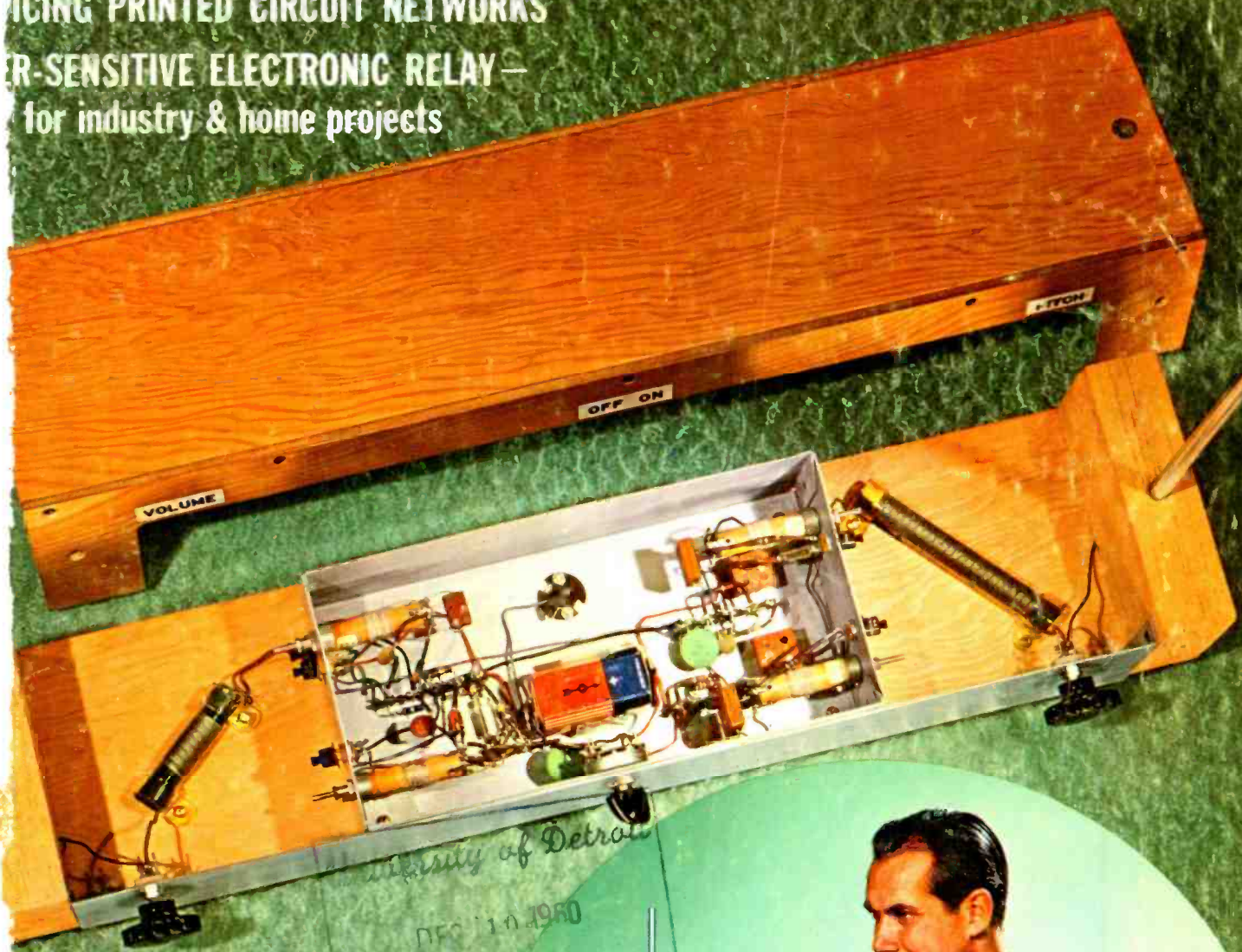


# ELECTRONICS WORLD

ADJUST YOUR SPEAKER TO YOUR ROOM  
STANDARD TUBES DEMONSTRATE V. H. F.  
PRECISION PRINTED CIRCUIT NETWORKS  
ULTRA-SENSITIVE ELECTRONIC RELAY—  
for industry & home projects

50 CENTS



Build Your Own  
**TRANSISTORIZED  
THEREMIN**



*University of Detroit*  
DEC 10 1950  
*Library*

W1G10120121  
UNIV OF DETROIT LIBR  
PERIODICAL DEPT  
4001 W MCNICHOLS RD  
DETROIT 21 MICH



## SYLVANIA-6AU4-GTA

WITH

## SARONG CATHODE

HELPS YOU

# "WRAP-UP" PROFITS!

**N**EW life-giving, profit-building features are built into every SYLVANIA-6AU4-GTATV-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 call-backs. When you ask your distributor for 6AU4-GTA's, always specify SYLVANIA.

Electronic Tubes Division, Sylvania Electric Products Inc., 1740 Broadway, New York 19, New York.



# SYLVANIA

Subsidiary of **GENERAL TELEPHONE & ELECTRONICS** 



LEARN

TK  
 SUBJECT 7800  
 NO COST .R688  
 V.45  
 J 100 - 100  
 1961

① TRANSISTOR complete coverage theory without mathematics. ② HEADLIGHT (Eye)—lecture LIGHT SENTIN LIGHT SWITCH TROUBLE-SHO for dead or weak low voltage auto radio tuners and trigger circuits. ③ LECTURE AND LAB. PRACTICE ON "SIGNAL SEEKER" AND "WONDER BAR" auto radio tuners and trigger circuits. ④ TRANSISTOR CIRCUIT TROUBLE-SHOOTING—lecture and lab. work analyzing defects in transistor circuits. ⑤ HYBRID-TYPE AUTOMOBILE RADIOS—low voltage tube and output transistor circuits. Lecture and lab. ⑥ DELCO-MATIC ALL-TRANSISTOR GARAGE DOOR OPERATORS—lecture and lab. ⑦ AUTO PORTABLE RADIOS—lectures and lab. practice on all-transistor portable radios. Get prepared for the all-transistor auto radio that will appear in the next few years.

**THE LATEST ON TRANSISTORS AND AUTOMOTIVE ELECTRONICS** 9 SUBJECTS AVAILABLE TO YOU AT THE FREE DELCO RADIO -GUIDE LAMP ADVANCED TRAINING SCHOOL. One week of instruction. No lab. fees. No tuition charge. Textbooks supplied.

In 1960 over 900 electronics technicians completed our one-week course. You, too, can receive this same valuable training in 1961. Bring yourself up to date on transistors and automotive electronics with personalized instruction at the General Motors Training Center near you. (See schedule below.)

Classes will be conducted by graduate engineers with special training in your field. Diplomas, awarded only to those who successfully complete the courses, will mean a great deal to you—and to your customers.

Register now through your local Delco Electronics Parts Distributor or write directly to Delco Radio Division, General Motors Corporation, Kokomo, Indiana, Attention: Service Manager.

GUIDE LAMP DIVISION GENERAL MOTORS CORP. ANDERSON, INDIANA



DELCO ELECTRONICS TRAINING SCHOOL SCHEDULE						
DATE	REGION 1	REGION 2	REGION 3	REGION 4	REGION 5	REGION 6
1-16	Philadelphia		Detroit		Dallas	
1-23		Charlotte	Detroit			
2-6	Washington			St. Louis		
2-13	Washington	Atlanta			Houston	
2-20			Cincinnati		Houston	Los Angeles
2-27						Los Angeles
3-6	Tarrytown	Memphis		Omaha		
3-13	Tarrytown					
3-20		Jacksonville	Cleveland			San Francisco
4-10	Boston		Cincinnati	Kansas City	El Paso	Portland
4-17	Boston	Atlanta		Kansas City	El Paso	
5-1		New Orleans	Pittsburgh	Minneapolis		Los Angeles
5-8	Union		Pittsburgh		Oklahoma City	
5-15				Milwaukee		
5-22		Memphis	Buffalo			San Francisco
6-5	Philadelphia			Chicago	Denver	
6-12		Charlotte		Chicago		Portland
6-19			Cleveland			
6-26	Union	Atlanta		Minneapolis	Dallas	Salt Lake City

ELECTRONICS WORLD is published monthly by Ziff-Davis Publishing Company, William B. Ziff, Chairman of the Board (1916-1959), at 431 S. Wabash Ave., Chicago 5, Ill. Second class postage at Chicago, Illinois. Authorized by Post Office Department, Ottawa, Canada, as second-class matter. SUBSCRIPTION RATES: one year U. S. and possessions, and Canada \$5.00; Pan American Union Countries \$5.50; all other foreign countries \$6.00.

Editor  
WM. A. STOCKLIN, B. S.

Technical Editor  
MILTON S. SNITZER, W2QYI

Service Editor  
SIDNEY C. SILVER

Associate Editor  
P. B. HOEFER

Editorial Consultant  
OLIVER READ, D. Sc., WTETI

Industrial Consultant  
WALTER H. BUCHSBAUM

Art Editor  
MILTON BERWIN

Art and Drafting Dept.  
J. A. GOLANKE

Advertising Director  
JOHN A. RONAN, JR.

Advertising Manager  
GEORGE E. MORRISSEY

Midwest Adv. Manager  
GILBERT J. JORGENSEN

Western Adv. Manager  
ADRIAN WHITED



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

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



Member  
Audit Bureau of  
Circulations



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

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

*First in radio-television-audio-electronics*

## CONTENTS

### INDUSTRIAL AND GENERAL ELECTRONICS

For the Record	W. A. Stocklin	6
Spot Radio News	Washington Correspondent	21
Recent Developments in Electronics		34
Computer Logic Circuits	Ed Bukstein	46
Electronic Crosswords	Bruce Balk	121
Calendar of Events		131

### HIGH FIDELITY AND AUDIO

Tailor Your Loudspeaker to Your Room	George L. Augspurger	38
Reverberation in Principle & Practice	George Owen	44
Transistorized Audio Line Amplifier	Dave Stone	61
Hi-Fi Audio Product Review		72
Checking Tape Recorder Heads	Robert James	86
Product Report (PACO Model ST-45 AM-FM Stereo Tuner) EW Lab Tested		104
Sound on Tape	Bert Whyte	111
Certified Record Revue	Bert Whyte	119

### TELEVISION-RADIO

Packaged-Circuit Service Problems	H. R. Holtz	41
Where Did the Gain Go?	Kenneth Bramham	42
Symbols for Symptoms	Wayne Lemons	48
"Filing" System for Parts	J. O. Paine	52
Mac's Service Shop	John T. Frye	60
Service Industry News		94

### TEST EQUIPMENT

A Versatile Impedance Checker	Harold Reed	33
R-C Bridges: Operation and Repair	David R. Anderson	50
The "Audio Check"	John Potter Shields	56
Accurate Peak A.C. Measurements	L. W. Born	66
New Tube Tester Data		80
A Variable Line-Voltage Isolator	Walter L. Stone	93
Product Report (Sencore "Mighty Mite" TC109 Tube Checker) EW Lab Tested		103

### COMMUNICATIONS AND AMATEUR

Reducing Transmitter Interference (Part 1. Harmonics & Spurious Signals)	James G. Arnold	53
Power-Line Carrier Communications	R. H. Murrell	58
Product Report ("Knight-Kit" Model C-27 CB Transceiver) EW Lab Tested		102
Hamming in Britain	Patrick Halliday	116

### ELECTRONIC CONSTRUCTION

A Transistorized Theremin	Robert A. Moog	29
V.H.F. Demonstration Oscillators	Lewis G. Blevins	36
A Sensitive Electronic Relay	Louis E. Garner	62
Transistorized Phono Oscillator	Bronson M. Potter	97
Five-Minute CB Timer	Leo Morgan	114

### DEPARTMENTS

Letters from Our Readers	10	Technical Books	88
Within the Industry	24	Manufacturers' Literature	112
What's New in Radio			128

Net Paid Circulation 251,895

Radio & TV News • Radio News • Television News Trademarks Reg. U. S. Pat. Off.  
Copyright © 1960 by Ziff-Davis Publishing Company. All rights reserved.

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

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



**NO ADVANCED EDUCATION NEEDED!**

**NO PREVIOUS TECHNICAL EXPERIENCE REQUIRED!**

**MEN 17-55**

Prepare now to enter one of the many profitable branches of

# ELECTRONICS

**SEND FOR FREE FACTS!**

The day the first Satellite spiraled into outer space will be known to thousands of men throughout the United States and Canada as "Opportunity Day" — because it brought to light the tremendous possibilities that the field of Electronics holds for the man who seeks a better job or a business of his own.

One of the great things about the giant field of Electronics is the fact that even a man who does not have an advanced education or previous technical experience can prepare for many profitable opportunities in his spare time at home . . . or, if he desires, he may attend our well-equipped CHICAGO or TORONTO laboratories.

If you seek a better job or a business of your own, why don't you fill in the coupon below for FREE facts?

Make "Satellite Day" your "Opportunity Day," too!

**DRAFT AGE?**

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

**LIVE-WIRE EMPLOYMENT SERVICE**

Through long-established contacts with well-known employers, DeVry Tech's Placement Department has helped many men toward better jobs in Communications, Guided Missile Control, Radar, Automation, Television, Instrumentation, etc. The service is free to graduates.

**SEND for 2 FREE BOOKLETS**

We'll give you a free copy of 2 interesting booklets, "Electronics in Space Travel" and "Pocket Guide to Real Earnings." See for yourself how you may take advantage of the opportunities in this fast-growing field.

**Get into One of Today's Fastest Growing Fields!**

**IN YOUR SPARE TIME AT HOME OR IN OUR CHICAGO OR TORONTO LABORATORIES.**

**Look at these Job Opportunities!**

Radar • Guided Missile Control  
 Television • Microwaves  
 Communications • Radio  
 Industrial Electronics • Computers  
 Automation Electronics • Broadcasting

**WILL NOT INTERFERE WITH PRESENT JOB!**

**EARN WHILE YOU LEARN!**



**MAIL COUPON TODAY!**

DeVRY TECHNICAL INSTITUTE  
 4141 Belmont Avenue, Chicago 41, Ill., Dept. EW-1-R  
 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 Electronics. I am interested in the following opportunities (check one or more):

<input type="checkbox"/> Space & Missile Electronics	<input type="checkbox"/> Communications
<input type="checkbox"/> Television and Radio	<input type="checkbox"/> Computers
<input type="checkbox"/> Microwaves	<input type="checkbox"/> Broadcasting
<input type="checkbox"/> Radar	<input type="checkbox"/> Industrial Electronics
<input type="checkbox"/> Automation Electronics	<input type="checkbox"/> Special "Short Courses"

Name \_\_\_\_\_ Age \_\_\_\_\_  
PLEASE PRINT  
 Address \_\_\_\_\_ Apt. \_\_\_\_\_  
 City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_  
 Check here if you face military service.  
 Canadian residents: Write DeVry Tech of Canada, Ltd.,  
 970 Lawrence Avenue West, Toronto 19, Ontario 2038

# DeVRY Technical Institute

CHICAGO • TORONTO

Accredited Member of National Home Study Council



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



# Very Hot News . . . from hallicrafters

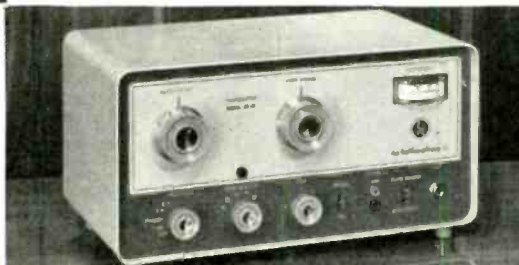
*Two great new kits... a complete, high-performance AM/CW station,  
from the world's most experienced designers of short wave equipment*

HALLIKITS, we call them—a completely new concept of kit engineering that brings to your workshop, for the first time, these two outstanding advantages:

*First*, the unparalleled design experience of Hallicrafters' communications labora-

tories; and *second*, production-line proof of "Constructability" *before you buy*.

Have a wonderful time! Save a bundle of money! End up with a station the most experienced amateur would be proud to call his own.



## HT-40 TRANSMITTER, \$79.95

A perfect match for the handsome SX-140, both in quality and appearance. Hallicrafters' transmitter leadership is evident in every precision-engineered feature of this crystal-controlled 75-watt beauty—features as important to old-timers as they are to novices.

- **FEATURES:** You get excellent CW performance as well as AM. Full band switching, 80 through 6 meters. Enjoy easy tune-up and crisp, clean styling that has efficient operation as well as appearance in mind. Unit is fully metered, TVI filtered.
- **SPECIFICATIONS:** Maximum D.C. power input: 75 watts. Power output in excess of 35 watts CW, 30 watts peak AM phone. (Slightly less on 6 meters.) Frequency bands: 80, 40, 20, 15, 10 and 6 meters.
- **TUBES AND FUNCTIONS:** 6DQ5 power output; 6CX8 crystal oscillator and driver; 12AX7 speech amplifier; 6DE7 modulator; silicon high voltage rectifiers.
- **FRONT PANEL:** Function (AC off, tune, standby, AM, CW); Band Selector (80, 40, 20, 15, 10, 6); Drive control; Plate tuning, plate loading, Crystal-V.F.O.; Grid Current; Meter; AC indicator light; RF output.
- **REAR CHASSIS:** Microphone gain; antenna co-ax connector; remote control terminals; AC power cord.

## SX-140 RECEIVER, \$94.95

Doesn't it make sense to team up your skill with the experience of a company who has designed and built more high-performance receivers than any other in the world? Especially when the result is the *lowest-priced amateur band receiver available?*

- **FEATURES:** You get complete coverage of all amateur bands 80 through 6 meters, with extremely high sensitivity and sharp selectivity. Unit has RF stage; S-meter; antenna trimmer; and XTAL calibrator. Tuning ratio is 25 to 1.
- **CONTROLS:** Tuning; Antenna Trimmer; Cal. Reset; Function (AC off, standby, AM, CW-SSB); Band Selector; Cal. on/off; RF Gain; Auto. Noise Limiter on/off; Selectivity /BFO; Audio Gain; phone jack; S-meter Adj.
- **TUBES AND FUNCTIONS:** 6AZ8 tuned RF amplifier and crystal calibrator; 6U8 oscillator and mixer; 6BA6 1650 kc. IF amplifier and BFO; 6T8A 2nd detector, A.V.C., ANL and 1st audio; 6AW8A audio power amplifier and S-meter amplifier; (2) silicon high voltage rectifiers.

**P.S.** Both units are available fully wired, and tested. SX-140, \$109.95. HT-40, \$99.95.

# halli-kits from hallicrafters

Chicago 24, Illinois

*... where the new ideas in communications are born!*

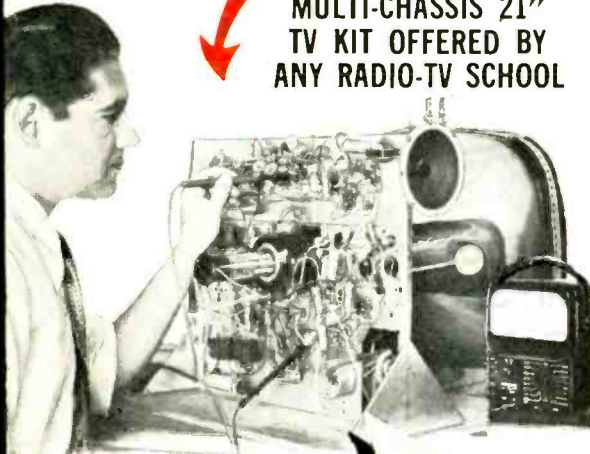
Export Sales: International Div., Raytheon Co., Waltham, Mass. Canada: Gould Sales Co., Montreal, P.Q.

# Here's The Offer No Other Radio-TV School DARES MAKE!

## LEARN AT HOME in Spare Time!

YOU DO MANY PRACTICAL JOBS with the kits we send you. That's right, you PRACTICE what we TEACH! You build a Signal Generator, AC-DC Power Pack, and AC-DC Superheterodyne Radio Receiver and top quality 21 inch TV Set. EARN AS YOU LEARN with the famous RTS 30 Day Income Plan. Full instructions provided. NO HIGH SCHOOL DIPLOMA NECESSARY. This is a COMPLETE course which starts with basic subjects and gradually advances to Radio-TV. . . . ALL FOR A PRICE YOU CAN AFFORD!

\*THE ONLY VERTICAL MULTI-CHASSIS 21" TV KIT OFFERED BY ANY RADIO-TV SCHOOL



YOU BUILD THESE AND OTHER UNITS!



MULTIMETER KIT INCLUDED!

\*Tubes Excluded

COMPLETE COLOR TV INSTRUCTION INCLUDED!

Each student is entitled to unlimited consultation service. All questions are answered promptly and completely by highly specialized instructors.

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



**RADIO-TELEVISION TRAINING SCHOOL**

815 E. ROSECRANS AVENUE  
LOS ANGELES 59, CALIFORNIA

L 101D

Est. 1922



Rush Coupon for FREE FACTS!

RTS Will Train You at a Price You Can Afford and When You Are a Qualified Graduate Will Help You Open a Service Shop of Your Own and Supply You With Every Bit of Equipment You Need to Get Started - Plus an Inventory of Parts and Necessary Supplies.

ALL FINANCED WITHOUT INTEREST OR CARRYING CHARGES!!

You Also Receive . . . Advertising Help and Material, Shop Plans, Business Systems, Letterheads, Calling Cards and Much More!

Here's What Two of Many Business Plan Shop Owners Have to Say!

This business takes in between \$1500 and \$2000 a month. I've had to hire help to keep up with it.

CULLEN W. IRBY  
Corpus Christi, Texas

The school lives up to its promises 100%. RTS does not lose interest in its students once they graduate.

