 10^-4 cm/dyne respectively. For the VR-227, the compliances are 3 x 10^-4 cm/dyne and 2 x 10^-4 cm/dyne. Recommended tracking forces are 2 to 4 grams for the VR-225, and 5 to 7 grams for the VR-227.

The price of the VR-225 is $27.95; the VR-227, $24.96.

**London-Scott 1000**

In an earlier article (RADIO-ELECTRONICS, November, 1958, page 83), the London-Scott 1000 integrated pickup was described briefly. It had just been introduced and only sketchy information was available. This British unit is unique in being a true vertical-lateral pickup instead of the 45-45 type we are accustomed to.

The arm is anodized aluminum with needle type pivots in the vertical and

---

**OCTOBER, 1960**

---

www.americanradiohistory.com
ball bearings in the lateral plane. Its height can be adjusted to accommodate various turntables. The counterweight is factory-set for a 3.5-gram tracking force. A small amount of viscous damping is used in the arm to damp its low-frequency resonance (which occurs at 14 cycles). The cartridge clips on to the arm.

The London-Scott 1000 is a variable-reluctance pickup. Two sets of coils are linked by the cartridge’s magnetic field. The L-shaped armature is of magnetic material and forms a part of the magnetic circuit for both sets of coils.

Fig. 3 is a simplified sketch of the pickup. The complete magnetic structure, including pole pieces, is not shown. The single lateral coil and two vertical coils are identical, so that a given stylus velocity in the appropriate plane will generate the same voltage in its corresponding coil. The two vertical coils are connected in opposition with their junction connected to one side of the lateral coil. The other end of the lateral coil serves as a common output lead for all signals.

A purely lateral motion of the stylus will induce a voltage in the lateral coil, but not in the vertical coils. Under these conditions, the same output voltage will appear at all three output terminals (LEFT, RIGHT and LATERAL). On the other hand, a purely vertical stylus motion will not generate a voltage in the lateral coil, but will develop equal and opposite voltages in the two vertical coils.

Fig. 3 — Interior of the London-Scott 1000 showing coil connections.

Drop of cement is used to fasten the Dacron thread to the London-Scott cartridge body.

London-Scott mounted on its arm.

General Electric VR-22.
In stereo operation, with the 45-45 system of recording, modulation of one groove wall will generate equal voltages which may be called \( L \), \( V_1 \), and \( V_2 \). Measured between the common lead and the left-channel output (assuming common and right-channel outputs will appear \( L - V_2 \) or zero volts. This electrical matrixing converts the vertical-lateral coil outputs into equivalent channels of a 45-45 system.

In this type of cartridge, it is not necessary to parallel the left and right outputs to cancel vertical output when playing monophonic records. The output is taken from the lateral coil only and the vertical output is ignored.

A Dacron DST showing membrane.

A Dacron thread is shown in Fig. 3. This is needed to restrain the stylus motion on the longitudinal axis (due to frictional drag on the record surface). It has no effect on the vertical or lateral motion of the stylus.

A bottom view of the cartridge, uncased, is shown in one of the photographs. The lateral coil is visible and the two vertical coils are hidden. The pole pieces direct the magnetic field through the coils, via the armature, which can be seen protruding (tip down) through the coil bobbin. The Dacron thread can also be seen.

The stylus assembly compliance is in the order of \( 3.5 \times 10^{-6} \) cm/dyne. The moving mass has been reduced to a very low value, less than one milligram. This places the high-frequency armature resonance well above the audio range and results in smooth response from 20 to 20,000 cycles. Output is 4 mv per channel. Channel separation is better than 25 db at mid-frequencies. The stylus has a 0.5-mil tip radius.

The London-Scott 1000 stereo pickup sells for $89.95 complete with arm rest, cables and hardware. To be continued.

"TRIPLETS, MADAME"

Doctors can now say it will be triplets or twins, or just a single baby, if encephalographs are taken during the expectant mother's fifth, sixth or seventh month. Research described in the Journal of the American Medical Association revealed that accurate diagnosis of the number of tiny hearts beating can be made during that period, with less certain determination earlier.

"TRIPLET, MADAME" was a medical exercise in shorthand, but the word "triplet" has been applied to human offspring in the past. "Madame," the French for "woman," was added to the name to give it a French air.

In July, 1957, page 91.

**DUO-JUNCTION**

By I. QUEEN

EDITORIAL ASSOCIATE

If you read Garner's article* on the G-E Unijunction transistor or other literature on this remarkable device, you know how useful and versatile it is. On the other hand, if you read the latest parts catalogs, you probably know that the Unijunction sells for about $15. Though well worth its price (it's made of silicon and dissipates nearly 500 mw), it is beyond the financial reach of many experimenters.

It is not generally known that 2 junction transistors can be directly coupled to show results like those of the Unijunction. For want of a better name, I have dubbed it the "duo-junction." For more theory and schematics on the two-transistor combination, consult The Junction Transistor and Its Applications (The Macmillan Co.), published in 1957.

Fig. 1—Unijunction operating curve.

![Diagram of Unijunction](image1)

**Fig. 2 (below)**

-Two-transistor duo-junction circuit.

![Circuit Diagram](image2)

If you read Garner's article* on the G-E Unijunction transistor or other literature on this remarkable device, you know how useful and versatile it is. On the other hand, if you read the latest parts catalogs, you probably know that the Unijunction sells for about $15. Though well worth its price (it's made of silicon and dissipates nearly 500 mw), it is beyond the financial reach of many experimenters.

It is not generally known that 2 junction transistors can be directly coupled to show results like those of the Unijunction. For want of a better name, I have dubbed it the "duo-junction." For more theory and schematics on the two-transistor combination, consult The Junction Transistor and Its Applications (The Macmillan Co.), published in 1957.

Fig. 1—Unijunction operating curve.

![Diagram of Unijunction](image1)

**Fig. 2 (below)**

-Two-transistor duo-junction circuit.

![Circuit Diagram](image2)

If you read Garner's article* on the G-E Unijunction transistor or other literature on this remarkable device, you know how useful and versatile it is. On the other hand, if you read the latest parts catalogs, you probably know that the Unijunction sells for about $15. Though well worth its price (it's made of silicon and dissipates nearly 500 mw), it is beyond the financial reach of many experimenters.

It is not generally known that 2 junction transistors can be directly coupled to show results like those of the Unijunction. For want of a better name, I have dubbed it the "duo-junction." For more theory and schematics on the two-transistor combination, consult The Junction Transistor and Its Applications (The Macmillan Co.), published in 1957.

Fig. 1—Unijunction operating curve.

![Diagram of Unijunction](image1)

**Fig. 2 (below)**

-Two-transistor duo-junction circuit.

![Circuit Diagram](image2)

If you read Garner's article* on the G-E Unijunction transistor or other literature on this remarkable device, you know how useful and versatile it is. On the other hand, if you read the latest parts catalogs, you probably know that the Unijunction sells for about $15. Though well worth its price (it's made of silicon and dissipates nearly 500 mw), it is beyond the financial reach of many experimenters.

It is not generally known that 2 junction transistors can be directly coupled to show results like those of the Unijunction. For want of a better name, I have dubbed it the "duo-junction." For more theory and schematics on the two-transistor combination, consult The Junction Transistor and Its Applications (The Macmillan Co.), published in 1957.

Fig. 1—Unijunction operating curve.

![Diagram of Unijunction](image1)

**Fig. 2 (below)**

-Two-transistor duo-junction circuit.

![Circuit Diagram](image2)

If you read Garner's article* on the G-E Unijunction transistor or other literature on this remarkable device, you know how useful and versatile it is. On the other hand, if you read the latest parts catalogs, you probably know that the Unijunction sells for about $15. Though well worth its price (it's made of silicon and dissipates nearly 500 mw), it is beyond the financial reach of many experimenters.

It is not generally known that 2 junction transistors can be directly coupled to show results like those of the Unijunction. For want of a better name, I have dubbed it the "duo-junction." For more theory and schematics on the two-transistor combination, consult The Junction Transistor and Its Applications (The Macmillan Co.), published in 1957.

Fig. 1—Unijunction operating curve.

![Diagram of Unijunction](image1)

**Fig. 2 (below)**

-Two-transistor duo-junction circuit.

![Circuit Diagram](image2)

If you read Garner's article* on the G-E Unijunction transistor or other literature on this remarkable device, you know how useful and versatile it is. On the other hand, if you read the latest parts catalogs, you probably know that the Unijunction sells for about $15. Though well worth its price (it's made of silicon and dissipates nearly 500 mw), it is beyond the financial reach of many experimenters.

It is not generally known that 2 junction transistors can be directly coupled to show results like those of the Unijunction. For want of a better name, I have dubbed it the "duo-junction." For more theory and schematics on the two-transistor combination, consult The Junction Transistor and Its Applications (The Macmillan Co.), published in 1957.

Fig. 1—Unijunction operating curve.

![Diagram of Unijunction](image1)

**Fig. 2 (below)**

-Two-transistor duo-junction circuit.

![Circuit Diagram](image2)

If you read Garner's article* on the G-E Unijunction transistor or other literature on this remarkable device, you know how useful and versatile it is. On the other hand, if you read the latest parts catalogs, you probably know that the Unijunction sells for about $15. Though well worth its price (it's made of silicon and dissipates nearly 500 mw), it is beyond the financial reach of many experimenters.

It is not generally known that 2 junction transistors can be directly coupled to show results like those of the Unijunction. For want of a better name, I have dubbed it the "duo-junction." For more theory and schematics on the two-transistor combination, consult The Junction Transistor and Its Applications (The Macmillan Co.), published in 1957.

Fig. 1—Unijunction operating curve.

![Diagram of Unijunction](image1)

**Fig. 2 (below)**

-Two-transistor duo-junction circuit.

![Circuit Diagram](image2)

If you read Garner's article* on the G-E Unijunction transistor or other literature on this remarkable device, you know how useful and versatile it is. On the other hand, if you read the latest parts catalogs, you probably know that the Unijunction sells for about $15. Though well worth its price (it's made of silicon and dissipates nearly 500 mw), it is beyond the financial reach of many experimenters.

It is not generally known that 2 junction transistors can be directly coupled to show results like those of the Unijunction. For want of a better name, I have dubbed it the "duo-junction." For more theory and schematics on the two-transistor combination, consult The Junction Transistor and Its Applications (The Macmillan Co.), published in 1957.

Fig. 1—Unijunction operating curve.

![Diagram of Unijunction](image1)

**Fig. 2 (below)**

-Two-transistor duo-junction circuit.

![Circuit Diagram](image2)

If you read Garner's article* on the G-E Unijunction transistor or other literature on this remarkable device, you know how useful and versatile it is. On the other hand, if you read the latest parts catalogs, you probably know that the Unijunction sells for about $15. Though well worth its price (it's made of silicon and dissipates nearly 500 mw), it is beyond the financial reach of many experimenters.

It is not generally known that 2 junction transistors can be directly coupled to show results like those of the Unijunction. For want of a better name, I have dubbed it the "duo-junction." For more theory and schematics on the two-transistor combination, consult The Junction Transistor and Its Applications (The Macmillan Co.), published in 1957.

Fig. 1—Unijunction operating curve.

![Diagram of Unijunction](image1)

**Fig. 2 (below)**

-Two-transistor duo-junction circuit.

![Circuit Diagram](image2)
SINGLE TRANSISTOR OPERATES EIGHT-INCH SPEAKER

By WILLIAM H. GRACE, JR.

There is no gimmick in the title—this simple little single-transistor radio has been tested in various localities and has repeatedly given a good report of itself. Tone quality is excellent and volume is truly surprising for the few components employed.

An efficient outside antenna and a good low-resistance ground must be available for loudspeaker results as there is no provision for r-f amplification in the circuit. An antenna about 75 to 100 feet long plus a waterpipe ground makes a combination that gives adequate volume for a large-sized room (within about 15 miles of local broadcasting stations). Actual antenna size will depend upon location and the field strength of signals in a given area. For example, 18 miles north of New York City, a 60-foot flattop brings in eight locals with fine quality and volume. In the uptown region of the city, a 45-foot length of lamp cord dropped out a window of a tall apartment house picked up 10 stations. Reports on the basic circuit from Richmond, Va., and the Chicago area were also favorable.

Circuit history

The schematic shows the two parts of the circuit. The first is the tuned or resonant section; the second is the detector-amplifier or output section. There is only a single connection, a small coupling capacitor, between them. No ground return is provided as none is required. While this system may appear unconventional to some readers, it is not a new idea and was often used in the days of spark in standard wave meters and receiving circuits. It is a most effective method of coupling and was chosen in this case for simplicity.

The detector-diode is connected direct to the base of the transistor without any series capacitor. This is not a new idea either. The Interflex principle was introduced by Hugo Gernsback, the editor of this magazine, some 35 years ago. He suggested in 1925 that a crystal detector be substituted for the conventional grid-leak-and-capacitor combination used in De Forest tube circuitry for improved quality and superior gain over that of existing circuits. He developed the ingenious Interflex receiver which many of the old-timers will recall building in the early 20's. The writer himself built such a receiver in 1926 and was favorably impressed with the results obtained with a single tube.

Shortly after the debut of transistors, the Interflex was adapted to use with both the point-contact and junction type transistors and the August, 1955, Radio-Electronics (page 54) printed an article on it. The circuit became a popular one and is widely used today in various applications—receivers, field-strength meters and, in modified form, in certain TV video-detector-amplifier circuitry. All present transistor circuits in which a diode

Breadboard model of receiver next to 8-inch speaker. Unit is quite small even though parts are spread out.

One transistor and a diode using Interflex principle result in good tone quality and volume.
replaces the usual base series capacitor are, of course, merely transistor adaptations of the original Interflex idea.

Construction

The receiver may be assembled in any way the builder elects. The author has constructed both breadboard and miniature versions with equally good results. It is easy to house the small number of parts in a case whose dimensions are slightly less than those of a postcard. No socket is required for the transistor because the adjacent parts provide sufficient support. Wiring is done with No. 18 copper wire, either solid or stranded. The soldered joints must be made with care so that cold joints will not cause trouble later.

Parts assembly is not difficult; the order closely follows that shown in the circuit diagram. The front panel is drilled for mounting the volume control and tuning capacitor (and output jacks if desired). The first rf choke (RFC1) is soldered directly to the antenna and ground terminals. If the set tunes broadly after all other adjustments have been made, reverse RFC1's connections. On the breadboard model (shown in the photographs), the battery is held in place by a plastic strap and a piece of sponge rubber.

Try different values for C1 to find the best compromise between good volume and desired selectivity. Somewhere between 15 and 30 µuf would be a good working value to try out first. If you have a small air trimmer on hand, wire it into the circuit to give an approximate idea of the value required. Substitute a fixed capacitor of the same size in the finished rig. C3, also a very small capacitor, serves as the only coupling link between the resonant section of the receiver and the detector-amplifier section. The exact value is again a compromise between volume and selectivity—too large a value will broaden the tuning; too small a value will diminish volume. A starting value of about 5 to 10 µuf is a good beginning to work from. I solved the problem by twisting together about 2 inches of No. 18 solid enamel-covered wire and then clipping off 3/4-inch lengths until the best value was found. This completes the front end.

One end of the second choke RFC2, is connected to the lower end of the volume control; the other end to the junction of C3 and the diode. Various diodes were tried, but the CK705 did as good a job as any tested. A 1N34 is also suitable. The volume control may be of almost any value between 25,000 and 200,000 ohms, but be sure it has an attached switch to turn off the battery when the set is not in use. If you are in an area of low field strength, the volume control may not be needed. But, as this receiver is designed to function in areas of medium to high field strength, the volume control is an asset.

The transistor is a Raytheon p-n-p junction type, the CK721. Many others (2N106, 2N109 and 2N64) were found satisfactory with the exception of the CK722. An n-p-n transistor may also be employed in this circuit, but the polarity of the diode (and battery) must be reversed. If the diode polarity is not correct, the circuit will not function.

In the miniature version, the output transformer was mounted inside a separate speaker case to reduce the space needed in the receiver case.

Speaker selection

Naturally, the actual output of a single-transistor receiver is but a few milliamps. Therefore it is very important to use a good output transformer and sensitive PM speaker. The very small output transformers are not suitable for use with this circuit and much better results will be obtained from one of the universal types such as the Stancor A-3850 or the Lafayette TR-12.

Proper impedance matching is most important for both volume and voice quality. The speaker should have a heavy magnet and high efficiency in converting the available electrical energy into sound. Several high-quality units were tested with excellent results when installed in an insulated enclosure, but good PM units and baffles are expensive. After a search for a combination that would deliver the goods without being too expensive, the Lafayette SK-150 was chosen. Mounted in a Karlson 8-inch enclosure, it gave results equal to some units costing several times as much. This is a British speaker with a magnetic flux density of 13,000 gauss and a 1-inch-diameter voice coil. Its impedance is 16 ohms and could be well matched with either output transformer mentioned above. The Karlson baffle is one of the better enclosures tried by this author. However, any good PM unit in a correctly designed baffle should produce good quality and volume with this tiny receiver.

It being a very simple circuit, not many things can go amiss, but any experienced builder knows that errors do creep in once in a while. It often takes as much know-how to get the most from a very simple receiver as it does from much more complicated rigs. A small loss of efficiency in complicated jobs is seldom apparent but, in receivers with low audio output, even a little loss is too much.

It is a wise move to place a meter in the collector circuit when a strong signal is being received and check the current drain. Readings of 10 to 20 ma are common, but it is desirable to limit the current to about 10 or 15 ma with the volume control under average operating conditions. The set has been run for periods well over an hour at better than 20 ma with no damage to the transistor.

The constructor may experiment with voltages higher than the 9 volts used by the author as long as the transistor specifications are not violated. Specified 15 volts in some tests with an increase in volume, but transistors can be ruined

![Schematic of single-transistor receiver. A good external antenna is required.](image-url)
One-transistor capacitance relay is easy to build.

Single Transistor Operates 8-inch Speaker (continued)

if the ratings are exceeded so keep your meter at hand when conducting such tests.

Pseudo-stereo

One other item of interest with this receiver was the use of two PM units of different sizes spaced about 8 to 10 feet apart to get a pseudo-stereo effect. One unit was the SK-150 mentioned above and the other a 4-inch model with a fairly large magnet for its small diameter. It was mounted in a separate baffle box—a homemade affair from plywood, a la the Karlsson design. As each unit has a noticeably different frequency response, the highs seemed to be more evident from the smaller speaker and the lows from the larger. The sound was pleasant to listen to and gave the impression that horns and violins were on the left while the bull fiddles and drums were to the right.

Both speakers may be operated from a single output transformer, or separate transformers in series may be used. The actual sound output or volume seems to be somewhat more when two speakers are used, but this may be only an illusion.

If no suitable PM speaker (and well designed baffle) is at hand, the receiver may be constructed and then tested with a pair of high-impedance magnetic earphones instead. Insert phone tips in the output jacks or clip them across the output transformer secondary, turn the set to the on switch position and check for proper operation and selectivity. If crossover is heard, it can be eliminated by reducing the value of C1 and C3. Remember that C3's capacitance may be lessened by snipping the open end with wire cutters.

If a PM speaker is added later, the values of C1 and C3 may have to be increased slightly over that found best for use on earphones to secure the best volume. Weak crossover is not heard on a speaker to the same degree as on phones.

Other factors that affect volume are the exact values of RFC1 and RFC2. The value of RFC1 will be found to be close to 250 microhenries for the antenna lengths suggested, but other values may well prove more effective for peaking the low-frequency end of the band with aerials of different length. If the builder wishes to get the maximum peaking action, a standard loop antenna may be substituted for RFC1. Set the tuning dial to a station in the vicinity of 550 kc, adjust the slug for best volume, then leave it alone.

The value of RFC2 was found to be between 2.5 and 5 millihenries for best results but lower values can be tried. Select the one that proves best. For some reason, not understood by the writer, certain rf chokes tested gave much better volume and selectivity than did others. Those with ceramic iron cores seemed somewhat superior. It may be due to differences in Q. Experimenting might prove advantageous.

The volume on earphones from a good local station should be on the uncomfortable side if the volume control is wide open when the set is working correctly. Such a signal on phones indicates that excellent loudspeaker results will be obtained.

END

EDUCATIONAL TV ON TAPE

Fifty tape recorders is a lot of machines, and at almost $50,000 apiece, that's about $2,500,000. But 43 educational TV stations around the country will be getting video tape recorders from the Ford Foundation soon. The National Educational TV & Radio Center is presently checking recorders to decide what brand they'll use. Meanwhile Ampex reports that over 100 TV stations now have their video tape machines. There are also more than 100 Ampex video recorders overseas. Current production rate is two machines every day, and orders are stacked up for more than a hundred units ahead.
WINDING A TRANSISTOR-POWER-SUPPLY TRANSFORMER

By R. L. WINKLEPLECK

TRANSISTOR converters of low-voltage dc to high-voltage ac (or dc) have many obvious advantages over the conventional vibrator type power supply. They're compact, have no moving parts and nothing to wear out. They introduce little or no noise into associated circuitry since the square-wave output is easy to filter, and they are very efficient when properly designed.

The wide selection of power transistors which combine relatively high alpha under load with comparatively low cost is rapidly sounding the death knoll for vibrator power supplies.

The only serious drawback is the high cost of transistor power transformers, which must be correctly designed for high efficiency. This cost bottleneck can be eliminated by rewinding an old transformer from the junk box. It is not claimed that such a rewound transformer is the full equal of the expensive commercial units. But it is possible to get fairly high efficiencies (with good design). This makes the home-rolled version very attractive if the thickness of your pocketbook is an important consideration.

Basic circuit

Fundamentally, a transistor power converter resembles a blocking oscillator or a multivibrator. The collectors of two transistors are connected to a center-tapped transformer primary. A feedback winding is connected to the two bases in such manner that the conducting transistor is biased forward and the nonconducting one cut off as long as current through half the primary winding continues to rise. This bias is maintained until the transformer saturates and can no longer supply the drive signal. At the instant of saturation, the base currents reverse. The conducting transistor now cuts off, and the other one is driven into conduction. This action is continuous and repetitive, producing an essentially square waveform. The secondary output voltage is proportional to the winding ratio. The frequency depends on the supply voltage, the primary inductance of the transformer and peak collector current.

If the saturation flux of the transformer core material is known, it is possible to design for a specific frequency.

In the absence of this information, it is still possible to design an efficient power supply. It can be made to fit the transistors available and the input and output voltages and currents desired, but the frequency will "fall where it may." This is not too important if you plan to rectify the output.

Saturation test

First, an old transformer must be selected. The larger the transformer, the higher its potential power output. The frequency will be relatively high, however, and good results are possible with almost any old filament or audio transformer with a core area of at least ¼ square inch. Dismantle the laminations, remove the old windings and make a matching winding form. This may consist of a 4- to 6-inch strip of wood with the same cross-section as the transformer core. A small square of thin wood is nailed across one end. Prepare a second piece with a square hole. This can be slid onto the core form and fastened in position to provide a winding area just the height of the window in the core (see photo). A strip of light cardboard (the width of the coil) is wrapped around the form and held in place with a piece of tape.

Three temporary coils wound on the form will be used to get information on core properties. Scramble-wind a 30-turn winding on each end of the form with enameled wire (which may be salvaged when the transformer is disassembled). The wire size used in these coils is not important. The center of the core area is wound with 30 turns of heavy enamel wire—No. 20 or larger is suitable. The completed three windings are now removed from the form and the transformer laminations reassembled around them. If a couple of strips of tape are laid across the form sticky side out (Fig. 1) and then folded across the completed windings, they will be much easier to handle.

Now for the tests! You'll need a storage battery (or other heavy-duty source) of the voltage which you plan to use with the power supply, a heavy-duty rheostat and a dc ammeter. These are connected in series to the heavy center test winding so the current to the winding can be varied and measured. A low, 60-cycle voltage is connected to one of the end windings. This should be 1 volt or less, otherwise it will confuse the reading. The 0.75-volt filament tip of a tube tester may be used or a suitable voltage divider may be temporarily hooked across the output of a spare filament transformer. The vertical leads from an oscilloscope are attached to the third coil and a horizontal scope lead is attached to either end of the ac winding (Fig. 2). Set the scope for horizontal input and apply the ac voltage.

Adjust the horizontal and vertical gain controls to produce a rectangular trace similar to Fig. 3-a. The figure may be reversed but this isn't important. This trace is the first cousin of the transformer's hysteresis loop. Now apply and gradually increase the dc. Notice that the height of the scope pattern shrinks as in Figs. 3-b and c. Increase the direct current until the almost-horizontal lines meet and cross as in Fig. 3-d. Note the meter reading. This is the current required to saturate the core. With this information it's time to start a little pencil work.

Calculating windings

Now we have to decide what transistors to use. When the switching capabilities of a transistor are not known, they can be assumed to be approximately five times their class-A amplifier ratings. You'll need a 30-volt AC (or other heavy-duty source). The cost of special transformers is obviously so high that most are salvaged from the form. The only cost is the transformer itself, provided the soft iron laminations are removed. The only possible design will be the transformer itself. You'll need the transformer form, the windings, the primary and secondary sections, and the core material.

The only thing you have to do is to decide the size of the core and the turns of wire. You can do this by calculating the required current and then multiplying it by the number of turns of wire per inch. This will give you the total number of turns of wire you will need on the form. You can then divide this number by the number of turns of wire you will need on the form. This will give you the number of turns of wire you will need on the form.

Example:

You have a core with a cross-sectional area of 1 inch. You need 200 turns of wire on the form. You will need 10 turns of wire per inch of core. This gives you 2000 turns of wire on the form.

From this you can calculate the number of turns of wire you will need on the form. You can then divide this number by the number of turns of wire you will need on the form. This will give you the number of turns of wire you will need on the form.

Example:

You have a core with a cross-sectional area of 1 inch. You need 200 turns of wire on the form. You will need 10 turns of wire per inch of core. This gives you 2000 turns of wire on the form. You can then divide this number by the number of turns of wire you will need on the form. This will give you the number of turns of wire you will need on the form.

Example:

You have a core with a cross-sectional area of 1 inch. You need 200 turns of wire on the form. You will need 10 turns of wire per inch of core. This gives you 2000 turns of wire on the form. You can then divide this number by the number of turns of wire you will need on the form. This will give you the number of turns of wire you will need on the form.

Example:

You have a core with a cross-sectional area of 1 inch. You need 200 turns of wire on the form. You will need 10 turns of wire per inch of core. This gives you 2000 turns of wire on the form. You can then divide this number by the number of turns of wire you will need on the form. This will give you the number of turns of wire you will need on the form.

Example:

You have a core with a cross-sectional area of 1 inch. You need 200 turns of wire on the form. You will need 10 turns of wire per inch of core. This gives you 2000 turns of wire on the form. You can then divide this number by the number of turns of wire you will need on the form. This will give you the number of turns of wire you will need on the form.

Example:

You have a core with a cross-sectional area of 1 inch. You need 200 turns of wire on the form. You will need 10 turns of wire per inch of core. This gives you 2000 turns of wire on the form. You can then divide this number by the number of turns of wire you will need on the form. This will give you the number of turns of wire you will need on the form.

Example:

You have a core with a cross-sectional area of 1 inch. You need 200 turns of wire on the form. You will need 10 turns of wire per inch of core. This gives you 2000 turns of wire on the form. You can then divide this number by the number of turns of wire you will need on the form. This will give you the number of turns of wire you will need on the form.

Example:

You have a core with a cross-sectional area of 1 inch. You need 200 turns of wire on the form. You will need 10 turns of wire per inch of core. This gives you 2000 turns of wire on the form. You can then divide this number by the number of turns of wire you will need on the form. This will give you the number of turns of wire you will need on the form.

Example:

You have a core with a cross-sectional area of 1 inch. You need 200 turns of wire on the form. You will need 10 turns of wire per inch of core. This gives you 2000 turns of wire on the form. You can then divide this number by the number of turns of wire you will need on the form. This will give you the number of turns of wire you will need on the form.

Example:

You have a core with a cross-sectional area of 1 inch. You need 200 turns of wire on the form. You will need 10 turns of wire per inch of core. This gives you 2000 turns of wire on the form. You can then divide this number by the number of turns of wire you will need on the form. This will give you the number of turns of wire you will need on the form.

Example:

You have a core with a cross-sectional area of 1 inch. You need 200 turns of wire on the form. You will need 10 turns of wire per inch of core. This gives you 2000 turns of wire on the form. You can then divide this number by the number of turns of wire you will need on the form. This will give you the number of turns of wire you will need on the form.

Example:

You have a core with a cross-sectional area of 1 inch. You need 200 turns of wire on the form. You will need 10 turns of wire per inch of core. This gives you 2000 turns of wire on the form. You can then divide this number by the number of turns of wire you will need on the form. This will give you the number of turns of wire you will need on the form.
should be rated at \(2\frac{1}{2}\) times the supply voltage you plan to use.

Divide the ampere-turns for saturation (determined by the test) by the collector-current rating of the transistor chosen. This gives the number of turns for each half of the collector winding since each transistor operates into half the winding. The wire size required may be determined from a reference source such as the wire table in the ARRL Handbook.

The center-tapped base-bias winding should consist of one-fifth the turns of the total collector winding. Very little current flows in this coil, so No. 26 or 28 wire may be used.

To get the number of turns for the output winding, multiply total collector turns by the desired output voltage, then divide by twice the supply voltage. This gives the open-circuit output voltage. The number of turns must be increased by from 20% to 50% if this voltage level is to be reached under heavy load. Wire size for the secondary may be quite small. In fact, it must be small if the windings are to fit the transformer window. You can determine the secondary wire size from the wire table. Pick out the smallest wire that will carry the load.

Winding the coils

The coils are wound on the wooden form which has first been prepared with the cardboard strip and the short lengths of binding tape placed adhesive-side out (Fig. 1). Enamelled wire is used for all windings. It should be laid in smooth layers; this way it will occupy far less space than if scramble-wound. The secondary goes on first. Some kind of winding jig can be fashioned from a hand drill or a lathe, winding the coils will be a lot easier. Leave plenty of wire for both ends. Wrap the secondary with a layer of tape and then do the center-tapped base bias winding. The collector coil is wound last. The tape strips are then pulled tightly across the windings, a final protective layer of tape is applied and the completed winding is slid off the form. Reassemble the laminations around the new winding.

If you intend to experiment with the number of secondary turns (to find what is required to put out the needed secondary voltage under load), the secondary may be wound last. However, the efficiency is reduced somewhat by this arrangement.

When you take the trouble to prepare an accurate winding form and wind the coils neatly, there should be no difficulty in keeping the overall size of the windings small enough to fit the window of the transformer core. It's always a good idea, however, to use the smallest wire which will carry the calculated current using the wire tables as your guide. Furthermore, place each turn tightly against its neighbor and keep the layers orderly.

Try it out

There are many transistor power supply circuits but the one shown in Fig. 4 is simple and dependable. It uses two resistors in a voltage-divider arrangement to assure easy starting under load. The high-voltage capacitor (C1) across the secondary is to reduce spikes which might damage the transistors. A high-capacitance low-voltage capacitor across the supply voltage will eliminate hash in associated equipment (if any is noted). The ratings of the rectifiers and the capacitors are determined by the output voltage and current.