HAROLD R. STANLAKE  
Perry, Michigan

**DON'T LOSE OUT — FIND OUT!**

RADIO TELEVISION TRAINING SCHOOL, Dept. EW-11  
815 E. Rosecrans Ave. Los Angeles 59, Calif.  
Rush me full information by return mail. (Please Print)

NAME \_\_\_\_\_ AGE \_\_\_\_\_  
STREET \_\_\_\_\_  
CITY \_\_\_\_\_ ZONE \_\_\_\_\_ STATE \_\_\_\_\_

**NO SALESMAN WILL CALL ON YOU!**

**MOST  
SENSITIVE  
MOST  
POWERFUL  
BEST  
SELLING**



**THE  
FISHER  
800** STEREO  
FM-AM RECEIVER

■ *Twice as sensitive as any competitive stereo receiver—and easily the most powerful, with a conservative rating of 60 watts distortion-free music power! The FISHER 800 incorporates the famous Golden Cascode Front-End for the outstanding FM sensitivity of 0.7 microvolts (20 db of quieting with 72-ohm antenna!) The AM signal is of FM calibre, for perfect FM-AM Stereo. The 800 offers unlimited flexibility for every application, including Center Channel, Tape Monitoring and Multiplex Stereo! Truly, here is an instrument you'll be proud to own and recommend to your friends! \$429.50*

*Write Today For Complete Specifications!*

**FISHER RADIO CORPORATION**

21-38 44th Drive • Long Island City 1, N. Y.



**... for the Record**

By **W. A. STOCKLIN**  
Editor

**W**HEN Christmases roll around in a matter of months instead of annually—it is a pretty safe bet you are well out of your teens. This year has moved fast—in the electronics industry in particular and the country as a whole. We have seen space probes and satellites hurled into outer space with unbelievable nonchalance and almost incredible success, redeeming the prestige we lost when the first Sputnik was orbited.

However, this first year in the new decade has proven less hopeful than our crystal-ball gazing last year indicated. There were a number of factors which contributed to this "softening of the economy" or "sliding recession" . . . or whatever phrase you select to characterize the present business climate.

Paradoxically, the Gross National Product remains at a record high, bank deposits are up, and more people are gainfully employed than ever before . . . but still the annual reports rolling in show earnings, sales, and profits all down over a like period in 1959.

Is the market oversold or are potential customers "running scared"? Practically every consumer survey shows that the public *has* cut back on planned purchases. Those who earlier in the year planned to buy a second TV set or invest in a color receiver, now report a change of heart. True, the cost of living has edged up, taking an even higher percentage of a man's take-home pay and leaving fewer "discretionary dollars" available for luxury purchase . . . but perhaps the industry itself has been falling down on the job by failing to provide that incentive-to-purchase that many consumers seem to require.

In an economy of plenty, such as we enjoy, would-be customers are inclined to be lethargic in the matter of pursuing merchandise since they know it is available and can be obtained any time the spirit moves them.

The true test of salesmanship is to create a desire, supply the need, and insure customer satisfaction. It is not necessary to make wild claims for quality products . . . and plugging non-existent features of poor merchandise has a way of boom-eranging unpleasantly.

Many people claim that our industry has been oversold. In some cases this may be all too true. Basically, however, the electronics industry has much to offer in comfort, convenience, and entertainment. Electronics in itself is enough of a "miracle" to create the desire for such products. But if, as some analysts claim, our market is "oversold," it is up to the sales departments of our manufacturers to develop a program that will create the incentive necessary to increase the sales of their products.

As we wind up this year and head toward 1961, it is our hope that the New Year has many good things in store for all of our readers. So, from the entire staff of **ELECTRONICS WORLD**, may we wish you all . . . .

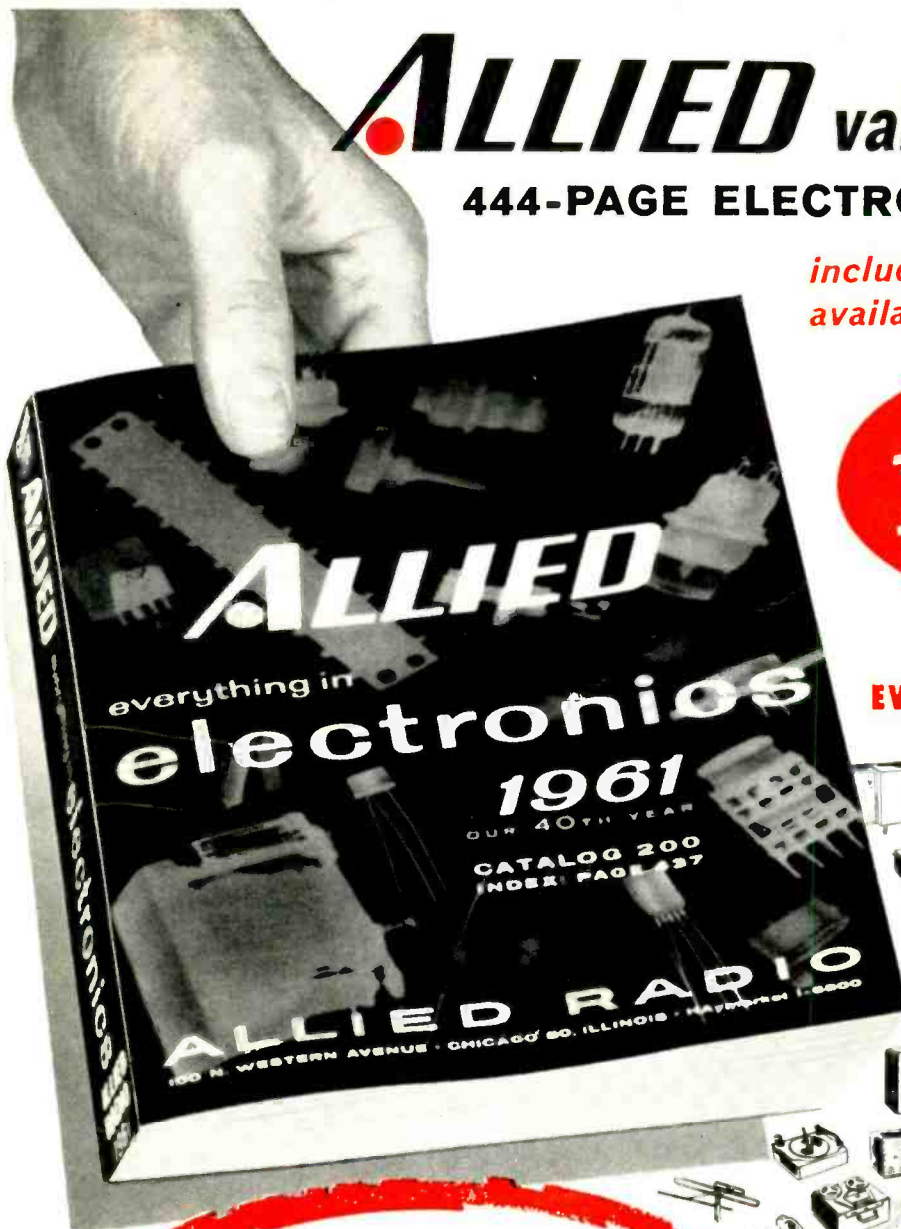
*Merry  
Christmas*



# ALLIED value-packed 1961

444-PAGE ELECTRONICS CATALOG

including special products available only from Allied



**free**

SAVE MOST ON

**EVERYTHING IN ELECTRONICS**

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

BUY ON EASIEST TERMS

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

## ALLIED exclusives:

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

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

*Exclusive Allied products save you more*

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

send coupon today  
 for 444-page catalog

**free**

## ALLIED RADIO

**Satisfaction Guaranteed or Your Money Back**

**World's Largest Electronic Supply House**



ALLIED RADIO, Dept. 1-A1  
 100 N. Western Ave., Chicago 80, Ill.

Send FREE 1961 Allied Catalog No. 200

Name \_\_\_\_\_  
PLEASE PRINT

Address \_\_\_\_\_

City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_



# SELECTIVE

**ELECTRO-VOICE'S MODEL 729 MICROPHONE** reduces random room noise and reverberation by as much as 67%

The Electro-Voice 729 cardioid microphone is the first low-cost microphone to offer the enormous advantages of a directional microphone and a virtually indestructible ceramic generating element. The ability to reject unwanted sound from the rear of the microphone permits better sound pickup and superior performance of associated equipment.

You get all this, and more, in the new E-V 729 at a list price of only \$24.50 with all trade discounts applying. The cardioid pickup pattern of the 729 dramatically reveals the greatly increased distance at which you can work from the microphone. It is virtually dead from any sound pickup from the rear, removes annoying room reverberation, and assures excellent microphone pickup even in the hands of inexperienced users. Response is peak-free, and the high output is ample for use with all

preamplifiers, tape recorders, public address microphones, communications equipment and similar equipment.

The generating element is indestructible ceramic, guaranteeing years of efficient operation in any climate and under wide variations of temperature and humidity. The 729 feels good in the hand; instantly lifts out of desk stand (supplied with microphone) without any hardware adjustment. A plug-in floor stand adapter is supplied also with each microphone. Built with E-V's traditional quality, the 729 is guaranteed satisfactory or your money back.

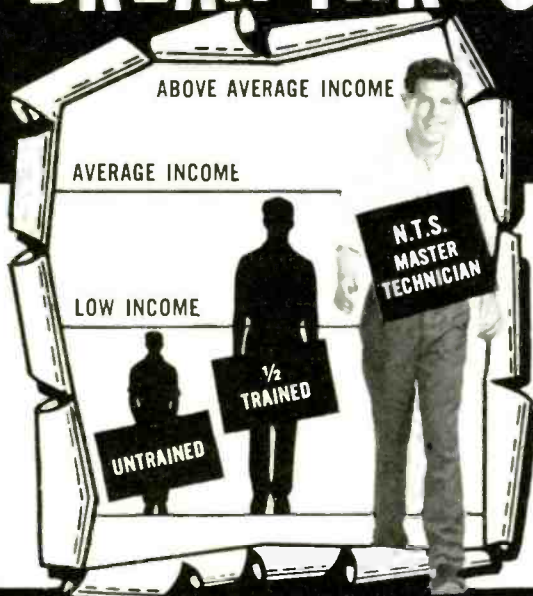
**Electro-Voice**<sup>®</sup>

Commercial Products Division  
ELECTRO-VOICE, INC.  
Dept. IN Buchanan, Michigan

# BREAK THROUGH TO HIGHER PAY

# in ELECTRONICS

## TV-RADIO



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

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

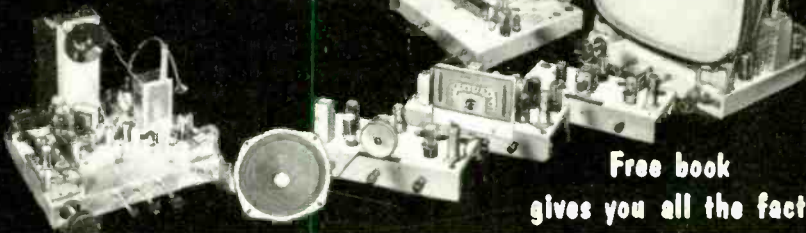
You work on actual job projects



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

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

### 19 BIG KITS YOURS TO KEEP



Free book gives you all the facts

### NATIONAL TECHNICAL SCHOOLS

WORLD-WIDE TRAINING SINCE 1905

4000 SO. FIGUEROA ST., LOS ANGELES 37, CALIF. U.S.A.

Write Dept. RH-11



#### RESIDENT TRAINING AT LOS ANGELES

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

WRITE FOR SPECIAL RESIDENT SCHOOL CATALOG AND INFORMATION



#### ACCREDITED MEMBER

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

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

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

You get lessons, manuals, job projects, unlimited consultation, graduate advisory service.

You build a Short Wave-Long Wave Superhet Receiver, plus a large-screen TV set from the ground up, with parts we send you at no addi-

tional cost. You also get a Professional Multimeter for your practical job projects.

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

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

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

#### N.T.S. HOME TRAINING is

- Classroom Developed
- Lab-Studio Planned
- Shop-Tested
- Industry-Approved
- Specifically Designed for Home Study



**MAIL COUPON NOW** for **FREE BOOK** and **ACTUAL LESSON**

**NO OBLIGATION! NO SALESMAN WILL CALL**

### NATIONAL TECHNICAL SCHOOLS

WORLD-WIDE TRAINING SINCE 1905

Mail Now To  
National Technical Schools, Dept. RH-11  
4000 S. Figueroa St., Los Angeles 37, Calif.

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

Name \_\_\_\_\_ Age \_\_\_\_\_  
Address \_\_\_\_\_  
City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_

Check here if interested ONLY in Resident Training at Los Angeles.  
VETERANS: Give date of discharge \_\_\_\_\_

## MINUTEMAN openings in Operational Electronics Design

Boeing's Aero-Space Division has openings now for Electronic/Electrical Engineers interested in the challenge and growth potential offered by the expanding Minuteman solid-fuel ICBM program.

Assignments are available for:

- Electronics Packaging Engineers, Electrical/Electronic and Mechanical Design Engineers whose experience and interest qualify them for —

Equipment wiring design  
Equipment miniaturization  
Model design  
Parts evaluation and related areas

- Electronic/Electrical design engineers whose education and experience qualify them for design of ground support equipment and associated test equipment, in the following specialized fields:

Transistor amplifier design  
Transistor power supply design  
Magnetic logic design  
Transistor circuit design  
Logic circuit design  
Systems analysis  
Systems design  
Equipment integration  
Communications design  
Radio noise and interference specialist  
Ground power equipment and cable design

At Boeing you'll enjoy the advantages of living in the uncongested Pacific Northwest, famous for mild year-round climate, fine schools and housing and unexcelled recreational facilities for the whole family.

Write today to: Mr. W. B. Evans,  
Boeing Airplane Company, P. O.  
Box 3707 - EXA, Seattle 24, Wash.



## from our Readers

### TRANSISTORIZED RAILROAD RADIOS

To the Editors:

Your article on "Railroad Radio" in the August issue was very interesting and comprehensive. We would like to bring up to date the last paragraph in which you say that partially transistorized equipment now in use has semiconductors in the audio output stages and in the power supplies. The latest *Motorola* railroad radio goes quite a bit further.

Our 64/12-volt universal "MOTRAC" railroad radio has a completely transistorized receiver, completely transistorized power supply, and a partially transistorized transmitter. The unit can be operated from either 64- or 12-volt power sources, thus making possible installation in either diesels or cabooses.

LEE WEDDIG  
Press Relations  
Motorola Communications &  
Electronics Inc.  
Chicago, Illinois

*We are certain that our readers will be interested in being brought up to date on the use of completely transistorized railroad radios.—Editors.*

### HAM RADIO CONSTRUCTION

To the Editors:

I have just finished reading Howard Pyle's article "Has Ham Radio Construction Improved?" which appeared in your August issue, and I enjoyed it very much.

But quite frankly, I do not agree with you that amateur radio construction has improved. The technical end has advanced unbelievably fast, particularly so since World War II, and the technical know-how of the amateur today has progressed accordingly. However, therein lies the basis of comparison for, considering the state of the art now and 30 or 40 years ago, actual construction has gone backwards, if anything. You see, I do not include "kit building" as construction for it is not, and there are relatively few hams today who build from the ground up. In the "old days" the ham usually built everything except meters, headphones, and tubes, and I have known some who were not stumped by these.

LESLIE E. WRIGHT  
New Woodstock, New York

*Here is a portion of Author Pyle's reply to the above letter.—Editors.*

Dear Les:

In connection with kits, I can agree with you only partially. True, the hard work is done by factories; holes are drilled and punched, panels lettered, etc., all of which greatly enhance the appearance of the finished product. Ac-

tual on-the-air performance is due, in my opinion, *not* to the fact that kits provide more workmanlike appearance, but to the fact that the *technical* developments, to which the ham has contributed in a major way, have progressed, as you say, to an almost unbelievable extent.

Nevertheless, there still remain a number of us of the "old school" who like at times to "build from scratch;" I know that I do. Naturally, we don't have the facilities which a modern kit factory must provide from the production standpoint. Sure, we can buy socket hole punches and many other tools unheard of in the pioneer days when we laboriously drilled a circle of small holes in a chassis, chiseled out the inner circle and patiently filed the edges.

I don't often go to that extreme anymore. In fact, I consider kits a boon to the experimenter who is willing to adopt conventional circuits and practice. For the man with a new idea (are there any?), the laborious process of developing your brain child the "hard way," is still pretty much of a "must." I often get a design idea for which no kit exists. I have a yen then to bring my "brain-child" into being, bend sheet metal (without a brake), drill and punch holes, letter panels with the small decals (not available to early pioneers), but I try to come up with a workmanlike job, based on background and experience.

For the newcomer to the ham ranks, there is no electronic background; probably not much mechanical experience. For him the kit is ideal. While assembling and wiring it, craftsmanship gradually rubs off on him and, when he has progressed to the stage where the urge to actually "build from scratch" and from his own design becomes overpowering, he cannot help but do a better job of construction than were he to be forced to grope in the semi-dark to produce a "breadboard" job such as appeared photographically on the first page of my article.

HOWARD S. PYLE  
Mercer Island, Washington

### TAPE RECORDER SPEED AT 50 CPS

To the Editors:

Recently I had to record a week's convention in Rio de Janeiro, Brazil, where the power is 50 cps.

Since I have many excellent portable recorders for 60-cycle operation, I wanted to be able to use them and still get good recordings. The solution was easy, and I want to pass it on to the readers of *ELECTRONICS WORLD*.

I recorded as usual, but when I got back to 60-cycle power, I dubbed (copied) the material to another machine. On it I had built up the diam-

Through  
**HOME STUDY**  
or in  
**RESIDENT CLASSES**

# ELECTRONICS

— field of opportunity —

the Grantham Communications  
Electronics Course prepares you  
for your first class commercial  
**F.C.C. LICENSE**

The Grantham home study course teaches you principles of electronics in a simple "easy-to-grasp" manner. Each new principle is explained first in *everyday language* and then, after you understand it, is associated with the proper *technical language*. You learn and remember more, because the emphasis is on *understanding* rather than on memorizing.

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 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.

Get details concerning *how* we can prepare you for your F. C. C. license and *how* that license can help you advance in electronics. Mail the coupon below to the home office of Grantham School of Electronics in Hollywood, Calif., and our free catalog will be sent to you promptly.

offers

interesting and profitable careers in  
RADIO AND TV BROADCASTING • TWO-WAY RADIO COMMUNICATIONS • RESEARCH AND DEVELOPMENT • RELAY STATION MAINTENANCE • AUTOMATION ELECTRONICS • TECHNICAL WRITING IN ELECTRONICS • INDUSTRIAL ELECTRONICS • ELECTRONIC COMPUTERS • MILITARY ELECTRONICS • INSTRUMENTATION • TELEMETERING • AERONAUTICAL ELECTRONICS • SPACE ELECTRONICS

and many other

interesting and profitable fields of the present and future

To get ahead in electronics, you must have the proper training and your employer must know that you have that training. Your F. C. C. license is a "diploma" in communications electronics granted by the U. S. Government, and it is recognized as such by employers. Grantham School of Electronics specializes in preparing you to earn this diploma.

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

	License	Weeks
Edgar T. Phelps, 931 Hickory Street, Poplar Bluff, Mo.	1st	12
Wayne Hogg, 4830 San Fernando Rd., Glendale, Calif.	1st	20
Robert Watson, Star Route, Box 24, Renovo, Pa.	1st	12
William H. Patchin, 3865 Westview Ave., NW, Canton, Ohio	1st	12
V. Dean DeVore, 309 Bess Street, Washington, Ill.	1st	16
Edward T. Wall, Box 184, Kenly, N. C.	1st	12
James W. Wranich, 4236 Michigan Street, Kansas City, Mo.	1st	20
Robert E. Sullivan, 2475 E. Douglas, Des Moines, Iowa	1st	12
Nelson S. Kibler, 1413 Patrick Henry Dr., Falls Church, Va.	1st	18
Barry L. Ulrich, 1110 Chestnut Ave., Barnesboro, Pa.	1st	14
Jerry E. Milligan, 707 Ragsdale Dr., Milan, Tenn.	1st	12
Robert S. Davis, 2100 10 Ave., So., Apt. 12, Birmingham, Ala.	1st	13

If you are interested in details concerning our training, indicate in the coupon below whether you prefer home study or resident classes, and mail the coupon to the School's home office in Hollywood, California — to the address given in the coupon — for free details.

## GRANTHAM SCHOOL OF ELECTRONICS

HOLLYWOOD

SEATTLE

KANSAS CITY

WASHINGTON

### FIRST CLASS F.C.C. LICENSE IN 12 WEEKS

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.

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

MAIL COUPON FOR FREE DETAILS — NO SALESMAN WILL CALL —>



(Mail in envelope or paste on postal card)

To: **GRANTHAM SCHOOL OF ELECTRONICS**  
1505 N. WESTERN AVE., HOLLYWOOD 27, CALIF.

Gentlemen:

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

Name \_\_\_\_\_ Age \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_

I am interested in:  Home Study  Kansas City classes  
 Hollywood classes  Seattle classes  Washington classes

16-A

for the Experimenter  
for the Boat Owner  
for the Hi-Fi Enthusiast  
for the Ham  
for the Retailer

# PRECISION adds 6 new products

to the  
**PACO**  
kit line!



**1  
NEW**

**PACO MODEL T-61C  
AND MODEL T-61F  
SELF-SERVICE TUBE CHECKER KITS**

For the enterprising retailer who wants to increase his store traffic with this extra service. 2 models: Counter (T-61C illus.) and Floor (T-61F). 24 tube sockets, 3 simple selectors. Complete instruction data cards make tube-checking a 'snap'.

Model T-61C (Kit) ..... Net Price: \$ 99.95  
Model T-61CW (Wired) ..... Net Price: \$134.95  
Model T-61F (Kit) ..... Net Price: \$124.95  
Model T-61FW (Wired) ..... Net Price: \$164.95



**2  
NEW**

**PACO MODEL B-12  
REGULATED POWER  
SUPPLY KIT**

Two instruments in one! A reliable source of variable regulated DC plate voltage from 0-400 volts at 150 ma, plus bias and AC filament voltages...with an exclusive 12.6 volt AC supply! Maximum stability. Lab-quality PACE double-jewelled D'Arsonval meters.

Model B-12 (Kit) ..... Net Price: \$69.95  
Model B-12W (Wired) ..... Net Price: \$99.95



**3  
NEW**

**PACO TK-6  
TOOL KIT**

For the kit-builder or experienced electronic technician, this complete set of precision-built English and American-made tools can handle any assembly job, large or small. Includes: diagonal cutters; long-nosed pliers; 40-watt soldering iron; two screwdrivers; a pair of wire-strippers, plus see-through carrying-case.

Model TK-6 ..... Net Price: \$9.95

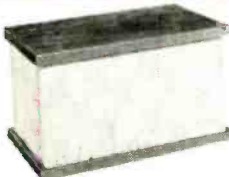


**4  
NEW**

**PACO MODEL G-15  
GRID DIP METER KIT**

Truly, a hand-held electronic "jack-of-all-trades" - VFO; Absorption Wavemeter; Signal Source; field strength Indicator, plus an exclusive visual/aural "on-the-air" Modulation Indicator. A 'must' for the ham or electronic technician who wants maximum quality at the lowest possible cost.

Model G-15 (Kit) ..... Net Price: \$31.95  
Model G-15W (Wired) ..... Net Price: \$49.95



**5  
NEW**

**PACO MODEL L-1  
HIGH FIDELITY  
SPEAKER SYSTEM  
SEMI-KIT**

A 'bookshelf' speaker system whose sound output and small size will astound you! So efficient, it assures perfect results even with low-powered amplifiers. Response, 50-14,000 cps. Only 15 1/4" x 9 1/4" x 8 1/2". 12 lbs. Assembly-time—1 hour!

Model L-1U (Semi-kit)  
in unfinished walnut ..... Net Price: \$24.95



**6**

**NEW  
PACO DF-90  
TRANSISTORIZED  
DEPTH FINDER KIT**

An absolute necessity for protection against shoals, and for finding that elusive school of fish! Range, 0 to 120 feet. Large, illuminated dial for easy readings. Operates on self-contained batteries or from ship's power source. Completely fungus and moisture-proof.

DW-90 (Kit) ..... Net Price: \$ 84.50  
DF-90W (Wired) ..... Net Price: \$135.50

PACO "Instruments in Kit Form" are produced under the auspices of **PRECISION APPARATUS COMPANY, INC.**, world-famous manufacturer of industrial and laboratory electronic test instruments for over a quarter of a century. Write for new complete PACO Catalog just off the press.



SEE THESE KITS AMONG LEADING  
ELECTRONIC PARTS DISTRIBUTORS  
**PACO ELECTRONICS CO., INC.**

70-31 84th Street, Glendale 27, L. I., N. Y.  
Kit Division of  
**PRECISION APPARATUS CO., INC.**  
a subsidiary of Pacotronics, Inc.

eter of the capstan drive shaft with Scotch splicing tape #41 where it pulls the tape until twelve seconds of leader and timing tape went through in ten seconds. My capstan shaft is approximately one-quarter inch in diameter and I needed exactly twelve inches of splicing tape for the job.

After the original tape is copied on the recorder with the built-up capstan, that copy will play at proper speed on any other recorder. It is only necessary to use the tape on the capstan once. Always play the copy with a bare capstan. The splicing tape is very thin and does not leave enough ridge at the beginning and end to make any apparent wow in the reproduced tape.

WES MILLER, Chief Engineer  
Southern Baptists' Radio  
and Television Commission  
Fort Worth, Texas

*We are pleased to pass along this very helpful hint to any of our readers who may desire to correct the speed of material taped at 50 cps. We also wish to thank Reader Miller for his thoughtfulness in advising us of his experiences in this regard.—Editors.*

#### CITIZENS BAND USE

To the Editors:

I have recently been on a ten-day trip through New England and have traveled on turnpikes, thruways, toll roads, and in isolated places, driving approximately 2000 miles. We felt at all times that if we needed help due to breakdown of our car, or finding a place to stay or eat, there was always someone available to help us through the use of our Citizens Band equipment.

In Buffalo for example, we heard several CB operators giving assistance to other CB operators in Niagara Falls and arranging for accommodations.

As a real-estate broker, I have six units, and they have been a great help in my business and well worth their cost.

JAMES D. QUILLEN  
Dover, Delaware

*Many of our readers have pointed out the usefulness of CB near on the road. Our write-up of "A National Travel Service Frequency for Citizens Banders" for just the above purposes in our September 1960 issue received a large number of favorable comments.*

—Editors.

#### THE CASCODE CIRCUIT

To the Editors:

As a co-inventor of the original low-noise cascode with A. B. Macnee and H. Wallman (U.S. Patent 2,644,860), I object to its being called the "Wallman" circuit, as was done in your September, 1960 issue. The triple invention of this circuit is based on the fact that I suggested it, Macnee and Wallman predicted its possible low-noise advantages theoretically, and I built and tested the first model.

Incidentally, Fig. 2 of Mr. Kyle's article should show the suppressor of the

# How to Get a Commercial FCC License



Automation



Microwave and Mobile Radio



Guided Missiles



Radio & TV Broadcasting



Aeronautical Electronics

do you know what an FCC license really can do for you in Electronics?

- ① More income for you every week
- ② A more interesting job in electronics

Chances are if you are reading this magazine, you can qualify for the really good jobs in electronics, like those shown at left . . . and it won't take long to do it. Your past training and experience in radio & TV repair, armed forces electronics, ham operator, etc. can be your foundation for a profitable career as an electronics technician. Send for the Career Information Material shown below today.

## Increase Your Technical Knowledge

Get a government license plus an understanding of such electronic applications as computers . . . industrial electronics . . . radar . . . communications . . . color TV . . . Instrumentation . . . Automation . . . Radio Telemetry . . . and many more.

SEND FOR INFORMATION TODAY

### CLEVELAND INSTITUTE OF ELECTRONICS

Desk RN-49,  
4900 Euclid Ave.  
Cleveland 3, Ohio

1. Raytheon Manufacturing Company
2. Radio Corporation of America
3. Jupiter IRBM, Army Ordnance Missile Command
4. Collins Radio Company
5. Radio Corporation of America

### Get This Handy Pocket Electronics Data Guide

# Free . . .

Puts all the commonly used conversion factors, formulas, tables, and color codes at your fingertips. Yours absolutely free if you mail the coupon today. No further obligation!

TO GET THIS FREE GIFT,  
MAIL COUPON TODAY!

# Free!



### CLEVELAND INSTITUTE OF ELECTRONICS

Desk RN49, 4900 Euclid Ave., Cleveland 3, Ohio

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

- |   |   |
|---|---|
| <input type="checkbox"/> Military           | <input type="checkbox"/> Broadcasting       |
| <input type="checkbox"/> Radio-TV Servicing | <input type="checkbox"/> Home Experimenting |
| <input type="checkbox"/> Manufacturing      | <input type="checkbox"/> Telephone Company  |
| <input type="checkbox"/> Amateur Radio      | <input type="checkbox"/> Other              |

In what kind of work are you now engaged? \_\_\_\_\_

In what branch of Electronics are you interested? \_\_\_\_\_

Name \_\_\_\_\_ Age \_\_\_\_\_

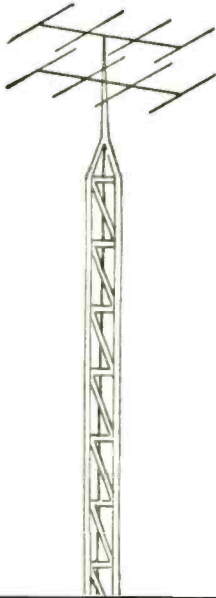
Address \_\_\_\_\_

City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_

#### FIND OUT HOW:

1. The new electronic devices can be handled by you
2. To solve the problems that will stump your fellow technicians
3. Training is Job Insurance when employment is tough to find . . . and more money for you when times are good



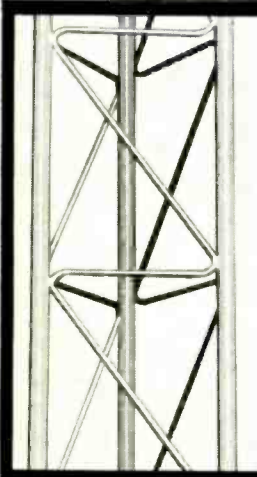


# THE MOST FAMOUS LINE OF TOWERS IN THE WORLD ARE ROHN!

*Here are the features that make them the largest selling and most accepted tower for television, radio, industrial and communications uses:*

- **ZIG-ZAG CONSTRUCTION**—proven zig-zag design means sturdiness and dependability that is truly outstanding. Tower sections are completely assembled and electric welded throughout for maximum strength and greater economy in erection.
- **HOT DIPPED GALVANIZED AFTER FABRICATION**—Entire tower sections are completely zinc coated after fabrication for the finest outer protection possible. Being galvanized after fabrication means no uncoated bolt holes, weld spots or seam to rust. All ROHN Towers last far longer and have less maintenance than competitive towers because of this feature.
- **HIGHEST QUALITY MATERIAL USED**—only highest quality laboratory-certified steel tubing is used (not pipe). Quality steel plus heavy gauges combine to give far greater strength than competitive towers.
- **COMPLETE LINE FOR WHATEVER YOUR NEEDS**—Fully self-supporting towers are available to 170 feet or lower; heavy duty guyed towers available up to 500 feet. Whatever your needs, check ROHN.
- **UNEXCELLED ENGINEERING**—all ROHN Towers are engineered to meet the most rigid requirements as outlined by all major communications equipment manufacturers and electronic industry associations.
- **UNIVERSAL ACCEPTANCE**—Hundreds of thousands of Rohn Towers are in use all over the world. They have withstood the "test of time"—the only true test as to the superiority of a tower. So why settle for less than the BEST? Insist on the largest selling tower in the world—ROHN.

For your needs and for all allied tower accessories, contact your local ROHN salesman or write direct for full information.



SEND THE HANDY COUPON INDICATING YOUR NEEDS

**ROHN**  
Manufacturing  
Company  
BOX 2000  
PEORIA, ILLINOIS

ROHN Manufacturing Company  
Box 2000  
Peoria, Illinois

Send me complete literature on the following ROHN Products:

- |   |   |
|---|---|
| <input type="checkbox"/> TV Towers            | <input type="checkbox"/> Amateur Towers   |
| <input type="checkbox"/> Communication Towers | <input type="checkbox"/> ROHN Accessories |

Name \_\_\_\_\_

Firm \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_

## 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 I-M distortion checks. Full range is from 20 to 200,000 cps, output 5 volts with minimum amplitude variation throughout whole range.

## OHMATSU ELECTRIC CO. LTD.

850 Tsunashima-Cho, Kohoku-Ku  
Yokohama, Japan.

new "LEADER" test instrument



6AK5 connected internally to the cathode. It may be noted that the word "cascode" was coined by F. V. Hunt, who originated this type of circuit in connection with a voltage stabilizer (unpatented). The series modification of the high-frequency circuit was made by E. K. Nelson in adapting it to TV tuners (U.S. Patent 2,775,659).

CHRISTOPHER P. GADSDEN  
Assistant Professor of  
Electrical Engineering  
Tulane University  
New Orleans, Louisiana

*Some authors have attacked Wallman's name to the cascode circuit for brevity and because the paper which formally described the development to the industry was written by him, and he placed his name on it first. However, Wallman has disavowed the practice of singling him alone for credit in a letter to the "Proceedings of the IRE," which Professor Gadsden was good enough to forward to us.—Editors.*

### PHOTOELECTRONIC BURGLAR ALARM

To the Editors

I recently bought a photoelectronic relay and light source kit from *Allied Radio* as a protective device against housebreaking, which is very bad here on Taiwan, especially for Americans.

I received the kit one morning, assembled it during the same afternoon, and had it installed and operating that night with a buzzer that I had to convert from a bicycle horn, as all doorbells and buzzers here are for 110 volts a.c. About 2 a.m. that same night, the buzzer sounded, and I had a sneak thief cornered with a baseball bat that just happened to be handy. The culprit is now weaving grass rugs in the local monkey house and will be there for a few months to come.

GORDON B. SCOTT  
Martin Company Tech. Rep.  
Tainan, Taiwan (Formosa)

*These kits work in the United States, too.—Editors.*

### LINE-VOLTAGE ADJUSTER

To the Editors:

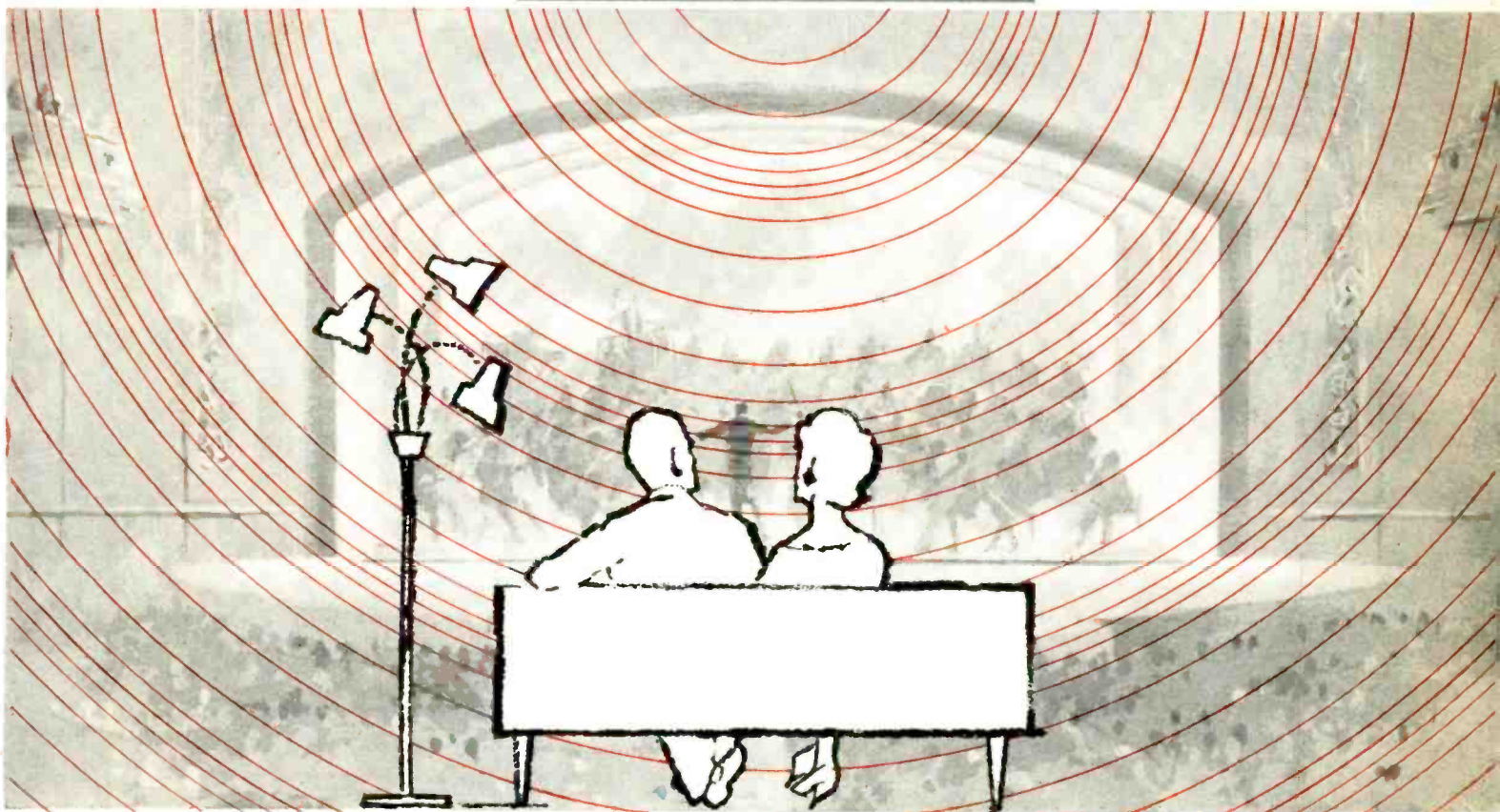
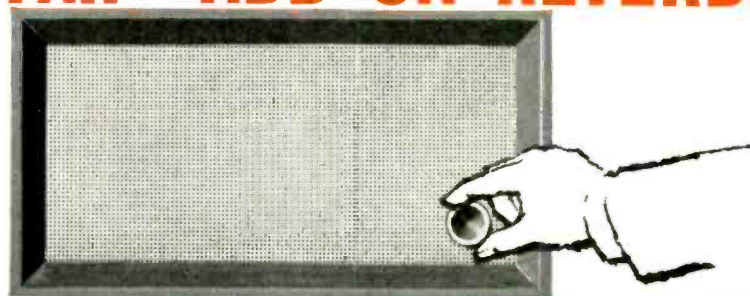
Before the smoke from burning transformers completely obscures Fig. 4 on page 67 of *ELECTRONICS WORLD* for November 1960, I urge you to change that wire leading downward from the lower left-hand terminal of  $S_1$  from its present position on the terminal "E" lead to a more logical spot, the "F" lead.

JOHN D. MCCURRACH  
Commonwealth Edison Company  
Chicago, Illinois

*We certainly appreciate the alertness of reader McCurrach in pointing out the improper connection that occurred in Fig. 4 of the article "A Line-Voltage Adjuster" by Ronald L. Ives. We are sorry that neither we nor Author Ives caught this when tracing the circuit operation through the various switches that are utilized in the line-voltage adjuster.—Editors.*



# NEW FROM UTAH — ADD-ON REVERBERATION



## MAKES YOUR LIVING ROOM SOUND AS LARGE AS A CONCERT HALL!

**Change acoustic dimensions** of a room to fit the music . . . switch from club lounge intimacy to concert hall grandeur at the touch of a dial. Controlled reverberation is the secret! Some of this year's consoles feature "built-in" reverberation. But Utah alone offers "Acousti-Control" — a self-contained reverberation speaker-and-amplifier that hooks into any radio, phonograph (mono or stereo), or component sound system.

**Here's how it works:** Hook Utah's "Acousti-Control" unit into any speaker system. Part of the original signal feeds through a carefully tuned device which delays the sound for 1/30th of a second. This delayed sound blends with the original sound to add acoustic dimension to the room. (The further you turn the knob, the larger the room sounds.) Makes monaural FM sound like stereo—adds startling dimension to stereo itself. Ask for a demonstration at your dealer's—or write for free literature and prices.

**utah**

UTAH RADIO & ELECTRONICS CORP.  
Huntington, Indiana



# PUZZLED

*...no need to be*

## look to this sign of assurance!

The Distributor displaying this sign will solve your tuner problems at a profit to you.

He has available the New Standard Tuner Replacement Guide, including replacement parts listings. This is the only Guide of its kind in the world. Covers all Standard tuners produced through 1959. Includes replacements for many tuners not produced by Standard. He handles our 48-hour Factory Guaranteed Repair Service and Trade-In Allowance on unrepairable Standard tuners.

*See This Authorized Distributor Today*



### **standard kollman**

INDUSTRIES INC. *Formerly Standard Coil Products Co., Inc.*  
2085 N. HAWTHORNE AVENUE, MELROSE PARK, ILLINOIS

Another outstanding product by the HIDDEN

**500\***

who plan for your future:



## TYPE TE LITTL-LYTIC<sup>®</sup> CAPACITORS



Transistors revolutionized the industry. And to make the most of their inherent advantages, they called for an entirely new group of components. Here, Sprague Research was the first to answer the call with the smallest truly reliable dry electrolytic made for transistor circuits—the Littl-Lytic. This reasonably priced capacitor is the most reliable subminiature you can buy for transistorized radios, hearing aids, wireless microphones, pocket wire recorders, and other miniature electronic equipment.

The remarkable reliability of Littl-Lytic is the result of a new manufacturing technique in which *all the terminal connections are welded*. Units are hermetically sealed and metal encased . . . *with no pressure joints* . . . there are no *"open circuits" with the passage of time*. Leakage current is extremely low as the result of the use of high purity foil and ultra-stable formation techniques. Sprague's catalog replacement ratings are the most comprehensive in the industry. They assure you of exact replacements to meet your day-to-day service requirements.

Littl-Lytic is a typical example of how Sprague Research keeps its products up-to-the-minute. Reliable components mean reliable service work—your business keeps pace with the electronic industry when you use Sprague.

**\*The "Hidden 500"** are Sprague's 500 experienced researchers who staff the **largest research organization in the electronic component industry** and who back up the efforts of some 6,000 Sprague employees working in 14 manufacturing operations—four at North Adams, Mass.; Bennington and Barre, Vt.; Concord and Nashua, N.H.; Lansing, N.C.; Grafton, Wis.; Visalia, Calif.; two at Ponce, Puerto Rico; and Milan, Italy.

don't be vague . . . insist on

**SPRAGUE<sup>®</sup>**

*world's largest capacitor manufacturer*



Replace improper equipment with the only  
microphone  
designed specifically **THE TURNER 350C**  
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: \$16.80 complete. See your Turner Distributor, listed below, he has the 350C in stock.



**ARKANSAS**

Little Rock: Southern Radio Supply  
Texarkana: Lavender Radio & T.V. Sup.

**CALIFORNIA**

Downey: Net Electronics  
Hemet: Gil Severns  
Hollywood: Pacific Radio Exchange  
Los Angeles: Radio Product Sales  
The Sound Foyer

Oakland: Elmar Electronics

Sacramento: Selectronics

San Francisco: Market Radio Sound Dept.

San Pedro: Marine Radio Service

**DISTRICT OF COLUMBIA**

Washington: Electronic Wholesalers

**FLORIDA**

Miami: East Coast Radio & TV

Tampa: Kinkade Radio Supply

**GEORGIA**

Atlanta: Specialty Distributing

**ILLINOIS**

Chicago: Nationwide Radio

Irving Joseph, Inc.

La Salle: Klaus Radio & Electric

La Salle Electronics

Peoria: Klaus Radio & Electric

**INDIANA**

Anderson: Seybert's Radio Sup.

Bloomington: Stansifer Radio Co.

Evansville: Hutch and Son, Inc.

Ohio Valley Sound

Fort Wayne: Pembleton Laboratories

Indianapolis: Brown Distributing Co.

Graham Electronic Sup.

Van Sickle Radio Supply

Kokomo: George's Electronic Sup.

Michigan City: Tri-State Electrical Sup.

Portland: Buck's Hi-Fi

Richmond: Fox Electronics Company

Terre Haute: Midwest Supply Company

**IOWA**

Cedar Rapids: Iowa Radio Supply

Des Moines: Bob & Jacks, Incorporated  
Radio Trade Supply Co.

**KANSAS**

Topeka: Acme Radio Supply

**KENTUCKY**

Lexington: Radio Equipment Co.

Louisville: Arcby Electronics

P. I. Burks Company

Peerless Electronic Equipment Co.

**LOUISIANA**

Baton Rouge: Davis Electronics Sup.