Connect the transformer as shown and apply 1 or 2 volts. It should start to oscillate immediately. Use a scope or voltmeter across the secondary to check. If nothing happens, reverse the feedback leads (to the transistor bases), reapply power and you should be in business.

Examples

These directions have purposely been given without examples so that you might use them to build a power supply to suit exactly your needs with the materials at hand. A couple of "for instance," however, are helpful: A

Fig. 4—Typical transistor power supply. The voltage and power rating of the supply will determine the ratings of the rectifiers and capacitors.
and there's some No. 28 wire available for it. Figuring a secondary voltage of 150 open-circuit, we multiply 45 (the collector turns) by 150 and divide by 12 (twice the supply voltage). This rounds out to 560 turns. While No. 40 or smaller would be OK, this isn't a big winding so a convenient spool of No. 32 is used. The coil form is chucked in the lathe and "away we go."

Even though a much larger secondary wire size was used than needed, the cross-sectional area of this winding is comfortably smaller than the window. If we'd decided on a much higher secondary voltage (requiring many more turns), it would then have been important to use the smaller wire so the windings would fit the window area.

When completed and hooked up in the multivibrator circuit, the output is 150 volts, no load, just as figured. A 60-milliampere load is applied which pulls the output down to 100 volts. This is an output of 6 watts. The 6-volt input is supplying 1.7 amperes (or a bit less) or 10 watts. Thus the efficiency is 60%.

By reducing the size of R1 and 2, but still retaining their 10:1 ratio, the output can be raised to 10 watts or even more—still at 60% overall efficiency. With these transistors, however, the base current must not exceed 100 ma. Any adjustment of the resistors must keep base current within this value.

Next, a small audio output transformer with a core area of 1/4 square inch from a junked ac–dc radio was rebuilt. It required only 20 ampere-turns to close the hysteresis loop. It was decided to lower the battery drain, so a center-tapped 50-turn collector winding was calculated to produce only 0.8-ampere collector current. This and the 10-turn bias winding were applied on top of the original transformer high-impedance winding. A test showed that it pulled just under 1 ampere, about as expected. The no-load output was 500 volts. It charged a 500-mf photoflash capacitor to 450 volts in 25 seconds and would make a fine power supply for an electronic photoflash outfit. Incidentally, the laminations in some small audio transformers are placed all one direction. For power purposes these laminations, when reassembled, should be alternated.

In instances where it is possible to salvage and use the old transformer secondary or primary intact, most of the work is eliminated. The collector and base windings go on fast and easily, occupying far less space than the original primary.

These two examples show the flexibility possible with this design procedure.

Your power supply can be designed for your car radio, for mobile equipment or for an electronic photoflash. Just remember that the transistors are working hard in some of these applications. They give off quite a bit of heat and must be mounted on a metal surface to help dissipate this heat. Check their operating temperature, if it goes over 150°F you'd better arrange a larger heat sink, a cooler location or perhaps a small fan to cool them. END
THE TUNNEL DIODE REALLY WORKS

These two practical circuits can be duplicated by the average experimenter

By I. QUEEN
EDITORIAL ASSOCIATE

THE tunnel diode is an amazing semiconductor. Articles on it and its applications have appeared in periodicals, but have often been too theoretical for readers who like to experiment. Exact voltage and component values are often missing, making it hard to duplicate the stated results. (The operating bias for a tunnel diode is generally very critical.)

The July issue of this magazine, page 26, carried an excellent discussion of basic principles of the diode. It showed that this device has a negative resistance sandwiched between regions of positive resistance. Fig. 1 shows a highly simplified form of the familiar tunnel diode curve. Current increases as voltage is increased up to about 0.1 volt, then decreases as voltage increases from 0.1 to a little less than 0.5 volt, when it again starts to rise with increasing voltage. Voltage and current values are typical for a 1N653 (Texas Instruments). Circuit theory indicates that such a device must be an excellent oscillator and switch. This article will give full details on a crystal oscillator for 27-30 mc and a switch that is triggered by light.

The oscillator

The negative resistance region means that the tunnel diode is a ready oscillator. As explained in the July issue, the load line must intersect the region of negative resistance (Fig. 2). This load resistance is smaller than the negative resistance of the diode, specified as -40 ohms for a 1N653. Ee, the circuit voltage, is a small fraction of a volt.

No battery with such low voltage is generally available, so a divider is needed. Fig. 3 illustrates the crystal oscillator. Note the low value for R3 (which determines circuit resistance). Oscillations occur when the voltage across the diode is about 0.2. Start with a 100-ohm pot for R1. To set it, vary R1 (and R2 for fine adjustment) and listen for the signal on a nearby receiver tuned to the crystal frequency. Tune C2 for maximum output. For 27-30 mc, L is 16 turns of No. 18 wire, ⅛-inch diameter, close-wound.

You may also adjust this oscillator and observe circuit operation by measuring voltages. Start with maximum resistance at R1 and R2, then raise the voltage across the diode. R2, the 20-ohm pot, is rather critical. Use 10 ohms for ease of control. At about 0.17 volt (as measured with a 20,000-ohms-per-volt meter) you will note a sudden jump (to about 0.2 volt) and oscillations will begin.

This circuit will work with any overtone crystal from 27 to 30 mc without retuning. This is hardly the upper frequency range of a tunnel diode. With smaller tanks you should have no trouble pushing the range higher. If you remove the crystal, the circuit will self-oscillate with a rough and unstable signal.

Once R1 has been determined for your particular diode and circuit, it may be replaced with a fixed resistor. A 47-ohm unit is just right for my oscillator.

For safety, limit diode current to a maximum of about 6 ma till you determine the current value for R1.

Construction is uncritical. In my unit, a battery and voltage-divider unit already on hand was used. That portion of the circuit could, of course, be mounted on the board with the other components.

Trigger switch

When the load line intersects the diode characteristic in three places (as load 1 does in Fig. 4) we have a switch. As an example, suppose the circuit voltage is Ee, about 1.2 volts. Load line 1 resistance is about 250 ohms. When the circuit is switched on, it stabilizes at point A.

Fig. 1—Tunnel diode characteristic in an idealized—or cubist—form.
Now if a weak positive pulse is applied to the diode, the operating point will rise over the peak. It will move along the downward slope quickly (due to negative resistance) and arrive at C. (Point B is an unstable position, and is of little importance in this explanation.) All this takes place instantaneously. Thus even a very weak pulse will trigger the circuit from A to C. In a 1N653 these points correspond to about 5 and 2 mA, respectively. (This is terrific amplification, if you want to look at it that way.)

The triggering push may be an externally applied voltage or it may be just a reduction in circuit resistance. To show this, refer to Fig. 5. Starting with maximum R1, lower the resistance. At about 5 ma the meter will suddenly deflect downward to 2 ma, although we are reducing R1. The operating point

\[ \text{Fig. 2—Operating point for tunnel diode oscillator.} \]

(Fig. 4) has moved up the curve till it reached the peak of the characteristic. At that instant (when it reaches the peak) it snaps to C. R2 (Fig. 5) is a limiting resistor.

Now increase R1. The slope of the load line becomes more horizontal until it coincides with load 2, at which instant the current will snap upward. For the 1N653 this occurs when the total series resistance is about 1,250 ohms. The current will snap from a low of 0.6 mA to 1.2 mA.

The circuit may be triggered by light falling on a photocell (Fig. 6). A low-resistance Hoffman S1-A solar cell is shown in series with the winding of a relay RY to be energized. Light falling on the solar cell increases the circuit voltage and triggers the circuit. The higher voltage corresponds to changing the load line from 2 to 3 (Fig. 4). When

59

© 2021 www.americanradiohistory.com
the new line touches the peak point on the characteristic, the circuit triggers and the relay drops out.

The photo shows an actual switching circuit based on the above experiment. The relay must have a low-resistance winding. Being unable to find a suitable unit, I modified a Sigma 5F-1000, which has two coils in series, for a total of 1,000 ohms. They are reconnected in parallel to cut resistance to 500 ohms. Observe polarity of windings. The yellow lead of each coil is soldered to the block of the other. A 470-ohm resistor is shunted across the windings. This lowers the resistance and the sen-

Fig. 4—How the tunnel-diode characteristic is used in switching.

Fig. 5—Tunnel-diode switching circuit.

sitivity of the relay. Now the relay should be adjusted to pull in at 4.6 ma, release at 2.5 ma, approximately. Prime the circuit by pressing the reset button, then lower R3 gradually until you are just below the trigger point. If triggering occurs, note the point and start over again, this time not advancing the control so far.

When properly set, the illumination from a 40-watt lamp at about 18 inches is sufficient to trigger the circuit and release the relay. Note that the solar cell is in series with the battery.

This circuit may be made so sensitive that it can be triggered by switching on or off a nearby soldering iron or other appliance. The magnetic field of the ac does it.

If you reverse the polarity of the solar cell, you can prime the circuit with illumination on the cell. Then you can trigger the circuit by interrupting the light falling on the cell, even for a brief instant.

CONVERGENCE has been made a great deal easier in the later-model color sets, for which we are duly grateful. RCA, for example, has mounted all the convergence controls on a separate board which can be set up on bolts above the back of the set so that it is accessible from the front.

Control circuitry in this department has changed too. RCA and others have adopted a very useful device, the "combination" control (Fig. 1). These are the ones marked R-G-1, R-G-2, etc. They work on both red and green at the edges of the screen, the most difficult place to get good convergences.

Some of these are inductance controls, some resistive pad types. They are found mainly in the horizontal dynamic-convergence circuits and their principle is exactly the same as the older types. The details vary from manufacturer to manufacturer, of course, so go by the detailed setup instructions furnished with each set.

Before we leave this circuit, there’s one point I’d like to mention: watch that contrast! We recently installed a late-model set. The color was beautiful, no fringing or contamination, and we were very pleased. A few days later, the owner called, complaining about fringing, impurity and several other things including loss of focus. We rushed over to the house to tune in a color program.

Sure enough, there were all the symptoms she had mentioned.

It was quite by accident that I turned the contrast control. Immediately, the picture cleared up and all the objectionable symptoms dis-

Fig. 1—Convergence board used by RCA in CTC10 sets. It is similar to the board in the August, 1960, issue, page 83.

END
grid circuit of the same second video amplifier (Fig. 3). These controls will have a slightly different effect than those we’ve used to. Check the installation instructions carefully and find out the control setting for correct operation. As a general rule, brightness should be set just below the blooming point and the contrast should be set as low as possible to avoid the slight blooming and excessive contrast that will mess up the picture.

**Fig. 3**—The contrast control has two methods of operation.

Another point that many of us overlook is checking the high voltage before attempting any convergence or purity adjustments. I have run into several sets lately with convergence trouble that cleared up when the high voltage was returned to its normal value. If the convergence has been worked over with the high voltage below normal, there will be some readjusting to do.

Installation instructions (or service data) on all sets will give the proper procedure for high-voltage tests and adjustments.

**Bad rectifier?**

An Emerson 1165 needed a new picture tube. We replaced it, and the picture didn’t fill the screen, so I paralleled the selenium rectifier with a new one and got a full raster (I let it play for about an hour). After I replaced the rectifier, the set wouldn’t work! There was a B-plus or bootstrap. We’ve replaced practically everything in the set including the flyback and oscillator coil. All capacitors and resistors in the horizontal section have been checked and double-checked. We’re about ready to try building a separate high-voltage supply!—R. M. P., San Diego, Calif.

I hate to say this (and I wouldn’t dare if I hadn’t done the same thing myself so many times), but have you checked that new rectifier that you put in? If the set worked for an hour with the old rectifier in, then went out completely with the new one, there must be something wrong in or around that rectifier!

If this isn’t the trouble, check the resistors in the B-plus circuit (the surge resistor, filter resistor, etc.). You might also check the capacitors while you’re there. There is a definite possibility that your trouble is originating in the B-plus rather than in the high-voltage supply. In many cases, replacing a rectifier will raise the supply voltage enough so that marginal components (right on the verge of going bad) will fall when the B-plus is brought back to normal. Also check the hardware and connections at the high-voltage rectifier socket.

**Vertical rolling**

Have you any suggestions for eliminating a stubborn vertical roll that appears when an RCA KS-92 is first turned on?—J. L., Newark, N. J.

Have I? Yes, sir! Like almost everything in television, this is a "single effect with many possible causes." You must locate this trouble by a process of elimination, taking the most likely suspects first.

Therefore, replace the tubes first: the 12AU7 and 6AQ5 oscillator and output. Next, check the parts circled in Fig. 4. These all play a part in determining the operating frequency of the oscillator. If a resistor is off value when cold or a capacitor is leaky, the time constant of the circuit is changed and it runs off frequency. This can be caused by operating temperature. So measure all resistors in these R-C combinations very carefully and replace any that show signs of being too far off in value.

Clip an ohmmeter across the resistor, then hold the tip of a soldering iron near the resistor for 3 or 4 seconds. If the value changes more than 5%, replace the resistor.

**Oscillator troubles**

In a cathode-coupled multivibrator with a stabilizing or ringing coil, (horizontal oscillator), I’ve found that sometimes you can short out this coil without affecting oscillator operation and sometimes you can’t! Furthermore, where a 6AQ5 phase detector is used, the oscillator control-grid voltage is normally zero. When you ground the control grid, the stabilizing coil can be shunted out and the picture made to “float” by adjusting the hold control.

I have worked for service an Admiral 21F1 that goes far out when the coil is shunted that a picture cannot be aligned in. Is there a variation of this circuit which won’t work with the coil shorted out? Or, does this mean trouble?—V. J. S., Cannon City, Colo.

You’re exactly right, up to a certain point. Normal voltage on the “input” grid of the horizontal oscillator is usually zero. The phase detector controls the frequency of the horizontal oscillator by varying this dc voltage. Therefore, we can ground this point and remove all “sync input” then removing one possible source of trouble in the horizontal oscillator circuit. Please note that in this type of circuit, horizontal sync is not applied to the oscillator! It never gets any further than the phase sampler. There, it and the pulses from the flyback are combined (in phase) and transformed into small dc voltages. When both sync and pulse are in phase, the net output is zero.

Now, as to the oscillator circuit going far out of sync when the ringing coil is shunted: this is an R-C-coupled multivibrator and the ringing coil is not primarily one of the frequency-determining elements! Its only use is to stabilize circuit operation. Frequency-determining elements are the resistors and capacitors in the coupling networks.

The ringing coil and capacitor form a high-impedance path between the oscillator plate and B-plus. In effect, they are part of the plate load impedance for this half. Therefore, when the coil is shorted, only the plate load resistor is left in the circuit. As B-plus is always (for darn well should be!) at ground potential for ac, if we shunt the ringing coil in a circuit using a small plate resistor, like your Admiral, the plate of that section is “too close to ground.” This cuts down the output and the multivibrator becomes badly unbalanced and gets very stubborn about working!

To cure this, simply increase the plate load resistor temporarily. Disconnect the plate resistor and raise it to about 15,000 to 20,000 ohms so that the plate impedance of this half of the multivibrator will have sufficient output to stabilize the circuit.

(Continued on page 66)

---

**Fig. 4**—All circled parts can affect vertical oscillator frequency.

---

**Fig. 5**—The plate load resistor must be made larger temporarily to operate the multivibrator with the ringing (Horiz. Lock) coil shunted.
GO STEREO IN STYLE . . . WITH HEATHKIT QUALITY AND ECONOMY!

ECONOMY STEREO AM/FM TUNER KIT (AJ-10)
Full fidelity AM and FM reception, plus up-to-the-minute design features are yours at minimum cost with this new Heathkit stereo tuner. Features include: 2.5 uv. sensitivity for 20 db of quieting; individual flywheel tuning; separate magic-eye tuning indicators for AM and FM; AM bandwidth switch; 3-position (off-half-full) automatic frequency control (AFC); FM multiplex adapter output; built-in FM rod antenna; terminals for external AM and FM antennas; “AM,” “STEREO” and “FM” function selector switch. 14 lbs. $59.95

HI-FI RATED 25/25 WATT STEREO AMPLIFIER KIT (AA-50)
In one handsome package, you get both stereo power and control, with a host of deluxe features. Hi-fi rated at 25 watts per stereo channel (50 watts monophonic), this new Heathkit design includes channel separation control . . . new mixed center speaker output . . . stereo reverse and balance controls . . . separate tone controls for each channel with ganged volume controls . . . five switch-selected inputs for each channel (stereo “mag. phono,” tape head, three hi-level). Extra input for mono “mag. phono.” Special outputs for tape recording. 30 lbs. $79.95

YOUR "BEST BUY" IS HEATHKIT HI-FI!

FREE CATALOG
Send for your copy today! . . . describes over 150 Heathkit hi-fi, ham radio, test, marine and general products.

STEREO/MONO RECORD PLAYER KIT
Four speeds (16, 33 1/3, 45 and 78 RPM); Sonotone 8TA4-SD ceramic stereo cartridge, 10 lbs. $33.95

MIXED LOWS STEREO CROSSOVER KIT
Delivers stereo bass frequencies to single woofers; highs to individual wing speakers. 10 lbs. $19.95

TRANSISTOR PORTABLE KIT
Tremendous value: 6-transistor circuits. Fun to build! XR-2P (plastic) 6 lbs. $29.95

Just 10% DOWN ON ORDERS OF $55 OR MORE!

www.americanradiohistory.com
HEATHKIT® ... FOR FLEXIBILITY and COMPATIBILITY!

ECONOMY STEREO PREAMPLIFIER KIT (AA-20)
A low-cost, versatile stereo preamplifier control center. Four inputs each channel accept magnetic cartridge; crystal or ceramic cartridge; and tuner, tape, TV, etc. Six position function switch gives flexible stereo or monophonic use. Features cathode follower outputs plus hi-level outputs for tape recorder drive, calibrated Baxandall-type tone controls for each channel, clutch-type volume controls, filament balance controls, and accessory AC sockets. Self-powered. Styled in black and gold. Shpg. wt. 8 lbs. $34.95 AA-20

PROFESSIONAL RATED
35/35 WATT BASIC AMPLIFIER KIT (AA-40)
Doubles as a superb dual 35 watt stereo amplifier or a full-fledged 70 watt monophonic amplifier. Features: mixed-channel center speaker output; individual level controls; "Stereo-Mono" switch (uses both amplifiers to one level control for monophonic use); dual outputs for 4, 8, 16 and 32 ohm speakers. Paralleling outputs for 70 watt monophonic use matches 2, 4 and 8 ohm speakers. 41 lbs. $79.95 AA-40 $8.00 d.n., $8.00 m.o.

Now ... a complete Mobile PA Sound System in easy-to-build, HEATHKIT® form!

MOBILE PA SOUND SYSTEM
Perfect for political campaigns, advertising, sporting events. The powerful amplifier operates from any 12 v. car battery. Features an all-transistor circuit; inputs for microphone and music source. Two channel mixing circuit "fades" auxiliary input when used with microphone supplied ... lets you override music with voice without changing control settings. Outputs for 8 and 16 ohm speakers. Mounts easily under auto dash. Mobile PA Amplifier Kit (AA-80). 7 lbs ... $39.95

COMMERCIAL SOUND SYSTEM (CSS-1): consists of AA-80 Amplifier; microphone; plywood car-top carrier; one 16 ohm, 15 watt outdoor speaker. 24 lbs .................. $84.95

COMMERCIAL SOUND SYSTEM (CSS-2): same as above except with 2 speakers. 30 lbs .................. $99.95

EXTRA HORN SPEAKERS (401-38): As described above, 6 lbs .................................................. $19.95

SAVE 50% ... ON THE WORLD'S BEST QUALITY KITS!
CITIZENS BAND TRANSCEIVER KIT  
(GW-10 Series)  
Superb 2-way Citizens Band communication! Superheterodyne receiver may be switched to crystal control or continuous tuning. Featured are automatic “series gate” noise limiter, adjustable squelch to silence receiver during “standby.” Press-to-talk microphone features coil-cord connection to the transceiver. Transmitter is crystal controlled on any one of 23 assigned channel frequencies chosen. Order model GW-10A for 117 v. AC operation, and GW-10D for 6 or 12 v. DC operation; both have self-contained power supply.  
GW-10A (117 v. AC) or GW-10D (6 or 12 v. DC)  
$62.95 ea.  
$6.30 dn., $6.00 mo.  

3-BAND "MARINER" TRANSISTOR DIRECTION FINDER KIT (DF-3)  
Priced far below pre-assembled units of comparable quality, the DF-3 includes such important features as: 9-transistor circuit, 6 flashlight battery power supply; pre-assembled, pre-aligned tuning section; new modern styling; rugged aluminum splash-proof cabinet. Covers broadcast band, beacon and aeronautical band, and marine-telephone band. Special “sense” antenna eliminates “double null” effect common in many direction finders. Circuit has high gain IF amplifier and audio output amplifier delivering up to 380 mw of audio power to the large 4" x 6" weatherproof speaker.  
DF-3  
$99.95  
$10.00 dn., $9.00 mo.  

TIME PAYMENTS!  
Use Heath's convenient time payment plan . . . only 10% down on orders of $55 or more.
MUTUAL CONDUCTANCE TUBE TESTER KIT (TT-1)

An impressive list of electronic and mechanical features make this tube tester one of the finest values in the electronics industry. Tests Gm (amplifiers) from 0 to 24,000 micromhos, Emission, Leakage, Grid Current (1/4 microampere sensitivity), Voltage Regulators (built-in variable DC power supply), Low Power Thyatron and Eye tubes. Features 300, 450 and 600 ma constant current heater supplies, Life Test, Hybrid Tube test, built-in switch-operated calibration circuit. Large, easy-to-meter. Constant tension, free rolling illuminated chart. Kit includes 7 wiring harnesses. Assembly skill of technician or higher recommended; assembly time, 40 hours average. Black leatherette case with white trim, nylon feet, removable top. A specialized tool of unusual value that will pay for itself many times over! 27 lbs. $134.95

TT-1
($13.50 dn., $12.00 mo.)

WORLD-WIDE, ALL BAND RADIO RECEPTION

- Ceramic IF "Transfilters"
- Five Bands
- Flashlight battery power

10 TRANSISTOR "MOHICAN" GENERAL COVERAGE RECEIVER KIT

First kit of its kind uses ceramic IF "Transfilters." Covers 550 to 30 mc on 5 bands, with 5 separately calibrated bands to cover amateur frequencies (including 11 meter citizens band). Powered by 8 flashlight batteries. Built-in 54" whip antenna, tuning meter, headphone jack. (less batteries) (20 lbs.) $109.95

GC-1
$11.00 dn., $10.00 mo.

HEATH COMPANY, Benton Harbor 20, Michigan

Please send the following HEATHKITS:

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

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

( ) SEND MY FREE COPY OF YOUR COMPLETE CATALOG

Name ____________________________
Address ____________________________
City __________________ Zone ____ State ______

Dealer and export prices slightly higher.

send today for Your FREE HEATHKIT® CATALOG

Over 150 items of hi-fi, marine, amateur, test and general equipment are illustrated and described in the complete Heathkit catalog.
TESTS AND REJUVENATES
all black & white and color picture tubes at correct filament voltage from 1 to 12 V.

TESTS AND REJUVENATES
110° tubes with 2.34, 2.68, 6.3 and 8.4 volt filaments.

TESTS AND REJUVENATES
color picture tubes. Checks each color gun separately same as black & white tubes.

Used by Thousands of Professional Servicemen
MAKES NEW PICTURE TUBE SALES EASIER

ACCESSORIES for USE ONLY with FORMER B&K Models 400 and 350 CRT
Model C40 Adapter. For use only with all previous B&K Model 400 and 350 CRT's. Tests and rejuvenates TV color picture tubes and 6.3 volt 110° picture tubes. Net, $9.95
Model CR48 Adapter. For use only with all previous B&K Model 400 and 350 CRT's. Tests and rejuvenates 110° picture tubes with 2.34, 2.68, and 8.4 volt filaments. Net, $4.95

See your B&K Distributor
or Send now for Bulletin AP15-E

B&K MANUFACTURING CO.
1801 W. BELLE PLAINE AVE - CHICAGO 13, ILL.
Export: Empire Exporters, 277 Broadway, New York 7, U.S.A.

(Continued from page 61)

work properly (Fig. 5). At this point, the horizontal oscillator should be able to float a picture across the screen, if all of the parts are good! If the oscillator will not work now, you have a defective part. A leaky capacitor or an off-value resistor will throw the time constant of the circuit far out of the correct range.

After getting the oscillator circuit to the point where it will work without the ringing coil, remove the shunt and replace the original plate resistor. Don't move the horizontal hold control. Turn the slug on the ringing coil until the picture locks in (perhaps not entirely steady, but much better than without it). (Remember, the sync input is still grounded.) Now remove the short from the grid. If the picture immediately goes far out of sync, there is trouble in the phase comparator.

Sound troubles
In a Philco E2006-11 portable TV the sound will not come on when the picture does. About 5 minutes later it comes in, or both show up at the same time, then the audio gradually dies away to come back with a hiss in about 5 minutes. After it's warmed up, nothing short of hitting it with a sledge hammer will make it cut out. Of course, out of the cabinet, it works beautifully.

—C. S., Wilmington, Calif.

I hate to say this, but it looks as if you have a good case of print-circuit trouble! It seems to be thermal in nature, from the description: the "loose wire" that is causing the trouble seems to be closing tightly once the set has heated up sufficiently.

There is one fairly good remedy for this. Using a medium to small iron, resolder all of the joints associated with the sound circuit, including the printed-circuit board!

If this drastic step fails, then replace the discriminator transformer. This trouble could also be caused by a defective base assembly, if one of the tiny built-in capacitors should be intermittent.

As you say, this set is used on shipboard quite a lot, you might check the 4.5-mh trap in the video output circuit. Salt-air corrosion could have caused one of the fine wires on this coil to be weakened. The same thing could account for the trouble in the discriminator transformer. After the trouble is located, spray the whole section with a good grade of acrylic plastic coating to prevent future corrosion.

Boost high voltage
Can the high voltage in a Television All be increased by using a 6CD6 instead of a 6B6G in a flyback circuit that has a Merit HV-10 transformer and a rectifier? I would like to obtain about 1-kv increase.—H. H. G., Lansdowne, Pa.

There is more than one way to approach this problem. I would suggest checking the 6B6G's screen voltage. If it is less than 350 volts, the screen resistor can be reduced in value to

RADIO-ELECTRONICS
obtain additional high voltage. Do not operate the screen over 350 volts, however, as tube life could be impaired. A high-voltage doubler will give a big stepup, which can in turn be reduced to desired value by using a suitable series resistance in the high-voltage lead. A 6CD6 output tube does give an advantage over a 6BG6. This requires circuit rewiring. In any case of raising the high voltage, the flyback transformer can become a limiting factor. If you are unable to scan the picture tube fully when the high voltage is increased, a larger flyback is required.

Asg-width coil

I have lost a lot of sleep over this one. In a Stromberg-Carlson TC-19, the width coil, (which also supplies the age keying pulse) was defective. All the replacement coils I can find have proved ineffective. The pulse at the keyer tube plate is correct in polarity, but I cannot get the age line to go more than 2 volts negative. An external bias of 6 volts restores the tube to full operation. I haven't been able to obtain an exact duplicate replacement part for this anywhere. Can you help me out?—B. C. New York.

The coil you refer to is not the width coil with an age winding, but a special transformer which supplies only the keying pulse for the age tube. The width control is in another circuit.

This is a very special transformer; so special, in fact, that I have been unable to find it listed (as an exact replacement, that is) in any of the multitude of catalogues I have. However, I have located a coil which, I think, will do the job.

The original coil (T in Fig. 6) has an 0.2-ohm primary resistance and a flyback transformer (PART) a 6OH secondary resistance. This would give it a tremendous stepup ratio.

Triad lists a coil which should do the trick: it is their WLC-29, with a primary inductance variable from 0.1 to 0.9 millihenry, and secondary from 4 to 28 millihenries. Because it has an adjustable core, you should be able to match the flyback tapping with the primary and get enough voltage out of the secondary to give you the correct pulse amplitude on your keyer tube.

As a precaution, you might check the signal level applied to the grid. Ordinarily this runs around 60 to 70 volts peak to peak.

![Diagram of Transformer T]

Fig. 6—Transformer T supplies high pulse voltage to age amplifier's plate. 16-ohm secondary resistance. This would give it a tremendous stepup ratio.

Triad lists a coil which should do the trick: it is their WLC-29, with a primary inductance variable from 0.1 to 0.9 millihenry, and secondary from 4 to 28 millihenries. Because it has an adjustable core, you should be able to match the flyback tapping with the primary and get enough voltage out of the secondary to give you the correct pulse amplitude on your keyer tube.

As a precaution, you might check the signal level applied to the grid. Ordinarily this runs around 60 to 70 volts peak to peak.

B & K MANUFACTURING CO.
1801 W. BELLE PLAINE AVE - CHICAGO 13, ILL.
Canada: Atlas Radio Corp., 50 Wingold, Toronto 19, Ont.
Export: Empire Exporters, 277 Broadway, New York 7, U.S.A.

NOW TEST ALL TUBES
with Models 500, 550, or 650 DYN-A-QUIK
SIMPLY BY ADDING THIS
NEW MODEL 610 TEST PANEL

TESTS OLD AND NEW TUBE TYPES
Measures Genuine Dynamic Mutual Conductance
Also Tests Thytratrons, Voltage Regulators,
Auto Radio Hybrid Tubes, Battery Radio Tubes,
European Hi-Fi Tubes, and most Industrial Types

Merely by adding the new "610" to your Dyna-Quik, you have all the advantages of fast, multiple-socket testing, plus freedom from obsolescence. Makes your B & K Model 500, 550, or 650 Tube Tester more useful and more valuable than ever! Enables you to test all present plus future TV, radio and other tube types for all shorts—gives highly sensitive grid emission and gas test—checks for leakage and life—with laboratory accuracy.

Speeds complete tube test, sells more tubes on-the-spot, saves call-backs, insures your professional reputation, and brings more servicing profit. It pays to invest in B & K professional equipment.

Model 610 Test Panel comes completely wired, ready to install and connect. Net, $49.95

Issues of helpful new tube information 4 times a year available on subscription

TAPE RECORDERS
HI-FI COMPONENTS
SLEEP LEARN KITS
MERITAPE
Low cost, high quality, recording tape. Choose from many. 1961 CATALOG
DRESSNER, 14-22K E. 17th St., Flushing 5, N.Y.

LOOK no further. If you're searching for hi-fi savings. Write us your requirements now.
Key Electronics Company
120A Liberty St., N.Y.C., N.Y.
Cleveland 14, Ohio.

ENGINEERING SCIENCE DEGREE
DEGREE IN
27 or 36 MOS.

Accelerated year-round program prepares for early employment in fields of Science and Engineering. Regular 4-year program for B.S. Degree completed in 36 months. Special engineering degree program in 27. Classes start each quarter—January, April, August and December. Graduates employed from coast to coast. Comparative costs of full-time graduate education. Students from 50 states, 40 countries, 20 buildings, dorms, gym, campus, home town and country. Earn while you study. Write for catalog and complete information.
1700 N. Western Boulevard. Dept. 27100, Chicago, Ill.

INDIANA TECHNICAL COLLEGE

END
Able to supply great power for short periods at ultra-high frequencies, the magnetron's chief non-radar application at present is in cooking foods

By TOM JASKI

YOU may not know it, but you have probably eaten food cooked by radio waves so thoroughly and rapidly that you couldn't tell it had been hard frozen minutes before. Modern electronic ranges can cook steaks in less than half a minute or turn out a piping hot frankfurter in seconds. The modern electronic way gives the restaurant diner foods that have been freshly cooked rather than wilted all day on a steam table, and it especially does away with hours of defrosting. One of the electronic marvels that can do this is the Raytheon Radarange, shown in Fig. 1.

Radio-frequency heating has been used in industry for many jobs during the past 30 years, but electronic cooking has not been around that long, and few are familiar with the equipment. While most industrial heating takes place at 13.8 mc, cooking ranges operate in the microwave regions. The frequency band of 2,400–2,500 mc has been assigned to industrial heating services by the FCC.

Heart of the Radarange and similar electronic cookstoves is the magnetron, powerful microwave generator, more familiar in radar installations. The magnetron in the range (Fig. 2) is mounted above the dish, and sprays high-energy radio waves with hundreds of watts of power directly at the food cooking it from the inside out.

The magnetron is a simple-looking tube, but the theory of its operation is rather complex. It can be understood if some very simple principles of electron motion are kept in mind. For example, an electron can be deflected in its flight by a magnetic field. Of course you know this, for the electron beam which lights the screen in your TV picture tube is deflected magnetically. Fig. 3 shows how an electron is deflected, a little by a weak magnetic field, and a great deal by a strong one. The amount of deflection depends, of course, on how long we leave the electron in the magnetic field and on how much momentum it has—in other words, how fast the electron moves. Since an electron always moves from a negative to a positively charged body (one with a shortage of electrons), the amount of positive charge (the potential) determines the speed of the electron, and thus the amount of deflection in a given magnetic field. To make the electron path curve more, we can either strengthen the magnetic field, slow down the electron, or do both at the same time!

Simple magnetron theory

An electron moving within a cylindrical anode with a cathode at the center and a magnetic field along its axis (Fig. 4) can be made to take different paths to the anode after leaving the cathode. The shape of the path depends on the strength of the magnetic field and the voltage on the anode. It
We will need this rotating cloud later in our explanation, so keep it firmly in mind.

We can operate a magnetron in two ways. One is called negative resistance and the other transient time or dynatron operation. We will discuss the former first, although few magnetrons operate that way now. But understanding it is fundamental.

Fig. 5 shows a split-anode magnetron, with an external resonant circuit and the supplies needed. If the tube is not oscillating, we have here the situation which has been redrawn in Fig. 6-a, where the anodes have the same voltage. The magnetic field is perpendicular to the paper, with the North pole above and the South pole below the paper. If, in such a tube, we could measure the potential (voltage) between plate and cathode, we would find that there is a gradual decrease of potential as we approach the cathode. If we jot down the location of our measurements and the potential measured and then connect points with the same potential, we find that the “equi-potential lines” as they are called form neat circles (Fig. 6-a). The number in each circle represents the potential at that “layer” of the cylinder.

If we send an electron from the cathode in Fig. 6-a and we have a fairly strong magnetic field, the path of the electron will be as shown. This is the cutoff condition. As the electron travels, it crosses regions of higher potential and is attracted to plate A. But before it can gain enough momentum to get to the plate, the magnetic field curves the electron away from plate A. It then crosses weaker field regions progressively, and the magnetic field keeps the path nearly circular.

But now let us see what happens if we reduce the voltage on one anode and increase it on the other. Now the equipotential lines no longer are nice circles but are badly distorted as shown in Fig. 6-b. What does this mean to the electron setting out from the cathode? As the electron starts out, it will meet conditions approximately like those in Fig. 6-a. But the change in potential region is much faster, and the electron gains somewhat more momentum from the field, but not enough to travel to plate A. Now it will curve back in a larger sweep, missing the cathode. And as it curves around the cathode, it will again pick up momentum in the rapidly differing field conditions encountered, and take another turn around. And again and again the field conditions the electron meets will cause it to take another turn (under the influence of the magnetic field) to travel the spiral path shown. Finally, after this long travel, the electron has lost a lot of its kinetic energy and is attracted to the nearest anode, which now is plate B. We have then the curious phenomenon that most of the electrons travel to anode B, the one with the lower voltage. Lowering the voltage on this plate has increased the current to it,
and we have a clearly negative resistance characteristic.

How do we use this to oscillate? Well, look again at Fig. 5. If we already had a voltage across the resonant circuit, this would provide the plates with the same voltage that we would see in Fig. 6, wouldn't it? Suppose now that we start the tube by warming the filament and then suddenly turn on the plate power. Nothing is symmetrical and so, in the first instant, one of the plates will get a little more current than the other. This will lower the voltage on that plate a little (through the coil impedance) and thus it will first attract more electrons, and we're off. The capacitor will charge until the voltages are even. Then the voltages through the inductance-storage energy will reverse, beginning to raise the voltage on the other plate, as in any other resonant circuit, and the tube is oscillating.

Of course at this high frequency (in the microwaves), the resonant circuit will probably not be the coil and capacitor we show but instead a resonant appropriately called a multicavity magnetron.) Notice that we have a coupling loop in one cavity to take the energy out. Now look at Fig. 8, where we have stretched out two cavities of the anode in an enlarged view to help us explain the action.

When we have a cavity excited in some way by radio-frequency energy, we can have a difference of potential at the two walls of the cavity. This is indicated as "" and "" in Fig. 8. The arrows show by convention the direction in which an electron would be slowed down. Thus, an electron approaching the heel of the arrow is being decelerated, and an electron approaching the point of an arrow is being accelerated.

In Fig. 8 we have also drawn one of the electrons in the whirling cloud we spoke of before. This electron approaches the heel of an arrow—in other words enters a retarding field as it approaches the "" segments, and loses some of its kinetic energy. This energy is imparted to the field in the cavity. How? Consider it in the following way: If the electron enters the field between the "" and the "", it will repel one electron charge from the field toward the "" electrode ("" ) of that cavity. That charge will flow around the outside of the cavity to the "", as indicated by the dashed lines. When the electron is past, the charge will flow back and re-establish the equilibrium in the field. The traveling electron loses kinetic energy and is then deflected from the cavity entrance by the magnetic field (which is here again perpendicular to the paper), and we show the path curved that way. The charges flow back and forth on the inner surface of the cavity constitute an oscillatory current.

But the electron travels on past the next cavity. If we make sure now that the electron will also find a retarding field there, the action will be repeated as at the first cavity, and the electron will lose some kinetic energy again. Eventually, after passing a number of cavities, it will lose enough energy to be attracted to one of the anode segments between the cavities, because, you may remember, a stationary positive voltage is still applied to the entire anode.

This is the mechanism by which we obtain energy from the electron cloud in the dynatron operation of the magnetron. It is, as you can see, very similar to the method used in traveling-
wave tubes (see Radio-Electronics, December, 1959).

Between cavities, the electron obtains some energy from the positive voltage on the anode. If we now arrange our anodes and cavities and our electron speed so that the electron passes each cavity at the time when there is a retarded field, the electron will deliver energy to each cavity in turn. Since the cavities are adjacent, the field in these cavities will be 180° (half a cycle) out of phase. (The anode of one cannot be the cathode of the next one!) The time the electron must spend between cavities is exactly a half-cycle of the radio frequency. The path of such an electron is also indicated in Fig. 7. We have here, as in the traveling-wave tube, taken advantage of the transit time of the electron, which is the reason we also call this the transit-time method of operation.

Of course we must again get the thing started. But this is very easy, for once we get the cloud of electrons rotating by adjusting the plate voltage on the multi-cavity anode and the magnetic field (which most often is steady, supplied by a strong permanent magnet), the electrons passing the cavities will start to excite them and build up the rf field on them, which we had shown in Fig. 8 with the "+" and "+". These symbols of course indicate a momentary condition. We cannot keep the electron whirling around indefinitely; it would then begin to take up more energy than it would deliver.

There is some optimum value for each type of magnetron.

Several other matters enter into magnetron operation. For example, there is the matter of strapping. The tendency of the cavities to get out of phase (because the electron which is losing energy might start to slow down) must be prevented. This we do by connecting each alternate anode segment with a heavy copper strap. This tends to equalize any voltage differences (rf, that is) on the alternate segments, and the cavities are thus kept in phase. Obviously we must have an even number of cavities.

The magnetron can be made to deliver enormous power for very short periods of time. Even then the magpie must be cooled. As you saw in Fig. 2, air or liquid cooling can be used. But even so, the "duty cycle" of the magnetron (the portion of each second during which it is putting out power) must be short for maximum efficiency of radiated power without burning up the tube. So we pulse the magnetron—supply plate power to it 120 times per second in the Radarange. Fig. 9 shows the complete circuit of one of these radaranges.

Most of the diagram is devoted to safety and control devices. T1 is the filament transformer and cathode connection. We bring this cathode to a high negative voltage 120 times per second (so that we can keep the plate nearest

* For safety, in case an interlock should fail or food particles reach the plate, shorting it to ground.

Fig. 9—Circuit of Raytheon Radarange.

Not shown are a second magnetron and power supply, for to the food grounded. This voltage is supplied by rectifiers V1, 2, 3, 4. These form an unfiltered full-wave bridge supply, providing the 120 pulses per second. The anode voltage of power transformer T4 is carefully regulated by magnetic amplifier T3. As you now know, the magnetron is very sensitive to voltage fluctuations.

Each Radarange contains two magnetrons. With switch S1 the operator can select OFF, LOW (one magnetron on) and HIGH (both on). He can preset the cooking time on the timer. Relays K2 and K3 provide a time delay, preventing the application of high voltage to the magnetrons until the filaments are warmed up. In the standby condition, when only the filaments are warm, they receive a higher voltage than when the plate power is on. As you will remember, some of the electrons return to the cathode, and these have additional heating effect. To prevent the cathode from overheating, we must reduce the filament supply while the power is on. Relay K3 inserts K3 in series with the heater to apply a lower voltage to the thermal contacts of time-delay relay K2 after that relay has provided the necessary time delay. However enough current passes to keep K2 energized. At this point contacts K3-a of relay K3 switch the 115-volt line to a higher tap on T1 to reduce the voltage applied to the magnetron filament to 9. This voltage is again reduced by K1 when that relay is energized by the cook button, and when it applies plate power to the magnetron. At December, 1959.)

The Radarange is the restaurant version. Industrial units are similar but some of them much larger. The 2,400-2,500-mc range of frequency is used because it is one of the most efficient available frequency bands for heating of foods. Actually 1,800 mc (10 cm) would be more efficient, but that frequency is occupied by other services.

This is the one industrial application of magnetrons, a microwave oscillator quite familiar from radar and other microwave applications. But you can be sure more and more of them will be used in industry as time goes by, particularly in the food industry, where they have the tremendous advantage that they can cook a large amount of food not only in a very short time, but also without discoloring it or changing its flavor.

www.americanradiohistory.com
SENCORE Most Popular Time Savers for Servicemen, Technicians, Engineers, Maintenance Men, Hobbyists!

"MIGHTY MITE" TUBE CHECKER

Smaller than a portable typewriter...yet will outperform testers costing hundreds of dollars.

A new dynamic approach to tube testing. Check over 1,300 tubes for cathode emission, grid emission, leakage, shorts and gas. A "mite" to carry but a whale of a performer that outperforms testers costing much more. New unique "stethoscope" approach tests for grid emission and leakage as high as 100 megohms yet checks cathode current at operating levels. Special short test checks for shorts between all elements. The Mighty Mite will test every radio and TV tube that you encounter (over 1,300!) plus picture tubes. Set up controls as easy as "A B C" from easy to follow tube chart. New features: • Meter glows in dark for easy reading behind TV set. • Stainless steel mirror in cover for TV adjustments. • Rugged, all steel carrying case and easy grip handle. • Smallest complete tester made. Measures only 9" x 8" x 2½" and weighs just seven pounds.

SENCORE SS105 SWEEP CIRCUIT TROUBLE SHOOTER

The Missing Link in TV Service . . .

IT'S A . . .
UNIVERSAL HORIZONTAL OSCILLATOR. For direct substitution. No wires to disconnect in most cases. Traces trouble right down to the defective component. Variable output from 0-200 volts, peak-to-peak. Oscillator will sync to TV sync signal giving check on sync circuits.

HORIZONTAL OUTPUT CATHODE CURRENT CHECKER. A proven method that quickly checks the condition of the horizontal output tube and associated components. Adaptor socket prevents breaking wires. Easily replaceable Roll Chart gives all necessary pin current and voltage data. New Roll Charts are Free.

UNIVERSAL DEFLECTION YOKE. A new, simple way to determine yoke failure accurately—without removing yoke from picture tube. Merely disconnect one yoke lead and substitute. If high voltage (also bright vertical line) is removed, TV yoke is defective.

DYNAMIC FLYBACK TRANSFORMER CHECKER. Merely flip switch to "Flyback Check" and meter will indicate condition of flyback transformer, in degrees of horizontal deflection. Extremely sensitive and accurate; even shows up one shotted turn on flyback.

VOLTMETER. For testing booths, screen and other voltages. Direct-reading volt- meter, 0-1000 volts.

SS105 is completely self-contained, nothing else is needed. New, improved Circuit.

"FUSE-SAFE" CIRCUIT TESTER FS3

Instantly tells you whether or not it is safe to replace fuse resistors, fuses, or circuit breakers. Separates red and green scale for each commercially available fuse resistor used in radio and TV. Eliminates guesswork, wasted time. Also handy for wattage checks up to 2100 watts at 115v.

$895

$950

$2895

$275

$275
**SENCORE**

You can own all these popular Time Savers for less than some Mutual Conductance Tube Testers!

---

**For TRANSISTOR RADIO SERVICING**

Everything you need for less than $50.00

---

**SENCORE**

TRC 4

TRANSISTOR-RECTIFIER CHECKER

$1995

Checks Transistors, Diodes, Rectifiers...

A transistor tester that is used by over 50,000 servicing engineers and experimenters from Coast to Coast. Recommended by TV and Radio manufacturers; used by such leading companies as Sears Roebuck, Bell Telephone and Commonwealth Edison. Tests indicate that the TRC will outperform testers costing many times more. The TRC tests all transistors for gain, leakage, and open or shorts. Simple to operate without set-up chart for service work and with set-up chart for more accurate checks. With batteries.

---

**SENCORE**

PS103

BATTERY ELIMINATOR & TROUBLE SHOOTER

$1995

Replaces Batteries During Repair...

Replaces batteries during repair time of transistor radios and helps trouble shoot, too. For transistor radio servicing, experimenting and to charge nickel cadmium batteries. Dual output voltage from 0 to 24 volts DC and read on meter. Low ripple ensures no hum or feedback problem. Meter reads from 0 to 100 MA. Shunted stage will cause current to read high as indicated on PF schematics; open stage will cause current to read low. To align transistor radio, tune in station signal and adjust IF plugs for maximum current. The PS103 is the only supply that will operate radios with tapped battery supplies; such as Philco, Sylvania, Motorola, etc.

---

**SENCORE**

HG104

HARMONIC GENERATOR

$995

 Finds Defective Stage in a Minute...

Believe it or not, just touch the output leads of the HG104 to inputs and outputs of transistors and a clear 1000 cycle note from speakers will tell you whether or not the stage is defective. Here is an unequaled time saver, not a "pencil" gimmick. It actually works every time from speaker to antenna. Two leads and calibrated output (not found on pencils) are a must for speaker connection, grounding to prevent RF spray and front end checks. Also saves time when servicing HiFi, TV and radios. With life-time batteries.

---

**Get all 3 COMPLETE TRANSISTOR RADIO SERVICE LAB**

All 3 Time Savers shown above in handsome display carton carrying case

MODEL T1107

$4985

---

**Get all 3 COMPLETE TRANSISTOR RADIO SERVICE LAB**

All 3 Time Savers shown above in handsome display carton carrying case

MODEL SL108

$4145

---

**SENCOBE 36 "HANDY 36"**

$1275

Substitute for Capacitors, Resistors...

Provides the 36 most often needed resistors and capacitors for experimenting, substituting or testing. Eliminates searching for replacement components, unnecessary soldering and unsoldering and the mess it creates. Says goodbye to crumpled parts. Flick of a switch instantly selects any of: 24 Resistors from 10 ohms to 5.6 megohms, 10 Capacitors from 100 mfd to .5 mfd, 2 Electrolytics, 10 mfd and 40 mfd at 430 Volts. All components are standard American brand.

---

**SENCOBE RS106**

RECTIFIER TROUBLE-SHOOTER

$1275

Locate faulty Rectifiers, Diodes...

This unique substitution unit simplifies trouble shooting rectifiers and diodes, gives you a positive check every time. Substitute for suspected rectifier or diode, watch picture or listen to sound and you'll known in seconds whether or not the rectifier or diode should be replaced. No guess work, soldering mess or time lost. The RS106 costs less than having loose rectifiers and diodes in the shop for testing and is worth many times more. A must for servicing voltage doubler circuits. Protected by a ½ amp Slow Blow Fuse.

---

**SENCOBE BE3 "ALIGN-O-PAK"**

Eliminates messy batteries in TV service work. Handy for alignment, AGC troubleshooting or checking gated sync circuits. Dual the voltage you need, 0-18 volts, positive or negative. Completely isolated DC supply, less than 0.1% ripple. Covers all voltages recommended by TV set manufacturers and in Photo Fact schematics. For 110-120V, 60 cycle AC

$725

---

**Dear Pat:**

Will you please...

☐ Send me...

☐ Check or M.O. enclosed (PP Prepaid.)

☐ Send C.O.D.

**Model Numbers**

**Distributor's Name**

Your Name

Street

City Zone State

ALL UNITS FULLY GUARANTEED OR MONEY BACK WITHIN 10 DAYS

---

**www.americanradiohistory.com**

---
TRANSISTOR FIELD-STRENGTH METER for the CITIZENS BAND

By LYMAN E. GREENLEE

MEASURING the field strength of a transmitter's radiated signal is an excellent way to evaluate the efficiency of any antenna or transmitter. The best way to do this is with a field-strength meter. Most Citizens-band transmitters are limited to 5 watts input. Therefore, they require the maximum antenna efficiency to make full use of the available power. The latest FCC rulings permit the operator to adjust the antenna tuning on Citizens-band transceivers. The only adjustments not allowed are those affecting the transmitted frequency, which must be held to within a tolerance of .005%. But without accurate equipment for measuring field strength, it is not easy to tell whether antenna or transmitter adjustments are for better or worse.

This direct-coupled two-transistor field-strength meter is simple and requires few parts (see schematic). A 27-mc base-loaded whip antenna feeds through a coaxial connector to antenna transformer T. A 10-µf fixed capacitor (C1) and the slug in the coil form allow tuning over all 23 Citizens-band channels. The diode detector feeds V1's base. This n-p-n transistor is direct-coupled to V2, a p-n-p unit. The meter is any 0-500-µa unit and is bypassed by C2 to avoid sudden pointer swings on signal peaks. A pair of 2,000-ohm headphones can be plugged into the phone jack to monitor speech from the transmitter. This is a very convenient way to check speech quality. Power is furnished by two penlight cells.

Operating procedure is straightforward: Set R6 at half-scale (about 2,500 ohms) and adjust R3 (inside the meter case) for a full-scale meter reading. Make this adjustment with no signal.
Now adjust T and R1 for maximum meter deflection with a 27-mc signal. The meter reads full scale with no rf signal, and R6 which is on the front panel is used to set the meter to full scale. R1 and R3 inside the case are adjusted once and left alone unless transistors are changed.

The circuit is temperature-sensitive (like all transistor circuits of this type) so R6 has to be adjusted each time the switch is turned on. If this full-scale meter adjustment is beyond the range of R6, reset R3 inside the case. In measuring field strength, we are primarily concerned with tuning the transmitter for maximum output, so we adjust for maximum meter swing regardless of the no-signal setting of the meter. Plugging in the phones will alter the meter reading, but this is of no consequence because field-strength measurements are normally made with the phones disconnected. The undistorted audio output is low, current through the phones being limited to 500 μA at 3 volts, but it is adequate for checking hum and modulation difficulties with a small transmitter. If the field-strength meter is being operated within 10 feet of the transmitter, the audio output will be distorted because of overloading. If it is necessary to work very close to the transmitter, remove the whip antenna. The easiest way to reduce the signal is to move away from the transmitter until a point is found where speech is clean and the circuit no longer overloads.

To evaluate different antennas, proceed as follows: Set up the field-strength meter at a known fixed distance from the antenna to be checked out. Set the meter to full scale with R6 and then turn on the transmitter, tune it to the antenna and take a field strength reading. In this way, various antennas, locations and transmitters can be compared. Use a tape measure and choose a convenient distance such as 25 or 30 feet for all measurements. By keeping the distance from the antenna constant, the relative meter reading will show antenna and transmitter efficiency and may be used as an accurate basis for comparing equipment. The rf output from the antenna can frequently be doubled or tripled with careful tuning and adjustment, and this is certainly worth while when we consider the low power and limited direct range of a Citizens-band transmitter.

The direct-coupled meter circuit has proved rugged and dependable in actual use. By reversing the polarity of the diode, the meter can be made to swing in the opposite direction with an rf signal and, if a transistor with low leakage is selected for V2, no signal "zero" reading on the meter will be small. With diode polarity reversed, R1 and R3 should be adjusted for a low initial meter reading, rather than a full-scale reading. This field-strength meter will give a satisfactory indication either way; the one you use is a matter of choice. When the diode polarity is reversed, set R6 for a full-scale meter reading with the maximum signal normally encountered.

Any of several base-loaded whip antennas can be used with the field-strength meter. Listed in order of best performance for this unit they are:

- International Crystal CRA 298
- Lafayette HE17
- Radio Shack 29D672 (I used this)
- Allied Radio 8SYX729
- Philmore AA59

Mount the meter, S, J1, J2, T, the batteries and R6 on the front panel. The rest of the parts should be mounted on a small ½-inch linen bakelite subpanel which is held in place by the meter as shown in the photograph. Layout is not critical and all the parts to be used may be placed on the unplugged panels and outlined with pencil to locate the mounting holes. The transistors are mounted with six flea clips, three per transistor. Parts on the subpanel, including the flea clips, should be wired before it is attached to the meter. Be sure to observe correct polarity when connecting the transistors, diode, electrolytic capacitor, and battery. Be sure to install the transistors correctly and remember one of them is an n-p-n while the other is a p-n-p. If you install them the wrong way, both will be ruined.

Specifications: Must for tuning up Citizens' band transmitters • Completely portable • Very sensitive direct-coupled transistor circuit.

Performance Data: Tests conducted by a member of the staff of RADIO-ELECTRONICS showed operation substantially follows author's specifications. Unit is excellent for 27 mc, yet does not react to high power at 21 mc (50 watts). Sensitive enough to give a reading from a 250-mw transmitter. Components are comparatively inexpensive.
For Push-Pull AND Push-Push
Switch Type Controls
it all adds up to Centralab

Look at the figures—78% of the TV, radio and hi-fi sets now being produced utilize push-pull or push-push controls! Only Centralab gives you a complete line of replacements for them—35 push-pulls, plus the only push-push units available!

To multiply your choice, these Centralab switch-type controls are divided into 4 types—Adashift, Universal Shaft, Fastatch or dual concentrics, and Twin types for stereo. Whatever kind you need, you can be sure your Centralab distributor has it.

For a complete accounting on these push-pull and push-push controls, ask your distributor for Bulletin 42-936 or write us for your free copy.

HUMAN hearing is amazing. Ever notice how you can be in a crowded room filled with people all talking at the same time and still be able to concentrate on a specific voice and separate it from all other sounds even though it may be no louder than the surrounding noise level?

This “cocktail-party effect” works so well that any two-earred listener can enhance the effective intensity of the desired voice by 5 to 15 db simply by mentally suppressing the background noise level.

All this is well and good, but can it be duplicated electronically? Yes, it can and has been done. The way to do it was described by E. E. David, Jr. and J. F. Kaiser of the Bell Telephone Laboratories at a meeting of the Acoustical Society of America.

The device these scientists use takes the output of two microphones (see diagram), compares them and cross-correlates them to generate a gating signal which is applied to the combined output of the two mikes. The gating raises the intensity of the combined signal only when energy from the desired voice arrives simultaneously at both microphones. At all other times the gate suppresses the combined signal. Noise or interfering speech is passed through the gate only if it occurs at the same instant as the desired speech signal.

Subjective tests with a prototype unit showed enhancements of 9 db in effective signal levels against an interfering single-talker background. A smaller enhancement, 5 db, was measured when two extra talkers interfered.

“Hummm.”
Mercury offers you more for your TEST EQUIPMENT DOLLAR!

Model 700 - Tests all transistors and diodes quickly and accurately • Checks all transistors (RF, IF, Audio, Power Output, Industrial) for leakage and gain • Checks all diodes for forward-reverse current ratio • No time consuming reference to static charts necessary • Positively cannot become obsolete as the Model 700 will accommodate new transistors as they are introduced • Sturdy hammer tone finish steel case • Size: 5½ x 7¼ x 3½”

Model 500 - Actually substitutes for 44 different values of resistors, condensers, electrolytics, power rectifiers, crystal diodes, power resistors and bias voltages. Substitutes: 20 values of resistors from 33 ohms to 10 megohms • 10 values of condensers 0.001 mfd. to .5 mfd. • 10 values of electrolytics from 4 to 130 mfd. • Power rectifiers up to 500 ma. • Crystal diodes • Power resistance, continuously variable up to 3000 ohms • Voltages, continuously variable up to 15 volts either polarity • Sturdy hammer tone finish steel case • Size: 5½ x 7¼ x 3½”

Model 400 - A 20,000 ohms per volt VOM and an accurate capacity meter. DC VOLTAGE RANGES: 0 to 15,75/150/300/750/1500/7500 V. • AC VOLTAGE RANGES: 0 to 15/75/150/300/750/1500 V. • RESISTANCE RANGES: 0 to 1,000/10,000,000 ohms/0 to 10 megohms • RANGES: 0 to 75 microamp. 7.5 ma./75 ma./15 amps. • CAPACITY RANGE: 0.001 mfd. to 80 mfd. • Sturdy hammer tone finish steel case • Size: 5½ x 7¼ x 3½”

Model 600 - Checks all power rectifiers in-circuit (whether Selenium, Germanium, Silicon, Copper Oxide, etc.) rated from all conductivity to 20,000 ohms per volt (either polarity). Checks with 100% efficiency for quality, faulting, shorts, opens, arcing. Life expectancy • Simple to use: Just clip test leads across rectifier under test without disassembling rectifier from circuit. Press test switch and get an instant indication on the 3-color metal scales • Checks all power rectifiers out-of-circuit with equal effectiveness • Sturdy hammer tone finish steel case • Size: 5½ x 7¼ x 3½”

New Mercury design projects meter forward . . . metal handle swings back to serve as rest so that instrument can be used in tilted position.

A multiple-socket tube tester • A CRT tester-reactivator • A 20,000 ohms per volt VOM and capacity tester all combined in one compact unit! • AS A TUBE TESTER will check emission, inter-element leakage and gas content of over 700 tube types • AS A VOM AND CAPACITY TESTER sensitivity is 20,000 ohms per volt/DC and 5000 ohms per volt/AC • Capacity range: 0.001 mfd. to 80 mfd. • Unbreakable mirror for TV adjustments inside detachable cover • Handpainted wood carrying case • Size: 17¾ x 9¼ x 4½” Dealer Net $99.75

A versatile economy priced tube tester • Checks quality (emission, shorts and gas) of over 700 tube types, including the newest series-string TV tubes, OZ26, gas regulators, hi-fi and foreign tubes • Checks each section of multi-purpose tubes. Easy-to-read 3 color meter scales • 17 long lasting phosphor bronze test leads. • Unbreakable mirror mounted under tester case • Sturdy hammer tone steel case • Size: 9 x 4½ x 2¼” Dealer Net $31.95 Wired Dealer Net $39.95

SOLD ONLY THROUGH PARTS DISTRIBUTORS

FREE The instruction manual for any instrument shown is available upon request . . . use coupon below.

MERCURY ELECTRONICS CORP. 77 Searing Avenue, Mineola, N. Y. E-10

Please send me instruction manuals of the test instruments I have checked.
[ ] Model 700 [ ] Model 101
[ ] Model 400 [ ] Model 102-P
[ ] Model 600 [ ] Model 102-C
[ ] Model 300 [ ] Model 201

Name _____________________________________________
Address _____________________________________________
City ___________________________________ State ________

www.americanradiohistory.com
see the exciting 1961

**knight-kits®**

A PRODUCT OF ALLIED RADIO

in this value-packed **ALLIED** catalog

**free**

444 pages
most complete
send for it!
use coupon
on next page

**knight-kits—Best by Design**

**FUN TO BUILD** Building it yourself is always satisfying fun—it's fun at its best when you build Knight-Kits—they're so beautifully engineered, so much easier, more pleasurable to work with...

**YOU SAVE** You save substantially because you buy direct from Allied at our money-saving big-volume-production prices—and because you do the easy building yourself...

**YOU OWN THE BEST** You'll be glad you built a Knight-Kit, because you'll own and enjoy with pride a true custom-built product, professionally engineered and styled—designed for superior performance...

**EASIEST TO BUY** only $2 down on orders up to $50; $5 down up to $200; $10 down over $200—up to twenty-four months to pay...