New Iberia: Brooks Electronics

**MASSACHUSETTS**

Boston: A. W. Mayer Company

O'Donnell Electronic Supply

Radio Shack Corp.

Lawrence: Alco Electronics

**MICHIGAN**

Ann Arbor: Purchase Radio Supply

Detroit: High Fidelity Workshop

Lansing: Offenauer Company

**MINNESOTA**

Minneapolis: Lew Bonn

National Electronics Co.

Harry Starks, Inc.

Schaak Electronics

**MISSOURI**

St. Louis: Radonics

**NEW JERSEY**

Berlin: Midstate Radio Supply

Jersey City: Nidisco-Jersey City

Mountainside: Federated Purchaser

**NEW YORK**

Albany: Greylock Electronics Supply

Buffalo: Radio Equipment Corp.

Farmingdale, L.I.: Gem Electronics

Forest Hills: Beam Electronics

Hicksville: Gem Electronics

Kingston: Greylock Electronics

Long Island City: Spera Electronics

Mt. Vernon: Davis Electronics

New York: Harvey Radio Company  
Acme Electronics

Poughkeepsie: Greylock Electronics

Rochester: Rochester Radio Supply

**NORTH CAROLINA**

Greensboro: Johannesen Electric Company

Raleigh: Southeastern Radio Supply Co.

Winston-Salem: Womack Company

**OHIO**

Cleveland: Pioneer Electronic Sup.

Columbus: Whitehead Radio Company

Mansfield: Wholesaling, Inc.

Toledo: Lifetime Electronics

**OKLAHOMA**

Oklahoma City: Johnson Wholesale

**OREGON**

Portland: United Radio Supply

**PENNSYLVANIA**

Homestead: M. Leff Radio Parts

Lancaster: George D. Barbey Co.

Lebanon: George D. Barbey Co.

Philadelphia: Radio Electric Service Co.

Pottstown: George D. Barbey Co.

Reading: George D. Barbey Co.

Wilkes-Barre: General Radio & Electronics

York: Radio Electric Service Co.

**RHODE ISLAND**

Providence: Del Padre Supply Co.

Zetka Distributors

**SOUTH CAROLINA**

Columbia: Dixie Radio Supply Company

**SOUTH DAKOTA**

Watertown: Burghardt Radio Supply

**TEXAS**

Houston: Sound Equipment Inc.

**VIRGINIA**

Arlington: Rucker Electronic Products

Falls Church: The Television Workshop

Richmond: Banner Electronics, Inc.

**WISCONSIN**

Chippewa Falls: Bushland Radio Spec.

Eau Claire: Bushland Radio Spec.

**THE TURNER MICROPHONE COMPANY** 900 17th St. N.E., Cedar Rapids, Iowa

Please send me further information on The Turner 350C citizen's band microphone.

NAME \_\_\_\_\_

STREET OR RFD \_\_\_\_\_

CITY \_\_\_\_\_

ZONE \_\_\_\_\_

STATE \_\_\_\_\_

Send this coupon to the nearest Turner distributor listed above or write The Turner Microphone Company for the name of a distributor in your area.



900 17th St. N.E. . . . Cedar Rapids, Iowa



Latest Information

on the Electronic Industry



By ELECTRONICS WORLD'S  
WASHINGTON CORRESPONDENT

**ELECTRONIC SPEED MAIL MAKES DEBUT**—An innovation in mailing featuring a microwave network and electronic facsimile was unveiled recently in Washington. Hailing the development as a... "major landmark in the evolution of postal service"... spokesmen said that the system should prove to be a practical and economical means of sending a "preferred type of mail." In operation, the sender types, writes, draws or otherwise imprints a message on a special form (similar to the V-mail form of World War II) and then folds, seals, and mails the form. At a local post office, it is sent to a Speed Mail unit. One machine places a code mark on the letter which guides it through a "brain" of the system—a complex electronic switching equipment—which directs it to the correct destination printing machine. Moving on to other machines, the sealed edges are then trimmed off; the latter is "read" and transmitted over a microwave network to the destination post office. There it is reprinted in its original form, automatically folded, sealed, and sent out to the addressee. Each sending and receiving unit can handle one letter every four seconds. At present, the basic transmission and reception system is between Washington and Chicago, with four sending and four receiving units in the capital and four divided between Chicago and Battle Creek.

**OVER 40 TRANSMITTERS BEAMED ELECTION RETURNS OVER VOA CIRCUITS TO WORLD**—The U.S. Information Agency global radio network, the Voice of America, involving 46 domestic and overseas transmitters with a total power of 3,000,000 watts, was used to send election returns worldwide. Besides making its studio facilities available to foreign correspondents, more than 30 feeder broadcasts were scheduled for overseas stations or networks located in Italy, West Germany, Austria, France, Spain, Luxembourg, Holland, Iceland, Norway, Turkey, Tanganyika, and Kenya.

**RUSSIA TO HAVE 15-MILLION TV SETS BY 1965, REPORT DISCLOSES**—By 1965, the number of TV sets in Russia is expected to increase from the now more than 3-million to over 15-million, according to a report appearing in a Russian magazine. The article, translated by a government agency, also notes that there will be, five years from now, 160 TV stations, compared to the 70 now operating. In addition, the report continues, new studios will be added to the three now in Moscow and a new tall tower for broadcasting will be erected in Ostankin. It was also revealed that both black and white and color will be transmitted at that time.

**FORWARD-SCATTER TRANSMISSION OVER NORTH ATLANTIC SOUGHT BY FAA**—The forward-scatter principle, successfully used by military and communications networks, may soon be used for airways communications, the Federal Aviation Agency announced recently. Based on the effectiveness of the Pan American Airline system in Ireland with a range of 400 miles, the FAA said that it believed forward scatter should be practical for both domestic and overseas operations. As a first step in determining the extent to which forward scatter might be used, the FAA will establish two terminals here and subsequently locate others in Europe.

**ELECTRONIC SUPERMARKET DEVELOPED**—A novel approach to electronic marketing—where a customer never handles the goods—has been demonstrated. The system features an automatic method of warehousing coupled with electronic order-taking which enables one to make a choice by inserting a card into slots over goods on display. The cards are then fed into a processing machine, which sets automatic dispensing from the warehouse into action.

**MICROWAVES FOR BUSINESS RADIO SERVICE**—Frequencies above 10,000 mc. will soon be available for the Business Radio Service, according to an amendment issued by the FCC.

**PROPOSED RULES TO AFFECT OPERATION IN 450-470 MC. BAND**—The rules governing the Public Safety, Industrial, Land Transportation and Citizens Radio Services, may be amended to require a reduction in the modulation-frequency deviation of all FM transmitters operating in the 450-470 mc. band from plus or minus 15 kc. to plus or minus 5 kc.

# Here's the SPECIALIZED

Let these 2 Ghirardi manuals teach you to  
**REPAIR ANY TELEVISION  
OR RADIO RECEIVER ever made!**



A. A. GHIRARDI

**SAVE \$2.00!**

Make your service library complete! Get both these famous Ghirardi books at a saving of \$2.00 under the regular price. See **MONEY - SAVING COMBINATION OFFER** in coupon.

Let these two famous training books teach you to handle all types of AM, FM and TV service jobs by approved professional methods—and watch your efficiency and earnings soar! Almost 1500 pages and over 800 clear pictures and diagrams explain EVERY troubleshooting and repair operation as clearly as A-B-C. No needless mathematics. No involved theory. You get straight-from-the-shoulder training of the type that teaches you to do the best work in the

shortest time. Each book is co-authored by A. A. Ghirardi whose radio-electronics training guides have, for more than 25 years, been more widely used for military, school and home study training than any other books of their types. Books are sold separately at prices indicated—or you save \$2.00 by buying them both. Use coupon or order from Dept. RN-11, Technical Div., Holt, Rinehart and Winston, Inc., 383 Madison Ave., New York 17, N.Y.

## **RADIO & TV CIRCUITRY and OPERATION**

Learn about circuits . . . and watch service headaches disappear

You can repair ANY radio, TV or other electronic equipment lots easier, faster and better when you're fully familiar with its circuits and know just why and how each one works . . . and that's exactly the kind of specialized training you get in Ghirardi's 669-page **RADIO & TV CIRCUITRY AND OPERATION** training guide. First it gives a complete understanding of

basic modern circuits and their variations. Finally it shows what troubles to look for and how to eliminate useless service testing and guesswork. Throughout, it gives you the above-average training that takes the 'headaches' out of trouble-shooting—the kind that fits you for the best-paid servicing jobs. Contains 417 clear illustrations.

Sold separately for \$9.00—or see **MONEY-SAVING COMBINATION OFFER.**

## **RADIO & TV TROUBLESHOOTING & REPAIR**

Complete training in modern service methods

**RADIO & TV TROUBLESHOOTING AND REPAIR** is a complete 822-page guide to professional service methods . . . the kind that help you handle jobs faster, more profitably. For beginners, this giant book with its 417 clear illustrations is an easily understood course in locating troubles fast and fixing them right. For experienced servicemen, it is an ideal way to develop better

methods and shortcuts; or to find fast answers to problems. You learn troubleshooting of all types from "static" tests to dynamic signal tracing methods. Step-by-step charts demonstrate exactly what to look for and how to look. A big television section is a down-to-earth guide to all types of TV service procedures. Read it 10 days at our risk!

Sold separately for \$10.00 or save \$2.00 on **MONEY-SAVING COMBINATION OFFER.**



## Cut Radio-TV Test Time IN HALF!

In modern electronic work it's what you know about using instruments that really counts!



This new 316-page **BASIC ELECTRONIC TEST PROCEDURES** manual with its more than 190 illustrations, pattern photos and procedure diagrams teaches you to test any circuit, equipment or component in a fraction of the usual time. In brief, it is a complete course

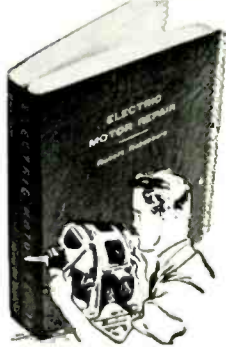
in professional instrument testing techniques! Covers different ways of doing jobs. For instance, you learn to check for distortion by the scope, rejection filter, harmonic distortion meter, wave analyzer or oscillator methods. You learn to measure resistance with a current meter, a voltmeter, voltmeter, ohmmeter, or via the bridge method—and so on through all types of testing.

Includes Current checks; measuring Power, Capacitance, Resistance, AF, RF, Phase, Distortion & Modulation; testing Tubes and Semiconductors; testing Amplifiers; checking Sensitivity, RF Gain, Fidelity, AVC Voltage, etc. Even includes industrial electronic test procedures. Everything is really complete—and written so you can understand it! Price \$8.00.

Order **BASIC ELECTRONIC TEST PROCEDURES** in coupon.

## Now! FIX ANY ELECTRIC MOTOR

Handle ANY job from minor repairs to complete rewinding



560 pages—Over 900 how-to-do-it pictures

It pays to train for something different! **ELECTRIC MOTOR REPAIR** is a complete guide that helps you cash in on this vast, rapidly growing field. Shows step by step how to handle all repair jobs (including complete rewinding) on practically ANY AC or DC motor or generator in common use—from fractional horsepower to giant industrial motors. Special duo-color binding brings text and related how-to-do-it diagrams side by side so that you learn fast, easily and right. Every job is explained so clearly you can hardly fail to understand it. Over 125,000 copies in use in motor repair shops, schools, and for home study. Fully approved by repair specialists, unions and instructors.

**TRAIN FOR BETTER PAY IN A FIELD THAT ISN'T CROWDED!**

It's the ideal book whether you want to train for a good-pay motor repair job or simply want to fix motors as a sideline or hobby!

Order **ELECTRIC MOTOR REPAIR** in coupon. Price only \$9.25.

## DON'T THROW OLD RADIOS AWAY!



Here's the data you need to fix old sets in a jiffy! Just look up the how-to-do-it data on that old radio you want to fix.

Four times out of 5, this giant, 3½-page, 744-page Ghirardi **RADIO TROUBLESHOOTER'S HANDBOOK** tells what is likely to be causing the trouble . . . shows how to fix it. No useless testing. No wasted time. Using it, even beginners can easily fix old sets which might otherwise be thrown away because service information is lacking. With a few simple repairs, most of these old sets can be made to operate perfectly for years to come.

**THE ONLY GUIDE OF ITS KIND!**

**Cuts service time in half!**

Included are common trouble symptoms and their remedies for over 4,800 models of old home, auto radios and record changers: Airline, Apex, Arvin, Atwater, Kent, Belmont, Bosch, Brunswick, Clarion, Crosley, Emerson, Fada, G-E, Kolster, Majestic, Motorola, Philco, Pilot, RCA, Silvertone, Spartan, Stromberg and dozens more. Includes hundreds of pages of invaluable tube and component data, service short cuts, etc. Specify **RADIO TROUBLESHOOTER'S HANDBOOK** in coupon. Price only \$10.00, 10-day trial.

USE COUPON FOR **10-day Free Trial!**

# TRAINING YOU NEED in its most complete economical and easily understood form

## TRAIN AT HOME FOR TV-RADIO-ELECTRONICS...at rock-bottom cost!

Now! Get your basic training from these two easily understood, low cost books!



Here is complete basic electrical-electronic training specifically written for beginners—priced at a fraction of what you might expect. 785 pages and almost 700 pictures, diagrams and charts in these two big books bring you top notch training that can pave your way to a fascinating electronic career. Every detail is fully and clearly explained. Nothing is omitted—nothing is condensed. In every respect, the material in these books compares more than favorably with "courses" costing many times as much!

**BASIC ELECTRICITY** — Fundamental electrical principles are the basis of all Electronics — and this 396-page manual gives you a complete working knowledge of them all! Covers everything from electromagnetism to phone principles, circuits, wiring, illumination, reactance, impedance, power factor, instruments, controls, measurements, and all types of components and equipment. Includes set-up diagrams, practical examples and problem solutions. Price \$6.25 separately. See Money-Saving Offer!

**BASIC ELECTRONICS** — This new 389-page guide takes up where Basic Electricity leaves off. Shows how electrical principles are applied in Electronics and gives you a sound grasp of electronic theory, methods, circuits and equipment. Over 375 illustrations explain details clearly. The ideal basic training to help you build a profitable future in TV, radio, communications, hi-fi, industrial electronics and related fields! Price \$6.25 separately.

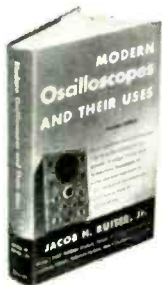
**ONLY \$11.00 FOR THIS COMPLETE HOME TRAINING!**

**Save \$1.50! See special Money-Saving Offer in Coupon!**

Here's everything you need to know about

## OSCILLOSCOPES!

Complete data on using the handiest instrument of all!



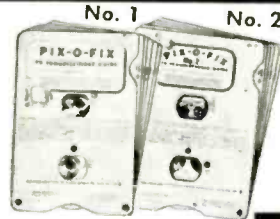
Scope experts get the big pay jobs!

Men who know how to use oscilloscopes on all types of jobs don't guess about troubleshooting and tough realignment problems! They locate troubles in a jiffy, adjust them quickly and accurately—and this famous 346-page manual teaches you the methods they use.

**MODERN OSCILLOSCOPES AND THEIR USES** gets right down to earth in telling you all about these versatile instruments and exactly how to use them. Particular

attention is paid to AM, FM, and TV realignment procedures. Every detail of testing with "scopes" is explained from connecting the "scope" and setting its controls to adjusting components in the chassis being tested. Illustrated instructions teach you to analyze patterns. Even includes data on quantitative measurements (as used in color TV servicing) and use of "scopes" in lab, industrial electronics and atomic work. 370 illustrations. Price \$8.00.

Specify **MODERN OSCILLOSCOPES AND THEIR USES** in coupon to order.



## SHORT CUT TO TV REPAIRS!

Just turn the dial of the pocket-size **PIX-O-FIX TROUBLE FINDER GUIDE!** When the picture in the PIX-O-FIX window matches the image on the TV screen—presto!—you've got your clue. PIX-O-FIX shows the likely causes of the trouble—indicates the re-

ceiver section involved—then gives clear repair instructions. Two PIX-O-FIX units Nos. 1 and 2 cover 48 different TV troubles. Together, they're a comprehensive guide to quick "picture analysis" servicing of any TV. Price only \$3.00 for the two.

## Get your COMMERCIAL OPERATORS LICENSE!

Train for radio's most fascinating, best paid jobs!



This famous book makes it easy to train for your FCC commercial license as an operator aboard ship, in aviation, broadcasting, telecasting, etc. **LICENSE MANUAL FOR RADIO OPERATORS** is a quick, easily understood guide that covers ALL

**EIGHT FCC examination elements**—not just some of them. Reviews almost 2200 exam questions. Covers everything you'll need to know to pass your examination for 1st or 2nd class radio-phone license with flying colors! Price \$6.75.

## REPAIR ANY ELECTRICAL APPLIANCE!

Save on repair bills! . . . Earn in your Spare Time!

This 370-page **ELECTRICAL APPLIANCE SERVICE MANUAL** helps you service practically any home electrical appliance. Includes standard and automatic washers, irons, toasters, ranges, cleaners, mixers, razors, clocks, motors, and many more.

Troubleshooting charts quickly help you locate troubles. Easy instructions guide you in making repairs. Tells how to make your own low-cost test tools. Includes appliance refinishing methods. An ideal guide for fixing your own appliances or for building a profitable appliance repair business! \$6.25.



**ORDER NOW**

## TRY ANY BOOK 10 DAYS FREE!

Dept. RN-11, Technical Division, Holt, Rinehart & Winston, Inc., 383 Madison Ave., New York 17, N.Y.

Send books checked for 10 day FREE examination at prices indicated plus postage. **SAVE!** Send cash with order and we pay postage. Same 10 day return privilege with money refunded.

Check here for **MONEY-SAVING SERVICE COMBINATION** on Ghirardi's Radio & TV CIRCUITRY & OPERATION and Radio & TV TROUBLESHOOTING & REPAIR. Price only \$17.00 for both (plus postage). Regular price \$19.00—you save \$2.00!

Check here for **MONEY-SAVING Basic Training COMBINATION ON BASIC ELECTRICITY and BASIC ELECTRONICS**. Price only \$11.00 plus postage for both big books. Regular price—\$12.50—you save \$1.50!

Check here to order

**INDIVIDUAL BOOKS**

- |   |  |
|---|--|
| <input type="checkbox"/> Radio & TV CIRCUITRY & OPERATION . . . . . \$ 9.00           | <input type="checkbox"/> Basic Electronics . . . . . \$ 6.25                             |
| <input type="checkbox"/> Radio & TV Receiver TROUBLESHOOTING & REPAIR . . . . . 10.00 | <input type="checkbox"/> Modern Oscilloscopes & Their Uses . . . . . 8.00                |
| <input type="checkbox"/> Basic Electronic Test Procedures . . . . . 8.00              | <input type="checkbox"/> PIX-O-FIX TV Trouble Finder Guides, Nos. 1 and 2 . . . . . 3.00 |
| <input type="checkbox"/> Electric Motor Repair . . . . . 9.25                         | <input type="checkbox"/> License Manual for Radio Operators . . . . . 6.75               |
| <input type="checkbox"/> Radio Troubleshooter's Handbook . . . . . 10.00              | <input type="checkbox"/> Electrical Appliance Service Manual . . . . . 6.25              |
| <input type="checkbox"/> Basic Electricity . . . . . 6.25                             | <input type="checkbox"/> Handbook of TV Troubles . . . . . 7.50                          |

OUTSIDE U. S. A. Add 50c to price of each book. Cash with order, but money refunded if books are returned in 10 days.

Name \_\_\_\_\_  
Address \_\_\_\_\_  
City, Zone, State \_\_\_\_\_

## New! Master Guide to TIME-SAVING TV SERVICE



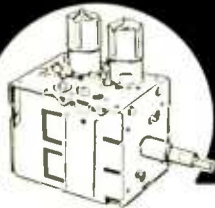
Almost regardless of set make or model this remarkable new 302-page **HANDBOOK OF TV TROUBLES** helps you track down TV troubles from the symptoms they produce in the set itself: screen intermittently dark; "blooming"; abnormal contrast; "snow"; poor detail; sync troubles; sound troubles—and all the many other symptoms that indicate something is wrong. Just turn to the "Quick Trouble-Finder Guide" inside the cover. Look up the symptoms exhibited by the set you're working on. The **HANDBOOK** then tells you just what to do and how to do it. Outlines time-saving shortcuts. Eliminates guesswork. More than 150 test patterns, wave form and circuit illustrations explain test results, details and procedures. Printed in large type and bound in sturdy varnished covers for use at the bench. All methods presented have been bench-tested by the author through actual shop-work! Price \$7.50.

**LOOK! LISTEN!** Then follow this easy guide!

and bound in sturdy varnished covers for use at the bench. All methods presented have been bench-tested by the author through actual shop-work! Price \$7.50.

Order **HANDBOOK OF TV TROUBLES** in coupon.

**TARZIAN Offers 48-Hour,  
Direct Factory Service  
on Tuner Repairs**



only  
**\$8.50**

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:

VHF 12 position tuner . . . . . \$22.00  
VHF 13 or 16 position . . . . . 23.00  
VHF/UHF combination . . . . . 25.00  
UHF only . . . . . 15.50

\*Subject to change



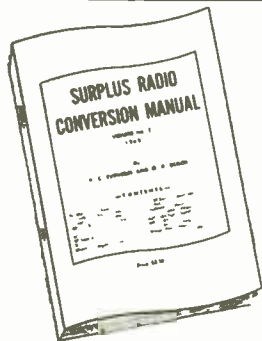
Tarzian-made tuners are easily identified by this stamping on the unit. When inquiring about service or replacements for other than Tarzian-made tuners, always give tube complement . . . shaft length . . . filament voltage . . . series or shunt heater . . . IF frequency, chassis identification and allow a little more time for service. Use this address for fast, 48-hour service:

**SARKES TARZIAN, Inc.**

Att.: Service Mgr., Tuner Division

Dept. 6

Bloomington, Indiana



New Volume III

## SURPLUS RADIO CONVERSION MANUAL

—gives new conversion data, instructions, and diagrams for putting surplus equipment to practical use.