**exclusive knight-kit MONEY BACK GUARANTEE**

Every Knight-Kit is unconditionally guaranteed to meet our published specifications for performance or your purchase price is refunded in full. Buy Any Knight-Kit! ...Build and Use It! It Must Perform Exactly as Claimed! Your Satisfaction is Guaranteed

**ALL-BAND SUPERHET RECEIVER**

Covers 540 kc to 36 mc, plus 6 meters; general coverage tuning and calibrated Amateur bandspread tuning. 83 YU 935 ......... $67.50

**DELUXE 70-WATT STEREO AMPLIFIER**

Super-power to drive any of today's speakers; the ultimate in control flexibility and functions. 83 YU 934 ............... $119.95

**BEST VTVM VALUE**

High sensitivity general-purpose VTVM; 11 meg input resistance; balanced-bridge circuit; 4½" meter. 83 Y 125 .... $25.75

**see many other HOBBYIST KITS**

"Space Spanner"® Receiver
"Ocean Hopper" Radio
Radio-Intercom
Clock-Radio

Transistor Radios
Intercom Systems
Electronic Lab Kits
Photoelectronic System

www.americanradiohistory.com
kovight-kits: best in build-your-own electronic equipment

**STEREO TAPE RECORD/PLAY PREAMP**
Professional quality; permits tape monitoring, sound-on-sound and echo effect; use with any tape transport.
83 YX 829 (less case) $79.95

**DELUXE 40-WATT STEREO AMPLIFIER**
Full frequency center channel. Finest amplifier available anywhere in this price range.
83 YU 774 $76.95

**SUPER-VALUE STEREO HI-FI AMPLIFIER**
20-Watt Stereo Hi-Fi Amplifier, with special clutch-type dual-concentric level control; biggest bargain in Stereo hi-fi.
83 YX 927 $39.95

**FM-AM HI-FI TUNER BUY**
Outstanding FM-AM Hi-Fi Tuner; with AFC and tuned RF stage on FM; includes multiplex jack.
83 YX 928 $49.95

**SUPERHET CITIZENS BAND TRANSCEIVER**
Dual-conversion receiver for highest sensitivity and selectivity; 2-channel crystal-controlled 5-watt transmitter.
83 YX 712-2 $79.95

**SENSATIONAL 4-BAND “SPANMASTER” RECEIVER**
For thrilling world-wide reception; exciting Short-wave and Broadcast; band-switching, 540 KC to 80 MC. With cabinet.
83 YX 288 $25.95

**FULL SELECTION OF INSTRUMENT KITS**
5” Oscilloscopes
AC VTVM
Tube Checkers
Signal Tracer
Audio Generator
Sweep Generator
Battery Eliminator
Capacity Checker
Transistor Checker
R/C Tester,
plus many others

**ALLIED RADIO, Dept. 162-K**
100 N. Western Ave., Chicago 80, III.

☐ Send FREE 1961 ALLIED Catalog

Name__________________________
Address__________________________
City__________________________Zone State__________

**SEND FOR THE 444-PAGE 1961 ALLIED CATALOG**
Write today for the world’s biggest electronics catalog, featuring the complete KNIGHT-KIT line. See the big news in quality electronic kits—save on everything in Electronics. Send for your FREE copy.

www.americanradiohistory.com
The completed unit. Author used a 6-terminal Jones plug to connect the separate power supply.

By J. H. THOMAS

In the excitement over the Citizens-band communications many may have overlooked the simultaneous change in the control channels, which allows 30 watts input on one of them, channel 23 (27.255 mc). Most radio control transmitters were designed for the earlier 5-watt maximum input. But here is a compact, powerful transmitter which can take advantage of the new regulations for class-C transmission. The unit (Fig. 1) has a 30-watt input and can be keyed (for carrier control) or modulated for control by audio tones. The modulator is included in the unit, but the power supply (Fig. 2) is separate. Fig. 1 shows the complete schematic of the transmitter and modulator. Half of a 12AV7 is the crystal oscillator. Here you should note that for 30-watt input the FCC requires .005% frequency control (for less than 3-watt input .01% is permitted). Make sure that the crystal you buy has the proper frequency tolerance. The second 12AV7 section is an amplifier driving the 6BQ6 final.

The 6BQ6 final amplifier is screen-modulated. This is one of the most economical ways of modulating, but you can’t use it and get 100% modulation—about 80% is the best that can be expected. This can be obtained with less than 1-volt signal at the modulator’s input. (For 100% modulation, the screen would have to be driven negative.)

Switch S enables the operator to select modulated or unmodulated operation. 82

Fig. 1—Circuit of the radio control transmitter.
creasing maximum tune the circuit capacitance.

in mc.

frequency L2 tune parallel, a dummy load, two operated with through

is

Fig.

tal

power into operation.

This kind of power can effectively shut down communication on the upper Citizens-band channels for miles around, if the communicators are using broadly tuned superregenerative receivers. So use the transmitter sparingly. The FCC permits the radio control transmitter to be on only when actually controlling objects.

In the modulator, with no modulation applied, R8 is adjusted for an antenna current of about 30% of the UNMOD position. However, this is difficult to judge with only a lamp load. Using a grid-dip oscillator as a detector may help, and it should show a reduction of about 50% with the modulator in the circuit.

What can you do with such a powerful transmitter? Well, for one thing you can consider control operations which would have had no margin of safety with low-power transmitters. The usual reliable range of ½ mile can now be increased to many miles. If you are a rocket fan, you can control missiles with it. If you just want to open the garage door, you can now make sure that the door is fully open before you get there. Or you can use this transmitter to call people with a paging receiver. Voice transmission is not permitted, but calling is. In the words of the FCC (Part 19, paragraph 19.34e) "... for the remote control of objects or the remote actuation of devices used solely as a means of attracting attention."

Many other new uses will crop up. Controlling agricultural machines and devices over considerable distances and turning irrigation pumps on and off are a few farm applications. Industrial uses would include opening and closing doors, guiding carts and loading devices, etc. A friend of mine uses his to anchor his boat a considerable distance from the pier. A special pelican hook disconnects the mooring line from a buoy after a control impulse starts the engine. Control of engine and rudder then brings the boat alongside, saving the owner an arduous rowing trip.

The station must be licensed by the FCC. Such a license is not hard to get if the equipment is crystal-controlled and meets other specifications as set forth in part 19 of the rules.

- Operates on Citizens band
- 30-watt input
- Long-range radio control
- Tone or carrier type operation

Unit meets author’s specifications. Transmitter has high output and seems to show no signs of frequency drift. If unit is stable—and this one is—it can be tuned to proper frequency. Transmitter must be on frequency. (Allowable tolerance is .005%.)

END
Changing a tube is often only the start of a repair job. It can indicate burnt-out resistors, shorted capacitors or other damaged components.

"That finishes Oz-wald," said the Old-Timer, laying down his soldering gun. "Now we'll let him sit and cook for a while. Make sure his horizontal sweep is back in order. So, Junior, with the work out of the way for a while this looks like a good day for me to do a little lecturin', so get ready."

The Young Ham tore off a couple of pieces from the filthy cloth which was referred to as "the shop's clean rag" and pretended to stuff them in his ears. The Old-Timer made threatening motions at him and resumed.

"Well, sir, there's more to 'tube-changing' than just pluggin' in new tubes. 'F'instance, if you open up a set and find the B-plus fuse blown, you might just put a new fuse in and go on, but if you do, you'll probably be back pretty soon. You oughta check the damper tube. Here." He pointed to it in the set on the bench. "See? Better check it for shorts by flipping it pretty hard with your finger, like this." He snapped his middle finger against the tube base. "If there's any shorts in it you'll notice it arcing and sparkin' right down here at the base of the elements. You m v short it out and blow a fuse, but better blow it now than after you leave. Lots of guys replace the damper tube anyhow, whenever they find that fuse blown, just for luck."

"How about the high-voltage rectifiers?" asked the Young Ham. "They give a bit of trouble too, don't they?"

"Yes, but not as much," replied the Old-Timer. "They're pretty easy to spot. If you can draw a fairly good arc from the plate cap, but haven't got any high voltage on the picture tube, change the rectifier. But don't assume the rectifier's good if you can't get an arc; I've found several of 'em that must have been shorted. If they're weak you'll get 'blooming.' The picture will get a lot bigger when you turn up the brightness control. Generally goes out of focus at the same time."

"Can't you get the same symptoms from the horizontal output tube?" asked the Young Ham.

"Nope, just the opposite," said the Old-Timer. "Usual sign of that is a narrow picture. Weak tube don't have enough poop to swing the beam all the way across. Also, a weak oscillator tube will narrow the picture. Look out though; I found one once that bloomed just like a bad 1B3—turned out to be a bad 6SN7 in the horizontal oscillator! Those are pretty scarce though. Y' want to look out for two-tube troubles. If the oscillator gets weak and don't drive the output tube and it's run for some time, the output tube may get weak from being underdriven and drawing too much plate current."

"Oh," said the Young Ham, "just like the final in my transmitter!"

"Free-cisely," said the Old-Timer. "Same identical thing, in fact. These horizontal output tubes operate just exactly like your finals. Horizontal linearity control works kinda like your plate tuning. It 'tunes' the output of the stage so it will work most efficiently. So if you lose the drive on one of these hard-workin' little tubes, the chances are you'll weaken it considerable. Now, then! Here's somethin' you've got to do every time you change the horizontal output tube or oscillator. Check to see that the output tube has the proper amount of drive on its grid. Unless you do that, the chances are the new tube won't last too long!"

"How you gonna check that without taking the set out of the box?" asked the Young Ham. "The grid's on the bottom, pin 5, isn't it?"
New life-giving, profit-building features are built into every SYLVANIA-6AU4-GTA TV-damper tube. Consider, for one feature, the SYLVANIA SARONG CATHODE and how it adds dependability to tube life. SARONG provides uniform spacing between cathode and plate—reduces possibility of plate-to-cathode arc-over. SARONG prevents the build-up of "whiskers" inside the cathode sleeve that can develop during other types of coating processes—reduces possibilities of cathode-to-heater arc-over.

Consider, too, the "pigtail" heater in SYLVANIA-6AU4-GTA. Welded securely to the stem-lead, it reduces heater "hot spots" and the possibilities of heater burnout. More... rectangular top and bottom micas with exceptionally wide slots increase the resistance of dc leakage paths, further reduce the possibilities of internal arc-over and breakdown.

There's extra profit assurance, too, with SYLVANIA-6AU4-GTA. Every one of them is tested for shorts, emission and the ability to withstand arc-over at 5000-volts peak inverse on the anode.

So, "wrap up" the profits you make by putting a "damper" on callbacks. When you ask your distributor for 6AU4-GTA's, always specify SYLVANIA.

"On the 6BQ6, 6CU6 and some others it is," answered the Old-Timer. "Here's the answer to that problem." He reached up to a little shelf over the bench, and brought down an adapter. Turning the set off, he removed the 6BQ6, plugged it into the adapter and replaced it in the set. Turning the set on, he reached for a vom lying nearby. "See? The grid comes out to these little studs on the side here. Measure it with that little vom we keep in the tube caddy. There's one of these adapters in the tool kit too. See here? 28 volts negative. That's about what it should be. For this tube and this set, that is. There's some variation, but not too much. Now if that'd been down around 15 volts, we'd have had to check the oscillator, the setting of the horizontal drive, or something. If you don't get enough drive, you'll notice the plate showing a little color and that ain't right. Shouldn't run red-hot, like the tubes in your transmitter sometimes do."

"Aww, they were only a little pink," said the Young Ham. "That just means they're good tubes!"

"Yep, df output and heat the ham shack, all for the same price, huh?" said the Old-Timer. "But we ain't interested in heatin' the house here; we just want a good picture."

"Yeah, and how about some of these tight-fitting doghouses? If you raised the tube that much, the plate cap would short to the shield or at least are over!" argued the Young Ham.

"Simple. Use some of that amateur ingenuity. Looky", and the Old-Timer pulled the tube, removed the adapter and slipped a short piece of solid insulated wire over the grid pin, after bending a loop on both ends and sliding the insulation back a bit. Replacing the tube, he clipped the voltmeter lead to the loose end. "Kievsten sie das, kinder?" he grinned. The Old-Timer had worked in St. Louis long enough to pick up a smattering of "commercial German" and never tired of showing it off.

"Jawohl, Grossvater!" said the Young Ham, who hadn't been listening to him all year for nothing.

"Nothing else," continued the Old-Timer, "you always oughta check your horizontal hold for proper range. In the average set with a good strong signal, you should be able to hold the picture over the entire range of the hold control. Of course, this means only the standard-carbon-pot type of hold control, not some of them sets like the RCA's and the Stewart-Warner 9126 where the hold control knob was actually the end of the plug in the horizontal oscillator coil and you could pull it out and turn it as long as you wanted to, almost. If your picture falls out with only a little turn of the control, chances are you've got a weak oscillator tube. Change it and see if your hold range doesn't go back to normal."

Combination troubles

"Now you go to the combination troubles. Stuff that's caused by one tube, but shows up like it was another one! Look here," taking a schematic from the file and spreading it on the bench. "What's going to happen if you get a heater-cathode short in this audio tube?"

"I don't know. Let's see . . . " and the Young Ham bent over the schematic (Fig. 1).

"I'll give you a hint. Follow the cathode circuit and see where it goes."

"It goes to . . . the if plate?"

"Yep. That's a series-B-plus circuit. They've got around 300 volts in the power supply, so to save makin' a voltage divider they connect the audio output and the video if's in series, for their plate supply. If you'll check the voltage you'll see that each one runs about 150 volts from plate to cathode. Now, you see they show the audio plate 260 volts, the cathode 15 volts, and the if plates 135 volts. This is from ground, of course. Now, what happens if you get a heater-cathode short in that 6V6 audio output?"

"You'd have the 260 volts on the if plates," said the Young Ham.

"Hello! Where'd you get the 260 volts?"

"Well, it'd go right through the audio stage and to . . ." said the Old-Timer.

"You said heater-cathode short! You'd have 260 volts on the audio plate and no voltage on the if's at all!"

"Now you're gettin' better," approved the Old-Timer. "Wouldn't get much, would you? That kind of 135 volts, on account of you'd lose the sound signal at the same time in the if's. So you might be lookin' for trouble there instead of in the sound tube where it actually was. If that audio tube gets too gassy or its coupling capacitor gets leaky, you got troubles too. That upsets the bias, also the current drain of the audio tube, and fouls up the plate voltages on the if stages."

"This gets more and more complicated as we go along," sighed the Young Ham.

"You ain't been anywhere yet," said the Old-Timer. "Another place where heater-cathode shorts'll really get you is in the series-heater TV sets (Fig. 2). Half your tubes will be lit, the other half dead. Whenever you see that condition, you can generally find a heater-cathode short somewhere. If you've only got three or four tubes burning, chances are they'll be burning real bright, on account of they're tryin' to use up all the current that should have supplied the whole string! Way to catch that is to look for the last tube in the string that's burning. Lot of people now are putting diagrams of the filament string inside the cabinets, bless their little hearts. Remember that Weh! I see. You checked yesterday? Had a 3AL5 shot out, and we looked on the diagram, traced it right down, and there it was. Sure appreciate the guy that put that there!"

"Yea, that's helpful," agreed the Young Ham.

"And we can use all the help we can get!" said the Old-Timer fervently.

"Here's another dandy. There's nothing these things would rather do than lead you up the garden path with a lot of false symptoms. You got a set with all the symptoms of age trouble: wavering, buckling and, if you check the voltage at the age test point, there ain't any. Ah ha! Age trouble, you say. You
change the age tubes; no help. Finally you come up with a grid-cathode short in the second if tube! It’s lowering the signal and shorting out the age in the if stages, and there you are.”

“That’s what was the matter with that Philco last week, wasn’t it? I remember what you called it!” laughed the Young Ham.

“All right, I’m ashamed of myself. Another case where you can get troubles, even after you replace the bad tube, is the neighbor that we had last Tuesday. Remember? 6BZ7 shorted out, so we replaced it. Still had snow, so we had to take out the tube and replace the two little resistors in the plate circuit that had burned to a crisp when the tube shorted. That’s the one where the ‘BZ7 plate was red-hot!”

“Now you take color sets, you’ll find all of the same symptoms in ‘em, just like the black and white. Only thing, you’ve got a few more circuits in ‘em. Now if you’ve got a good picture, but no color or the color won’t hold, you start lookin’ for some tube that handles the whole color signal—the burst amplifier, color killer, bandpass amplifier, and so on. Now if only one color was missin’, say you didn’t have any red in your picture, you’d start lookin’ for a tube that handled only red signals—a de restorer, or red amplifer, or somethin’ like that. Simple, see?”

“Yeah, simple,” agreed the Young Ham, dubiously. “I can imagine!”

“Now you can also get interments from tubes and lots of ‘em! Take that set last week. Three other guys had worked on it without finding the trouble. I turned it on and the trouble showed up right away. I had to pull it out of the cabinet and check it with a scope, though, to be sure. It would play along perfectly and then blow! What a blast! Scope showed no signal at the plate, but plenty at the grid. Nothin’ between the two points except tube, so I replaced it. Took my high-power magnifyin’ glass to the thing and, sure enough, you could see it then. The cathode ribbon was loose where it was welded to the tube pin! When she got hot, away she went, pulled loose. Like I say, I was just luckier than those other guys. It showed up for me.”

“Aw, that wasn’t luck, that was superior technical ability,” said the Young Ham. “You’re just smarter than they are. How about a raise?”

“I’ll raise you, young squirt, said the Old-Timer. “Well, Ozz-wald,” addressing the TV set which had been playing perfectly throughout all this discussion, “I reckon you’re all right, so we can bundle you up and take you to your owner. Rain’s stopped and it’s about time to choose up sides an’ go home.” As he reached for the cheater cord, the picture gave a couple of wiggles, bowed in the center, and quietly faded out. The Old-Timer stared at it in amazement, while the Young Ham roared with laughter. Peering into the back of the set, the Old-Timer shrugged and reached for a SU4. “Guess the darn thing musta been listenin’.” He grinned. “Got a bad tube!”
INJEC-CHECK

INDUSTRIAL TEST UNIT

One-transistor instrument is a measuring device, continuity checker, signal injector and audio generator

By WM. F. KERNIN

HERE is a device, originally designed to handle a measurement problem in industrial electronics, that proved to have numerous practical uses in the radio and TV service business as well as on the home experimenter's workbench. To list some of its uses to date: a preset level or temperature indicator, a tube filament checker, a continuity checker, an a-f-r-f signal injector. It is simple and efficient—completely self-contained, battery-powered and compact enough to fit into your tool box.

Originally, an instrument to indicate when the solution in a tank had reached a given level was needed. Visual indication was desired. Cords from the electric line were taboo, for safety reasons; economical, long-life battery operation was required. For a sensing element, two probes were to be used, so that when the solution touched both at the set level, the indicator light would go on. One difficulty—any voltage on the probes must be ac. Direct current would decompose the solution. And this ac must present no shock hazard.

The schematic diagram shows the circuit that fulfilled all those needs. A transistor blocking oscillator power supply provides the high voltage for the NE-51 indicator light. It is patterned after the high-voltage GM counter supply presented by Thomas G. Knight, RADIO-ELECTRONICS, September, 1956. Bias resistor R is much lower than normal to "buck up" the output of the generator. Capacitor C determines primarily the frequency or pulse repetition rate. The radio-frequency choke-RFC—is included to improve the efficiency of the oscillator by blocking the oscillator energy from the dc power supply. Jacks J1 and J2 are the input terminals for the sensing probes. An UTC H-1 miniature transformer was used because of its rugged construction, improved terminals and better mounting system. However, the less expensive O-1 or O-2 may be used.

The output potential in this unit lights the NE-51 to full brilliance when the probes are shorted. However, there is no shock hazard even if one should grab the bare probes in both hands.

Power for the unit is supplied by two inexpensive penlight cells. Current drain averages 4 ma.

A level indicator

In operation, the probe tips are set at the desired height in the tank or vessel. Filling of the tank may begin as soon as the unit is turned on—no warmup time is needed. When the solution contacts the probes, NE-51 lights. When the level falls, the contact path between probes is broken—and the light goes out.

The unit may be used as a minimum level indicator. Here the light would stay lit until the solution fell below the preset level of the probes.

As a checkout feature for the unit, a momentary shorting switch may be connected between J1 and J2. To check the condition of the device when turned on, the switch is closed and, if all is well, the light should go on.

Proper operation depends upon a fair degree of conductivity of the solution. No attempt was made to use it with volatile or turbulent liquids.

Also a thermometer

As a set-temperature monitor, the unit is used with a mercury contact thermometer as the sensing element. This type of thermometer—particularly the delicate, precision ones—requires a low-potential low-current indicating device to avoid contaminating the mercury. The NE-51 draws only 50 microamperes to glow at full brilliance in this unit. Hence it works well with the mercury contact thermometer.

And a continuity checker

Now for the bonus. By adding the tube sockets shown by the broken lines in the diagram, the original unit can be used as a go-no-go tube filament and continuity checker.

The NE-51 indicator light brilliance is not affected by normal filament resistance. Lowest current filament may be tested as surely as the highest.

The photographs show the layout used for a typical unit. A 4 x 4 x 2-inch utility box is the basic package. The choice of tube sockets shown covers most of the common tube types found in service work. To handle CRT and odd tubes as well as continuity checks, a pair of external test probes such as those used with the typical vom may be plugged into J1 and J2.

Operation as a filament continuity checker is simple. The unit is turned on; the tube is inserted in the proper socket. If the light lights, the filament is good. The same holds true using probes—continuity lights the light.

Or a signal injector

This device combines in one package
Inside view of Inject-Check

The instrument is basically a transistor oscillator and neon-tube indicator
R-3-200 ohms, 1/2 watt
C=10 pf, 10 volt
T-transformer, UCG H-1, O-1, O-2 or equivalent
V=COX2
RFC=4 choke, 7.5 mh
S-pot switch
BATT=1-3-volt penlight cells (2)
PILOT-NE-51, bayonet socket, clear (velv
J1, 2-lamp jack H, 4-100 or equivalent)
Tube sockets (octal, local, 6-pin miniature, 7-pin
miniature), battery holder, 4 x 4 x 2-inch box
Miscellaneous hardware

Send for Coyne's

7-Volume Job-Training Set

Answers ALL Servicing Problems QUICKLY . . .
Makes You Worth More On The Job!

Put money-making, time-saving TV-RADIO-ELECTRONIC KNOW-HOW at your fingertips—examine Coyne's all-new 7-Volume TV-RADIO-ELECTRONICS Reference Set for 7 days at our expense! Shows you the way to easier TV-Radio repair—time saving, practical working knowledge that helps you get the BIG money! How to install, service and align ALL radios and TV sets, repair color-TV, UHF, FM and transistorized equipment. New photo-instruction shows you what makes equipment "tick". No complicated math or theory—just practical facts you can put to use immediately right in the shop, or for ready reference at home. Over 3000 pages; 12000 facts! SEND NO MONEY! Just mail coupon for T-Volume TV-Radio Set on 7-Day FREE TRIAL! We'll include the FREE BOOK below. If you keep the turn-in, pay only $4 in 7 days and $4 per month until $27.25 plus postage is paid. Cash price only $24.95. Or return set at our expense in 7 days and owe nothing. Either way, the FREE BOOK is yours to keep. Offer limited, so act NOW! FREE DIAGRAM BOOK!

"Learned more from your first two volumes than from 5 years work!"—Guy Bliss, New York
"Swell set for either the servicer or the beginner. Every service bench should have one."—Milton Mastrush, Iowa.

TV-RADIO Servicemen or Beginners...

FREE TRlAL! We'll send you this big book, "TV-Radio Television Picture Patterns and Diagrams Excel Graphically FREE set for enrolling Coyne's 7-Volume Shop Library on 7-day FREE TRIAL!" Shows how to cut servicing time by reading picture-patterns, plus schematics diagrams for many TV and radio sets. Yours FREE when you keep the 7-Volume Set or not! Mail coupon TODAY!

TV-RADIO-ELECTRONICS Shop Library!

Like Having An Electronics Expert Right At Your Side!

TV 3-EVERYTHING ON TV-RADIO PRINCIPLES! 330 pages of practical explanations; hundreds of illustrations.

TV 2-EVERYTHING ON TV-RADIO FM RECEIVERS; 453 pages; fully illustrated.

TV 3-EVERYTHING ON TV-RADIO CIRCUITS; 316 pages; hundreds of illustrations, circuit diagrams.

TV 4-EVERYTHING ON SERVICING INSTRUMENTS! How they work, how to use them. 358 pages; illustrated.

TV 5-EVERYTHING ON TV TROUBLESHOOTING! Covers all types of sets. 437 pages; illustrations, diagrams.

TV 6-TV CYCLOPEDIA! Quick and concise answers to TV problems in alphabetical order, including UHF, Color TV and transmitters. 88 pages.

TV 7-TRANSISTOR CIRCUIT HANDBOOK! Practical Reference covering Transistor Applications; over 200 Circuit Diagrams; 410 pages.

FREE BOOK—FREE TRIAL COUPON!

Educational Book Publishing Division
COYNE ELECTRICAL SCHOOL
1455 W. Congress Parkway Dept. AO-TI, Chicago 7, Illinois

Yea! Send me COYNE'S 7-Volume Applied Practical TV-RADIO-ELECTRONICS set for 7-DAY FREE TRIAL per your offer. Include "Patterns & Diagrams" book FREE!

Name ___________________________ Age ______

Address ___________________________

City ___________________________ Zone ___________________________ State ___________________________

Mail coupon and $1.00 plus postage. 7-Day Money-Back Guarantee.

OCTOBER, 1960

www.americanradiohistory.com
SUPERIOR'S NEW MODEL TW-11  STANDARD PROFESSIONAL

TUBE TESTER

* Tests all tubes, including 4, 5, 6, 7, Octal, Lock-in, Hearing Aid, Thyatron, Miniatures, Subminiatures, Noval, Subminars, Proximity fuse types, etc.

* Uses the new self-cleaning Lever Action Switches for individual element testing. Because all elements are numbered according to pin-number in the R.M.A. base numbering system, the user can instantly identify which element is under test. Tubes having tipped filaments and tubes with filaments terminating in more than one pin are truly tested with the Model TW-11 as any of the pins may be placed in the neutral position when necessary.

* The Model TW-11 does not use any combination type sockets. Instead individual sockets are used for each type of tube. Thus it is impossible to damage a tube by inserting it in the wrong socket.

* Free-moving built-in roll chart provides complete data for all tubes. All tube listings printed in large easy-to-read type.

Model TW-11—TUBE TESTER . . . Total Price $47.50—Terms: $11.50 after 10 day trial, then $6.00 per month for 6 months if satisfactory. Otherwise return, no explanation necessary!

NOISE TEST: Phone-jack on front panel for plugging in either phones or external amplifier will detect microphonc tubes or noise due to faulty elements and loose 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. As a result, the calibration for low-current types has been restricted to a small portion of the scale. The extra scale used here greatly simplifies testing of low-current types.

The Model TW-11 operates on 110/120 Volt 60 Cycle A.C. Comes housed in a handsome, portable saddle-stitched Texon Case. Only $47.50

SUPERIOR'S NEW MODEL 80

20,000 OHMS PER VOLT ALLMETER

THE ONLY 20,000 OHMS PER VOLT V.O.M. SELLING FOR LESS THAN $50 WHICH PROVIDES ALL THE FOLLOWING FEATURES:

- 6 INCH FULL-VIEW METER provides large easy-to-read calibrations. No squinting or guessing when you use Model 80.

- MIRRORED SCALE permits fine accurate measurements where fractional readings are important.

- CAPACITY RANGES permit you to accurately measure all condensers from 0.0025 MFD to 30 MFD in addition to the standard volt, current, resistance and decibel ranges.

- HANDSOME SADDLE-STITCHED CARRYING CASE included with Model 80 Allmeter at no extra charge enables you to use this fine instrument on outside calls as well as on the bench.

NOTE: The line cord is used only for capacity measurements. Resistance ranges operate on self-contained batteries.

Model 80—ALLMETER . . . . . Total Price $42.50—Terms: $12.50 after 10 day trial, then $6.00 monthly for 5 months if satisfactory. Otherwise return, no explanation necessary!

GENOMETER

7 Signal Generators in One!

✓ R.F. Signal Generator for A.M.
✓ R.F. Signal Generator for F.M.
✓ Audio Frequency Generator
✓ Color Dot Pattern Generator
✓ Marker Generator

A versatile all-inclusive GENERATOR which provides all the outputs for servicing:

A.M. Radio * F.M. Radio * Amplifiers * Black and White TV * Color TV

R.F. SIGNAL GENERATOR: VARIABLE AUDIO GENERATOR: VARIABLE GENERATOR: In addition to a fixed 400 cycle sine-wave audio, the Model TV-50A Generator provides a variable 300 cycle to 20,000 cycle peak wave audio signal. The Model TV-50A projects an actual Bar Pattern on any TV Receiver Screen. Pattern will consist of 4 to 16 horizontal bars or 7 to 20 vertical lines.

$47.50 NET

EXAMINE BEFORE YOU BUY!

USE APPROVAL FORM ON NEXT PAGE

RADIO-ELECTRONICS

www.americanradiohistory.com
**The Model 88... A New Combination**

**TRANSPORTER RADIO TESTER and**

**DYNAMIC TRANSMITTER TESTER**

The Model 88 is perhaps as important a development as was the invention of the transistor itself, for during the past 5 years, millions of transistor radios and other transistor operated devices have been imported and produced in this country with no adequate provision for servicing this ever increasing output.

The Model 88 was designed specifically to test all transistors, transistor radios, transistor recorders, and other transistor devices under dynamic conditions.

**AS A TRANSPORTER RADIO TESTER**

We feel sure all servicemen will agree that the instruments and methods previously employed for servicing conventional tube radios and TV have proven to be impractical and time consuming when used for transistor radio servicing. The Model 88 provides a new simplified method of diagnosis - a technique developed specifically for transistor radios and other transistor devices.

An R.F. Signal source, modulated by an audio tone is injected into the transistor receiver from the antenna through the R.F. stage, past the mixer into the I.F. Amplifier and detector stages and on to the audio amplifier. This injected signal is then followed and traced through the receiver by means of a built-in High Gain Transistorized Signal Tracer until the cause of trouble, whether it be a transistor, some other component or even a break in the printed circuit is located and pinpointed. The injected signal is heard on the front panel speaker as it is followed through the various stages. Provision has also been made on the front panel for plugging in a V.O.M. for quantitative measurement of signal strength. The Signal Tracing section may also be used less the signal injector for listening to the "quality" of the broadcast signal in the various stages.

**AS A TRANSPORTER TESTER**

The Model 88 will test all transistors including NPN and PNP, silicon, germanium and the new gallium arsenide types, without referring to characteristic data sheets. The time-saving advantage of this technique is self-evident. A further benefit of this service is that it will enable you to test new transistors as they are released.

**SPECIFICATIONS:**

- **Model 88**
  - Operates on a self-contained 4½ volt battery and is always ready for instant use on the bench or in the field.
- **Signal Injector**
  - The signal injector used in the Model 88 is a new departure in signal source design. Previously, signal sources were provided by signal generators operating on a single frequency and requiring retuning. The Signal Injector of the Model 88 employs a transistor in a grounded emitter self-modulating blocking oscillator generating a low R.F. frequency capable of driving transistors to 30 megacycles. A power output of over 2.5 volts peak to peak is provided. An attenuator prevents overload of the receiver or the amplifier under test.
- **Signal Tracer**
  - Two high-gain grounded emitter transistors are utilized in a high gain amplifier with sufficient output to operate the built-in 4½ inch V.O.M. Speaker. A diode is used as a switch to prevent overload of the output stage. A volume control permits attenuation of strong signals. Provision is also made on the front panel for the addition of a meter or an oscilloscope for quantitative evaluation of the signal strength.
- **Transistor Tester**
  - The transistor tester used in the Model 88 measures the two most important transistor characteristics needed for transistor servicing; leakage and gain (beta).
  - The leakage test measures the collector-emitter current with the base connection open circuited. A range from 50 to 100,000 shows covers all the leakage values usually found in both high and low power transistor types.
  - The gain (beta) translates the change in collector current divided by the base current. Inasmuch as the base current is held to a fixed value of 50 microamperes, the collector current calibrated in relative gain (beta), is read directly on the meter scale.
  - The Model 88 will test all transistor types, including NPN or PNP, germanium, silicon, gallium arsenide and the newer diffused junction and mesa types.

**SHIPPED ON APPROVAL**

**NO MONEY WITH ORDER — NO C. O. D.**

$38.50

---

**Try any of the instruments on this or the facing page for 10 days before you buy.**

If completely satisfied then send down payment and pay balance as indicated on coupon. No Interest or Financing Charges Added. If not completely satisfied return unit to us, no explanation necessary.