Contents include:

701-A; AN/APN-1; AN/CR-7; AN/URC-4; ARA; BC-442, 453-455, 456-459, 603, 696, 950, 1066, 1253; CBY-29125, 50083, 50141, 52208-11, 52232, 52302-09; FT-241A; MBF(COL-43065); MI-7/ARC-5; R-9/APN-4; R23-R28 ARC-5; RAT; RAV; RM-52(53); RT-19/ARC-4; SCR-274N; SCR-522; T-15/ARC-5 to T-23/ARC-5.

For list of contents of Vols. I and II, send stamped, addressed envelope. \$3.00 per volume

at your distributor, or add 10% on orders to



**EDITORS and  
ENGINEERS, Ltd.**

Summerland 2, California

Bookstores: order from Baker & Taylor, Hillside, N.J.

# Within the Industry

**ORLAND O. SCHAUS** has joined *Audio Devices, Inc.*, of New York, manufacturer of magnetic tapes, as manager of research and engineering.



Dr. Schaus has been technical director of *Cyanamid of Canada* for the last six years. Before this, he was Lecturer in Chemical Engineering at McGill University in Montreal where he received his Ph.D. in physical chemistry and his B.S. in chemical engineering. Dr. Schaus is a director of the Chemical Institute of Canada.

**DR. HARRY F. OLSON, RCA Laboratories**, has been elected president of the Audio Engineering Society for 1960-61.

Serving with Dr. Olson are Herman H. Scott, *H. H. Scott, Inc.*, executive vice-president; L. R. Burroughs, *Electro-Voice, Inc.*, central vice-president; Pell Kruttschnitt, *Capitol Records, Inc.*, western vice-president; C. J. LeBel, *Audio Instrument Co.*, re-elected secretary; and R. A. Schlegel, *RKO Teletadio Pictures, WOR Division*, re-elected treasurer.

New governors include Murray G. Crosby, *Crosby Laboratories, Inc.*; John M. Hollywood, *CBS Laboratories*; and Dr. M. R. Schroeder, *Bell Telephone Laboratories*.

**ALFRED STROGOFF** has been named vice-president and general manager of *Adler Electronics, Inc.*, New Rochelle, N.Y.



Since joining the firm in 1949 as a design engineer, Mr. Strogoff has held key positions in every phase of the firm's operations, including manufacturing, sales, and administration.

He is a member of the executive committee of the EIA, Institute of Radio Engineers, Armed Forces Communications and Electronics Association, and the American Society of Mechanical Engineers. He is a graduate of Worcester Polytech.

**LAFAYETTE RADIO ELECTRONICS CORP.**, Jamaica, N.Y. has created a nationwide chain of associated, franchised stores to distribute electronic parts, high-fidelity components, and allied products. Stores are presently in operation in Trenton, N.J. and Waterbury, Conn. with a new store scheduled to open in Denver

around the first of the year . . . **HICKOK ELECTRICAL INSTRUMENT CO.** has opened a new 14,000-square-foot electronics research center at 1348 East 133rd St., East Cleveland, Ohio . . . Ground has been broken in Paris, Illinois by **ZENITH RADIO CORPORATION** for the construction of a new radio receiver and electronic component manufacturing plant. The first unit will provide 100,000 square feet of floor space for the company's wholly owned subsidiary, **CENTRAL ELECTRONICS, INC.** . . . **TELECHROME MANUFACTURING CORP.** is building a 40,000-square-foot addition to its plant in Amityville, L.I. The new section will house executive offices as well as expanded engineering, manufacturing, and laboratory facilities . . . **CLEVITE TRANSISTOR** has moved into its new plant at 200 Smith Street in Waltham, Mass. . . . **SYLVANIA ELECTRIC PRODUCTS INC.** has begun construction of a new electron tube research and development center in Emporium, Pa.

**C. P. OLIPHANT** has been named managing editor of the technical book division of *Howard W. Sams & Co., Inc.*, Indianapolis.

In his new post, Mr. Oliphant will be responsible for the operation of the book division, including technical editing and coordination of production and art departments with editing, among other duties.

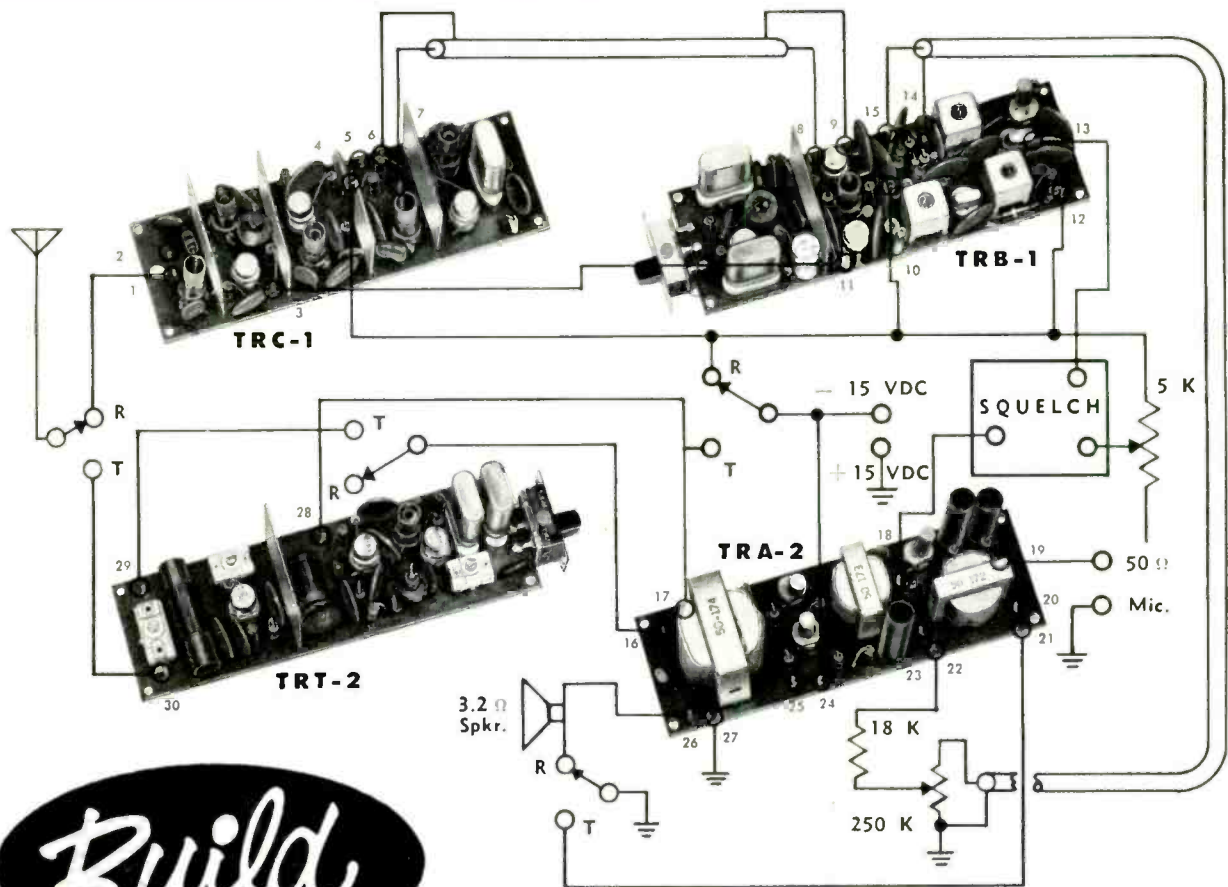
He has been associated with the company for the past eight years and was a professional service technician. He is the author of several standard servicing texts.

**JULIAN SPRAGUE**, president of *Sprague Electric Company*, died recently at the age of 57. He was a well-known figure in the industry and actively associated with the EIA, NEMA, AMA, and AIM. He was president and/or director of a number of firms both in and out of the electronics field . . . **DR. REMO PELLIN** has joined the semiconductor products division of *Motorola Inc.* as product manager, semiconductor materials. He was formerly associated with *DuPont*

. . . **NEVILLE W. JAMES** has been named reliability-quality control engineer of *International Resistance Co.* . . . *RCA Electron Tube Division* has announced the appointments of **JOSEPH T. CIMORELLI** as manager, engineering, receiving tube operations and **KENNETH G. BUCKLIN** to the newly created post of manager, new products engineering. Both







*Build this*

## ALL TRANSISTOR TRANSCEIVER

Now you can build your own All Transistor, Crystal Controlled, Portable Transceiver for Citizens band or Amateur communications. International sub-assemblies, prewired and tested are "quickly" interwired and ready for operation. Fifteen transistors for transmitting and receiving. Dual conversion superheterodyne receiver. Noise limiter and squelch. International precision crystals and highest quality components throughout. Power requirements: 15 volts dc @ 60 ma average. Positive ground.

### TRC-1 CONVERTER

Crystal controlled, 3 transistors for 10 meters or Citizens band. RF amplifier, mixer/oscillator. Double tuned front end. IF output 6 mc. Others on special order. Power: 15 volts dc @ 5 ma. Wired, tested with Crystal. Cat. No. 300-132 ..... \$17.95

Special IF (Cat. No. 300-140) ..... \$22.50

### TRB-1 MIXER IF UNIT

Six transistors, 2 diodes. 6 mc RF amplifier/mixer. Crystal controlled

local oscillator. 455 kc IF. Noise limiter/squelch. Input 6 mc. Specify frequency. Wired, tested with crystals. Cat. No. 300-131 ..... \$32.50

### TRA-2 AUDIO UNIT

Three transistors. Input 100,000 ohms and 50 ohms. Speech amplifier for dynamic microphone. Push-pull power amplifier class B. Output 300 mw. Wired and tested. Cat. No. 400-104 ..... \$21.50

### TRT-2 TRANSMITTER

Crystal controlled. Three transistors. Output 100 milliwatts minimum with #1 transistors. Power stage uses special HF transistors. Wired and tested less crystals and transistors. Cat. No. 200-118 ..... \$10.00

#1 Transistor Kit (100 mw output). Cat. No. 150-128 ..... \$17.50

#2 Transistor Kit (50 mw output). Cat. No. 150-129 ..... \$9.00

Crystals FCB for Citizens band (.0025%) ..... \$4.75

Crystals FA-5 for Amateur (.01%) ..... \$4.00



**ASSEMBLY PARTS KIT** makes it easy to interwire subassemblies. Kit includes base plate, squelch control, volume control, transmit-receive switch and antenna connector. Cat. No. 150-136 ..... \$9.95

ORDER DIRECT FROM INTERNATIONAL CRYSTAL MFG. CO.

**INTERNATIONAL  
CRYSTAL MFG CO., INC.**

18 NORTH LEE • OKLAHOMA CITY, OKLAHOMA

**FREE  
1961 CATALOG**

SEND FREE 1961 INTERNATIONAL CATALOG

NAME \_\_\_\_\_  
ADDRESS \_\_\_\_\_  
CITY \_\_\_\_\_ STATE \_\_\_\_\_

**THIS IS THE  
GREATEST  
'CONTINENTAL'  
OF THEM  
ALL...**



the *Norelco*<sup>®</sup>  
**CONTINENTAL '400'**

*The exciting stereo-record/stereo-playback specifications on the new Norelco CONTINENTAL '400' (EL3536/54) provide only an indication of what "the greatest Continental of them all" holds in store for the music lover, studio-recordist or high fidelity enthusiast who is seeking a professional quality stereo machine at a modest price.*

*New 4-track tape recorder guild-crafted by Philips of the Netherlands*

- ◆ **FOUR-TRACK STEREOPHONIC RECORDING AND PLAYBACK** ◆ **FOUR-TRACK MONOPHONIC RECORDING AND PLAYBACK** ◆ **THREE TAPE SPEEDS—1 $\frac{1}{6}$ , 3 $\frac{3}{4}$  AND 7 $\frac{1}{2}$  IPS**
- ◆ **COMPLETELY SELF-CONTAINED, INCLUDING DUAL RECORDING AND PLAYBACK PREAMPLIFIERS, DUAL POWER AMPLIFIERS AND TWO NORELCO WIDE-RANGE LOUDSPEAKERS (SECOND IN LID)**
- ◆ **CAN ALSO BE USED AS A QUALITY STEREO HI-FI REPRODUCING SYSTEM WITH TUNER OR RECORD PLAYER** ◆ **FACILITY FOR MIXING PHONO AND MIKE INPUTS**
- ◆ **HEAD-GAP WIDTH—.00012"** ◆ **FREQUENCY RESPONSE—50 TO 18,000 CPS AT 7 $\frac{1}{2}$  IPS** ◆ **WOW AND FLUTTER—LESS THAN .15% AT 7 $\frac{1}{2}$  IPS** ◆ **SIGNAL-TO-NOISE RATIO—48 DB OR BETTER** ◆ **CROSSTALK—55 DB** ◆ **PORTABLE** ◆ **STYLED BY THE CONTINENT'S TOP DESIGNERS** ◆ **RUGGED**



*A Norelco dual element stereo-dynamic microphone is standard equipment with the CONTINENTAL '400'*

*For a convincing demonstration of all of the features and qualities that make the Continental '400' "the greatest 'Continental' of them all," visit your favorite hi-fi center, or photo dealer, or write for complete literature to: North American Philips Co., Inc. High Fidelity Products Division 230 Duffy Avenue, Hicksville, L. I., N. Y.*

men will make their headquarters in Harrison, N.J. . . . **JAY S. SALZ** is the new general manager of *Trio Laboratories, Inc.* . . . *Lafayette Radio Electronics Corp.* has elected **ROBERT LAUB** vice-president for sales and **JACK BREAKIRON** vice-president of mail order operations . . . **W. W. SMITH** has been appointed chief of engineering development for *Babcock Electronics Corporation* . . . **RICHARD B. VOSK** has joined *Transdyne Corp.* as assistant director of engineering . . . **EDWIN S. DAVIS** has been appointed device design engineer by *Industro Transistor Corporation* . . . The distributor division of *Amphenol* has appointed **R. F. MEINICKE** vice-president for sales . . . The new post of director of marketing at *Allied Radio Corp.* is being filled by **THORNTON S. ADAMS**. He was formerly marketing consultant to the firm . . . **CLARENCE H. HOPPER** is the new president of *CBS Electronics* . . . **JOHN E. CLARKE** has joined *Computer Diode Corp.* as manager of applications engineering.

**JACOB H. RUITER, JR.** has been named manager of sales promotion for the *Weston Instruments Division, Daystrom, Inc.*



In his new capacity, Mr. Ruiter will assume over-all responsibility for advertising and sales promotion activities. Before joining the firm, he was associated with the electronics division of *Curtiss-Wright* and *Allen B. DuMont Laboratories*.

He is the author of two books, a senior member of the IRE, and former president of the New Jersey chapter of National Industrial Advertisers Assn.

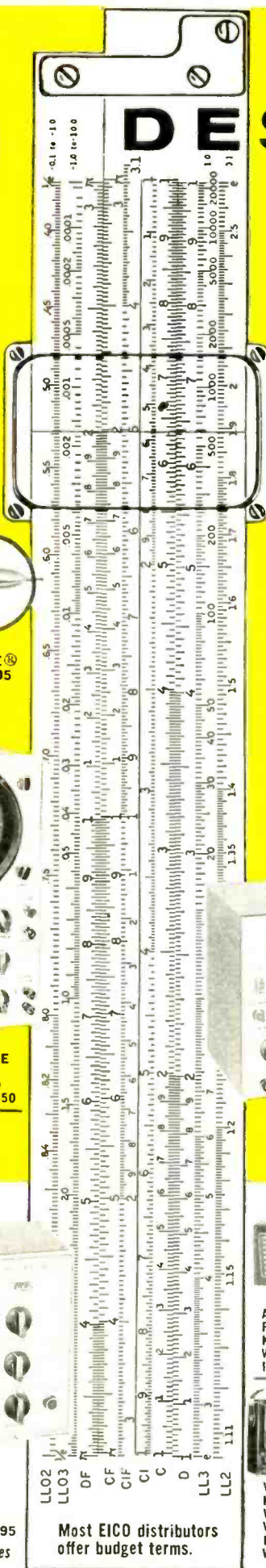
**TERMINAL ELECTRONICS, INC.** and **HUDSON RADIO & TELEVISION CORP.**, major electronic parts and equipment suppliers in the New York metropolitan area, have merged to form **TERMINAL-HUDSON ELECTRONICS, INC.** Corporate headquarters are at 236 West 17th Street, New York. The company will continue to operate its various retail outlets in the area . . . **DALE ELECTRONICS, INC.** of Columbus, Nebraska has acquired **SIOUX RADIO PRODUCTS** of Yankton, S.D., producer of coils and ferrite antennas for radio and TV. . . . **GENERAL TELEPHONE & ELECTRONICS INTERNATIONAL INCORPORATED** has acquired a majority interest in the Radio Communications Division of **MAGNETTI MARELLI** of Milan, Italy . . . **INTERNATIONAL COMMUNICATIONS CORPORATION** has been established in Santa Monica, California to design and manufacture airborne and marine navigation and communication equipment. Lawrence Hermes is president of the new corporation . . . **ESPEY MFG. & ELECTRONICS CORP.** has established a new division at Saratoga Springs, New York which will be known as the **SARATOGA SEMICONDUCTOR DIVISION**. The company will produce a line of semiconductor components for military and industrial equipment.



# DESIGNED

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

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



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



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

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



**C** RF SIGNAL  
GENERATOR #324  
KIT \$26.95 WIRED \$39.95  
Turn Page For More EICO Values

**A** By far the best professional VTVM value in electronics; nobody but EICO brings you such outstanding instrument performance for so low a price! Calibration without removing from cabinet. Measure directly p-p voltage of complex & sine waves: 0-4, 14, 42, 140, 420, 1400, 4200. DC/RMS sine volts: 0-1.5, 5, 15, 50, 150, 500, 1500 (up to 30,000 volts with HVP probe, & 250 mc with PRF probe). Ohms: 0.2 ohms to 1000 megs. 4 1/2" meter, can't-burn-out circuit. 7 non-skip ranges on every function. Zero center.\* Features EICO's exclusive UNI-PROBE: your terrific time-saver, performs all functions: a half turn of probe-tip selects DC or AC-Ohms!

**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 mc. Vert. Sens.: 25 mv/in.; input 2.3 megs; direct-coupled & push-pull throughout. 4-step frequency-compensated attenuator up to 1000:1. Sweep: perfectly linear 10 cps-100 kc (ext. cap. for range to 1 cps). Pre-set TV V & H positions. Auto sync limiter & amplifier Direct or C coupling; balanced or unbalanced inputs; edge-lit engraved lucite screen with dimmer control.

**C** More features and versatility, more range and accuracy than in generators costing three to four times as much. 150 kc to 435 mc with ONE generator in 6 fundamental bands and 1 harmonic band! ±1.5% frequency accuracy. Colpitts RF oscillator directly plate-modulated by K-follower for improved modulation. Variable

depth of internal modulation 0-50% by 400 cps Colpitts oscillator. Variable gain external modulation amplifier: only 3 volts needed for 30% mod. Turret-mounted, slug-tuned coils for max. accuracy. Fine & Coarse (3-step) RF attenuators. RF output 100,000 uv, AF output to 10 v.

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

**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 Gm, Gp & peak emission. Simultaneous selection of any one of 4 combinations of 3 plate voltages, 3 screen voltages, 3 ranges of continuously variable grid voltage (with 5% accurate pot.). Sensitive 200 ua meter. 10 six-position lever switches: freepoint connection of each tube pin. 10 push-buttons: rapid insert of any tube element in leakage test circuit. Direct reading of inter-element leakage in ohms. New gear-driven rollchart. CRA Adapter \$4.50.



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



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



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



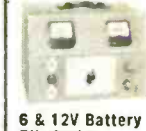
Power & Bias  
Supply for  
Transistorized  
Eqt. #1020  
Kit \$19.95  
Wired \$27.95



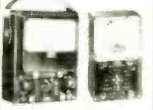
DeLuxe  
Multi-Signal  
Tracer #147  
Kit \$24.95  
Wired \$39.95



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



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



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



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

Most EICO distributors offer budget terms.

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

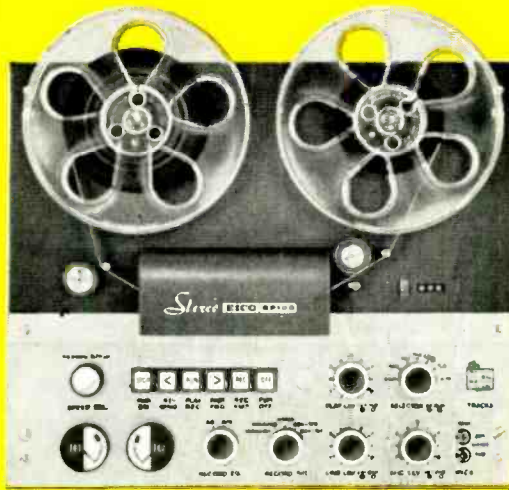
Name.....  
Address.....  
City..... Zone..... State.....

SEE OUR OTHER ADVERTISEMENT ON PAGE 113

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

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

*dedicated  
to  
perfection*



**4-TRACK STEREO TAPE DECK**

**MODEL RP-100W**

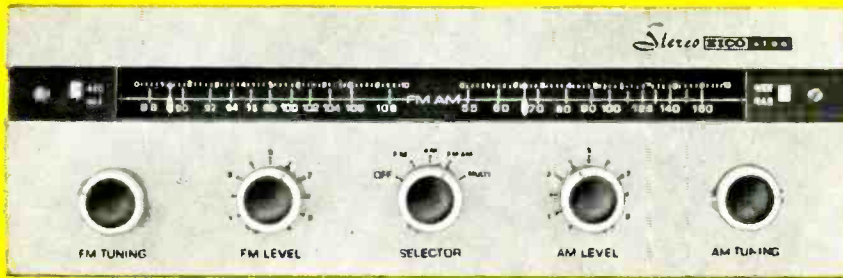
Completely assembled, wired and tested.  
**\$395.00**

**MODEL RP-100K**

Semi-kit includes a completely assembled and tested transport, electronics in kit form. **\$289.95**

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

**NEW MEDALIST LINE.**



**FM-AM STEREO TUNER ST96**

Kit **\$89.95** Includes Metal Cover and FET Wired **\$129.95**

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

**FM TUNER**

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

**AM TUNER**

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

**OF EICO STEREO.**



**70-WATT INTEGRATED STEREO AMPLIFIER ST70**

Kit **\$94.95** Includes Metal Cover Wired **\$144.95**

**40-WATT INTEGRATED STEREO AMPLIFIER ST40**

Kit **\$79.95** Includes Metal Cover Wired **\$124.95**

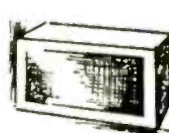
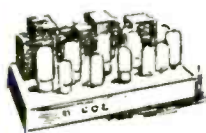
**BOTH AMPLIFIERS:** Complete stereo centers plus two excellent power amplifiers. Accept, control, and amplify signals from any stereo or mono source.

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

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

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

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



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



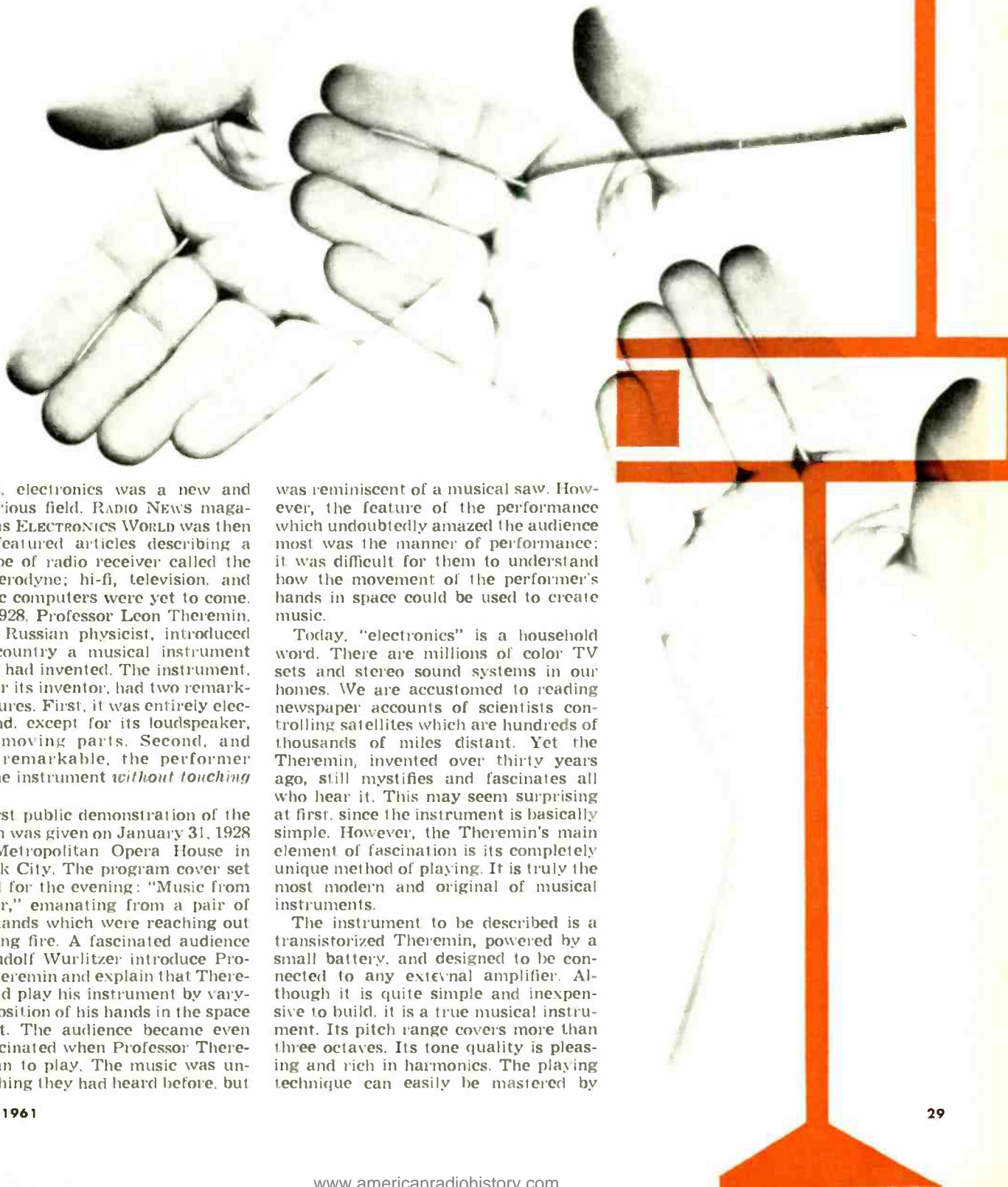
EICO, 3300 N. Blvd., L.I.C. 1, N. Y. EW-1  
 Send free 32-page catalog & dealer's name  
 Send new 36-page Guidebook to Hi-Fi for which I enclose 25¢ for postage & handling.  
 Name \_\_\_\_\_  
 Address \_\_\_\_\_  
 City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_

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

# A TRANSISTORIZED THEREMIN

By ROBERT A. MOOG

Build this self-powered, three-octave instrument that will bring "music from the ether." Self-contained unit may be connected to any external amplifier and speaker.



**I**N 1928, electronics was a new and mysterious field. *RADIO NEWS* magazine (as *ELECTRONICS WORLD* was then called) featured articles describing a novel type of radio receiver called the superheterodyne; hi-fi, television, and electronic computers were yet to come. And in 1928, Professor Leon Theremin, a young Russian physicist, introduced to this country a musical instrument which he had invented. The instrument, named for its inventor, had two remarkable features. First, it was entirely electronic and, except for its loudspeaker, had no moving parts. Second, and equally remarkable, the performer played the instrument *without touching it*.

The first public demonstration of the Theremin was given on January 31, 1928 at the Metropolitan Opera House in New York City. The program cover set the mood for the evening: "Music from the Ether," emanating from a pair of slender hands which were reaching out of a raging fire. A fascinated audience heard Rudolf Wurlitzer introduce Professor Theremin and explain that Theremin would play his instrument by varying the position of his hands in the space around it. The audience became even more fascinated when Professor Theremin began to play. The music was unlike anything they had heard before, but

was reminiscent of a musical saw. However, the feature of the performance which undoubtedly amazed the audience most was the manner of performance; it was difficult for them to understand how the movement of the performer's hands in space could be used to create music.

Today, "electronics" is a household word. There are millions of color TV sets and stereo sound systems in our homes. We are accustomed to reading newspaper accounts of scientists controlling satellites which are hundreds of thousands of miles distant. Yet the Theremin, invented over thirty years ago, still mystifies and fascinates all who hear it. This may seem surprising at first, since the instrument is basically simple. However, the Theremin's main element of fascination is its completely unique method of playing. It is truly the most modern and original of musical instruments.

The instrument to be described is a transistorized Theremin, powered by a small battery, and designed to be connected to any external amplifier. Although it is quite simple and inexpensive to build, it is a true musical instrument. Its pitch range covers more than three octaves. Its tone quality is pleasing and rich in harmonics. The playing technique can easily be mastered by

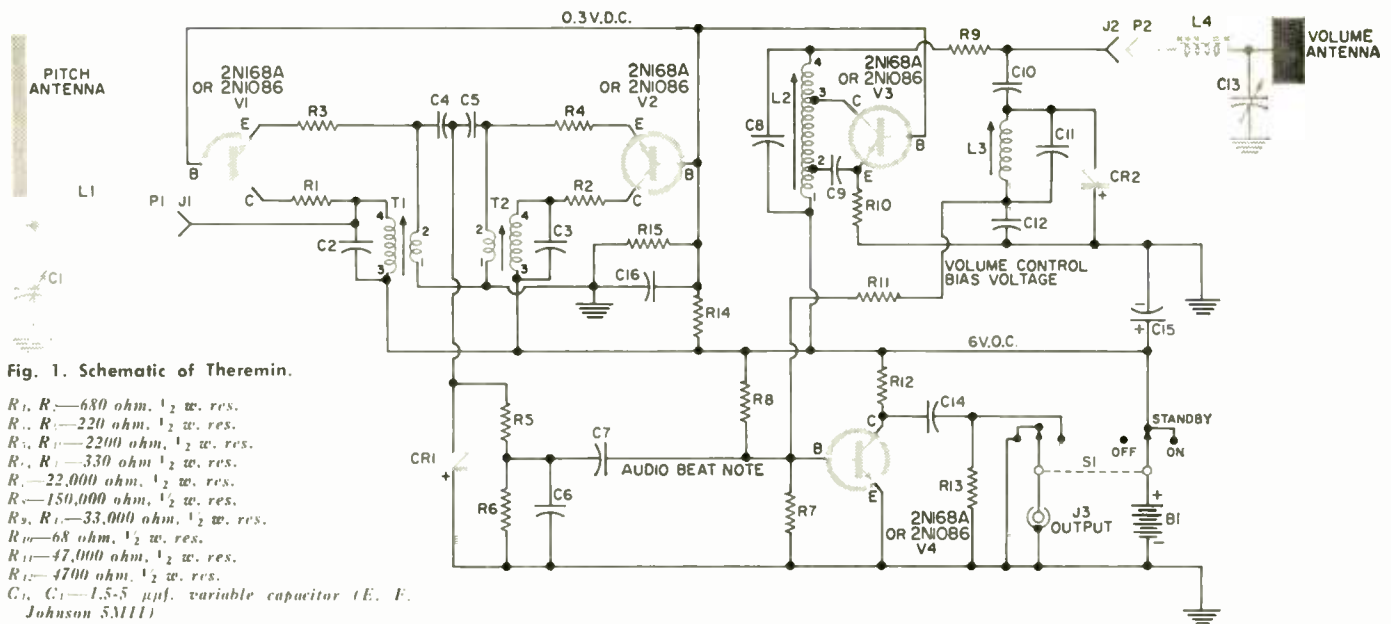


Fig. 1. Schematic of Theremin.

- R<sub>1</sub>, R<sub>2</sub>—680 ohm, 1/2 w. res.
- R<sub>3</sub>, R<sub>4</sub>—220 ohm, 1/2 w. res.
- R<sub>5</sub>, R<sub>6</sub>—2200 ohm, 1/2 w. res.
- R<sub>7</sub>, R<sub>8</sub>—330 ohm, 1/2 w. res.
- R<sub>9</sub>—22,000 ohm, 1/2 w. res.
- R<sub>10</sub>—150,000 ohm, 1/2 w. res.
- R<sub>11</sub>, R<sub>12</sub>—33,000 ohm, 1/2 w. res.
- R<sub>13</sub>—68 ohm, 1/2 w. res.
- R<sub>14</sub>—47,000 ohm, 1/2 w. res.
- R<sub>15</sub>—4700 ohm, 1/2 w. res.
- C<sub>1</sub>, C<sub>13</sub>—1.5-5 μf, variable capacitor (E. F. Johnson 5M111)
- C<sub>2</sub>, C<sub>3</sub>, C<sub>5</sub>—3900 μf, mica capacitor ±10%
- C<sub>4</sub>, C<sub>6</sub>, C<sub>12</sub>—1 μf., 10 v. ceramic capacitor
- C<sub>7</sub>, C<sub>15</sub>—47 μf., 10 v. ceramic capacitor
- C<sub>8</sub>, C<sub>11</sub>—560 μf, mica capacitor ±10%
- C<sub>9</sub>—0.05 μf, ceramic capacitor
- C<sub>10</sub>—2 μf., 12 v. elec. capacitor
- C<sub>16</sub>—2.2 μf., 3 v. ceramic capacitor
- L<sub>1</sub>—75 mhy. pitch antenna coil (Moog 11-311) or three 25 mhy. ferrite-core r.f. chokes in series (J. W. Miller 6308 or Meissner 19-1053). See text.
- L<sub>2</sub>—Volume oscillator coil (Moog 11-302, see text)

- L<sub>3</sub>—Volume control coil (Moog 11-303, see text)
- L<sub>4</sub>—10 mhy. volume antenna coil (Moog 11-312) or two 5 mhy. ferrite-core r.f. chokes in series (J. W. Miller 6304 or Meissner 19-1051).
- T<sub>1</sub>, T<sub>2</sub>—Pitch oscillator transformer (Moog 11-301, see text)
- J<sub>1</sub>, J<sub>2</sub>—Pin or banana jack
- J<sub>3</sub>—Phono jack
- P<sub>1</sub>, P<sub>2</sub>—Pin or banana plug
- S<sub>1</sub>, S<sub>2</sub>—D.p., 3-pos. rotary switch (Mallory 3123J)
- B<sub>1</sub>—6-volt battery (Eveready 724 or equiv.)

- CR<sub>1</sub>, CR<sub>2</sub>—1N34 or equiv.
  - V<sub>1</sub>, V<sub>2</sub>, V<sub>3</sub>, V<sub>4</sub>—“n-p-n” transistor (G-E 2N-168A or 2N1086 or equiv.)
- NOTE: Coils for this unit may be purchased direct from R. A. Moog Co., Box 263, Ithaca, N.Y. Price for a complete set of coils (T<sub>1</sub>, T<sub>2</sub>, and L<sub>1</sub> through L<sub>4</sub>) is \$12.50 plus postage. Individual coils are also available. In addition, a complete kit of parts for the construction of the Theremin is available. Orders for coils or requests for information on the kit should be sent direct to the company.

anyone with a musical ear. And, most important from a musician's viewpoint, the instrument is exceptionally stable and reliable.

### How it Works

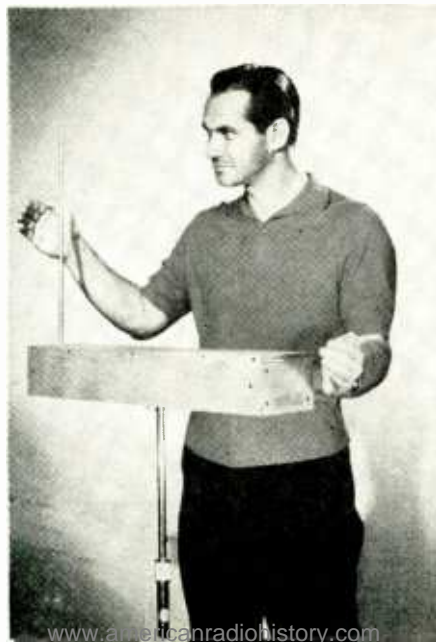
The Theremin works by taking advantage of the fact that the hand is a conductor of electricity, and that its connection to the rest of the body effectively grounds it. Thus, the hand can be regarded as a grounded plate of a capacitor. If the hand is moved with relation to another electrical conductor, we have a variable capacitor. In playing the Theremin, the performer varies the capacitance between his right hand and a "pitch-control antenna" to determine the pitch of the tone, and varies the capacitance between his left hand and a "volume-control antenna" to determine the loudness of the tone.

How does the Theremin utilize capacitance to control the pitch (frequency) or loudness of a tone? To answer this question, let us first examine the pitch-generator section of the schematic diagram (Fig. 1). The pitch-generator consists of two stable r.f. oscillators, V<sub>1</sub> and V<sub>2</sub>, both of which operate at about 150 kc. The signals from these two oscillators are mixed through C<sub>4</sub> and C<sub>5</sub>, and rectified by CR<sub>1</sub>. The frequency of the signal appearing at the junction of C<sub>4</sub> and C<sub>5</sub>, which is the output of the rectifier circuit, is equal to the difference between the frequencies at which V<sub>1</sub> and V<sub>2</sub> oscillate. If V<sub>1</sub> and V<sub>2</sub> are oscillating at the same frequency, then the difference frequency is zero and no a.c. voltage appears at the junction of C<sub>4</sub> and C<sub>5</sub>. If the oscillation frequency of V<sub>1</sub> is one

per-cent lower than that of V<sub>2</sub>, then the difference frequency appearing at the output of the rectifier circuit is one per-cent of 150 kc., or 1.5 kc. This frequency is in the middle of the audio-frequency spectrum, and is about two and one-half octaves above middle C on the piano. Thus, by lowering the oscillation frequency of V<sub>1</sub> by only one per-cent, the difference frequency can be swept through a wide pitch range, starting at "zero beat" and going continuously up in pitch through all but the highest notes on a piano.

This one per-cent change in the oscillation frequency of V<sub>1</sub> is caused by the change in hand capacitance. Hand capacitance never exceeds a fraction of a micromicrofarad. If this capacitance

Performer's right hand determines pitch while his left hand controls the volume.



were to be applied directly across the tank of oscillator V<sub>1</sub>, the oscillation frequency would change by only a few hundredths of a per-cent. Naturally, this change is not enough to produce an adequate pitch range for a musical instrument.

To increase the effect of the hand capacitance on the frequency of oscillation of V<sub>1</sub>, a coil with high inductance, low distributed capacitance, and low loss (L<sub>1</sub>) is connected between the pitch-antenna and the tank of oscillator V<sub>1</sub>. This antenna coil forms a series-resonant circuit with the combined capacitance of C<sub>1</sub> and the pitch-antenna, the resonant frequency of which is slightly below the resonant frequency of the oscillator tank. The total impedance of this series-resonant circuit, as seen by the oscillator tank, is much lower than the impedance of just the pitch-antenna alone. In addition, the change in impedance of the series-resonant circuit resulting from variation in capacitance at the pitch-antenna is also much greater than the change in impedance of just the pitch-antenna alone. These two factors combine to greatly increase the effectiveness of the pitch-antenna, so that a change of a fraction of a micromicrofarad at the pitch-antenna does, in fact, cause the difference frequency to change by as much as 1.5 kc.

The coupling of oscillators V<sub>1</sub> and V<sub>2</sub> through capacitors C<sub>4</sub> and C<sub>5</sub> produces two effects which are desirable in a Theremin. First, the oscillators tend to synchronize when their frequencies are very close together, making it easy for the performer to adjust for "zero beat." Second, even when the oscillators are

not synchronized, they "pull" each other. This pulling is characteristic of any beat oscillator circuit in which the oscillators are coupled. As a result of the pulling, the waveform of the audio difference frequency signal is saw-tooth-like, and contains a succession of overtones that impart a pleasing quality to the tone. The degree of coupling has been set to give a moderate amount of pulling, but not enough to cause instability at low difference frequencies.

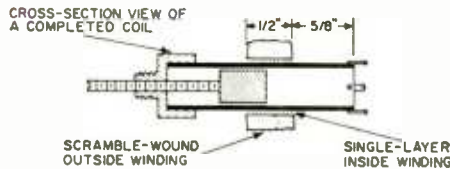
Now let us turn our attention to the volume-control section. In this section, as in the pitch-generator section, the combined capacitance of the control antenna and  $C_{11}$  is in series with a high-inductance, low-loss coil  $L_1$ , forming a series-resonant circuit.  $L_1$  is connected to a fixed-frequency oscillator  $V_2$  through a large resistance  $R_{11}$ . The impedance of the antenna series-resonant circuit is lowest when its resonant frequency is equal to the oscillator frequency, and increases as its resonant frequency is lowered, for instance by the addition of hand capacitance to the volume-control antenna. When the impedance of the antenna circuit increases, the r.f. voltage at the junction of  $R_{11}$  and  $L_1$  also increases. This r.f. voltage is applied across the parallel-resonant circuit  $C_{11}$  and  $L_2$ , and is rectified by  $CR_{11}$ . A negative d.c. voltage, which is proportional to the r.f. voltage, is thus developed at the junction of  $R_{11}$  and  $C_{11}$ . When the resonant frequency of the antenna circuit is equal to the oscillator frequency, the d.c. voltage at the junction of  $R_{11}$  and  $C_{11}$  is only a few tenths of a volt. As the resonant frequency of the antenna circuit is lowered, this voltage increases to about five volts.

Although the pitch-antenna circuit and the volume-antenna circuit are similar, they are applied in different ways. The pitch-antenna circuit is connected directly across the tank of oscillator  $V_1$ , and is used to change the frequency of oscillation. The volume-antenna circuit is connected to the tank of oscillator  $V_1$  through a large resistor, and is used to change the amplitude of the r.f. voltage at the junction of  $R_{11}$  and  $L_1$ .

The d.c. voltage developed at the junction of  $R_{11}$  and  $C_{11}$  is applied through  $R_{12}$  as bias to the base of control amplifier  $V_1$ . By increasing the d.c. bias voltage, the collector current of  $V_1$  can be decreased until it is completely cut off. The audio signal from the pitch-generator section is also applied to the base of  $V_1$ . The a.c. output signal appearing at the collector of  $V_1$  can be varied in amplitude from about 0.5 volt (minimum d.c. control voltage) to zero (maximum d.c. control voltage), and is fed to the output jack through isolating capacitor  $C_{11}$ .

The instrument is powered by a small six-volt battery. The current drawn by each of the three oscillators is stabilized by its emitter resistor, the base voltage being fixed by the resistive voltage divider  $R_{11}$  and  $R_{15}$ . Total battery current is about 8 ma.

A three-position switch is used to turn the instrument on. The first position is "off," and no battery current flows. The



CROSS-SECTION VIEW OF A COMPLETED COIL

1/2" 5/8"

SCRAMBLE-WOUND OUTSIDE WINDING SINGLE-LAYER INSIDE WINDING

General Instructions:

1. Use one-half-inch diam., slug-tuned coil forms (CTC LS4JK or J. W. Miller 22A000 RB1)
2. Use #36 enameled and cotton-covered wire.
3. Space the windings  $\frac{1}{8}$ " from the lug end of the form and wind the coils  $\frac{1}{2}$ " wide (see diagram above).
4. Always wind in the same direction around the coil form, for a given coil.
5. Coat the completed coils with a polystyrene-base coil dope.

Specific Instructions:

1.  $T_1$  and  $T_2$ : First, wind 20 turns in a single layer. Start of this winding is terminal #1 and the end is terminal #2. Next, scramble-wind 145 turns over the 20-turn layer. Start of the 145-turn winding is #3 and the end is #4. Do not wind tape or other insulation between the first and second windings.
2.  $L_1$ : Start at terminal #1. Wind 5 turns in a single layer and bring a tap out to terminal #2. Next, scramble-wind 30 more turns and bring another tap out to terminal #3. Finally, scramble-wind 95 more turns and connect the end of the winding to terminal #4.
3.  $L_2$ : Scramble-wind 130 turns.