**Moss Electronic, Inc.**

Dept. D-813, 3849 Tenth Ave., New York 34, N.Y.

Please send me the unit checked on approval. If completely satisfied I will pay on the terms specified with no interest or finance charges added. Otherwise, I will return the unit for a 10 day trial positively canceling all further obligations.

<table>
<thead>
<tr>
<th>Model</th>
<th>Total Price</th>
<th>$6.50 within 10 days. Balance $6.00 monthly for 8 months.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model 88</td>
<td>$38.50</td>
<td>$6.50 within 10 days. Balance $6.00 monthly for 8 months.</td>
</tr>
<tr>
<td>Model TV-10</td>
<td>$47.50</td>
<td>$11.50 within 10 days. Balance $6.00 monthly for 8 months.</td>
</tr>
<tr>
<td>Model TV-50A</td>
<td>$47.50</td>
<td>$11.50 within 10 days. Balance $6.00 monthly for 8 months.</td>
</tr>
</tbody>
</table>

Name__________________________

Address__________________________

City__________________________

State__________________________

All prices net, F.O.B. New York, N.Y.

Export Division Rocke International Corp., 13 East 44th St., New York 10, N.Y.

OCTOBER, 1960
If you're among the thousands who think that an ordinary television antenna atop the roof is safe from lightning, you're wrong, says the Lightning Protection Institute.

Studies of some 1,500 lightning-fire and damage losses, reported in newspapers during a 3-month period, reveal that upward of 4% of them involve television sets and their antennas. That's no small matter—$4,500,000 annually.

Those facts pointedly illustrate that an unprotected antenna actually invites lightning to strike. There are more than 40,000,000 television masts in this country, and it is inevitable that this forest of high-rising metal towers will help to increase the losses suffered from lightning strikes—unless the masts are protected.

Total annual lightning losses in the US are placed at 600 persons killed, more than 1,500 injured, along with $120,000,000 in property losses. Lightning is the biggest single cause of fires in rural and outlying suburban areas, being responsible for 37% of all such fires.

Tying the TV antenna into the home's lightning-protection system is one means of helping to reduce losses. Where a building does not have a complete lightning-protection system, grounding the TV mast properly will only partially protect it. To ground a TV antenna adequately, in addition to a 10-foot ground rod, tie-in should be made to the water system, electrical and telephone grounds and any metallic bodies within 6 feet of the down conductor. Ordinary TV installations in themselves are inadequately grounded, and the antenna is not a lightning-protection device.

Basic information

Lightning will most likely strike the highest object in an area. Because of its height above surrounding objects, the antenna becomes this most likely lightning target.

A TV antenna, even though grounded according to most set manufacturers' recommendations (and with a lightning arrester), does not offer sure lightning protection for the set. It is not connected with a heavy enough cable nor does it provide the proper paths to earth to function as an efficient lightning rod.

Most antennas, contrary to popular belief, do not have lightning arresters. And an arrester is not full protection in itself—the mast must also be tied in with the correct conductor cable to a ground rod sunk 10 feet deep in moist earth.

When lightning does hit an ungrounded antenna, its path is most likely to be down through the house. It may leap over to the wiring system or water pipes, or follow the antenna lead. At the least, you can expect damage to whatever mechanical equipment the bolt passes through (Many TV sets have ended in a ruined tangle of wires) and at the worst, injury or death to occupants.

Scores of lightning losses involving TV antennas lead the Lightning Protection Institute to endorse strongly this requirement in the Underwriters' Laboratories code:

"Radio and television masts of metal, regardless of location on building, shall be bonded with standard conductor and fittings to the main conductor of the lighting protective system. It is also recommended that a lightning arrester be installed on the lead-in wire, tape, or cable."

Where a television antenna is installed on a building provided with lightning protection (a lightning-rod system), the metal mast or supporting tower should be connected to the system. If the tower rises appreciably above the building, it should also have a down conductor connecting it directly to ground to conform to National Bureau of Standards requirements.

Alternate method

Where a building is not provided with a complete lightning protection system, and safety with economy is the watchword, the institute advises full protection of the TV antenna and set. This will partially protect the building proper. This is recommended on the premise that some protection is better than no protection at all.

If the TV antenna is centrally located, grounding the mast can be tied in with complete lightning protection for the home by continuing the cable in both directions (and adding terminals at 20-foot intervals) from the mast along the roof ridge and down to ground on two sides of the building. This is not a job for the usual TV installation man. Considering the danger to life and property, the importance of trained engineering skill becomes even more vital. Don't hesitate to seek professional help or advice in all instances, whether for protecting a TV set and antenna or for a complete lightning-protection system. However, if the antenna is at either end of the building, the TV mast alone is comparatively simple.

The drawing illustrates how the lightning arrester is connected to the TV lead-in and then fastened to the mast with an approved pipe clamp (which generally comes with the arrester). Many good arresters are on the market; the important thing to
An increasing number of TV-related lightning fires occur each year. Most could be prevented if proper grounding techniques were used.

Watch for is the Underwriters' Laboratories label.

The drawing also illustrates how the ground cable is connected to the TV mast, using a UL-approved cable clamp.

The ground cable is run from the connection at the mast, along the roof ridge (hidden by placement along ridge rolls), down the cable side (hidden under eave), then down the building side.

There are several rules governing cable installation. The cable shall have no bends sharper than 90°. The radius of all curves should be at least 8 inches. Lightning, with its sudden rise time, will not travel through a cable that has sharp bends if it can find a shorter path to ground (a jump across several feet to a water pipe is not uncommon). The cable is to be supported every 3 feet on open-air runs, and maintain a horizontal or downward course, free from down and up (V or U) pockets.

The cable is connected to an approved ground rod with a standard ground-rod clamp. The ground rod is driven 10 feet into permanently moist soil, at least 2 feet away from the house foundation.

**Standard materials**

Copper and aluminum are acceptable materials for lightning-protection systems, but should never be used together without special connectors. Aluminum parts must be larger than equivalent copper parts for equal conductivity.

The copper cable should weigh at least 187.5 pounds per 1,000 feet (individual wires making up the cable should be at least of No. 17 gauge). This cable is three times the size of a No. 6 cable which most manufacturers and installers recommend. Aluminum cable should weigh at least 95 pounds for the same length.

Ground rods, solid copper or copperclad, should be at least ½ inch in diameter and 10 feet long.

Connectors and fasteners must be of the same material as the cable. Galvanized or plated-steel nails, screws or bolts are not acceptable on copper or aluminum installations.

**Service available**

The Lightning Protection Institute, a non-profit Chicago organization, offers its help whenever it is needed by any—one—home owners, plant engineers, organizations or individuals. Sponsored by reputable, long-established lightning-equipment manufacturers, the institute was set up to promote the science and improve the methods of lightning protection (and to advise and give information).

Another of its purposes is to formulate and press for the practice of ethical standards in all phases of the lightning-protection industry. In this role, it works toward the goal of full inspection and official approval of all lightning-protection systems, new or old.

While the institute does not take any part in actual equipment testing or field inspections of installers and their work, the group works closely with Underwriters' Laboratories.

If you plan to protect your TV antenna and set, entire home or plant against lightning and there is any question regarding materials or installation, the best way to get the answer is to write to the Lightning Protection Institute, 53 W. Jackson Blvd., Chicago 4, Illinois, for Lightning Facts and Figures.
All 55 million TV owners will want their sets to be in first-class condition when the umpire calls "Play ball!" The neighborhood technician whom owners know best will be the one to benefit. Don't miss this profit opportunity! General Electric is going all-out to help you—by telling World Series fans whom to call, where to go for fast, reliable TV check-up. To the technician who installs G-E tubes! He's the best! And just around the corner!

Long before the first day's pitchers have been named, G-E displays and promotions will be pulling customers into your shop. Once play starts, fans in most large cities will receive frequent radio reminders that you are ready to serve them fast and well. Go World Series with General Electric! Get ready for a B-I-G two weeks of business! See your G-E tube distributor! Distributor Sales, Electronic Components Div., General Electric Company, Owensboro, Ky.
IN EVERY INNING WITH PROGRAM!

GO WORLD SERIES to ring up service dollars!

Timely, high-impact display items like these will draw more customers to your shop, pay off in stepped-up income. General Electric has ready for you many other World Series displays, advertising helps, and novelties, all new and exciting. See them today at your General Electric tube distributor's!

Progress Is Our Most Important Product

GENERAL ELECTRIC
NEW FROM ARKAY

Manufacturers of the world famous line of Golden '60 electronic kits

VERSATILE MULTITESTER KIT

For laboratory, service shop and amateur use


Model M-4 $13.50

NEW 23" 10° TV TUNER KIT

WITH STAGE- BY-STAGE ASSEMBLY AND CHECK SYSTEM

Unique ARKAY tuner kit permits checking of each stage as it is finished. Modern slimline chassis. Five separate controls plus fine tuning ring on channel selector. Clean design, superb performance.

Model 14723 $79.95 less C.A.T.

5 tube radio DYNAMIC DEMONSTRATOR

mounted on easy-to-read schematic board

A complete radio education in one project. Consists of a 5 tube superhet radio mounted on a large demonstration board. Clearly illustrates circuitry and the functions of the components.

Model DDS $39.95

10 project EXPERIMENTERS KIT

10 PROJECTS ONLY $13.95

Educational, practical. Build a radio receiver, phone-microphone amplifier, broadcast station, signal tracer, electronic timer, five other projects. Teaches functions of circuitry while you have fun building. With detailed 12 pg. instruction manual, all prices 5% higher west of the Mississippi

For complete catalogue of ARKAY KITS write today to:
ARKAY
88-06 Van Wyck Expressway, Richmond Hill 18, N.Y.

AM-detecter in AM and AM-FM receivers. The pentode can also be used as an rf amplifier; the diode for automatic volume control. The only difference between the two tubes is in their heater ratings. The 6E07's heater is rated at 6.3 volts, 200 ma. The 12E07 at 12.6 volts, 150 ma.

Maximum ratings of the pentode section of these RCA tubes when used as a class A1 amplifier are:

- $V_o$ (positive value) 300
- $V_o$ (negative value) 300
- $V_o$ (pos bias value) 0
- $V_o$ (neg bias value) 50
- $P_r$ (watts) 3
- $G_{2\text{out}}$ (mw) 200
- $G_{2\text{out}}$ (for G2 voltages up to 150) (mw) 600

The diode section of the 6E07 is rated at 1-ma maximum plate current.

2N734, 2N735, 2N736

A group of general-purpose, n-p-n double-diffused silicon mesa transistors

2N734, 2N735, 2N736

with a beta range that starts at 20 (minimum for the 2N734) and goes on up to 200 (maximum for the 2N736). All have a free-air dissipation rating of 500 mw and a high breakdown voltage.

LEADER TEST INSTRUMENTS

new "LEADER" test instrument

LAG-55 AUDIO GENERATOR SINE SQUARE

A multi-purpose generator for measurements on audio equipment -amplifiers, speakers, networks. Three waveforms: sine, square and complex for all types of measurements including response, distortion, transient and 1-M distortion checks. Full range is from 20 to 200,000 cps, output 5 volts with minimum amplitude variation throughout whole range.

The LEADER test instruments are being used in the more than 36 countries, attesting their excellence in design, performance and usefulness.

OHMATSU ELECTRIC CO. LTD.
2596, 5-CHE ME, KAMIMEGURO, MEGURO-KU, TOKYO, JAPAN

Cable Address 'OHMATSUELEC' TOKYO

OUT OF SPACE? You bet we'd like to - if we were to tell you all about AUDION's "Out of this World Hi-Fi Valves!" Write for free Catalog

85% higher west of the Mississippi

SPECIAL PACKAGE DEAL QUOTE
No sale too small. Trades accepted. BONAFIDE offers biggest discounts on all standard brands. Expert advice always given.

BONAFIDE ELECTRONICS

Dept. RE-10, 80% Cortland St., N.Y. 7, N.Y.

WE WILL NOT BE UNDERSOLD

www.americanradiohistory.com
Maximum ratings for these Texas Instruments transistors are:

- \( V_C = 735 \) (new ratings)
- \( V_C = 736 \) (high ratings)
- \( h_{fe} = 5 \) (5 ma), (1 ke)

The diagram shows a simple cascaded audio amplifier using the 2N736. It has a typical current gain of 92 db at 1 ke.

10-Pin Tubes

A new construction in miniature receiving tubes is the 10-pin envelope announced by Sylvania. The unit uses the regular 9-pin arrangement (like the 12AX7 or 12AU7) with an additional pin centered in the pin circle. The first tubes to use the new design are a double tetrode for use as an rf amplifier, oscillator-mixer in FM tuners and receivers. Another unit will be a triode for use as an rf amplifier, oscillator-mixer and afe.

7262-A

A 1-inch camera tube (vidicon) intended for use in small, compact, transistorized television cameras. It can be used for televising black-and-white or color scenes in industrial and other closed-circuit TV applications. The high sensitivity of the tube makes possible high-quality pictures under normal room lighting conditions. The sensitivity of the 7262-A can be expressed as equivalent to a photographic film with an ASA exposure index of 600.

New Xcelite "Seizer"?

Handy as an extra hand or helper. Clamps tightly or lightly ... for moments or minutes.

Special Offer 25c

Hear these
authentic recordings
of dramatic events
from
"The Amazing World of
Short Wave Listening"
read by Alex Dreier, Radio-TV "Man on the Go"
- President's voice from outer space
- Actual capture of a desperate criminal
- Radio amateur at Little America
- Ships at sea...aircraft in action!

S-38E
receiver
$59.95

New Xcelite "Seizer"?

Outreach, out-holds needle-nose pliers. Handy a spot too small for it. Approx. 6" long. Dazzling of uses: Holds and positions wires for soldering, retrieves small parts from inaccessible places, it's a heat sink. Two-position snap-lock won't slip, yet releases with a twist of the fingers. All stainless steel — precision machined and tempered for smooth action and years of service.

2 Models: No. 43H curved nose and No. 42H straight — Ask your distributor to show you Xcelite Seizers today.

www.americanradiohistory.com
Is Your Library of Tung-Sol Tips Up To Date?

So far there have been ten issues in Tung-Sol’s free monthly series of Tung-Sol Tips. Each one contains important technical information for servicemen who want to get more of the lucrative industrial electronics service business. If your library is not complete here is your opportunity to bring it up to date. Or perhaps you have not yet subscribed to Tung-Sol Tips. If that’s the case this is the time to get your name on the mailing list. The service is free, the only cost is the 4¢ stamp you’ll use to send us your name. New subscribers will get all back issues.

Tung-Sol Tips is edited to give servicemen a broad understanding of electronic components and their use in industrial equipment. Everything from theory of operation to application, installation and maintenance is covered. Tips is another of the many services which Tung-Sol offers to help servicemen expand their businesses.

So if you are not yet on the mailing list or if you have missed out on any of the first issues get in touch with your Tung-Sol distributor or write directly to Tung-Sol Electric Inc., Newark 4, N.J.

Sales Offices: Atlanta, Ga.; Columbus, Ohio; Culver City, Calif.; Dallas, Texas; Denver, Colo.; Detroit, Mich.; Irvington, N. J.; Melrose Park, Ill.; Newark, N. J.; Philadelphia, Pa.; Seattle, Wash.

Canada: Toronto, Ontario.

These 10 Important Subjects Should Be In Your Tung-Sol Tips Library

1. Semiconductor Rectifiers
2. Gas-Filled Rectifiers
3. Theory of Thyatron Operation
4. Practical Applications of Thyatrons
5. Photo-electric Theory and Operations
6. AC Amplifiers
7. Practical Applications of AC Amplifiers
8. DC Amplifiers and Choppers
9. Mobile Equipment Communications
10. 11-Meter Band Citizen’s Communications

Back copies are available, write for those you want.

Soon to be on its way to subscribers, No. 11 is devoted to DC Power Supplies.

TUNG-SOL®
UP TO FOUR TIMES THE WORKING DISTANCE OF CARDIOD TYPES* with the Electro-Voice model 644 sound spot

Of all the audio problems confronting sound engineers, one of the most difficult to overcome is the use of microphones in spacious areas. Churches, auditoriums and amphitheaters present formidable problems in room acoustics and reverberation which degrade audio quality. Consequently, microphones cannot be placed at conventional distances from the source of sound. Under such conditions, loss of level and "presence" further add to the enigma of proper pick-up. The Model 644 Sound Spot is the answer. Here is a microphone providing acceptance within an included angle of 90° at high frequencies, high axial sensitivity, wide frequency response extending from 40 to 12,000 cps and excellent wind noise cancelling characteristics. Its highly directional feature permits unusual microphone working distances as well as startling flexibility in loudspeaker placement. Effective cancellation of sound at the rear and sides for unparalleled rejection of random noise, reverberation and feedback without frequency response loss. See Polar Pattern. Stop at your Electro-Voice distributor today and let him demonstrate the Model 644.

*Depending on Acoustical conditions.

Other features: Output level—53 db, 150 ohm and high impedance. Impedance changed by moving one connection to connector. Low impedance only: line balanced to ground and phases. Acoustalloy diaphragm, shielded from dust and magnetic particles. Non-welded circuit with Alnico V and Ferro magnetic iron. Pressure cast case, 3/16" thread. Satin chrome finish, 10 ft. cable with MC4M connector ON-OFF switch. Size: 7/8" diam. 16" length. Net Wt.: 2 lb. 9 oz. less cable. List Price $110.00. Desk stand available (extra).
RCA Kits

FOR VALUE, QUALITY AND PERFORMANCE!

RCA WV-38A (K)
VOLT-OMH-MILLIAMMETER

$29.95* (includes batteries, probe and cable with slip-on alligator clip, ground lead and clip, assembly and operating instructions) (available factory-wired and calibrated—only $43.95*)

Exclusive features make this RCA VOM kit the buy of a lifetime! Extra 1-volt and 0.25 volt (290 mv) ranges for wider usage in transistor servicing—new handle clip accommodates probes and test leads for extra carrying convenience. Assemblies in a breeze.


SPECIFICATIONS: Input Resistance—20,000 ohms per volt on DC; 5,000 ohms per volt on AC. Accuracy—±3% DC; ±5% AC (full scale).—Regular Scales—2.5, 10, 50, 250, 1000, 5000 volts, AC and DC, 50 uA; 1, 100, 500 ma, 10 amps DC. Extra Scales—250 mv and 1 volt (dc). Frequency Response—AC flat from 10 cycles to 50 kc usable response at 500 kc. OHms—3 ranges: Rx1—(0.2-2,000 ohms); Rx100 (0-200,000 ohms); Rx10,000 (0-20,000,000 ohms) Dimensions—W. 5/8", H. 6 1/2", D. 3/4".

RCA WO-33A (K)
3-INCH OSCILLOSCOPE

only $79.95* (complete with Low-Cap, Direct Input Probe and Cable) (also available factory-wired and calibrated—only $129.95*)

The first 'scope kit with 'get-up-and-go!' Use it for practically everything—video servicing, audio and ultra sonic equipment, low level audio servicing of pickups, mikes, pre-amps, radios and amplifiers, troubleshooting ham radio, hi-fi equipment, etc., and you can take it with you, on the job anywhere.

FEATUREING: voltage-calibrated frequency-compensated, 3 to 1 step attenuator—scaled graph screen and calibrating voltage source for direct reading of peak-to-peak voltages—"plus-minus" internal sync—holds sync up to 4.5 kc—shielded input cable with low capacitance probe included—weights only 14 pounds—includes built-in bracket to hold power cord and cables.

SPECIFICATIONS: Vertical Amplifier (Narrow Band Position)—sensitivity, 3 rms mv/inch; Bandwidth, within 3 db, 20 cps to 120 kc; Vertical Amplifier (Wide Band Position)—sensitivity, 100 rms mv/inch; Bandwidth, within 3db, 5.5 cps to 5.5 kc; Vertical Input Impedance—At Low-Cap cable input—10 megohms, 10 uf (approx.); At Direct-Cable Input—1 megohm, 90 uf (approx.). Sweep—Circuit—Sweep Range, 15 cps to 75 kc; Sync, external, ± internal; Line Sweep, 160° adjustable phase.

RCA WV-77E (K)
VOLTOHMYST®

only $29.95* (also available factory-wired and calibrated only $42.95*)

Think of it—an RCA Voltohmyst Kit at this low, low price! You get famous RCA accuracy and dependability, plus the easiest to assemble kit you’ve ever seen!

FEATUREING: ohms-divider network protected by fuse—ultra-slim probes and flexible leads—sleeve attachment on handle stores probes, leads, power cord—separate 1/2 volt rms and 4 volts peak-to-peak scales for accuracy on low ac measurements—front-panel lettering acid-etched.

SPECIFICATIONS: Measures: DC Volts—0.02 volt to 1500 volts in 7 overlapping ranges; AC Volts (rms)—0.1 volt to 1500 volts in 7 overlapping ranges; Resistance—from 0.2 ohm to 1000 megohms in 7 overlapping ranges. Zero-center indication for discriminator alignment—Accuracy—±3% of full scale on dc ranges; ±5% of full scale on ac ranges—Frequency Response—Full within ±5%, from 40 cycles to 5 Mc on the 1, 5, 15, 50 mc and 500 mc ranges and the 4, 14, and 40 volt peak-to-peak ranges—DC Input Resistance—standard 11 megohms (1 megohm resistor in probe).

*User Price (Optional)

See them all at your local RCA Test Equipment Distributor!

RADIO CORPORATION OF AMERICA
ELECTRON TUBE DIVISION
HARRISON, N. J.

NEW PRODUCTS (Continued)

control, push-to-talk button, telescoping antenna. Kit or wired, carrying case and shoulder strap. —Heath Co., Benton Harbor, Mich.


ALL-CHANNEL TUNER for crystal-controlled Citizens-band receivers. Plugs into receiver in place of crystal.

No batteries or power source needed. 2-inch vernier dial. 2 x 4 x 4 inches—Crowe Electric Products Co., PO Box 171, Orange, N. J.

AUDIO-GENERATOR, model 605. Sine-, square-wave output. 20 to 200,000 cycles. Pushbutton range selection. Schmitt trigger circuit supplies square wave. Output voltage: sine wave 0 to 5

(rms), square wave 20 mv to 7 (peak to peak). Less than 1% distortion on sine wave. Square-wave rise time 0.2 usec.—Jackson Electrical Instrument Co., 124 McDonough St., Dayton, Ohio.

AC VTVM model 715, 10 ranges up to
NEW PRODUCTS (Continued)

300 volts full scale. Low range 10 mv full scale. Accuracy 5% of full scale.

Response 10 to 400,000 cycles ±1 db. Db markings on scale, range switch.—Simpson Electric Co., 5200 W. Kinzie St., Chicago 44, Ill.

CAPACITOR ANALYZER, Transcap model TCA-1, for low-voltage low-leakage tantalum and aluminum electrolytic capacitors as well as other low-voltage units. 5 ranges cover 1 µf to 2,000 µf.

Meter reads insulation resistance from 50 to 20,000 megohms and leakage current down to fractional microamps. Power factors measured by Wien bridge from 0 to 50%—Sprague Products Co., 335 Marshall St., North Adams, Mass.

REACTANCE RULE solves resonant-frequency, inductive-reactance, capacitive-reactance, coil-Q and dissipation-factor problems. Frequency range 5 cycles to 10,000 mc. Re-issued.—Shure Brothers, Inc., 222 Hartney Ave., Evanston, Ill.

STEREO CARTRIDGE model 9T. Turnover ceramic type. Smooth distortion-free response. Response 20 to 17,000 cycles ±1 db. Compliance 3.5 x 10⁻⁶ cm/dyne. Low tracking force (2 grams for pickup arms, 3 grams for changers) reduces stylus wear, in—(Continued on page 106)

M A S T E R GUIDE TO TIME-SAVING TV SERVICE

This "automatic teacher" TAKES THE GUESSWORK OUT OF TV TROUBLE-SPOTTING AND REPAIR!

Covers all causes of practically every trouble you are likely to be called on to fix including:

- BRIGHTNESS TROUBLES—CONTRAST TROUBLES—PICTURE DISTORTION—UNSATISFACTORY PICTURE DETAIL—LINE OR BARS IN PICTURE—SYNCHRONIZATION TROUBLES—MISSING PICTURE—SIZE AND CENTERING TROUBLES—SOUND TROUBLES—TELEVISION INTERFERENCE, ETC.

It isn't a "study" book! From beginning to end, this big new manual is designed for daily use right at the bench as an outstandingly complete, easily understood guide to practically any job on any TV receiver.

Just turn to the index. Look up the trouble symptoms exhibited by the TV you're working on. The HANDBOOK OF TV TROUBLES then tells you exactly what and where to check. Outlines time-saving short cuts. Explains puzzling details. Eliminates guesswork and useless testing. More than 150 test patterns, wave form and circuit illustrations explain test results and procedures so clearly you can hardly fail to understand.

LOOK! LISTEN! Then Follow This Easy Guide!

Almost regardless of set make or model, this remarkable new 302-page Handbook helps you track down TV troubles from the symptoms they produce in the set itself—screen intermittently dark; "blooming"; abnormal control in spots; "snow"; poor detail; sync troubles; sound troubles—and all the many other symptoms that indicate something is wrong. Then it explains how to make needed adjustments or parts replacements.

HANDBOOK OF TV TROUBLES is printed in large type and has sturdy, varnished covers for "use the job" use. Its QUICK GUIDE TV TROUBLE INDEX helps you find what you want in a jiffy. Throughout, the Handbook is a real time-saving money-saver for beginners and experienced service men alike! Try it for 10 days at OUR RISK. Price $7.50.

TRI IT — YOURSELF!

This Easy TV TROUBLE-SPOTTING Guide!

A modern manual for fast, "symptomatic trouble analysis" and servicing of TV receivers.

SERVICEMEN KNOW! Here they pay less and get the best

HUSH ®

Chemically-Electronically, engineered for Tuners and Switching Mechanisms.

When New HUSH is applied it will wash-away that dirt, leaving clean and positive contacts protected by a lasting lubricant, New HUSH is made from the finest solvents and it contains Electro-Silicone oils. Also available—2 oz. 8 oz., 32 oz. containers

6 oz. Spray can $2.25 net

EVER - QUIET ®

Since 1949

VOLUME CONTROL AND CONTACT RESTORER EVER QUIET is a free-flowing liquid that leaves no powder residue. Scientifically designed to keep away the dust and prevent wear and tear to the control or potentiometer, cleaning the contacts and leaving a safe protecting film. Harmless to metals, wire or paper. Also available—32 oz. containers

6 oz. Spray can $1.59 net

2 oz. Bottle & dispenser 79c net

CHEMICAL ELECTRONIC ENGINEERING, INC. Matowan, New Jersey

OCTOBER, 1960
A Home Study Program for Engineering Technicians and Professional Engineers Comparable in Technological Content to College-Level Electronics Residence Courses.

CREI's Extension Division offers combinations of courses in advanced electronics engineering technology to meet present or future employment requirements, and step up your earning power.

A CREI program, the product of 33 years experience, is neither short-cut nor magic formula. It is an accredited home study curriculum which may take as little as 18 months, or as much as 3 years, depending upon the course selected and amount of stick-to-itiveness brought to bear. The program is designed specifically for men employed in a technical capacity in the electronics industry, where a shortage of manpower with advanced technical education not only exists, but shows every likelihood of increasing.

Now fifth in volume among American industries, the electronics industry offers almost unlimited employment and advancement opportunities. Applications of new electronic developments in automation, instrumentation, industrial electronics, aeronautical electronics, guided missiles, servomechanisms, computers, astronautics and tele-metering create new jobs every day. Yet, paradoxically, industry growth does not always mean individual growth. Companies actively seeking men with modern, advanced technological knowledge are simultaneously firing mediocre men who lack this knowledge.

CREI students (more than 20,400 are currently enrolled) keep pace with the needs of the ever-advancing electronics industry and are eagerly sought by employers who offer solid opportunities for rapid promotion.

Since 1927 we have directed the technical education of students in advanced electronics engineering technology. We developed the prototype civilian electronics course for the Army Signal Corps in 1941, supplied 300,000 texts to the U. S. Navy in a special course for radio technicians in the South Pacific in 1943, trained hundreds of technicians during World War II for the Signal Corps. We co-founded...
the National Council of Technical Schools, which first established scholastic and business standards for the technical school field. We were among the first three technical institutes whose curricula were accredited by the Engineers' Council for Professional Development. In 1946 we instituted the group training programs used by companies representing the cream of the electronics and aviation industries. CREI courses are widely employed today in company-sponsored educational plans by companies throughout the U.S. and Canada.

What does this record of achievement mean to you as a CREI student? It means that industry and the Armed Services alike respect CREI men. It means that your CREI diploma is a door-opener. Significantly, Help Wanted ads often specify "CREI education or equivalent required." Our Placement Bureau, which helps graduates and advanced students find more desirable positions, is always available to CREI men. While no placement guarantees will be made by CREI or any other reputable institution, for many years the demand for CREI graduates and advanced students has far exceeded the supply.

CREI HOME STUDY ADVANTAGES.

This advanced technical education is accomplished on your own time, during hours chosen by you. You waste no time in travel. You have plenty of time to do your best. Your work is under the supervision of a regular staff instructor who guides your progress step by step. Courses are prepared and taught by men experienced both in teaching and in electronics, presented in easy-to-understand form, kept up to date by periodic revision. Experience in more than three decades of home-study teaching, during which time we have corrected and commented on many hundreds of thousands of examinations, enables us to anticipate questions in our lesson material.

CREI STUDENTS are professional electronics engineers and technicians, all over the world and in every phase of electronics, about one-third military, the rest civilian. Their median age is 28. In 1958 they devoted approximately 1,572,400 hours to 104,831 lesson texts, answered and were individually graded upon 1,048,310 searching questions and engineering problems. They studied advanced electronics engineering technology associated with transistors, microwaves, forward scatter, computers, servomechanisms, radar, electronic navigational devices and the entire field of modern electronics. New students enrolled during the year are on the missile ranges of Vandenburg AF Base and Cape Canaveral. They are at Almagordo and China Lake, at SAC bases around the world. They are in the research laboratories and manufacturing plants where the latest electronic equipment is designed and produced. They maintain electronic equipment for United Air Lines, and Trans-Canada Air Lines. They share in electronics at All America Cables and Radio, Inc., and The Martin Co. They work for USIA (Voice of America) and Columbia Broadcasting System, for Gates Radio and Federal Electric, to name but a few. All of the firms mentioned offer their personnel CREI education under company sponsorship. CREI men are found by the hundreds among field engineers of major electronic manufacturers. They're across the world and across the street. They're men you'll compete with—to gain or hold your place in the electronics profession.

If ambition is part of your make-up—if you want to convert interest and energy into dollars of income—if you want to convert your spare evening hours into material benefit and the personal satisfaction that comes with advancement and respect of your associates—then CREI's home study education assures you of:

1. A solid foundation of college-level, advanced technical electronic engineering knowledge.
2. A means of keeping abreast of the complex developments in electronics.
3. The ability to communicate intelligently with your engineering associates and superiors.
4. The best preparation for professional advancement in electronics as the industry demands.