Fig. 2. Details on coils employed in unit.

second position is "silent" or "standby," in which battery current flows but the output jack is shorted to ground. The third position is "play" or "on," and the short across the output is removed. This arrangement is needed to eliminate the transient accompanying the initial flow of battery current from getting into the amplifier and being heard as a thump at the loudspeaker.

Construction

Building a transistor Theremin is a relatively easy matter. Since the two control antennas have to be separated by at least twenty inches and have to be about three and one-half feet from the ground, we found it convenient to mount everything on a plywood board, and fasten a flange with a standard microphone-stand thread (Atlas AD-11) to the bottom of the board. The entire instrument can then be supported by a microphone stand. The photos reveal the layout of components on the board. The board is  $\frac{1}{2}$ " plywood, 24" long by  $5\frac{1}{2}$ " wide. Two pieces of wood  $5\frac{1}{2}$ " x  $3$ " x  $1\frac{1}{2}$ " are fastened at either end of the board.

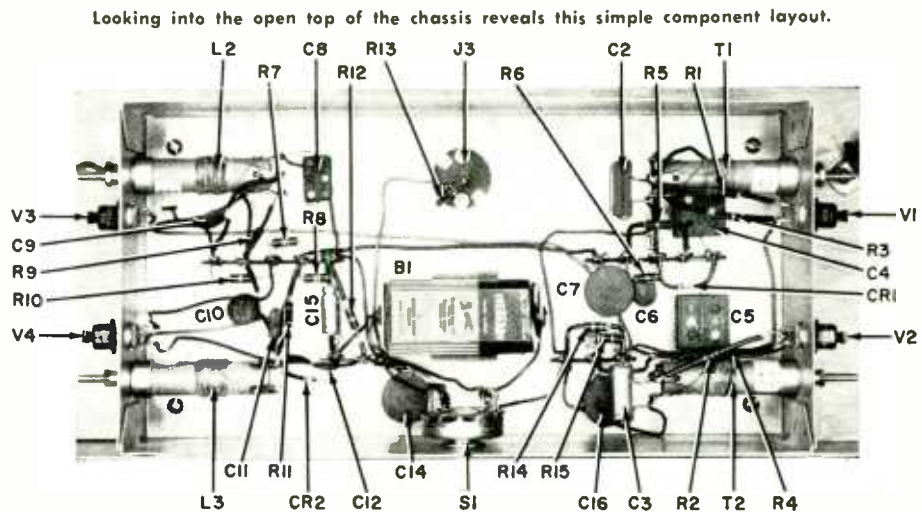
These pieces of wood hold the antennas. The pitch antenna, which goes on the right end of the board if you are right-handed, is an aluminum rod  $\frac{3}{8}$ " in diameter and 21" long ( $\frac{3}{8}$ " aluminum rod is sold in hardware stores that carry Reynolds "do-it-yourself" aluminum). A vertical hole slightly larger in diameter than the  $\frac{3}{8}$ " rod is drilled through the block that goes at the right end of the board. A wood screw is put into the board beneath the block hole, so that with the block in place, the rod can be dropped in the hole, and will rest on the screw head. A wire is fastened to the wood screw before the block is screwed to the board.

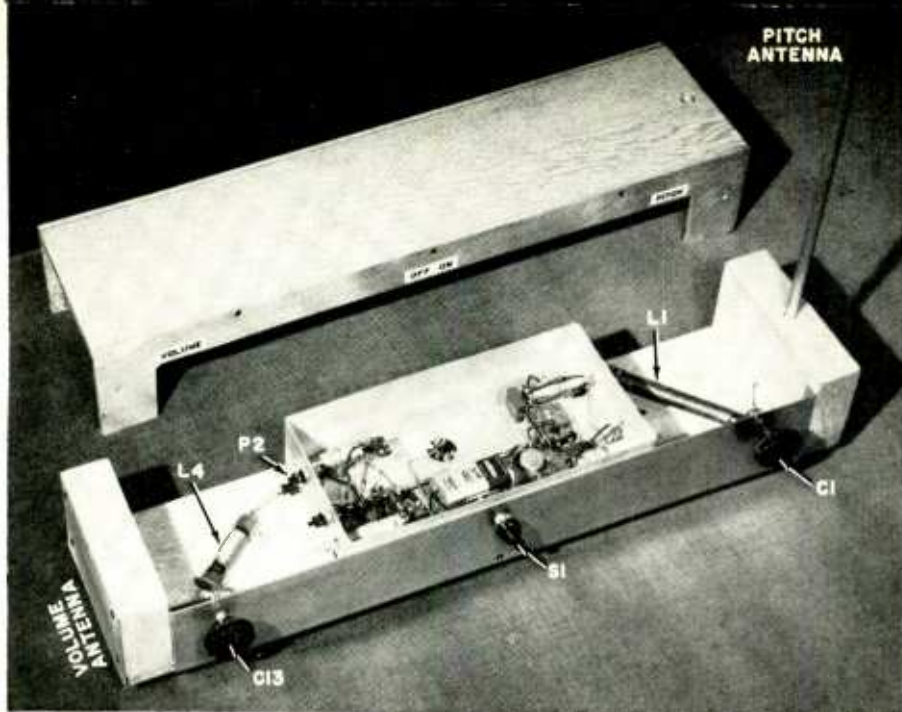
The volume-control antenna is a sheet of aluminum,  $5\frac{1}{2}$ " x  $3\frac{1}{2}$ ", fastened to the outer face of the block at the left end of the board. Connection to the antenna is made by a wire under one of the mounting screws.

All components, except the antenna circuit components, are mounted on a  $5$ " x  $10$ " x  $3$ " aluminum chassis (Bud AC-404) on the middle of the board. The antenna coils  $L_1$  and  $L_2$  are mounted on the board between the chassis and the end blocks, and tuning capacitors  $C_1$  and  $C_{11}$  are mounted on a  $3$ " x  $22$ " sheet of aluminum that runs across the entire front of the instrument between the two end blocks. This arrangement minimizes the stray wiring capacitance in the antenna circuits, but provides shielding between the performer's hands and the antennas when he adjusts  $C_1$  or  $C_{11}$ .

Other layouts may be employed as long as two requirements are heeded: First, the two antennas must be separated by at least twenty inches, so that the motion of the right hand does not affect the left antenna, and vice versa. Second, the antenna capacitances must be kept small. Don't mount the antennas near large pieces of metal. Keep the leads coming from the antennas as short as possible. And, finally, use only wood or other insulating materials for the bottom board and the cover.

The chassis layout is not critical, but it is most convenient to mount the components in the pitch-generator section on the side of the chassis nearest the pitch antenna, and the components in the volume-control section on the side





Over-all view of the entire instrument with its wooden cover removed to show layout.

nearest the volume antenna. It is also convenient to mount the output jack on the bottom of the chassis, so that the cord going to the external amplifier can be plugged in through a hole in the plywood board, out of the way of the performer.

Placement of the coils in the chassis is important. The centers of the pitch-oscillator coils should be at least three inches apart, in order not to increase the coupling between the oscillators. Similarly, the volume-oscillator coil should be at least three inches from  $L_1$ . Also, none of the coils should be closer than one-half inch to the sides of the chassis. A suitable layout is shown in one of the photos. Regular lug strips are used to mount most of the components. The use of transistor sockets, rather than soldering the transistors directly in the circuit, is desirable in the long run.

The layout, as shown in the photographs, is correct for a right-handed person. If you are left-handed, simply reverse the layout so that the pitch-antenna is on the left end of the board. Of course, a left-handed person can play a right-handed instrument, simply by standing behind the instrument instead of in front of it.

### Coils

The coils  $T_1$ ,  $T_2$ , and  $L_1$  through  $L_4$  have been specially designed for this instrument and are available direct from the manufacturer. The coils can also be assembled from standard components and materials. The variable coils  $T_1$ ,  $T_2$ ,  $L_2$ , and  $L_3$  are wound on one-half-inch diameter slug-tuned coil forms. The winding dimensions and material specifications are given in Fig. 2. A partially completed pitch oscillator coil and a completed coil are shown in one of the photos. If the instructions in Fig. 2 are followed carefully, the electrical characteristics of the hand-wound coils will be nearly the same as those of their commercially produced counterparts.

The antenna coils are machine-wound by a special method called "progressive-

universal," and cannot be duplicated by hand-winding. However, satisfactory substitutes for the antenna coils may be assembled from standard ferrite-core r.f. chokes. For  $L_1$ , connect three 25 mhy. ferrite-core chokes in series, and for  $L_2$ , connect two 5 mhy. ferrite-core chokes in series. Because of their low "Q" and high distributed capacitance, air-core or powdered-iron-core chokes cannot be used in place of ferrite-core chokes to make up the antenna coils.

### Setting the Coil Slugs

After checking the wiring thoroughly, turn the instrument on and check the voltages at the two points shown in the schematic. If the voltages check, connect an external amplifier to the output jack, and short the junction of  $R_{11}$  and  $C_{12}$  to ground. If a loud hum is heard when the base terminal of  $V_1$  is touched with the finger, the amplifier stage is working and the pitch adjustments may now be set. Place the Theremin on a microphone stand, and at least two feet from any large objects. Set the slug in  $T_1$  all the way out, and the slug in  $T_2$  half way in. Turn  $C_1$  so that its plates are half meshed. With the junction of  $R_{11}$  and  $C_{12}$  still shorted to ground, advance the slug in  $T_1$ . When the resonant frequency of  $T_1$  approaches that of  $T_2$ , a loud, high beat note will be heard, which decreases in pitch as the slug in  $T_1$  is advanced, and disappears entirely when the two pitch oscillators are zero-beating (operating at the same frequency).

If the slug in  $T_1$  is advanced still further, a beat note is again heard. Leave the slug in  $T_1$  at the point where the beat note starts again. Now check the pitch-antenna as follows: Set  $C_1$  so that, when you stand away from the instrument, the oscillators zero-beat, but a beat note is heard as soon as your hand is within eighteen inches of the pitch-antenna.

Now move your hand slowly toward the antenna and listen closely. The pitch of the tone will go up gradually. If at one point it jumps suddenly to a very

high note, then the resonant frequencies of  $T_1$  and  $T_2$  are too low. Retract the slug in  $T_2$  a couple of turns and repeat the adjustment procedure. If no jumps in frequency are heard as the hand approaches the pitch antenna, touch the antenna and listen to the pitch of this note. If it is about three octaves above middle C on the piano, then  $T_1$  and  $T_2$  are adjusted correctly.

If the note is much higher than three octaves above middle C, then the resonant frequencies of  $T_1$  and  $T_2$  are too low. Retract the slug in  $T_2$  one turn and repeat the adjustment procedure. Similarly, if the note is much lower than three octaves above middle C, then the resonant frequencies of  $T_1$  and  $T_2$  are too high. Advance the slug in  $T_2$  one turn and repeat the adjustment procedure.

If you don't have a piano, you can whistle a high note and this will be close



If the instructions in Fig. 2 are followed carefully, the coils will look like this. Top view shows just single-layer inside winding of  $T_1$ . Completed coil is below.

to three octaves above middle C. By repeating the above procedure a couple of times the correct setting of  $T_1$  and  $T_2$  will be achieved.

To set the slugs in  $L_2$  and  $L_3$ , remove the short from the junction of  $R_{11}$  and  $C_{12}$  to ground, and place it from the junction of  $C_{11}$  and  $C_2$  to ground. Connect a 20,000 ohms-per-volt voltmeter from the junction of  $R_{11}$  and  $C_{12}$  to ground. retract the slugs in both  $L_2$  and  $L_3$  all the way and set  $C_1$  so that the plates are about one quarter meshed. The voltmeter should read a couple of volts. Standing away from the volume-antenna, advance the slug in  $L_2$ . The meter reading will drop, reach a minimum, then slowly start to climb. Set the slug where the meter reading is at a minimum. At this point, the frequency of oscillation of  $V$  is equal to the resonant frequency of the volume-antenna circuit. Next, place your hand on the volume-antenna and advance the slug in  $L_3$ . The meter reading will now increase, reach a sharp maximum, then decrease. Set the slug in  $L_3$  where the meter reading is at its highest value (about five volts). This completes the setting of  $L_2$  and  $L_3$ .

You are now ready to try your Theremin. Set the instrument on a microphone stand, and at least two feet from walls or large pieces of furniture, and connect it to the amplifier. The Theremin is tuned first by setting the volume  
(Continued on page 125)



# A Versatile Impedance Checker

By HAROLD REED

Used with standard test gear, this test box enables quick and accurate measurement of unknown impedances.

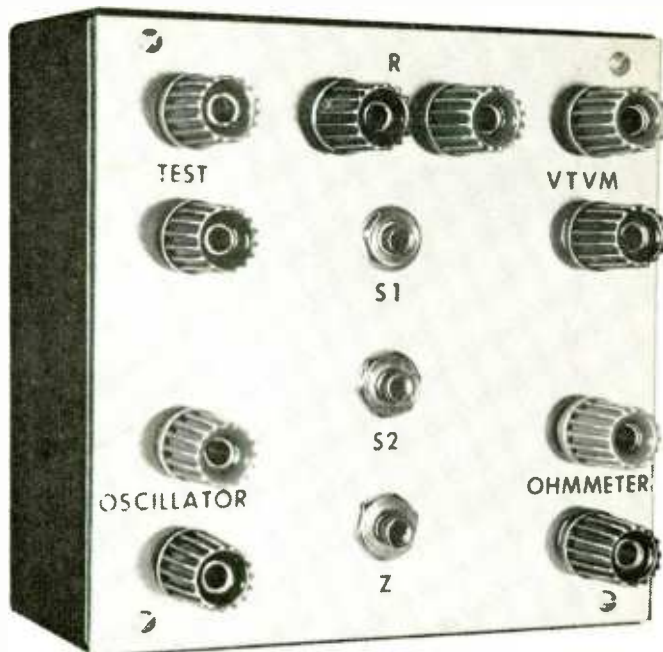


Fig. 1. All connections required for an impedance test set-up are made and switched through this simple device.

EVERY TECHNICIAN, whether he does some kind of servicing or any other kind of work, runs into situations where he should be able to make impedance measurements at various points in electronic equipment. This is particularly true of audio technicians. Cases where knowledge of the impedance is important would include those where modifications or additional equipment or circuits are to be incorporated in a system.

It is true that the specifications for electronic devices generally state input and/or output impedances in ohms. However, these are the impedances for which the devices were designed. That is, the stated input impedance is the source impedance that should be matched to the unit, and the output should work into a load of the stated output impedance. But these figures do not necessarily specify the true input and output impedances of the device itself.

Consider, for example, a line amplifier in an audio network. Filters or equalizers are to be added to this system. For these additions to work properly, the actual impedances at the points where they are to be introduced must be known and the filters must be designed accordingly.

The amplifier is specified as having a 600-ohm output. However, like most quality amplifiers in use today, it has negative feedback around the output stage. This means that the actual impedance looking back into the amplifier can be below 100 ohms. It may also be said that the amplifier has an input of 50 ohms. Yet, to improve gain, the input transformer may be unloaded in such a way, going into the first stage, that the actual impedance seen may be over 1000 ohms.

The test-instrument accessory described here facilitates the measure-

ment of such impedances. Requiring only three push-button switches, ten binding posts, and a small standard cabinet (Figs. 1 and 2), it can be built simply and inexpensively. It is used in conjunction with such conventional equipment as an oscillator, a v.t.v.m., and an ohmmeter.

The cabinet measures 4 x 4 x 2 inches. All binding posts and switches are mounted on the front panel. The binding posts used by the author were of the 5-way type. While these are available from more than one source, the ones used were in the Lafayette MS-566 kit, which includes exactly ten posts. They were spaced on 3/4-inch mounting centers to accept standard, dual banana test plugs and were insulated from the cabinet by fiber shoulder washers.

The three switches are all single-pole, double-throw units, but momentary, spring-return types are desirable. The ones actually used were push-button switches, Lafayette MS-449. They are shown in Fig. 2 in the normal position, when the push-button is not depressed. Since there is nothing critical about parts placement or wiring, the schematic and the front panel, shown in Fig. 1, are sufficient for adequate duplication. Designations in both illustrations agree with each other except that S<sub>3</sub> in

the schematic has conveniently been identified as Z, for impedance, in Fig. 1.

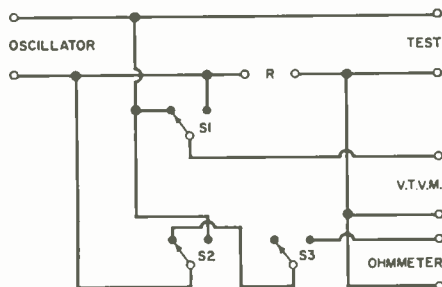
## Using the Checker

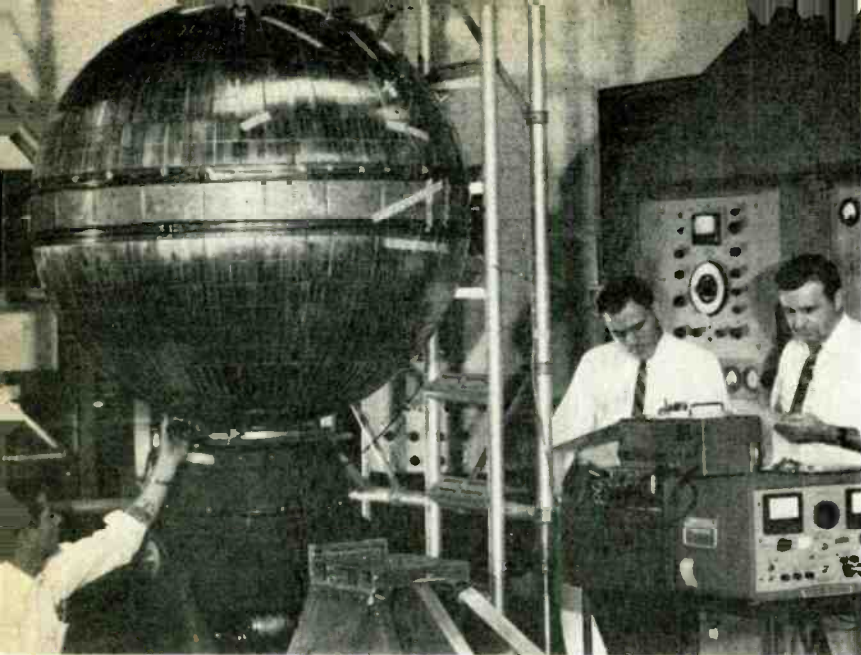
Although the device may be used in numerous impedance-measuring applications, the constructor will understand its operation sufficiently from an example using an audio amplifier. To measure its output impedance, the output terminals from the amplifier are connected to the "Test" binding posts. An audio v.t.v.m. (or other suitable voltmeter) and an ohmmeter or other resistance-measuring device are connected to the correspondingly labelled binding posts. A variable resistor or potentiometer is connected to the R binding posts. Its value will depend on the order of impedance being measured, and should be selected so its value is that of the rated impedance or slightly greater.

Now a generator is connected to the input of the amplifier to provide a signal whose frequency is that at which impedance measurements are ordinarily made on the equipment under test. For an audio amplifier, this can be 1000 cps. Note that no connection is made to the "Oscillator" binding posts of the checker in this test. The generator and/or the amplifier gain control are adjusted to provide a convenient voltage reading on the voltmeter, which is across the amplifier output—say 1 volt. Depress switch S<sub>2</sub>, which shunts the resistor across the amplifier output and the meter, and hold it down. Now vary the resistor until the voltage reading drops to half of the initial reading—half a volt here. Release S<sub>2</sub>. The resistance across the amplifier output equals actual output impedance. Remove amplifier connections from the test binding posts. Depress S<sub>3</sub> (Z) to shunt in the ohmmeter. This will give a direct reading of the desired impedance.

(Continued on page 92)

Fig. 2. Switches and binding posts are chief components in this passive network.





### ◀ "Courier" Communications Satellite

A model of the 500-pound "Courier" satellite, recently orbited by the U.S., is shown here undergoing vibration tests. The purpose of the satellite is to relay messages for communications between ground stations. In operation, it accepts messages from one ground station, stores them, and on command, delivers them to another ground station. The electronics in the *Philco*-built satellite uses but a single vacuum tube along with nearly 1300 transistors and diodes.

### Transistorized Police Radio

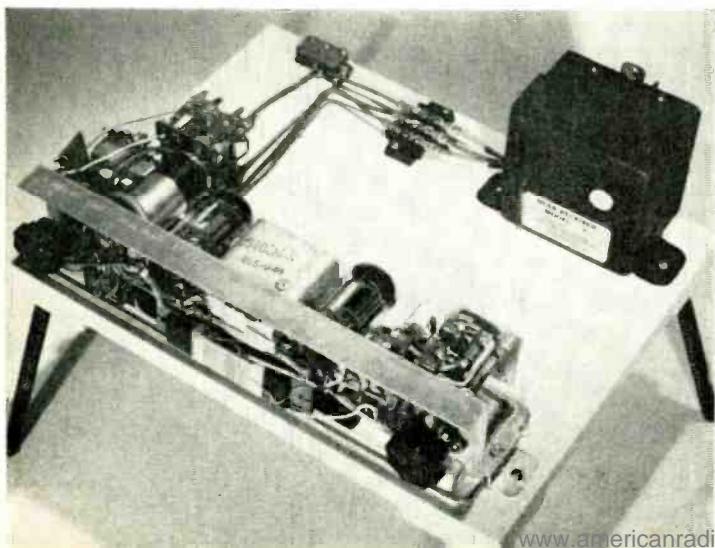
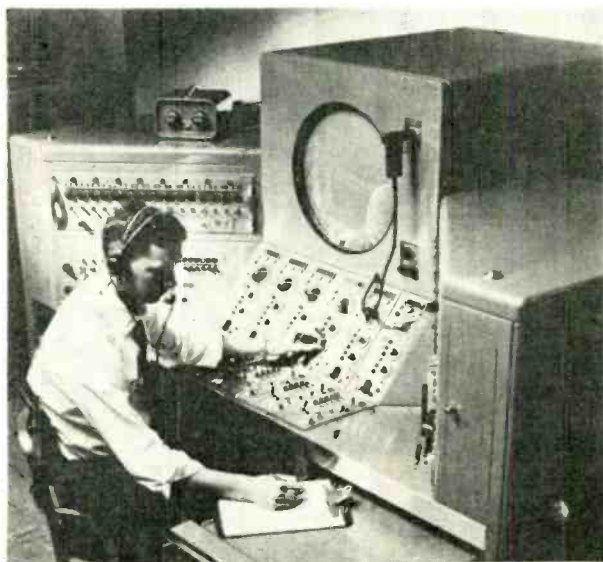
Newark, N. J. has become the first major city to use a two-way radio system employing transistorized equipment, with inauguration of the police department segment of a hookup that will tie in fire and public works vehicles later. The compact FM communications gear is being installed in city vehicles under a 5-year agreement with *RCA*.