QUALIFICATIONS FOR CREI. College degree is not essential. If you have had basic electronic education, practical experience in electronics and a high school education, you can probably qualify. A good way to find out: Use the postage-paid card. It will bring you the free 54-page book which has launched thousands on their advanced careers: "Insurance for Your Future in the New World of Electronics." Tuition is reasonable and may be paid monthly. It takes just one $10-a-week raise to repay your investment in CREI education and leave you a substantial bonus the first year. Available to veterans under GI bill.

RESIDENCE SCHOOL in Washington, D.C. for those who can attend classes. Day and evening classes start at regular intervals. Qualified graduates earn AAS degree in approximately 27 months. Electronics experience not required for admission.

CAPITOL RADIO ENGINEERING INSTITUTE
ECPD Accredited Technical Institute
Curricula: Founded 1927
Dept. 1410-G
3224 16TH ST., N.W.
WASHINGTON 10, D.C.
If you are a career-minded engineer or technician . . .

RE-DIRECT your future aims to high standing in NUCLEAR ENGINEERING technology

Learn Nuclear Engineering Technology through an advanced home study program offered by CREI ATOMICS. Enrollment is limited.

ONLY A LIMITED NUMBER OF MEN will be accepted at this time for this program of home study offered by CREI ATOMICS, an expertly-staffed extension division of The Capitol Radio Engineering Institute. U.S. Atomic Energy Commission states about the severe shortage of trained people in nuclear technology: "... the immediate goal is to retrain, through short courses . . . those already grounded in traditional disciplines." Through CREI ATOMICS you can now combine your present technical education and engineering experience with knowledge in nuclear engineering and technology. The result: increased career opportunities and corresponding income advantages as the nuclear field develops.

Program of study includes—
Nuclear Physics, Reactor Physics, Thermodynamics, Reactor Technology, Reactor Controls, Instrumentation for Reactor Control, Isotopes, Health Physics—many other subjects

NEW PRODUCTS (Continued from page 101)


ORGAN TUNER uses spinning stroboscopic disc. AutoTuner tunes most electronic organs in minutes. 6¾ x 5¼ x 2¼ inches. Microphone included.—Schober Organ Corp., 43 W. 61 St., New York 23, N. Y.

SUPER TWEETER T-802. Response 3,000 to 40,000 cycles (to 22,000 cycles ± 2 db). Dispersion 120° in all directions. Power 30 watts. Built-in crossover and brilliance control. Impedance 8 ohms.—University Loudspeakers, Inc., 80 S. Kensico Ave., White Plains, N. Y.

HORN TWEETER, Tempo High Note. 2 x 6-inch horn loaded compression type. Shielded magnetic circuit, wide-angle sound dispersion.—Oxford Components, 556 W. Monroe St., Chicago 6, Ill.

SPEAKER - Baffle combination uses Magni-Magic inverted speaker. 4 series: (1) speaker and baffle; (2) speaker, baffle, volume control; (3) speaker, baffle, control, 70-volt transformer; (4) speaker, baffle, transformer. Blond, mahogany, walnut. 8-inch, 5-watt, 8-ohm speaker. Screw terminals.—Utah Radio & Electronic Corp., 1124 E. Franklin St., Huntington, Ind.

TRIHELIX SPEAKER SK-180. 3 independent speakers on single frame. To minimize interaction, smaller speakers mounted off-center. Built-in crossover network with brilliance control. Overall response 20 to 20,000 cycles (30 to 12,000 cycles ± 3 db).—Lafayette Radio Corp., 165-08 Liberty Ave., Jamaica 33, N. Y.

SPEAKER SYSTEM model XP-2. Two 8-inch woofers, 5-inch tweeter. Response 35 to 15,000 cycles. Built-in crossover network. 22 x 12 x 11¼ inches. High compliance plus high efficiency. Enclosure filled with Acoustiglas to eliminate panel resonance. Birch, cherry, walnut, mahogany.—Fisher Radio Corp., 21-21 44th Dr., Long Island City 1, N. Y.

SPEAKER ENCLOSURE model 6. Unfinished. Cutout for 8-inch speaker; sound-reinforcing ports. 10 x 16 x 9 inches. ½-inch plywood, sanded on top and sides. Damping material installed. —Homewood Industries, 26 Court St., Brooklyn, N. Y.

USE THIS COUPON TO REQUEST DETAILED CATALOG

CREI Atomics 1410-G
3224 16th Street, N.W.
Washington 10, D.C.
Please send me complete information about CREI ATOMICS.
name__________________________
street__________________________
city________ state________
job title__________________________

www.americanradiohistory.com
NEXT MONTH

LOOK FOR THESE FEATURE ARTICLES IN

Radio-Electronics

HI-WAY FM — THE EASY WAY
You can buy an FM radio for your car—but the monthly payments for some of them come pretty high. There's an easier way—do it yourself. You can build this sensitive and selective FM car tuner, using a low-priced commercial set or an FM kit as the basic unit.

HOW TO FIX RADIOS FASTER AND BETTER
The Old-Timer insists he can diagnose the trouble in any radio receiver in five minutes—and he proves it! He says, "The only way to make money in radio repair is to fix 'em fast, but good!" You can learn—and earn a lot from the tips he gives you.

MORE EFFICIENT PA SYSTEMS
Listen as an old PA man tells how a few tricks can make amplifiers sound better and increase their power-handling ability. This one will make your PA work—a lot easier—and more profitable.

SIMPLE SWEEP GENERATOR USES VARICAP
Make your old sig gen into a sweep generator. It's easy using one of the new variable capacitance diodes. You can combine varicaps and inductances to give any desired deviation up to 600 kc.

ALL THIS AND MORE IN RADIO-ELECTRONICS NOVEMBER ISSUE ON SALE OCTOBER 20 • RESERVE YOUR COPY NOW.
1 year $4 • 2 years $7 • 3 years $10

ON OCTOBER 31st RATES GO UP TO
1 year $5  2 years $9  3 years $12

Radio-Electronics
154 WEST 14th STREET • NEW YORK 11, N. Y.

ON OCTOBER, 1960
...the world's standard wherever sound quality and dependability are paramount.

The prime purpose in the design of every Shure microphone is faithful sound reproduction. All are painstakingly designed, developed, manufactured and tested for flawless performance coupled with longest possible trouble-free service. Regardless of price, they will perform according to specifications and will operate for years without deviation from their original standards.

MICROPHONES FOR EVERY APPLICATION— IN EVERY PRICE RANGE

NEW UNIDYNE III
World's most compact probe type microphone with truly cardioid unidirectional pick-up pattern. Only 5⅝" long. Dual impedance, superb response. Can be transferred from stand to hand instantly—without tools. $51.00 Net.

UNIDYNE
World famous dynamic microphone. Most widely used indoor- outdoor uni-directional microphone. Specified by leading sound engineers, and most requested by celebrities. $49.80 to $81.00 Net.

COMMANDO
Controlled magnetic omni-directional. A significant achievement in quality sound at nominal cost. Can be handheld, worn around neck, put into stand or withdrawn instantly, without tools. $16.50 to $23.10 Net.

The versatile MULTI-PROBE DOES THE WORK OF 4 PROBES!

DC Probe
AC/Ohms Probe
RF Probe
Lo-Cap Probe

Now for the first time—distance with MERCURY— a MULTI-PROBE that does all the work of 4 different probes. Functions: DC position... matches VTVM input impedance... AC/Ohms position... for all low frequency, low impedance, voltages and wave forms... RF position... a demodulator for checking RF voltages, wave forms and signals and TV, radio RF and IF stages... Lo-Cap position... a must for high impedance, TV sync and radio circuits where regular probes overload the circuit.

TAPE RECORDERS, model 101 (shown) plays, records half-track monophonic. Response 50 to 12,000 cycles at 7⅛ ips. 5 transistors, 2 tubes. Model 262-SL plays 4-, 2-track stereo; records ¾-track monophonic. Response 30 to 18,000 cycles at 7⅛ ips. Model 262-D deck same specifications as 262-SL. All 117 volts, ac-operated. — Superscope, Inc., 8150 Vineland Ave., Sun Valley, Calif.

TAPE-PLAYER KIT model AD-70 for prerecorded 4-track stereo tapes. For use with separate stereo preamplifier. Single control selects stop, play, rewind, fast-forward. Mounts vertically or horizontally. Flutter and wow below 0.35%, harmonic distortion less than 2%. Finished, unfinished bases available.—Heath Co., Benton Harbor, Mich.

PORTABLE RECORDER model MR511 works on 7 AA-size cells, house current or 12-volt auto systems. Plays 1½ hours at 1⅛ ips. 3-inch reels. Transistorized. 7 pounds, 3 x 6⅝ x 10⅜ inches. '61 line ranges from stereo recorder-players to monophonic models for home use.—Teletronics Corp., 35-18 37 St., Long Island City 1, N.Y.

TURNTABLE AND ARM Realistic

Shure Brothers, Inc., 222 Hartrey Avenue, Evanston, Illinois
NEW PRODUCTS (Continued)


HIGH-FIDELITY pickup arms and turntables. ST-33 turntable (shown): hysteresis-synchronous motor, 4 live-rubber shock absorbers, polyurethane drive belt. ¼-inch steel mounting plate has hole for pickup arms. PK-33 turntable similar in kit form. 212 series arms dual-viscous-damped. Kits available.—Gray Manufacturing Co., 16 Arbor St., Hartford 1, Conn.

CABINET KIT model CK-14. Elliptical port broadens frequency response.

No source separation between high, middle, low frequencies.—Lafayette Radio Corp., 165-08 Liberty Ave., Jamaica 33, N.Y.

ANTENNA TOWER No. 55. Rigidity and strength in heights up to 450 feet. 10-foot hot-dipped galvanized sections constructed on 18½-inch triangular pattern.—Rohn Manufacturing Co., 6718 W. Plank Rd., Peoria, Ill.

TARZIAN TUNERS

Noted for their DEPENDABILITY ...HIGH QUALITY and LOW COST

That's why the world's leading set manufacturers rely on the trouble-free TARZIAN TUNER for the excellent performance of their receivers.

Today TARZIAN TUNERS are backed up by more than 15 years of experience in the design ... development ... and production of more than 15 million TV Tuners.

And, Tarzian is the only commercial manufacturer offering both the HOT ROD (turret-type) and SILVER SEALED (switch-type) ... as well as the newer Hi Fi FM Tuner. All embody the high standards of QUALITY ... DEPENDABILITY ... and PERFORMANCE that have made Tarzian a leader in the field.

For more information, write to: Sales Department Tuner Division

SARKES TARZIAN INC

east hillside drive • bloomington, indiana

Manufacturers of Semiconductors, Air Trimmers and Broadcast Equipment

END

All specifications are from manufacturer's data

OCTOBER, 1960
BECOME A RADIO TECHNICIAN
for only $26.95
BUILD 20 RADIO CIRCUITS AT HOME
with the New Progressive RADIO "EDU-KIT®"
All Guaranteed to Work!

PRACTICAL
HOME
RADIO
COURSE
NOW INCLUDES
* 12 RECEIVERS
* 3 TRANSMITTERS
* SQ. WAVE GENERATOR
* AMPLIFIER
* SIGNAL TRACER
* SIGNAL INJECTOR
* CODE OSCILLATOR

FREE EXTRAS
* SET OF TOOLS
* RADIO & ELECTRONICS TESTER
* ELECTRIC SOLDERING IRON
* TESTER INSTRUCTION MANUAL
* "HOW TO DRIVE AMATEUR RADIO" COVERED IN H.I.G.U.
* QUIZZES & TV BOOK & FCC AMATEUR LICENSE TRAINING
* FREE INSTRUMENTS 
* ALIGNMENT TOOL & WRENCH SET 
* CERTIFICATE OF MERIT

WHAT THE "EDU-KIT®" GIVES YOU
The "EDU-KIT®" offers you an outstanding PRACTICAL HOME RADIO course at a ridiculous price. Out kit is designed to train Radio & Electronics Technicians, making use of the most modern methods of home training. You will learn through constructive, serviceable R.C. and TV repairs, under FCC amateur supervision.
You will learn how to identify radio symbols, how to read and interpret schematic diagrams, how to make and check simple circuits, and under your guidance, how to operate electronic equipment, how to build radio, TV and other communications equipment. Today it is no longer necessary to spend hours in long, expensive, overcrowded classrooms. You will receive a radio education in your home. We are sure that you will enjoy the "EDU-KIT®" as your hobby, business or job; it is the best value on the market.

THE KIT FOR EVERYONE
The Progressive Radio "EDU-KIT®" was specifically prepared for any person who has a desire to learn Radio. The "EDU-KIT®" has been used successfully by young and old in all parts of the world, by radio clubs, schools and colleges, as well as by the U.S. Army and Navy, and representatives of Armed Forces Personnel internationlly.

THE EDUCATION REQUIRES NO INSTRUCTOR. ALL INSTRUCTIONS ARE INCLUDED. EVERY STEP IS CLEARLY EXPLAINED. YOU CAN'T MAKE A MISTAKE.

PROGRESSIVE TEACHING METHOD
The Progressive Radio "EDU-KIT®" is the foremost educational radio kit in the world. It is so efficiently constructed as to be the standard in all schools, colleges, and radio schools throughout the United States. It is the only kit in the world that is so constructed that a person is taught through a logical, step-by-step method, learning the radio principles as he builds the circuits. This method is based on actual practice in radio and television sets. The student gradually builds a complete radio, adding parts as he progresses.

UNCONDITIONAL MONEY-BACK GUARANTEE
The Progressive Radio "EDU-KIT®" has been sold to many thousands of individuals, nationally and internationally throughout the world. It is guaranteed internationally as the ideal radio course. If it is not popular among the Progressive Radio "EDU-KIT®" Student, the price will be refunded in full, without question or obligation, and without delay. If it is not popular among the Progressive Radio "EDU-KIT®" Student, the price will be refunded in full, without question or obligation, and without delay.

ORDER FROM US-RECEIVE FREE BONUS RESISTOR AND CONDENSER KIT WORTH $1.00
Send "EDU-KIT®" Postpaid. Enclose full payment of $26.95.
Send "EDU-KIT®" pay by check or money order.
Send us FREE additional information describing "EDU-KIT®".

Silvertone 7140-A
Complaint was color fringing obviously caused by poor vertical dynamic convergence. When an attempt was made to adjust convergence, no response was obtained from the red or green horizontal phasing controls. The control circuit is shown in the diagram.

A scope check showed drive voltages being applied to the circuit, but that very little voltage was developed across the coils and trimmer capacitor. There was evidently a short or open in the circuit.

An ohmmeter check indicated no shorts or opens. Yet the 900-volt sine waveform refused to appear when the receiver was turned on. After a bit of wasted time, we discovered that the 25-280 µf trimmer would short under the applied ac voltage, though it checked out OK at the 1.5 volts applied by an ohmmeter.

The faulty trimmers were replaced, using units having a top range of 500 µf. This corrected the difficulty. We found that the top value of 280 µf in the original trimmers necessitated turning the adjusting screw down tightly to set the phase correctly. Because of the high compression force, the trimmers failed to hold up under stress of the high ac voltage.

Using replacement trimmers with a top value of 500 µf permitted correct phase adjustment without excessive compression.—Robert G. Middleton

PIX STREKS AND FLASHERS
Streaks and flashes in a television picture are often caused by a minor defect in the tuner—a dirty switch contact or wiper. This can usually be cured by spraying the contacts and wipers with a contact cleaner. Use a perfume atomizer to get a fine penetrating spray or try one of the new spray cans.—W. C. Warren

PHILCO MODEL UG3052-BL
This model often has a very noisy and defective tuner. The channels will not hold on station, sound is intermittent and, in extreme cases, there is no picture. A cursory examination of the tuner may lead the technician to diagnose the trouble as contact oxidation, or just plain dirty contacts and springs—but beware. Close inspection reveals that the tuner will not be repaired so easily. In fact, several jobs that crossed the bench led me to believe that the tuner was ready to fall apart. Anything in it you touched caused the set to cut out, with loss of most of the sound, and snow. You decide the tubes are defective or that a portion of the printed circuit is down under the surfboard, regardless of the steps taken to find the trouble, as soon as these receivers are plugged in and the station selector is turned to one of the local channels—the same old trouble!
CORONADO 15TV4

Complaint: No rater.

Cure: Check B-plus at pin 3 of the 25W4 damper. If it reads about 220 volts instead of the recommended 280, check for an open 0.47-μF capacitor from the screen grid of the 25BQ6 (the horizontal output tube) to ground. In one set with this trouble, both the horizontal oscillator and output transformers were singing and would have been suspect. However, a quick check showed normal voltages and waveforms in their circuits.—George D. Philpott

FORD 74BF

A stubborn ease of distortion in this auto radio hybrid was solved when we discovered the transistor bias control was set at maximum resistance. As emitter current was normal at this setting, it indicated an unusually sensitive transistor. When a more normal transistor was substituted and the bias readjusted, the distortion disappeared.—Chase Bass

THE TURNER 350C

Replace improper microphone designed specifically for citizen's band

This reasonably priced, mobile-type ceramic microphone is the perfect replacement for the many improper, tape recorder-type microphones now being used on CB equipment. Has DPST switch wired for relay operation with easily reversible terminals to allow modifications (if necessary); wiring diagram enclosed with each microphone; hanger button and standard dash bracket for mobile rig mounting; and an 11" retracted (five foot extended), plastic-jacketed, coiled cord. Response: 80-7,000 cps. Output: -54 db. List price: $16.50 complete. See your Turner Distributor, listed below. He has the 350C in stock.

Massachusetts
Boston: A. W. Mayer Company Radio Shack Corp.
Lowrence, A. C. Electronics
Michigan
Ann Arbor: Purchase Radio Supply
Detroit: High Fidelity Workshop
Lansing: Offenbacher Company
Missouri
St. Louis: Rodanics
New Jersey
Berlin: Madate Radio Supply
Jersey City: Nidisco-Jersey City
Mountainside: Federated Purchaser
New York
Buffalo: Radio Equipment Corp.
Farmingdale, L.I.: G & W Electronics
Forest Hills: Beam Electronics
Mt. Vernon: Davis Electronics
New York: Harvey Radio Company
Acme Electronics
Ohio
Cleveland: Pioneer Electronic Supply
Columbus: Whitehead Radio Company
Montpelier: Whiting, Inc.
Toledo: Lifetime Electronics
Oregon
Portland: United Radio Supply
Pennsylvania
Lancaster: George D. Barby Co.
Philadelphia: Radio Electric Service Co.
Reading: George D. Barby Co.
Wilkes-Barre: General Radio & Electronic
York: Radio Electric Service Co.
Texas
Houston: Sound Equipment Inc.
Virginia
Arlington: Rucker Electronic Products
Fall Church: The Television Workshop
Wisconsin
Chiwaukee Falls: Bushland Radio Sales
Eau Claire: Bushland Radio Supply
TWO POWER MEGAPHONES

Of the circuits shown, the 1-watt unit (Fig. 1) will be adequate in most uses. The input load impedance is the primary of an output transformer. The 4-8-ohm secondary is not used. The 6-watt megaphone (Fig 2) is very powerful and can be considered a deluxe model. Wiring and parts layout are not critical and both amplifiers are de-

---

TUBE REPLACEMENT GUIDE

EVERYONE who uses vacuum tubes NEEDS this new 1960 Expanded Edition TUBE GUIDE!

Contains over 4600 direct substitutions, including radio & TV receivers, tubes used in Hi-Fi & Stereo, foreign tubes and TV picture tubes.

All tubes suggested for substitution have characteristics similar to those they are to replace, FIT INTO SAME SOCKET & NEED NO WIRING CHANGE.

Two chapters cover complete listing of 738 TV Pix tube replacements including newest 110" tubes.

Substitutes given for over 414 foreign tubes, also lists 410 transistor substitutes. The only complete GUIDE featuring all receiving tube SUBSTITUTIONS WITHOUT SOCKET CHANGES ORREWIRING.

This valuable book will save you TIME & MONEY and permit operation even though original tubes are unavailable. Guaranteed Money Back in 5 days if Not Satisfied. Order from your Parts dealer or RUSH COUPON NOW! $1 Postpaid

---

Purchasing A HI-FI SYSTEM?

Send Us Your List Of Components For A Package Quotation

PARTIAL LIST OF BRANDS IN STOCK

Jim Lansing* Altec Lansing
Electrovoice Jensen
Hartley & Viking
University
Acoustic Research
Jensen
Whirlpool
USL Citizen Band
Gonset * Hallicrater
Texas Crystals
Cancercone
Bell & G.E.
Weathers
Harmar-Kordon
Eico * Pilot
Acroson
Quad Ampl & Spkr's
Quad Changer
Bogen
Dyotic * Fisher
H. H. Scott
Thorens * Sherwood
Peatons * Roberts
Ampex * DeWald
Sney * Taedberg
Challenger
Wallen
Garrard
Miracle
Glass-Evers
Rack-O-Kut
Components
Narloco
Fairchild
Picherley * Gray
Audio Tips
Magogard
Artison Cabinets
Rockford Cabinets
*Fair-Traded

All merchandise is brand new, factory fresh & guaranteed.

---

AIREX RADIO CORPORATION

64-RE Cortlandt St., N.Y. 7, CO 7-2137

---

---

---

---
NOTEWORTHY CIRCUITS (Continued)

signed for use with standard 6-volt lantern batteries. The transistors in the

MORE ON THE SNITCHER

After building the Snitcher described in the November 1959 issue (page 35), I decided to make a couple of changes.

6-watt version must be mounted on a heat sink.—Bendix Semiconductors

put considerably. I also wound a new coil with 104 turns of No. 36 cotton-covered wire close-wound on a 1/4-inch

form (Supercex C-1 or equivalent). The coil's tap is connected to the antenna and V3's collector. This increases stability

NOTEWORTHY CIRCUITS (Continued)

First I substituted a simplified amplifier-modulator unit. Then I decreased the value of R3, the oscillator base resis-

tor, to 74,000 ohms. This increased output

— VOLTAGE-LIMITED SUPPLY —

The diagram shows a simple regulated dc supply. The Zener diodes both rectify and limit the supply's output voltage. They are selected to act as clippers in combination with the potentiometer. This limits the voltage to which the capacitor can be charged. The arrange-

ment provides control of more power than could ordinarily be handled by

these Zeners and can be used wherever extreme regulation is not vital.—International Rectifier News END

GERNBACK LIBRARY

Low-cost, paper-covered books on all phases of TV, radio, audio-high

fidelity and practical electronics ON SALE AT ALL BETTER PARTS Dis-

tributors.

TV PICTURE TUBES

AT LOWEST PRICES

NEW TUBES

400/P 516.95 2126/P 322.95

1MW/P 16.95 2106/P 22.95

ALL ALUMINIZED: 128/P 15.95 219/P 26.95

108/P 5.75 178/P 59.95 212/A/P 157.75

12L/P 8.50 170/P 17.00 2167/P 17.75

16L/P 9.95 177/P 17.60 218/A/P 15.75

10L/P 12.00 187/P 13.50 218/A/P 15.75

16L/P 12.75 179/P 21.50 21/F/P 14.50

16L/P 14.50 170/P 9.95 2126/P 14.05

16L/P 9.95 177/P 17.60 218/A/P 15.75

16L/P 10.95 189/P 12.00 218/A/P 15.75

16L/P 12.00 189/P 21.00 21/F/P 14.50

17VP 12.50 212/A/P 15.75 27/F 29.95

1 year warranty

All tubes from factory sealed tubes supplied for 31V 6.50, 32V 7.00. Prices include the return of a similar tube f users, with same performance and grade. All tubes, and materials supplying the glass, and other parts of the tube, are guaranteed to pass our strict test before leave the factory. ALL TUBES IN STOCK.

Before you take time to make up a special cord to connect 2 units, check or write for Switchcraft Catalog S-590.

MARKING CONNECTING CORDS

Before you take time to make up a special cord to connect 2 units, check or write for Switchcraft Catalog S-590.

OVER 190 MOLDED CABLES WITH DIFFERENT TYPES CONNECTORS AND LENGTHS.

Stocked by

Electronic Parts, Musical and Photo

DISTRIBUTORS.

5579 N. Elston Ave., Chicago 30, Ill.


OCTOBER, 1960

www.americanradiohistory.com
"I've never been without PHOTOFACT..."

"I've never been without Sams PHOTOFACT folders. No service shop can afford to be without them. The schematics are complete with a world of other time-saving information."
—Hubert Hammett
Henderson, Texas

Service Technicians! YOU EARN MORE...
YOU RATE with the public when you own the PHOTOFACT service data library!

You enjoy maximum earnings as the owner of a complete PHOTOFACT Service Data Library! It’s inevitable, because no matter how expert you are, you can always save more time on any job, get more jobs done daily—EARN MORE, DAY IN AND DAY OUT...

What’s more—as the owner of a complete PHOTOFACT Library, you know your customers’ sets best. You can actually show each customer you have the PHOTOFACT Folder covering his very own set. Result: You command public respect and acceptance which paves the way to more business and earnings for you.

NOW IS THE TIME TO JOIN

THE POWERFUL NEW PROGRAM FOR QUALIFIED TECHNICIANS

If you now own a PHOTOFACT Library or plan to own one, you can apply for membership in “PEET.” It’s the first industry program really designed to build powerful public acceptance for the Service Technician who qualifies. Builds enviable prestige and business for its members. Benefits cost you absolutely nothing if you qualify. Ask your Sams Distributor for the "PEET" details, or mail coupon today.

"PEET"

HOWARD W. SAMS & CO., INC.
1726 E. 38th St., Indianapolis 6, Ind.

☐ Send me full details on the new "PEET" Program.
☐ Send full information on the Easy-Buy Plan and Free File Cabinet deal.
☐ I’m interested in a Standing Order Subscription.
☐ I’m a Service Technician ☐ full-time; ☐ part-time

My distributor is ____________________________

Shop Name ____________________________

Attn: ____________________________

Address ____________________________

City ____________________________ Zone State

TECHNICIANS' NEWS

NEW KC LICENSE LAW

The City Council of Kansas City (Mo.) passed a new ordinance regulating TV and radio servicing after the old one had been declared void in a suit brought against the city by The Electronic Association of Missouri (TEAM). The Honorable Tom J. Stubbs, presiding judge, had ruled that the old law was altogether too broad and unreasonable.

Judge Stubbs also said: "I think the ordinance is bad for a further reason...the Board of Examiners are directed to take into account the character and reputation of the applicant for a license and, as I construe the ordinance, may refuse to recommend an applicant for a license if the board concludes that his character is such that he shouldn’t have a license." The new ordinance makes no mention of character.

The old law applied to all electronic devices containing tubes, transistors or both. The new law pertains to "radio and/or TV receiving apparatus and associated components.

Service dealers and technicians are divided into three groups—Class One for both radio and TV servicing, Class Two for TV only and Class Three for radio alone. License fees are $10 annually for a technician and $25 for a service dealer.

The law also provides that customers must receive a copy of a bill showing the date(s) when work was performed; make, model and serial number of the set; full name and serial number of the licensee; name and address of the customer and the charge computation. The computation must specify what work was done and the amount charged for each part replaced. The dealer must keep his copy of the bill for 2 years.

WANT ASSOCIATION?

Those interested in forming a service association in Great Falls, Mont., are asked to contact LeRoy Peck, Peck’s Radio-TV, 1010 First Ave. South, Great Falls.

OFFICERS RE-ELECTED

Raymond G. Tuszynski was re-elected president of the Electronic Service Association of Butte, Montana. Harry Carroll was re-elected recording secretary; Kenneth Venner, treasurer; and Al Laurick, trustee. New officers are Mrs. Eileen Gies, corresponding secretary and Bjarne Johnson, trustee.

CLOSED-CIRCUIT INSTRUCTION

Closed-circuit TV was used by General Electric Co. for instructing a class of television technicians at Buffalo,
N. Y. One camera was used to bring into view intricate assembly operations and to scan meters, charts and oscilloscopes. One 17-inch color monitor and six 21-inch sets were used for the technicians. All service technicians in the Buffalo, N. Y., area (independent and G-E) were invited to attend.

Audience reaction was very favorable, according to Steven R. Mihalie, television service manager. "Giving each person a close-up view, even of waveforms and meter readings, established a close relationship between student and instructor and greatly facilitated an exchange of information," he said.

HESTER INJURED
Robert W. Hester, past president of NATESA, was seriously injured in a fall from a ladder while installing an air conditioner, according to The Hoosier Test Probe. His shop is located in Mission, Kan.

LICENSENNG CAMPAIGN
The California State Electronics Association is behind a massive signature campaign for state licensing. The program centers around a dummy ballot which is offered to technicians around the state. They are asked to indicate that they would vote for a state license bill and then sign their names. The ballots are then forwarded to State Legislators.

The ballot has the statement "As a registered voter of [county] I would support my vote, the licensing of radio and television technicians in the State of California" printed on it. Extra copies are available for technicians to give to their customers.

IOWA OFFICERS
The Television Electronic Service Association of Iowa (TESA) elected Henry Gulliver as its new president, states the T.E.S.A. Beacon. Bob Normon was elected vice president; Don Price, secretary; Ed Villemel, treasurer. Members of the Board of Directors are Howard L. Bonar, Gene Wieron, George Rizzo, Jim Yordy, George Miller, Leland Scott, J. R. Jackson and Jack Betz.

OCTOBER, 1960

PUBLICATIONS LIST
Below is a list of most of the magazines, folders and newsletters published by service associations around the country. A complete list of associations is planned for a forthcoming issue.

One of the most important things an association needs is publicity. If you make the public aware of you and what you stand for, you have taken the first step toward eliminating the doubt with which much of the profession is regarded. Do not make this statement lightly. Association publications from all over the country agree that a major problem to the industry is the fringe group of dishonest technicians. What good does it do to set high standards of ethical, conduct, etc., unless the public knows about it? Publicity is a powerful weapon in the fight to upgrade the profession!

Yet some associations seem to be almost ashamed to admit they exist. Many groups have not answered our letters inquiring as to the name of the secretary or president. Some associations will not even reveal their address. We are only trying to find individuals wanting to know the name of their nearest association. We send what information we have, but often we do not know the name of the officer to contact or even if the association is still active.

For information, write to: Associations Editor, Radio-Electronics, 154 W. 14 St., New York 11, N. Y.

ARTSD NEWS
Don Hamill, editor Associated Radio & TV Service Dealers 4972 N. High St. Columbus 2, Ohio

CINTI TESA NEWS
Horace J. Grebe 2385 Kalorama Ctn. Cincinnati 41, Ohio

CSEA DIGEST
Chet Spink, editor California State Electronics Association
Oib Publications
Rm. 46-A Porter Bldg. San Jose, 13, Calif.

STATS NEWS
Pern Laflin, editor Electronic Technicians Association of Ohio, Inc. 1923 Sylvania Ave. Toledo, Ohio

E. T. G. NEWS
Donald A. Ciclitri, editor Electronic Technicians Guild, Greater Boston Chapter PO Box 124 W. Somerville 44, Mass.


HOOSIER TEST PROBE, THE Frank J. Teskey, editor Indiana Electronic Service Association PO Box 3123 Indianapolis 22, Ind.


NATESA SCOPE
Alber C. W. Sanders, president National Alliance of TV & Electronic Service Associations 5708 S. СТ Ll Chicago 29, Ill.

101 Key Troubleshooting Waveforms for Horizontal AFC-Oscillator Circuits
by C. W. Middleton
First in a brand-new series by the author of the best-selling "101 Key Troubleshooting Waveforms" book. Shows 101 abnormal waveforms (obtained when various circuit components become defective), accompanied by circuit symptoms, tests and evaluations of results. Supplementary notes provide background information. Covers the three most popular horizontal AFC-oscillator configurations: the multivibrator and blocking oscillator with pulse-width AFC, and the multivibrator with duo-diode AFC. With this book by your side you need never be puzzled by an abnormal waveform! 100 illustrations; 128 pages; $0.5 x $1.50. Only $200

Servicing Transistor TV Receivers by Milton S. Kiver and Charles G. Gray
Only book of its kind on this subject, tied with the applications of the first transistor TV models. The authors introduce you to the transistor and to basic transistor circuits. Then, you are shown, step by step, how transistors are used in the tuner, video-1F amplifier, video-detector, audio amplifier, AGC, sound, sync-separator, and horizontal and vertical deflection sections. Includes full data on the application of tube-set techniques; servicing differences between tube and transistor TV's; handling, testing and troubleshooting of transistors; checking operating points, shorted and open transistors; plus special servicing tips on specific circuits, emphasizing horizontal-deflection systems. Illustrated, 272 pages; $0.95 x $1.50. Only $4.50

Experiments In Industrial Electronics by Melvin Whitmer
You can have a hands-on course in dozens industrial devices work by actually sitting down and building them. Learn to learn a new skill. Projects are simple enough to appeal to the beginner, yet meaty enough to satisfy the professional, and are not designed to glean hardened scar. You'll build a photoelectric door switch, a smoke detector, burglar alarm, store window novelty, thickness tester, etc., that harnesses capacitance, DC motor control (including one for a portable turntable), and the famous transistorized water heater. May be a useful book as your gateway to a profitable future in the fast growing field of Industrial electronics. $1.95

NEW AND VITAL SAM BOOKS

101 Key Troubleshooting Waveforms for Horizontal AFC-Oscillator Circuits
by C. W. Middleton
First in a brand-new series by the author of the best-selling "101 Key Troubleshooting Waveforms" book. Shows 101 abnormal waveforms (obtained when various circuit components become defective), accompanied by circuit symptoms, tests and evaluations of results. Supplementary notes provide background information. Covers the three most popular horizontal AFC-oscillator configurations: the multivibrator and blocking oscillator with pulse-width AFC, and the multivibrator with duo-diode AFC. With this book by your side you need never be puzzled by an abnormal waveform! 100 illustrations; 128 pages; $0.5 x $1.50. Only $200

Servicing Transistor TV Receivers by Milton S. Kiver and Charles G. Gray
Only book of its kind on this subject, tied with the applications of the first transistor TV models. The authors introduce you to the transistor and to basic transistor circuits. Then, you are shown, step by step, how transistors are used in the tuner, video-1F amplifier, video-detector, audio amplifier, AGC, sound, sync-separator, and horizontal and vertical deflection sections. Includes full data on the application of tube-set techniques; servicing differences between tube and transistor TV's; handling, testing and troubleshooting of transistors; checking operating points, shorted and open transistors; plus special servicing tips on specific circuits, emphasizing horizontal-deflection systems. Illustrated, 272 pages; $0.95 x $1.50. Only $4.50

Experiments In Industrial Electronics by Melvin Whitmer
You can have a hands-on course in dozens industrial devices work by actually sitting down and building them. Learn to learn a new skill. Projects are simple enough to appeal to the beginner, yet meaty enough to satisfy the professional, and are not designed to glean hardened scar. You'll build a photoelectric door switch, a smoke detector, burglar alarm, store window novelty, thickness tester, etc., that harnesses capacitance, DC motor control (including one for a portable turntable), and the famous transistorized water heater. May be a useful book as your gateway to a profitable future in the fast growing field of Industrial electronics. $1.95

JUST OUT
HOWARD W. SAMS REPLACEMENT GUIDE FOR TV & AUTO RADIO CONTROLS
Vol. 3. Greatly expanded—covers 22,000 TV and over 1,000 auto radio models; lists replacement scene/number; locations of controls, front panel controls, etc. Indexed. $500 $15. Only $15.

HOWARD W. SAMS & CO., INC.
Order from your Sams Distributor today, or mail to Howard W. Sams & Co., Inc., Dept. K-20 1720 E. 38th St., Indianapolis 5, Ind.

Send me the following books:

[ ] "101 Key Troubleshooting Waveforms" (WAM-1) $0.5

[ ] "Servicing Transistor TV Receivers" (KST-1) $0.5

[ ] "Replacement Control Guide" (RCG-5) $0.5

Enclosed. Send Free Book List

Name

Address

City Zone State

(Outside U.S.A. priced slightly higher)

www.americanradiohistory.com
The DYNakit STEREO 70 is in a class by itself among high quality stereo power amplifiers, and no others can approach its unique combination of quality, reliability, simplicity and sheer listening pleasure for the discriminating audio buyer.

**BEST IN EVERY WAY**

Whether you purchase a kit, or prefer a factory wired and tested STEREO 70, you can be sure performance specifications will be met or exceeded in all respects. The basic DYNakit amplifier circuit, utilizing Dynaco's patented output transformers (worth one-half the cost of the kit) and other top quality components, yield an amplifier of uncompromised performance.

The two 35 watt amplifiers provide sufficient power for any need, in a compact, attractive package which you can assemble in one enjoyable evening. DYNakit's heavy duty preassembled etched circuits save you more than ½ of the effort, and provide an added measure of reliability for years to come. Detailed step-by-step instructions and large pictorial diagrams enable the kit builder to construct this amplifier with complete confidence even without previous experience.

It is not necessary to spend a lot of money to have the best sound available. DYNakits are designed to be the finest and to be used by those who are not satisfied with less than the best. The ultimate economy lies in sustained performance of equipment whose quality makes changes needless. We invite you to visit your high fidelity dealer and compare the DYNakits with the most expensive alternatives. Send us a postcard for complete specifications.

**Finest Performance**

35 watts continuous (80 watts peak) each channel at less than 1% distortion. Frequency response ±0.5 db from 10 cps to 40 Kc. Power response within 1 db of 35 watts without exceeding 1% distortion. Hum and noise below 90 db below 35 watts (below audibility) due to choke filtered power supply. Superior quality wave performance at any test frequency demonstrates its outstanding transient response and unconditional stability under any load. Perfect results are obtained with any dynamic or electrostatic loudspeaker. 1.3 volt sensitivity enables use with any preamplifier. Close tolerance components provide accurate stereo balance.

**Most Conservative Operation**

Output tubes operated at only 65%, of capacity and filter capacitors less than 85% of rated voltage. High efficiency operation allows cooler running. Traditional Dynaco design makes possible a one-year guarantee, unique in the kit field, and seldom found on the most expensive amplifiers. In the words of one reviewer:

"This amplifier's components are operated more conservatively than those in any other commercial amplifier we have tested... its power and distortion ratings are completely conservative. Its listening quality is unsurpassed."—H.H. Leb, Report, High Fidelity Magazine, December, 1959.

**Highest Quality Components**

Matched EL3 output tubes, XXP etched circuit boards, highest quality plastic molded capacitors and all premium grade resistors assure utmost reliability. Critical components are preassembled on the etched circuit board. Heavy plated (gauge bright nickel steel chassis for unparalleled structural rigidity. The cover, which is included, is finished in abrasion-resistant charcoal brown baked vinyl.

**Patented Dynaco Circuit**

The DYNaco-developed pentode-triode phase-inverter-driver and advanced-design feedback output stage minimize the number of phase-shifting stages, providing improved overload and stability characteristics by virtue of its implicit simplicity. Fewer stages mean lower distortion, exclusive Dyna Bietal eliminates need for critical adjustments.

**COMING! The New DYNATUNER**

Stereo 70—$99.95 kit, $129.95 assembled, including cover.

**TECHNICIANS' NEWS**

**TESA NEWS**

Helen S. Bassin, editor
TESA of Wisconsin
PO Box 6091
Milwaukee 9, Wis.

**TSA-DY NEWS**

Harold Chase, editor
TV Service Association
7819 Rugby St.
Philadelphia 50, Pa.

**TSA NEWS**

Harold Chase, editor
TV Service Association of Mich., Inc.
8225 Woodward Ave.
Detroit 2, Mich.

**TSA SERVICE NEWS**

Clifton W. Cox, president
Klickitat County TV Service Association, Inc.
500 E. Pine
Seattle 22, Wash.

**TV SERVICE**

Jack Meeser, editor
Independent TV Service Dealers Association of Los Angeles County, Inc.
215 S. Carondolet
Los Angeles 7, Calif.

**VANGUARD, THE**

Ted Schmertma, editor
Tri-State Council of TV Service Associations
140 Westfield Ave.
Camden, N. J.

**ADVICE TO SET OWNERS**

TV owners can save themselves trouble by carefully studying repair contracts before signing them. Attorney General Louis J. Lefkowitz of New York State believes, Mr. Lefkowitz, in an article in TV Guide magazine said that America has the finest technicians in the world, but there will always be "business sharpshooters." He advised set owners to do the following:

Don't permit your set to be taken from your home for repairs without receiving a written estimate of the repair cost.

Obtain written assurance that no additional repairs will be made unless you agree and that, if you don't wish the extra repairs, the set will be returned immediately.

Never sign a contract without reading it carefully.

Never sign a repair contract which contains blank spaces. Hundreds of people are victimized in this way every day.

When dealing with an unknown repair service, check with your Chamber of Commerce, Better Business Bureau or technicians' association.

Mr. Lefkowitz cites one New York firm that victimized set owners of more than $1,000,000 before being driven out of business. The company advertised that TV repair costs could be paid for with as little as 50 cents per week. Once the sets were in the shop, however, the customer was notified that a new picture tube was needed and a down payment of at least $35 was required. The customer had no choice but to pay, without knowing if the tubes were really needed.

**REFUSED MEMBERSHIP**

The Electronic Service Association of Butte, Mont., voted to deny membership to a probationary member, Stuart A. Mayo, Grounds were price advertising in violation of the association's code of ethics, and it was found that a new picture tube was needed and a down payment of at least $35 was required. The customer had no choice but to pay, without knowing if the tubes were really needed.

**AD GIMMICK**

**TESA News of Wisconsin reports an interesting advertising gimmick being tried in Kansas City. The shop has a flat rate no matter how many times the station goes out. [How much trouble does this station have? —Editor]**
REGENERATIVE TRANSISTOR PAIR

Patent No. 2,864,062
Johannes S. Schaffner, Syracuse, N.Y. (Assigned to General Electric Co.)

This invention is a way of making a pair of junction transistors behave like a point-contact transistor. Readers probably know that the point-contact is an easy oscillator and can generate sine, square, pulse and sawtooth waves. A junction type is more rugged, efficient and easier to manufacture than the point-contact.

![Diagram of a p-n-p transistor](image)

**Fig. 1** shows a p-n-p transistor (V1) directly coupled to a n-p-n unit (V2). Its input characteristic is drawn in Fig. 2. This idealized "curve" has three distinct regions.

With negative input (I1) V1 blocks and no current flows into V2's base. The input resistance is that of a reverse-biased diode (V1 emitter-base) which is positive and large. See region I.

Both transistors conduct when I1 is positive. Note that V2's collector current (I2) is greater than I and is opposite in direction. V1, which is equal to E - I1R, goes down as I1 rises. This is negative resistance as shown in region II.

Very large I1 results in a large voltage drop across R. Due to the low potential difference between V2's collector-emitter, this transistor ceases to function. The input resistance is now that of a positive biased diode (V1 emitter-base) and is positive and small. Refer to region III.

**Fig. 3** shows a free-running oscillator. The operating point is chosen so that the negative-resistance region corresponds to zero input current. For more data see story on page 5.

DEFLECTION CORRECTION

Patent No. 2,936,400
Thomas H. Tasham, Jr., San Diego, Calif. (Assigned to General Dynamics Corp., Rochester, N.Y.)

When an oscilloscope is used for precise measurement or display, its deflecting plates must be positioned accurately. If they slant (see diagram), the resulting display will slant likewise. If the plates are distorted, the error may be corrected by this external circuit.

E1 is the horizontal deflecting voltage, E2 the vertical deflecting voltage, and E3 the summing voltage.

**Fig. 2**

WALTZ ME AROUND AGAIN, WILLIE!

A phase aligned for increasing your profits. Since the original equipment meets all demands, this model of the Oxford, major suppliers for original equipment, provides the finest replacement speakers for any and every application. A complete line for your every need.

OXFORD Components
A Division of Oxford Electric Corp.
556 West Monroe St., Chicago 6, Illinois

Oxford Speakers are available from recognized electronic part distributors.

FREE
ask your hi-fi dealer for

**Audio Empire**

all new edition
up-to-date component prices
PLUS
the quick easy way to figure service charges
EQUALS

Paul Rie's
OFFICIAL PRICING DIGEST

**VOL. 5, NO. 1**

Flat rate and hourly service charges, based on and showing regional and national averages, plus up-to-date list or resale prices on over 63,000 components. Arranged alphabetically by manufacturers and products, numerically by part number. Compact, convenient size fits in tube caddy, toolbox or pocket. $5.00 per copy from your distributor.
WORLD FAMOUS
MOHAWK MIDGETAPE PROFESSIONAL 500
HIGH SPEED
POCKET TAPE RECORDER

Used by NBC - CBS
and numerous radio and TV
stations, for recording
in the field.

Records anything it hears and
plays it right back in
unbelievable broadcast quality.

Special built-in "VU Meter".
Weighs only 3 lbs.

For literature on model 300 . . . 400 . . . 500
write Dept. RE.

AT ELECTRONIC PARTS JOBBERS

2 FOR 1
DC
POWER SUPPLY

1 . . . operates ALL auto radios
—transistor, hybrid, tube—
2 . . . operates miniature radios
—transistor portables—
also operates experimental trans-
istor circuits, relays, use it for electro-
plating, laboratory work.

Transistor protection.
EPL patented cooling.

2 OUTPUT RANGES

VOLTS CURRENT RIPPLE
0.16 5 amps. 0.5%
0.20 76 ma. 0.15%

Compare and you'll
buy Model PS-2 $49.95

Also—Kit Model KPS-2...$43.50

Send for FREE literature, name of your jobber!

Electro Products Laboratories
4501-R Ravenswood, Chicago 40, III.

NAME

ADDRESS

CITY STATE ZIP

RADIO-ELECTRONICS

NEW PATENTS (Continued)

vertical. A fraction of E8 is combined with E4
at the amplifier. E5 is the corrected horizontal
deflection voltage.

Consider the display of a vertical line which,
due to plate misalignment, will slant. When the
trace is at the top, plate A must be negative
with respect to ground. Therefore E3 is also
negative, and E5 must be negative relative to E1;
Thus the beam is tilted toward the right.

When the trace is at the bottom, A is positive.
This means that E5 will be more positive than
E1, and the beam will be attracted more to the
left. It is obvious from this discussion that
the display will be more vertical than it would
otherwise be. R is adjusted as required for com-
plete correction.

ELECTRIC BLANKET TOOLS
Patent No. 2,938,356

According to this invention, blankets, flying suits, apparel or bedding can be used to cool the
body. It utilizes junctions of dissimilar metals or semiconductors passing direct current.
These junctions are cooled when current flows

TRIPLE TRANSISTOR
Patent No. 2,936,384
John R. White, Westbury, N. Y. (Assigned to Hasel-
nine Research, Inc.)

Here are three transistors formed of a single
crystal. There are five layers, with a slot cut
to cross the top. The lower push-pull transistor is la-
beled V1, V2 is at the upper left, V3 at the upper
right. V1's collector is an emitter for V2 and
V3, for direct coupling.

A modulator using this unit is shown. The
bases of V1, V2 are biased from a voltage divider.
V3's base returns to ground through R. Output
may be taken from the collector of V2 or V3.
Don't miss it! A million have sent for it already! Send for your copy of Radio Shack's new 1961 Electronics CATALOG

FREE

Plus a full year's FREE SUBSCRIPTION to all other Radio Shack Catalogs as issued

Save up to 50% all year long on the latest and best items in the whole fascinating field of Electronics.

You get fast, accurate service!

- Every order processed the same day received. No delays!

You can pay as you earn on Radio Shack's Easy Budget Plan. Low as $2.00 down.

You can open a convenient Monthly Charge Account. "Add-on" orders are easy.

GUARANTEE: Radio Shack guarantees you must be satisfied with any item you order or your money back. 15-day no-risk home trial on any item!

MAIL COUPON TODAY

RADIO SHACK CORPORATION Dept. 60K10
730 Commonwealth Ave., Boston 17, Massachusetts

Without obligation, please send me FREE AND POSTPAID, your latest giant Electronics Catalog plus every new issue for one full year.

Name:
Address:
Post Office or City Zone State

RADIO SHACK Corporation
730 Commonwealth Avenue
Boston 17, Massachusetts
V. H. F. TELEVISION TRANSLATORS

Complete — aligned and assembled. Ready to install on your new system or as a replacement for older systems. A complete high output amplifying system with conversion. The RX-17A uses two BT proven quality MCS Amplifiers with M.A.R.S. Converter CX-30A and Metered Final (F-17A). The system is capable of one watt PLUS output with as little as 50 microvolts input. The usual range of automatic gain control enables complete pre-adjustment to accommodate ANY useable signal level. Metered output eliminates guesswork for fast — efficient operation. Automatic Cut Off (available). Code Identifier (available).

AVERAGE VALUE SPECIFICATIONS:
Gain: 110-120 DB
Conversion Accuracy: Up to .0025%.
AGC: 40 DB plus.
Input Range: 50 to 5000 Microvolts.
Output: One Watt Plus.
Power: 115 Volts AC 60 Cycle (140 Watts).
Cables: Low loss input and output cables and baluns to match 300 OHM are included.

For Full Information Write
Mid America Relay Systems, Inc.
Serving the Television World from the Heart of America
GENERAL SALES
601 Main Street
Rapid City, South Dakota
INTERNATIONAL DIVISION
Rocke International Building
13 East 40th Street
New York 16, N. Y., U. S. A.
Cables "ARLAB" N. Y. All Codes

LOOP OILER
A small narrow loop of thin wire makes an excellent oiler for carrying a small amount of oil into a tight spot and not elsewhere. Such a device may be made from a strand of stranded wire soldered to a heavier piece of wire. The loop should be rather small—not more than about five wire diameters across or the oil will not form a film.

In practice, the loop picks up a drop of oil from the nozzle of an oil can. It is touched to the point to be lubricated and twisted slightly so the oil flows on the part from the loop.—L. Shaw

SOLDERING-IRON CLEANER
A piece of fine screening tacked to a scrap piece of wood makes a fine scratchboard for a soldering iron.

Wiping the iron's tip across the screen occasionally removes excess drops of solder and crust from the tip efficiently.
—Charles A. Cunningham

TESTING AT TOP OF SOCKET
The tips of ordinary test prods won't fit into the pin holes of miniature tube sockets. This is a definite handicap when you want to check voltages from the top of the chassis rather than from underneath. To overcome this handicap, file or grind the ends of your prods to fit. You'll have to make them smaller and more pointed.—Albert Mason

NEW FLOCK FOR TURNTABLE
Have you ever tried to pry the C washer off the spindle on a record player only to have the screwdriver slip and run a gash across the face of the turntable? With a little time and patience such an accident can be remedied with no one the wiser.

Write for complete details about the Gernsback Technicians' and Hi-Fi Book Club Plans.
Gernsback Library, Inc.
154 West 14th St.
New York 11, N. Y.

For An Important Message Concerning Your Career In Electronics See Page 69
TRY THIS ONE (Continued)

First scrape some flocking off the rim of the turntable with a penknife. In most cases the turntable is set down in a well and the rim is out of view. Next, carefully apply some general-purpose cement to the gash and brush on some of the flocking. If this is done neatly, once the cement is set you will never know the difference.—Frank A.

Salerno

TRANSISTOR LIFE SAVER

Before you start to solder a transistor into a radio, TV or other electronic device, disconnect the set's power cord.

If the set is connected when you touch the tip of your iron to the transistor lead, you may ruin the component. This happens if there is leakage from the tip to the power line inside the iron or gun. The current path is from the power line, through the iron's tip, through the chassis, to chassis ground, and back to the power line. Though the diagram shows an ac-de set, the same type of thing can also ruin transistors in sets that have a power transformer.—J. C. Alexander

PLASTIC TV KNOBS

The TV technician installing a chassis in the cabinet after an initial repair job often finds the plastic knobs so worn that they refuse to stay on the knurled shafts. Attempts to shrink the plastic with a soldering gun usually result in a messy, loose knob. At best, some technicians jam the knobs on the shafts, using wood or plastic tape to provide the necessary grip. These methods are sometimes effective, but not very permanent.

An alternative method that works calls for simply slipping the proper type of insulating spaghetti tubing into the oversized knob hole, using a little cement to hold it in place, then fitting the knob on the shaft.

Walsco Flexitube spaghetti, a polyethylene type, or Alphlex PVC-106 seem best for this purpose. Either may be purchased in various sizes.—George D.

Philippett

GOODBYE TO TRIAL-AND-ERROR METHODS

Every circuit calculation you need can now be done accurately with

THE ALGEBRA OF ELECTRONICS

YOU'LL BE AMAZED at how easily it is to figure capacitance, inductance, impedances, etc., for ANY part of ANY electronic circuit. With this one book, THE ALGEBRA OF ELECTRONICS, you will quickly master the tools, techniques and shortcuts needed.

Three Great Books in One!

First, it's a textbook. All practical mathematical techniques explained clearly, step-by-step; easy to follow by those with no more math training than high-school algebra and simple differential calculus.

Second, it's a handbook. Graphic and tabular answers to common electronic problems for those not wishing to work out complex derivations themselves.

Third, it's a review. Every equation, every concept, every type of circuit described along with its practical on-the-job applications. 100 problems are shown, with methods and answers provided.

THE ALGEBRA OF ELECTRONICS was written by Chester H. Peere, Consultant to the Director of the National Bureau of Standards. Dr. Peere discusses basic laws and fundamental principles, practical methods of solving simultaneous equations. He develops electrical methods, transformed analysis, rules for adding and subtracting, and develops the mathematics of electronic devices, all illustrated with diagrams.

TRY IT FREE for 10 Days

Whether you're a repairman, technician, or engineer, you'll find THE ALGEBRA OF ELECTRONICS both profitable and interesting. Write today for a FREE 10-DAY EXAMINATION COPY. No obligation — unless you want to keep the book. Mail coupon today to:

Van Nostrand
Dept. 1810A, Princeton, N. J.

ELECTRONICS of the Future

127 TOPICS
340 Pages
267 Illustrations

1. Waves and Their Applications
2. Basic Laws of Electricity
3. Methods of Solving Simultaneous Equations
4. The Mathematics of Electronic Devices
5. Electrical Methods
6. Transformed Analysis
7. Rules for Adding and Subtracting
8. Standing Waves
9. Standing Wave Analysis
10. The Mathematics of Alternating Currents
11. Voltage
12. Current
13. Electric Power
14. Series and Parallel Circuits
15. Series Resistance Complex Phases
16. Mutual Inductance
17. Transformer Design
18. Grid Control
19. P.M. Amplifiers
20. F.M. Modulators
21. Mutual Inductance
22. Tuning
23. Tuning Components
24. Tuning Devices
25. Tuning Systems
26. Voltage
27. Inductance
28. Capacitance
29. Noise
30. Demodulation

SAVE on EVERYTHING in STEREO HI-FI and ELECTRONICS

444-PAGES • VALUE PACKED. Write today for the looring Electronics Catalog. World's largest selection, including products and values available only from ALLIED SAVE ON:
- Everything in Hi-Fi Music Systems & Components
- Biggest Selection of Hi-Fi Cabinetry
- Exclusive Knights® Super-value Stereo
- Knight-Kits® — Best in Build-Your-Own Hi-Fi
- Tape Recorders and Phonograph Equipment
- Everything in Electronic Parts, Tubes, Transformers, Test Equipment, Amateur Gear, P.A. Systems, TV Accessories, Tools, Books

Only $25 Down on orders up to $50

ALLIED RADIO

Send for 1961 ALLIED CATALOG today!

SAVE over $5 at ALLIED. Write for FREE 1961 ALLIED CATALOG today!
### Table: TUBE VALUES

<table>
<thead>
<tr>
<th>Qty. Type</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.22µF</td>
<td>$0.50</td>
</tr>
<tr>
<td>0.22µF</td>
<td>$0.50</td>
</tr>
<tr>
<td>0.47µF</td>
<td>$0.50</td>
</tr>
<tr>
<td>0.47µF</td>
<td>$0.50</td>
</tr>
<tr>
<td>0.50µF</td>
<td>$0.50</td>
</tr>
<tr>
<td>0.50µF</td>
<td>$0.50</td>
</tr>
<tr>
<td>0.68µF</td>
<td>$0.50</td>
</tr>
<tr>
<td>0.68µF</td>
<td>$0.50</td>
</tr>
<tr>
<td>1.0µF</td>
<td>$0.50</td>
</tr>
<tr>
<td>1.0µF</td>
<td>$0.50</td>
</tr>
<tr>
<td>1.5µF</td>
<td>$0.50</td>
</tr>
<tr>
<td>1.5µF</td>
<td>$0.50</td>
</tr>
<tr>
<td>2.2µF</td>
<td>$0.50</td>
</tr>
<tr>
<td>2.2µF</td>
<td>$0.50</td>
</tr>
<tr>
<td>3.3µF</td>
<td>$0.50</td>
</tr>
<tr>
<td>3.3µF</td>
<td>$0.50</td>
</tr>
<tr>
<td>4.7µF</td>
<td>$0.50</td>
</tr>
<tr>
<td>4.7µF</td>
<td>$0.50</td>
</tr>
<tr>
<td>6.8µF</td>
<td>$0.50</td>
</tr>
<tr>
<td>6.8µF</td>
<td>$0.50</td>
</tr>
</tbody>
</table>

---

### Up to 75% OFF on BRAND NEW TUBES

**GUARANTEED ONE FULL YEAR!**

You can rely on Rad-Tel's speedy one day service!

Not Used — Not Pulled Out Of Old Sets • Each Tubs Individually and Attractively Boxed!

<table>
<thead>
<tr>
<th>Qty. Type</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>022µF</td>
<td>$0.50</td>
</tr>
<tr>
<td>022µF</td>
<td>$0.50</td>
</tr>
<tr>
<td>047µF</td>
<td>$0.50</td>
</tr>
<tr>
<td>047µF</td>
<td>$0.50</td>
</tr>
<tr>
<td>050µF</td>
<td>$0.50</td>
</tr>
<tr>
<td>050µF</td>
<td>$0.50</td>
</tr>
<tr>
<td>068µF</td>
<td>$0.50</td>
</tr>
<tr>
<td>068µF</td>
<td>$0.50</td>
</tr>
<tr>
<td>100µF</td>
<td>$0.50</td>
</tr>
<tr>
<td>100µF</td>
<td>$0.50</td>
</tr>
<tr>
<td>150µF</td>
<td>$0.50</td>
</tr>
<tr>
<td>150µF</td>
<td>$0.50</td>
</tr>
<tr>
<td>220µF</td>
<td>$0.50</td>
</tr>
<tr>
<td>220µF</td>
<td>$0.50</td>
</tr>
<tr>
<td>330µF</td>
<td>$0.50</td>
</tr>
<tr>
<td>330µF</td>
<td>$0.50</td>
</tr>
<tr>
<td>470µF</td>
<td>$0.50</td>
</tr>
<tr>
<td>470µF</td>
<td>$0.50</td>
</tr>
<tr>
<td>680µF</td>
<td>$0.50</td>
</tr>
<tr>
<td>680µF</td>
<td>$0.50</td>
</tr>
<tr>
<td>1000µF</td>
<td>$0.50</td>
</tr>
<tr>
<td>1000µF</td>
<td>$0.50</td>
</tr>
</tbody>
</table>

---

### Super-Special!

**KIT OF 100 Bi-Pass Condensers**

Over 50% Are 600V Others 400V And 200V at $3.95 each

** Values .001 to 1 mf**

**Values .001 to 1 mf**

Not a Kit, but Completely Wired

**STEREO AMPLIFIER CHASSIS $4.95**

- Single, $5.95 ea.
- Set of tubes: 2-2SC5s, 1-12AX7: $3.50
- Set of 3 1/2" knobs: 30¢

Send for FREE TROUBLE SHOOTER GUIDE AND NEW TUBE & PARTS CATALOG.

---

**RAD-TEL TUBE CO.**

55 Chambers St.
Newark, N. J.

**TERMS:** 25% deposit must accompany all orders — balance C. O. D.

$1 HANDLING CHARGE FOR ORDERS UNDER $5. Subject to prior sale.

Please add postage. No C. O. D.'s outside continental U. S. A.
For 1960 It's... "Compact" tools by VACO®

For the Electronics Service Trade

- "Compact" In Size: they fit the pocket
- "Compact" In Price: they fit your pocketbook too

Ask Your Parts Jobber or Your Jobber Salesman

VACO PRODUCTS COMPANY, 317 E. Ontario St., Chicago 11, Illinois
In Canada: Atlas Radio Corp., Toronto 19, Ontario

PACKAGE HI FI or SINGLE COMPONENTS
You'll find our prices low and service fast.
Write for our quotation
CENTER INDUSTRIAL., Inc.
74-H Cortlandt Street, New York 7, N.Y.

TARZIAN Offers 48-Hour, Direct Factory Service on Tuner Repairs

only

$8.50

Price Effective Jan. 1, 1960

That's right. Net. $8.50 per unit and $15 for UV combinations, including ALL replacement parts. 90-day warranty against defective workmanship and parts failure. Tuners repaired on approved, open accounts. Replacements offered at these prices* on tuners not repairable:

<table>
<thead>
<tr>
<th>Tuner Type</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>VHF 12 position tuner</td>
<td>$22.00</td>
</tr>
<tr>
<td>VHF 13 or 16 position</td>
<td>$23.00</td>
</tr>
<tr>
<td>VHF/UHF combination</td>
<td>$25.00</td>
</tr>
<tr>
<td>UHF only</td>
<td>$15.50</td>
</tr>
</tbody>
</table>

*Subject to change

Tuners repaired undergo a thorough inspection and adjustment by our best-trained technicians. They are then tested and approved for reshipment. All replacement parts are new. No repairs are made to used parts.

100% Money-Back Guarantee

 ALWAYS NEEDED

ALWAYS THERE

HERE'S HOW TO GET YOUR START in Radio-Electronics!

The most important training of all!

Now you'll really understand circuits—components—equipment!

No matter what you want to do in radio-electronics, this unique 396-page BASIC ELECTRICITY manual brings you the kind of down-to-earth training you absolutely must have. Bounded with it, you'll read technical articles with new understanding. You'll know what's what about circuits, components, and equipment. Every detail of electric-electronic procedure and operation will be far clearer to you than ever before.

BASIC ELECTRICITY covers the entire field: from circuits and currents to polystyrene and phone principles... from tubes to transistors... from batteries, instruments and measurements to motors, generators, transformers, and all the rest.

More than 300 pictures and set-up diagrams make things doubly clear. Then, to top off your basic training, it includes an easily understood 61-page INTRODUCTION TO ELECTRONICS. Read it for 10 days at your risk!

10-DAY FREE EXAMINATION

Department, K-100, Technical Division
HOLT, RINEHART & WINSTON, Inc.
383 Madison Ave., New York 17, N.Y.

Send BASIC ELECTRICITY training manual for 10-day free examination. If you like it, I will take you $4.25 (plus postage) in full payment. Either way, I shall return book, no questions asked. Send $4.25 with order and we pay postage, 10-day money-back guarantee.

Name
Address

OUTER U.S.A. $5.25 cash, 10-day money-back guarantee.

TRY THIS ONE (Continued)

GOODWILL KINK

As an extra service to the customers that bring older model radios to our shop for repair, we mark the set's dial at 640- and 1240-ke (Conelrad alert frequencies) with arrows cut from red plastic tape. Customers seem to appreciate the interest we show in their welfare. To determine the exact location of each arrow, we just set up the signal generator to each frequency, calibrate the set's dial and stick the arrows in place.—Allen C. Johnson

END

50 Years Ago
In Gernsback Publications

HUGO GERNSBACK, Founder

Modern Electrics
Radio Experiments
Radio Experimenter
E. E. Smith. 1908
Radio Experiments
Radio Experimenter
E. E. Smith. 1908

In October, 1910, Modern Electrics


"Pardon me, do you have a scrap of paper? There's a radio program I don't want to miss."
RCA Electron Tube Div., Harrison, N. J., launched a new advertising and sales promotion campaign, the biggest of its kind in its history, for its all-new premium Silverama TV picture tube. Newspapers, trade and consumer magazines, radio and TV, direct mail and outdoor advertising will be used.

Electronic Instrument Co., Inc., Long Island City, New York, is offering distributors of its line of Eico hi-fi equipment, test instruments and other electronic equipment, in kit or wired form, colorful neon and clock neon signs for window and interior display.

CBS Electronics, Danvers, Mass., again received an award from NATESA for outstanding service in creating better customer relations. A. L. Chapman, CBS Electronics president (center) accepts the award from Mac Metoyer, NATESA president. J. H. Hauser, CBS Electronics sales manager; Frank J. Moeh, executive director of NATESA, and R. V. Bontecou, CBS Electronics vice president of marketing, look on (left to right).

H. H. Scott, Inc., Maynard, Mass., has

**OCTOBER, 1960**
A "brass-tacks" guide to
TIME-SAVING
TEST PROCEDURES!

BASIC ELECTRONIC
TEST PROCEDURES
is a big new 316-page
manual with the kind
of "brass-tacks" training
that helps you locate
TV, AM and FM troubles
in a hurry. Teaches you exactly
what instruments to use and
exactly when and how to use
each type. Tells how to sub-
institute one instrument for
another and how to develop
time-saving, money-making
test methods.

Complete—
Easy to Understand!

Here are some of the subjects it covers: Current
Checks; making measurements of Power, Capac-
tance, Inductance, Resistance, AF, RF, Phase,
Distortion & Modulation; checking Sensitivity,
RF Gain, Fidelity, AVC Voltage, Operating Volt-
ages etc. Includes handy VISUAL ALIGNMENT
& DISTORTION

PHOTOGRAPHS

RADIO-ELECTRONICS

PHOTOGRAPHS

RADIO-ELECTRONICS can use good
photographs of service benches, test
bench setups, high-fidelity audio layouts, and any
other interesting and
original radio-electronic devices. We will pay $7.50
each for good professional photos or equivalent,
suitable for reproduction. Full information on subject
photographed will increase their acceptability.

The Editor, RADIO-ELECTRONICS

154 West 14th St.

New York 11, N. Y.

TV TUNERS OVERHAULED

ALL MAKES AND

MODELS — .95

UHF/VHF COMBINATION $19.90

90 DAYS WARRANTY

SAME DAY SERVICE

ON POPULAR TYPES—48 HOURS MOST OTHERS

Overhaul charge includes labor and minor parts; tubes and
major parts are extra at net prices.
Tuner to be overhauled should be shipped complete; include
ure, shield, cover and any damaged parts. Quote model and
state complaint. Pack well and insure.

WE WILL SHIP C.O.D.—F.O.B. CHICAGO OR TORONTO

5710 N. WESTERN

CHICAGO 34, ILL

U.S.A.

136 MAIN ST.

TORONTO 13

CANADA

Suppliers of rebuilt TV Tuners to manufacturers, technicians & service dealers, coast to coast.

Original and Only Complete TV Tuner Service covering the North American Continent.

BUSINESS AND PEOPLE (Continued)

offered to replace any original London-
Scott 1000 stereo cartridges with the
new ruggedized version. The company
has also announced that it had received
a Certificate of Merit for excellence of
design and execution from the Art
Directors Club of Boston for its booklet
"How to Use Stereo High Fidelity
Components in Your Decorating Plans."

Raytheon Co.'s Distributor Products
Div.'s Unicenter in Westwood, Mass.,
has installed a new machine which

automatically bonds clear-plastic con-
tour blisters to cardboard merchandiser
panels so that 10 transistors can be
shipped and displayed together.

Rek-O-Kut Co., New York, played
host to 94 winners of its Tropical Holi-
day dealer-incentive promotion on a

week-long trip to Nassau in the
Bahamas. Dealers and their wives are
shown boarding the chartered plane for
the return trip.

Vaco Products

Co., Chicago, is of-
fering purchasers of its Crimcut cut-
ting and crimping
tool a dollar book,"Shop Kinks," for
25c.

Kenneth B. Shaffer (left) was pro-
moted to manager, distributor sales, of
the RCA Electron Tube Div., Harrison,
N. J., succeeding D. M. Branigan,
who was recently appointed manager,
electronic components marketing, of RCA's
International Div. Shaffer had been
distributor field sales manager. John R.
Meagher (right) was appointed man-

PRACTICE 10 DAYS FREE!

Dept. RE-100, Technical Division
HOLT, RINEHART & WINSTON, INC,
383 Madison Ave., New York 17, N. Y

Send BASIC ELECTRONIC TEST PROCEDURES
Manual for 10-day free examination. If I like book,
I will then pay $6.50 (plus postage) in full payment.
Otherwise, I will return manual and owe nothing.
(SAVE! Send $3.80 with order and we send extra.
Some 10-day return privilege with money refunded promptly.)

Name

Address

OUTSIDE U.S.A.—$6.50 cash. 10-day money-
back guarantee.

THE SCHOBER ORGAN CORPORATION, OHIO

43 West 61st Street, New York 23, N. Y.

Manufacturers of the World-Famous Schober Organ Kits.

RADIO-ELECTRONICS
TV TIPS FROM TRIAD

"It's this kind of job that makes me envy the box boy's career at a supermarket," said Joe, the Junior PTM, as he gloomily eyed the job on the bench.

"You should be an expert on them, since that's the second one in three days," said Bill.

"Same set, same trouble, but not same cure," said Joe. "The first set came in with a short between the yoke windings. I went down and picked up the replacement, compared terminal numbers, connected it, and it worked fine. This set came in, same type of short, so I bought the same yoke as before, compared numbers, connected it, and got a fine picture, but it was upside down and backwards. When I reversed the leads to make it read right I had the worst case of 'ring ripple' I have ever had."

"Did you, by any chance," asked Bill, "buy a replacement with all the parts wired in?"

"The counterman said it was an 'exact' replacement," answered Joe defensively. "But why was it perfect in one case, and like this in the second?"

"Hm," said Bill, as he looked, "did you notice where the leads came out of the first yoke when you had it mounted?"

"Out the bottom," said Joe promptly.

"Well, they come out the top the way this one is mounted," said Bill. "If I remember correctly they used different mountings in different runs. When you installed this yoke you had exactly the right anti-ring network on exactly the wrong terminals, because you had to reverse polarity to make the picture read 'right.' If you follow my system, use new parts to duplicate the wiring (and mounting) of the original, you would never know about this kind of trouble."

MORAL: It is probably impossible to "exactly" replace over four thousand yokes from a line of less than a hundred. If you use the correct basic unit (proper deflection and inductance) plus a Network Kit to duplicate the original installation, you will find that nearly all jobs can be done quickly and easily. Review your yoke fundamentals as outlined in PTM #3, a copy of which is available from your Triad Distributor or from Triad in Venice. Triad Transformer Corporation, 4055 Redwood Avenue, Venice, California.
and listed for 12 makes of sets. This 8½ x 14½-inch chart has 12 pages.—GC Electronics Co., Div. Textron Electronics, 400 S. Wyman St., Rockford, Ill.

COMPRESSOR-LIMITER amplifier and control unit are described in a 4-page folder. — Westrex Corp., Recording Equipment Dept., 6601 Romaine St., Hollywood 38, Calif.


CATALOG of stereo and test equipment, radio and TV components, Citizens-band equipment, tools, books, public-address systems, cameras, etc. Catalog 310 is largest (320 pages) and most comprehensive offered in firm’s history.—Lafayette Radio, 165-08 Liberty Ave., Jamaica 33, N. Y.

REFERENCE DATA for TV-antenna systems. Booklet JP-1 lists cable data, frequency data for the different channels, information on manufacturer’s tapoffs and a chart to simplify db calculations.—Jerrold Electronics Corp., 15 St. and Lehigh Ave., Philadelphia 32, Pa.

MICROPHONES are listed in Catalog M10. There are 12 pages of specifications, photographs, applications and prices. 8½ x 11 inches.—Astatic Corp., Conneaut, Ohio.

POWER SUPPLY HANDBOOK lists variable-frequency ac supplies, variable-voltage dc supplies (up to 600,000 volts) and voltage regulators. Seven pages of technical data cover such subjects as ripple, ac regulators and frequency changers.—Sorensen & Co., Inc., Richards Ave., S. Norwalk, Conn.

MULTICONDUCTOR cables in round and ribbon styles are listed in an 18-page catalog. Conductors and insulating materials (including Teflon) are discussed.—Times Wire & Cable Div., International Silver Co., Wallingford, Conn.

CLOSED CIRCUIT TV and its uses are covered in the 14-page booklet How to Use Direct-Wire TV. Some of the subjects discussed are medical uses, student training, pilferage protection and interdepartmental communication.—Argus A-V Systems Dept., Argus Cameras, Inc., 405 Fourth St., Ann Arbor, Mich.

TERMINAL BLOCKS and switches are described and illustrated in 32-page catalog No. 16. Blocks are barrier and pressure-contact (setscrew) types. Toggle switches meet military specifications.—Kulka Electric Corp., 633-643 S. Fulton Ave., Mount Vernon, N. Y. END

Written for technicians and students of physics, this begins with atomic theory, which is explained clearly with the aid of illustrations. The second chapter discusses fission and shows how energy is released. The last two chapters (most of the book) deal with types of reactors and power plants. Large sketches, cutaway drawings and photos show details of actual reactors. Specifications, control systems, cost and output are given.

**TRANSISTORS. Saedi, Unlimited, 626 S. Federal St., Chicago, Ill. 8½ x 11 in. 30 pp. $1.25.**

In a brief and elementary manner, this book explains transistor operation. It compares basic transistor circuits with those using tubes and discusses certain types of amplifiers and oscillators. A few pages give servicing hints. —IQ


More than a million vehicles are equipped for radio communication. This book discusses and explains the theory and practice of mobile transmitters and receivers, their alignment and repair. Topics include selective calling, afc, squelch, antennas and power supplies. The book is directed to those who are already familiar with basic radio. The final chapter tells how to set up shop for servicing two-way radio sets and gives a rundown on the latest test equipment. —IQ


This book is written at the level of the junior high student. It begins with an interesting discussion of the work done by physicists, engineers and technicians, then proceeds to a study of electricity and its everyday uses. Experiments with batteries, motors, circuits and radio sets are described. A continuity tester and tube checker are among make-it-yourself items.

A 22-page manual, supplied free to teachers, discusses tools, shop layout, activity boards for experiments, and answers the questions given in the text.

**MOON BASE,** by T. C. Helvey. John F. Rider Publisher, Inc., 116 W. 14 St., New York 11, N. Y. 5½ x 8½ in. 72 pp. $1.95.

Before attempting anything as hazardous as a manned expedition to the moon, scientists must know conditions...
LEARN
RADAR MICROWAVES
COMPUTERS—TRANSMITTERS
CODE • TV • RADIO
A Non-Profit Corp.
Founded in 1929
Write for Free Catalog to Dept. RE-10
Classes now forming

engineer your degree in 27 months

1. "How to Succeed" Career Guide—36-page gold mine of career tips and information
2. "Job Catalog" of opportunities in your field of interest
3. "Sample Lesson" (math) to demonstrate the famous I. C. S. method.

Send today for your free I. C. S. Career Kit with these 3 famous booklets. There’s no obligation. This may be the big break you’ve been waiting for. Mark and mail the coupon today.

FREE!
ELECTRONICS CAREER KIT

If you’re interested in breaking into a good-paying job in Radio-TV-Electronics, I. C. S. will send you absolutely free a famous Career Kit with 3 famous booklets that have helped thousands of others—just like yourself—on the road to real success. Includes:

1. "How to Succeed" Career Guide—36-page gold mine of career tips and information
2. "Job Catalog" of opportunities in your field of interest
3. "Sample Lesson" (math) to demonstrate the famous I. C. S. method.

Send today for your free I. C. S. Career Kit with these 3 famous booklets. There’s no obligation. This may be the big break you’ve been waiting for. Mark and mail the coupon today.

INTERNATIONAL CORRESPONDENCE SCHOOLS
Dept. 376632, Scranton 16, Penna.
Please send free Career Kit with 3 famous booklets:
- General Electronics
- Radio-TV Serv's
- Practical Electricity
- Industrial Electronics
- Sound Eng'tl. Serv's
- Power Eng'tl.
- Radio TV Eng'tl.'s
- Electronic Driveline
- Electronic Servicing
- Electrical Tech's
- Other

Name
Address
City ___ State ___ Age ___

MAIL COUPON TODAY!

MILWAUKEE SCHOOL OF ENGINEERING
Dept. RE-1040, 1625 N. Milwaukee St.
Milwaukee, Wisconsin 53212

Please send FREE "Your Career" booklet
I’m interested in [ ] Electronics [ ] Radio-TV [ ] Computers [ ] Electrical Engineering [ ] Mechanical Engineering

(PLEASE PRINT)

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

I'm eligible for veterans education benefits.

Discharge date __________

131

www.americanradiohistory.com
NEW BOOKS (Continued)

in space and on the moon, and how humans will probably react to them. This authority presents a factual, frank discussion of the technical and psychological aspects. He makes recommendations as to food, air, equipment, medical care, etc. He concludes that the optimum crew would consist of two men and a woman.

RCA RECEIVING TUBE MANUAL. RCA, Electron Tube Div., Harrison, N. J. 5'/2 x 8'/4 in. 432 pp. $1.95.

The useful data crammed into this latest edition makes it a big dollar's worth. It describes uses, tests and installations of tubes and the design of circuits. About 60 pages at the beginning describe the use of tubes in basic circuits. About 20 more at the end are devoted to practical schematics of amplifiers, radios, power supplies, etc. Detailed characteristics are listed for recommended type tubes. Discontinued and renewal types are identified by being listed in smaller type.

INTRODUCTION TO ELECTRIC CIRCUITS, by Herbert W. Jackson. Prentice-Hall, Englewood, N. J. 6 x 9 in. 477 pp. $8.75.


Both volumes are highly recommendable for their clarity and coverage. Both discuss fundamentals of magnetic circuits, dc and ac networks and measurements.

The first volume is written at the level of technical schools and is well suited for self-study. A chapter on vector analysis prepares the student for chapters on impedance and resonance. There are many numerical examples with answers.

The volume by Ward is more advanced and is directed to majors in electrical engineering. The author uses calculus. Topics include ferromagnetism, magnetic fields and transients. Problems and study questions are included. END

OPPORTUNITY ADLETS

Rates—50c per word including name and address. Minimum ad 10 words. Cash must accompany order. 10% discount for 12 consecutive issues. Missprints not guarantee. For display ad rate, 15% of space rate. Dis. issue must reach us on or before 10 October, i960.

RADIO-ELECTRONICS

154 West 14 St., New York 11, N. Y.

RADIO, Top Quality $14.95, AM & Tube $6.95. AM-FM $32.95. Add $1.00 shipping. MYRKS INVENTIONS, 625 Gay Norristown, Tenn.


PHOTO COPYING—RADIO-TELEVISION PRINTING—REPRODUCTIONS—INFORMATIONS. Contact Master Kit Company, Box 200, Delierville, Ont.

ALL MAKES OF ELECTRICAL INSTRUMENTS AND REPAIR SCHOOLS. MILLENNIUM INSTRUMENT CO., 128 Liberty Street. New York, N. Y.

AMUX, Convictive, Crown, Magnecord, Precision, Norvel, Bluebell, Tandberg, Sherwood, R dés-Kust, Sono, Shure, True Tone, etc. DEPARTMENT STORES—Dealers—WATERFRONT, etc. $1.50, lakes may be sent free.

DON'T BUY HI-FI COMPONENTS. Kits, Tape, Tape Recorders until you get our free, low return mail samples. Discover Vol To Prof. R/C. Browsing Free. HI-FIDELITY CENTER, 117/2 First Avenue, New York 20, N. Y.

COMPONENTS, Recorders, Tapes FREE Wholesale Catalog. CARBON, 315 T East 96th St., New York 28, N. Y.

DISCOUNTS UP TO 50% on Hi-Fi amplifiers, tuners, speakers, tape recorders, individual quotations only, no orders. CLASSIFIED AD EXCHANGE. 275 East 53rd Street, Brooklyn, NY 13.


PROFESSIONAL ELECTRONIC PROJECTS—Organs, Transmitters, Computers, etc. Each kit, List Price, Parks, Box 1100, Lake City Station, beaten 55. West.

RADIO & TV TUBES at Manufacturers' Price 100% Guarantee! Brand New or Pulled UNITED RADIO. Box 1000-H, Newark, N. J.

SONGFORMS and LYRICS WANTED! Mail to: Tin Pan Alley, Inc., 100 Broadway, New York 11, N. Y.

LEARN WHILE ASLEEP. Hypnosis with your recorder, photographs or recording new electronic techniques endless tape. Precise, detailed course. LEARNING-LEARNING ASSOCIATION. Box 24-545, Olympia, Wash.

DO YOU BUY RECEIVING TUBES OR ELECTRONIC COMPONENTS, send NOW for your Giant Free Buyer's No. 165—familiarly known Zaltron-Full-first Quality, TV-Radio Tubes, plus all types of electronic components, kits, Accessories, etc. All prices quoted are F.O.B. New York. Mail order form to save you P.F.F.—Why Pay More? ZALTRON TECHNOLOGY, 225 W. 42nd St., New York 36, N. Y.

RADIO & TELEVISION REPAIRING MAGAZINE. New line make brands only 20c each. 15% off on mail orders of 50. Prentice-Hall, Englewood, N. J. 6 x 9 in. 372 pp. $10.00.

CASH PAID! Sell your surplus electronic tubes. Want unused, clean radio and TV receiving, transmitting, special-purpose, Magnetrons, Kilowatts, broadcast types, etc. Want military & commercial test and communica
tions equipment such as R.C.S.P. A.F.F. and others. Also want commercial receivers and transmitters. For a fair deal write B.S.W. 514 Broadway, New York 13, N. Y. Walker 5700.

5-8 hour with your recorder. AUDIOGRAPHIC LABORATORIES, 2913 Santa Fe, Independence, Mo.

NEW RADIO-TV TUBES. Brand Name, Automobile and obsolescent Wholesale. WHOLESALE PRODUCTS. Dealers 24, Mass.

DIAGRAMS FOR REPAIRING RADIOS & TELEVISION. 521 E. Cline Ave. DIBREX SERVICE. Box 672 H. East Indianapolis, Ind.

NEW CONCEPT OF LEARNING SELF-HYPNOSIS. Now on tape or record! Free literature. MCKINLEY-SMITH CO., Dept. 97, Box 1005, San Bernardino, Calif.


MANUFACTURING AND PURCHASING ELECTRONIC PRODUCTS IN JAPAN. Every 4 month overseas must re
turn special edition for drivers who are interested in Japan. Here is an editorial for Japan's electronic equipment. All Japan helps establishes freedom. Your purchase and opinion is important to the future of New Manufacturing. Order your copy of New Nakajima-Table Pub., No. 2, 22-15 Shimbashi, Tokyo. Call...-"ribune TELEPHONE TOKYO 7-1540." Also available for distribution contacts for new electronic products.
Lafayette Radio's 1961 Catalog

America's "Electronics & Hi-Fi Shopping Center"

40 years of service to Audiophiles, Experimenter, Hobbyists, Engineers, Technicians, Students, Servicemen and Dealers. HERE IT IS — the biggest, best and most comprehensive catalog you can ask for. Choose from thousands of items, all available for immediate delivery at the lowest, money-saving prices. And, as always, SATISFACTION GUARANTEED OR MONEY REFUNDED.

"The Best Buys In The Business"

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

Exclusive at Lafayette. Lafayette Kits: Build a path to a new world of entertainment. Created, designed and engineered for top quality at top performance — there's more fun in doing it yourself, especially when it's so easy. An exclusive product of Lafayette Electronics — easily the best value for your money any day.

PLUS Hundreds of "specials" you'll find only at Lafayette.

Easy Pay Plan. The simplest, and quickest way to get what you want, when you want it. As little as $2 down... up to 24 months to pay.

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

Lafayette Radio Electronics Corp.
Dept. JJ-6, P.O. Box 196
Jamaica 31, N.Y.

Send me the FREE Lafayette 324 page 1961 catalog 610

Name: ____________________________
Address: ___________________________
City: __________________ Zone: ______ State: ______
NEW! LAFAYETTE HE-15A
2-WAY SUPERHET CITIZENS BAND TRANSCEIVER!

Not Superregenerative but SUPERHET!
Complete 2-WAY COMMUNICATIONS FOR BUSINESS, HOME, FARM, BOAT, AND SPORTS

NOW WITH ADDED FEATURES
- Effective Full-Wave Variable Noise Limiter
- Five Prong Microphone Jack for Easy Relay Addition
- RF Jack on Front Panel
- 5 Transmitting Positions
- Tuneable Receiver Over Full 23 Channels
- Planetary Vernier Tuning
- Complete with Transmitting Crystal for Channel 9

THE GREAT VALUE IN THE CITIZENS BAND FIELD
Just think - now you can have economical, efficient 2-way radio communication from your home, office, shop, auto, truck or boat. Literally hundreds of uses. The Lafayette HE-15A Superheterodyne Transceiver is both a compact precision transmitter and receiver designed to operate on the new Class C Citizens Band. Two or more of these units furnish your own communications system covering up to 8 20 mile or more radius depending on antenna height and terrain.

The Lafayette HE-15A meets all FCC requirements and operates in much the same manner as police and other short-wave communications systems. The Transceiver features 5 crystal controlled transmitting channels operating at a maximum legal power input of 5 watts fully modulated, RF stage in both transmitter and receiver. The 5 position crystal selector on the front panel selects any one of 5 transmitting frequencies. These 5 crystals are readily accessible by means of a removable front plate. The superheterodyne receiver is tuneable over the full 23 channel band with 5 watts audio output, AFC, and an amazingly effective Full-Wave Variable Noise Limiter. The noise limiter is continuously variable from the front panel for diminishing ignition and other unwanted noise pickup. A new 5 prong microphone jack makes connection to a push-to-talk relay a cinch. RF jack on the front panel may be used to monitor the current in the line tubes using external meter.

Controls include a 3 position function switch (transmit, receive, and transmit with spring return), planetary vernier tuning plus variable noise limiter. Output impedance matches 52 and 72 ohm antenna with Amphenol-type coax connector. Has large 4" FM speaker. Should lack for crystal or ceramic microphone, power receptacle in rear for AC line and 6 or 12 volt external power supply. Supplied with single transmitting crystal for channel 9, high output crystal microphone, and brackets for easy mounting of units in auto, boat, etc. Operates on 115 volts AC. Addition of 6 or 12 volt power supply (separately supplied) adapts transceiver for mobile operation.

TUBE COMPLEMENT: 26AU6/6EM8, 16AL5, 16V6, 112AX7, 16AK4, Shpg. wt. 11 lbs.

5.00 Down


HE-16 For 12 Volts
Net 10.50
HE-18 For 6 Volts
Net 10.05

TRANSMITTING CRYSTALS: For any of the 23 channels. Specify channel or frequency.

HE-630 Net 1.95

NEW! LAFAYETTE TELESCOPIC CITIZENS BAND WHIP ANTENNA

- Chrome Plated
- Telescopes From 16½ to 40"h
- Mounts Vertically or Right Angle

A unique antenna value. This high quality three section telescoping antenna is designed for attachment directly to your Citizens band transceiver. Ideal for point to point operation over fairly short distances.

New! LAFAYETTE RADIO FIELD INDICATOR

- Provides a Continuous Indication of Transmitter Output
- Rugged 200 vat Meter Movement • Completely Portable

- Requires no Electricity, Batteries or Transmitter Cables

With this rugged, new radio field indicator you can check performance of your marine, mobile or fixed transmitter actually measures the RF field generated by any transmitter between 100MC and 250MC regardless of any features. 200 vat meter movement with a variable sensitivity control. Phone jack at rear of indicator accepts earphones thus providing an unusual check of transmitter output. Antenna extends from 3½ to 10½'. Powerful magnet on bottom plate allows easy mounting on car dashboard or metal surfaces. Use anywhere - requires no electricity or batteries. Dimensions: front panel 3½"W X 2½"H X 1/8"D.

New 10,000 OHMS PER VOLT MULTITESTER

Outperforms Instruments Many Times Its Size

- Extra Large 3½" Meter Face
- Completely Wired and Tested
- All Accessories Included

A convenient, pocket-sized instrument with an unusually sensitive 14,000 ohms per volt AC-DC meter, 1% resistors, single range selector switch. First capacity range requires 120V AC, second range requires 6V AC. Durable Bakelite case and panel, probes, and flexible leads are plastic coated and color coded. Complete with batteries, 4½ x 3½ x 1½". Shpg. wt. 1½ lbs.

TE-10
Net 9.95

TE-18 Pigskin Carrying Case, shpg. wt. 6 oz. Net 1.95

Please include shipping charges with order

NEW YORK, N.Y. 100 6th Avenue BRONX, N.Y. 542 E. Fordham Rd.
NEWARK, N.J. 24 Central Avenue PARAMUS, N.J. 429 Route 17
PLAINFIELD, N.J. 159 W. 2nd Street

Phone Jack 516-08 Lafayette
LAFAYETTE RADIO
165-08 Liberty Avenue Jamaica 33, New York

www.americanradiohistory.com
LAFAYETTE HI-FI KITS

Build A Path to A New World of Entertainment

ENGINEERING:
Created with the non-technical builder in mind. There's much more fun in assembling your own kit... and it's so easy.

DESIGN:
Each kit has the fine professional-looking touch. Sturdy to blend with every decor.

VALUE:
You can't get better units at these money-saving prices.

QUALITY:
Top performers due to high quality parts and engineering.

All Lafayette Kits are Available on the Easy Pay Plan.

Lafayette Radio Dept. JJ-6
P.O. Box 190 Jamaica 31, N.Y.

Send me the FREE 324-Page 1961 Catalog No. 610

Cut Out and Paste

Name ____________________________

Address __________________________

City _______ Zona _______ State ______

OCTOBER, 1960

www.americanradiohistory.com
PACO ELECTRONICS CO., INC.
70-31 84th Street, Glendale 27, L. I., New York Kit Division of PRECISION Apparatus Co., Inc., a subsidiary of Panaconics, Inc.

SERVICEMEN
T.V. and RADIO TUBES
ALL TOP NAME BRANDS
60-16,800 plus, New test-quality, genuine boxed. No Jobs.
Representatives wanted for all areas. High commissions.
RADIO TUBE SPECIALISTS
397-75 Ave., Brooklyn 15, N. Y.

To Learn Some Vital Facts About Your Career In Electronics
See Page 70
... and you can't go after big cartridge business without

ASTATIC

THE ONLY, REPEAT ONLY, COMPLETE PHONO CARTRIDGE LINE

Whether you sell, install or use phono cartridges, you're ahead with the one dominant name in the industry — ASTATIC. Only Astatic can give you, on every single replacement, the ORIGINAL or DIRECT REPLACEMENT cartridge that exactly matches the other components of the player.

AND VERY OFTEN THE PRICE IS BELOW THAT OF SUBSTITUTES.

This is the one sure way to best results, to fullest quality and fidelity of sound reproduction. THIS IS THE ONE SOURCE OF MAXIMUM SALES AND PROFITS FOR YOU.

IT'S BETTER BUSINESS TO SELL ASTATIC LEADER WITH ORIGINALS — FIRST WITH REPLACEMENTS

ASTATIC CERAMIC AND CRYSTAL PHONO CARTRIDGES; STEREO AND MONAURAL, PLUG-IN AND CONVENTIONAL, WITH DIAMOND OR SAPPHIRE STYLI

THE Astatic CORPORATION, CONNEAUT, OHIO

IN CANADA: CANADIAN ASTATIC, LIMITED, TORONTO, ONTARIO

EXPORT SALES: ROBURN AGENCIES, INC., 431 GREENWICH ST.
N. Y. 13, N. Y., U. S. A.

FIRST NAME IN PHONO CARTRIDGES, NEEDLES, MICROPHONES
to help you sell more

RCA Silverama Picture Tubes

... the All-New replacement picture tubes that command premium price and profits.

Here are the facts—proof that RCA Silverama is your customers' best picture tube buy.

FREE OF GLASS DEFECTS. Glass cord lines, scratches, chips, or buffed faceplates are common defects found in many brands of tubes made with used glass. Surest way to avoid these defects and also obtain the latest optical advances in faceplate engineering: an All-New RCA Silverama!

ALL-NEW. Of the three largest-selling brands of replacement TV picture tubes, only RCA Silverama is guaranteed 100% all-new—new glass, new gun, new phosphor, new everything! You'll get written proof—right on the warranty card.

FINEST SCREEN QUALITY. Advanced screen coating and bonding processes combined with RCA's giant vibration-free screen settling machines ensure the maximum in picture screen quality and uniformity.

RCA "KNOW-HOW" RCA's continuous product research and advanced design engineering have resulted in RCA Silverama picture tubes being steps ahead of all other brands.

WORLD'S FINEST. RCA Silverama is manufactured in the world's most modern manufacturing plant using all-new premium-quality materials. Result: RCA Silverama is the world's finest picture tube.

RCA Electron Tube Division, Harrison, New Jersey

The Most Trusted Name in Electronics

RADIO CORPORATION OF AMERICA

www.americanradiohistory.com