# Recent Developments in Electronics

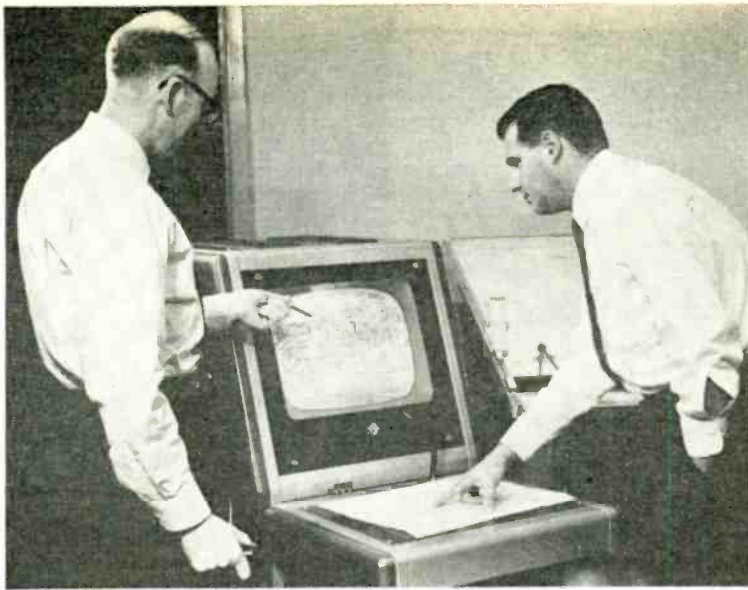
### ▶ Electronic Air-Traffic Control

A new electronic system, developed for the Air Force by *Avco Corp.*, is undergoing tests for controlling air traffic above busy air terminals. Called "Volscan," the system makes it possible for 120 aircraft to take off and land each hour, or one every 30 seconds. Here an operator at one of the consoles is setting in initial data for an aircraft's approach. Operating under all types of weather conditions, the system employs radar and radio as well as electronic computers—under the supervision of air-traffic controllers—to direct the arrival and departure of aircraft.



### ▶ "Compactron" Defense Radio

A breadboard hookup of a "Compactron" table radio with a National Emergency Alarm Repeater receiver (right rear corner) is shown here. This setup, recently tested by the Office of Civil and Defense Mobilization, results in the radio being turned on automatically upon receipt of an alarm impulse that signifies a defense or weather alert. Two *G-E* "Compactrons" in the receiver take the place of 5 ordinary tubes.

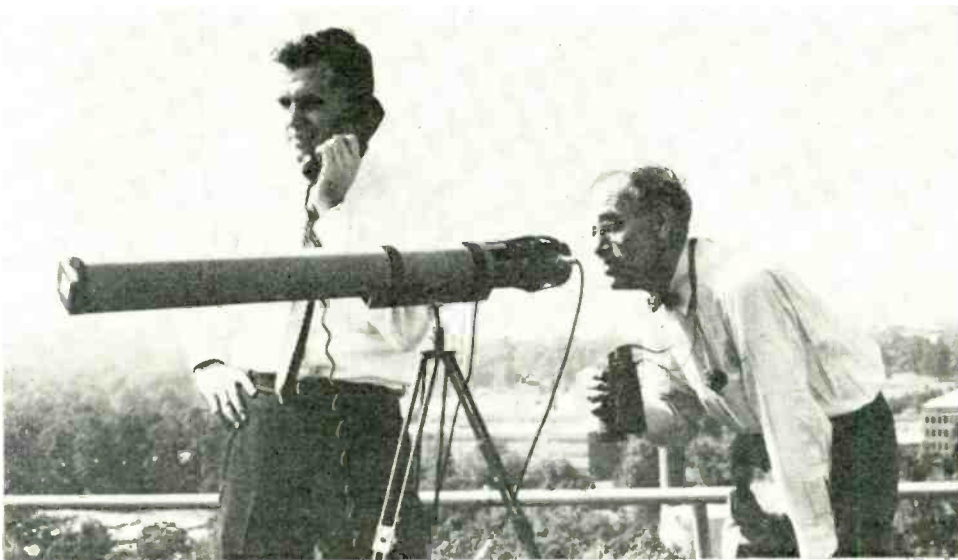


### ◀ Microfilm Video Transmission System

A video transmission system that instantly brings drawings on microfilm from a central library to a remote high-resolution TV viewer was demonstrated recently by *Nord Photocopy & Electronics Corp.* The system uses a flying-spot scanner rather than a vidicon camera and lights to generate a video signal that is transmitted *via* cable to the viewer. The operator at the TV viewer is able to scan and enlarge any portion of the film with a magnification of up to 60 times microfilm aperture size.

### Multi-Polarized Antenna ▶

A new multi-polarized antenna which can do the work of four separate types of antennas in operating with missiles or space vehicles has been developed by the Electronics Division of *Chance Vought*. The highly flexible unit will be used aboard the USNS "Range Tracker," the Pacific Missile Range's first tracking vessel. The single antenna can be used with facilities for tracking, telemetering, or command control of missiles or space vehicles. With its complete polarization coverage, it can perform the functions of four types of antennas—vertically polarized, horizontally polarized, and clockwise and counterclockwise helical antennas. Polarization can be selected either through remote switching or automatically, providing instant response.



### ◀ Optical Maser

During communication experiment with an optical maser, D. F. Nelson (left) and W. L. Bond, *Bell Telephone Laboratories*, maintain phone contact with experimenters at the *Laboratories' Holmdel, N. J.* location. Light from the maser was flashed from Holmdel to the Murray Hill, N. J. location shown, 25 miles away, where it was received on a phototube. The general principles of optical maser operation were described in our article "The Laser—a Light Amplifier," on page 39 of our September, 1960 issue.

### Missile Radars ▶

Fire-control radars for the Navy's new surface-to-air "Tartar" missile are shown on the new guided missile destroyer "Charles F. Adams," commissioned recently in Boston. Developed and produced by *Raytheon* for the Navy, the radars help guide the missile despite enemy evasive tactics or jamming devices. The new radars, called AN/SPG-51, can be used as part of the ship's over-all fire-control system to fire the vessel's conventional guns.



# V.H.F.

# Demonstration Oscillators

By LEWIS G. BLEVINS

Complete details on the construction of some simple v.h.f. oscillators from ordinary beam-power receiving tubes for experiments or for classroom demonstrations.

**C**ASUALLY reading that a 50L6GT beam-power tube makes an excellent oscillator in the very top portion of the v.h.f. band will likely cause you to do a double take, just to see if you've read it correctly the first time. Actually, receiving-type beam-power tubes in the class of the 50L6GT, 50B5, 50C5, etc. will readily develop up to 3 watts output at frequencies as high as 300 mc., while the 6Y6-G, 6V6-G, and 6L6-G will produce considerably larger power outputs up to 200 mc.

In 1938, two independent research teams at the Cruft Laboratory, Harvard University, discovered that beam tubes of all types, 6Y6-G, 6V6-G, 6L6-G, etc. support v.h.f. parasitic oscillations of great intensity when connected in ap-

Inspection of the basic beam-tube oscillator circuit of Fig. 1 indicates that it differs from conventional circuitry in that the oscillations occur in the screen-plate circuit, with the control-grid playing no part. Oscillations not only occur with the screen and plate at the same potential, but can be maintained at screen voltages ranging from -40 volts to values well above the plate potential of the 6Y6-G. The tank circuit consists of parallel brass rods connected at one end to the tube's plate and screen terminals, and bridged at the other end by a large blocking capacitor  $C_b$ . A second capacitor,  $C$ , is used to detune the length of rods extending beyond  $C_b$ . All power-supply connections to the control-grid, heater, and tank circuits are isolated by means of adjustable choke coils which are tuned to act as parallel-resonance wavetraps.

A simplified breadboard version of the beam-tube oscillator is shown in Fig. 2 while the schematic is given in Fig. 3. This unit was developed for use in the classroom to demonstrate standing waves. The very-high-frequency output of the oscillator is inductively coupled to a parallel wire (Lecher) line. Standing waves are set up on the line wires

and a simple neon-lamp detector is moved along the line to locate two voltage maximums, which are a half-wavelength apart. If we let  $d$  = length of a half-wavelength in inches, the frequency of the beam oscillator's output is found by means of the simple formula:  $Frequency \text{ (megacycles)} = 5905/d$ .

### Construction

The components for the beam-tube oscillator and power supply are mounted on a plywood baseboard, as shown in Fig. 2. Since the 450-ohm voltage dropping resistor for the heater of the 50L6GT tube produces considerable heat, it is kept away from the other components by mounting it on the left, rear corner of the baseboard on one-half-inch stand-offs. The rheostat shown in the front, left end of the baseboard is a 500-ohm, 25-watt wirewound unit which is used as a d.c. voltage control. This unit was from the junk box and it has been found that a 250-ohm, 5-watt wirewound fixed resistor can be substituted without any sacrifice in performance.

A barrier terminal strip (also from the junk box) provides a convenient means of supporting the 150-ma. sele-

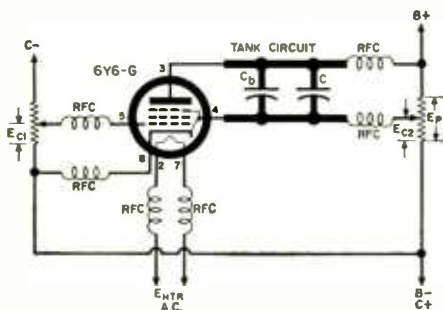
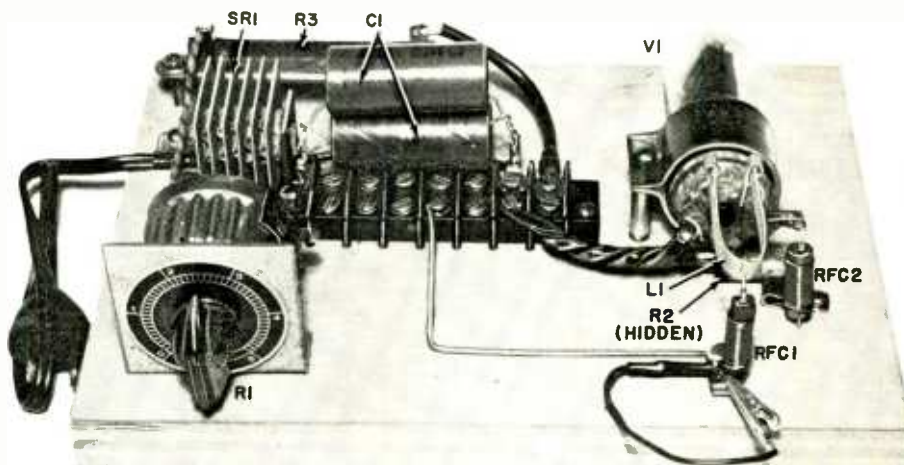
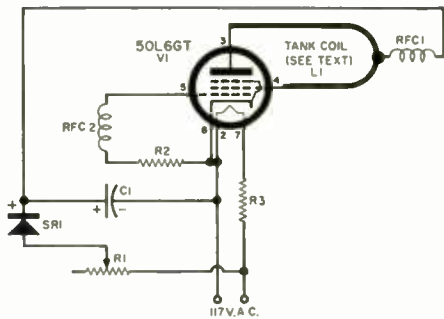


Fig. 1. Basic beam-tube oscillator circuit.

parently conventional amplifier circuits and operated at rated voltages. In fact, the oscillations persisted under such diverse conditions that it seemed to be a real problem to eliminate them in circuits in which they were not wanted. A study was undertaken by Ronold King (see "Beam Tubes as Ultra-High Frequency Generators," *Journal of Applied Physics*, September, 1939) in order to devise means for preventing the generation of these troublesome very-high-frequency currents and, after a preliminary series of experiments had revealed the rather unusual qualities of beam tubes in sustaining such currents, a more detailed investigation was conducted.

Fig. 2. Breadboard model of one of the demonstration units built by the author.





- R—500 ohm, 25 w. wirewound rheostat or 250 ohm, 5 w. wirewound fixed res. (see text)
- R<sub>2</sub>—33,000 ohm, 1 w. res.
- R<sub>3</sub>—450 ohm, 25 w. wirewound res.
- C<sub>1</sub>—80 μf., 150 v. elec. capacitor (two 40 μf. in parallel)
- RFC, RFC—See text
- L—Tank coil (see text)
- SR—150 ma., 130 v. selenium rectifier
- V—50L6GT tube

Fig. 3. Circuit of simplified oscillator.

nium rectifier and the pair of 40-μf., 150-volt electrolytic capacitors which are connected in parallel to give 80 μf. for filtering the output of the half-wave rectifier, as shown in the schematic diagram, Fig. 3.

To secure the highest possible output frequency from any beam tube used in this circuit, connections should be made direct to the tube pins and the tank circuit formed by soldering a heavy jumper wire directly across the tips of the pins connecting the tube's screen and plate. See Fig. 4. (Modifying the tube by removing the base and making connections direct to the leads will, of course, result in a slightly higher frequency.) To permit changing the tank circuit without the necessity for soldering connections each time, the author settled for the next best arrangement in the form of a low-loss octal socket made of polystyrene. The metal mounting strap is removed from the socket and miniature Fahnestock clips soldered to the screen, plate, and control-grid lugs as close to the body of the socket as possible. The metal lugs are removed from holes No. 1 and No. 6 of the socket and all protruding ends of the lugs cut off beyond the soldered connections.

The 50L6GT tube is supported horizontally above the baseboard by a Lucite clamp around its base and a stand-off. A 3/4-inch wide, 1/8-inch thick strip of Lucite is heated and bent around the base of the tube to form a clamp, as shown in Fig. 2. The flattened edges of the clamp are drilled for a 6-32 machine screw, which holds it and the tube to the top of a 3/4-inch diameter, 1-inch-long aluminum stand-off, tapped in both ends for a 6-32 screw. The stand-off is held to the baseboard with a 6-32 machine screw.

Directly beneath the Fahnestock clip soldered to tube socket terminal No. 5, the control-grid connection, is another Fahnestock clip screwed to the baseboard. One end of the 33,000-ohm grid-bias resistor is connected to this clip by forming a loop in one of the lead wires and clamping it under the head of the wood screw holding the clip to the baseboard. The other end of this resistor is soldered to terminal lugs No. 8 and No.

2 of the octal socket, which are also wired to the d.c. power supply's negative and the common heater load of the 50L6GT tube. These clips provide an easy means of changing r.f. chokes in the control-grid of the tube, which must be changed to match each new tank circuit.

A second Fahnestock clip is screwed to the baseboard near the front edge, directly in line with the tube, and wired to the positive terminal of the d.c. supply. A short length of insulated hook-up wire, terminated in a miniature alligator clip, is connected to this Fahnestock clip for convenience in changing the r.f. choke that connects between the positive terminal of the d.c. supply and the tank circuit. Both of the r.f. chokes used in this oscillator circuit must be matched to the frequency of the particular tank circuit in use.

### Operation

A simple tank circuit for use in checking out the beam-tube oscillator is shown in Fig. 5A. No r.f. chokes are required with this simple tank coil, which consists of 6 turns of #14 plastic-insulated solid copper wire (the kind that is used for inside house wiring) wound side-by-side on a 3-inch diameter form. Slide the coil off the form, bunch the turns snugly together, and tape tightly at three points as shown. Bend the lead

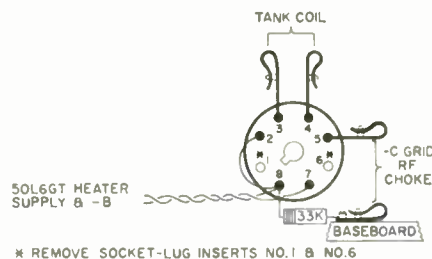


Fig. 4. Bottom view of octal-socket wiring.

wires at right angles to the coil and strip the ends for connection to the Fahnestock clips of the 50L6GT tube's screen and plate. Remove about 1/8-inch of the plastic insulation from the coil winding at the mid-point for a tap. The exact location is not critical, an inch or two in either direction from true center will suffice.

To test the oscillator, the miniature alligator clip from the positive side of the d.c. power supply is connected directly to the tap on the coil, omitting the usual r.f. choke. A short length of bare wire, connected between the Fahnestock clips in the tube's control grid, replaces the r.f. choke normally required at that point.

A simple r.f. output indicator, consisting of a single 3-inch diameter turn of the same type wire used for the tank coil, with the ends connected to the terminals of a miniature 6-volt lamp, is shown in Fig. 5B. With the voltage control rheostat set to its mid-point, a value of 250 ohms, the r.f. output of the beam-tube oscillator is sufficient to light the 6-volt lamp to full brilliance when its single turn loop is brought to within a half inch of the tank coil. The output frequency of the oscillator, using this

tank coil, will be approximately 25 mc.

When using this unit for demonstration, be sure to be careful of the exposed a.c. and d.c. voltages that exist.

### Tank Coil & R.F. Choke Data

A tank coil suitable for 6-mc. consists of 8 turns of #14 plastic-insulated, solid copper wire, of the same type as used for the test coil, wound on a 6-inch diameter form. The turns are bunched, taped, and center-tapped in the same fashion as the test coil. The r.f. choke may be omitted from the tank circuit and the positive lead from the d.c. supply connected directly to the coil's center-tap. An r.f. choke must be used in the oscillator's control-grid circuit, but its value does not seem at all critical. An extensive collection of video peaking coils in the author's junk box performed properly in the circuit.

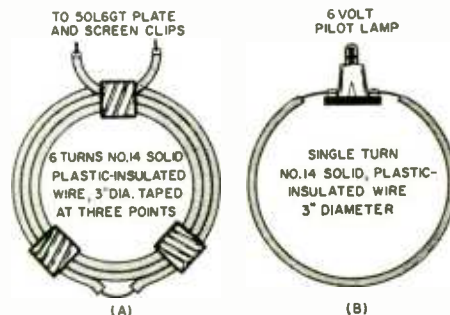
The 75-mc. tank coil consists of 11 turns of #12 solid copper wire close-wound on a 1/4-inch diameter form, which is then removed. The r.f. choke coils for use with this tank coil each consists of 57 turns of #36 s.s.c. wire wound in a single layer on a 1 3/32-inch diameter form, occupying a length of 3/4 inch. A molded composition resistor having a resistance of 1 megohm or more, is used as the choke form. The r.f. choke supplying positive d.c. to the tank may be connected to either the plate or screen end of the coil, or tapped-in at some point on the coil.

The tank for 200 mc. consists of a strip of copper, 1/4-inch wide, bent in the form of a "U" that is 1 3/4 inches long, with the sides spaced 1/2 inch apart. The matching r.f. chokes are wound on 7/32-inch diameter, 1/2-inch long molded composition resistors having a resistance of 1 megohm or over, with 5 turns of #28 enamel wire. (Fig. 2 shows this unit.)

### Circuit Refinements

The over-all performance of the beam-tube oscillator operating at the higher frequencies can be greatly improved by incorporating a third r.f. choke in the tube's cathode lead at the socket. Further improvement may be secured by inserting additional r.f. chokes in the heater leads of the tube at the socket, and removing the jumper connection tying the cathode to one side of the heater. Since the performance of the oscillator has proven entirely satisfactory for demonstration purposes, these additional improvements have been omitted for simplicity.

Fig. 5. (A) Twenty-five megacycle tank coil for oscillator check. (B) Output indicator.



# Tailor Your Loudspeaker To Your Room

By GEORGE L. AUGSPURGER



How to get the most out of your loudspeaker system in a particular listening room by use of equalizing circuits.

**E**VERYBODY agrees that a loudspeaker must be considered as part of the room in which it is placed. But as soon as you ask the question, "What should I do to make a loudspeaker system sound best in *my* listening room?", the area of agreement vanishes.

Some experts recommend lots of overstuffed furniture and drapes to make a small room "acoustical." Others advise the use of mirrors and glass-covered pictures hung on the walls. One group has resolved the problem with a single formula: big room—big speaker, little room—little speaker. (Unfortunately, it doesn't always work out this way.) One successful dealer gets rid of the whole difficulty by telling his customers that in a stereo system room

acoustics don't matter very much any more.

Obviously, these conflicting theories are more confusing than helpful. But the situation isn't really so complex if we look at it logically.

There are two things to consider: the characteristics of the loudspeaker system and the acoustics of the room. It is the interaction of these *plus* the personal listening preferences of the audiophile which determine how well the system sounds.

#### Room Acoustics

Contrary to what many people have been told, lots of overstuffed furniture and drapes will not make a small room sound like a concert hall.

Certainly, a reasonable amount of ab-

sorption is required. Some of today's modern houses have rooms built entirely of glass and concrete. These make wonderful echo chambers, but you can't carry on an understandable conversation, much less listen to the Pittsburgh Symphony.

Even if the total absorption in a room is within acceptable limits, it must be well distributed. Large parallel hard surfaces (picture windows facing a plaster wall, or uncarpeted floors and hard ceilings, for example) can generate a peculiar flutter as the sound bounces back and forth.

The absorption of sound by carpets, drapes, and furniture affects high frequencies primarily. However, the natural rate at which walls and ceilings flex can absorb substantial acoustic en-

ergy in the bass range. But absorption by diaphragm action usually does not affect a wide band of frequencies—it will introduce one or two “holes” at frequencies where the walls tend to become acoustically transparent.

Fortunately, such absorption bands are usually not serious enough to noticeably deteriorate the acoustical qualities of a room. But they may give rise to objectionable interference in the adjoining apartment. Sometimes a different location for the loudspeaker system will let you make more noise (if you like your music loud) without antagonizing the neighbors. If this doesn't work, about the only thing that can be done is to turn down the volume control.

There is still a third acoustic phenomenon which is extremely influential in determining the sound of your hi-fi system.

Suppose we have a room 20 feet long with a loudspeaker system at one end. Over most of the audio range, sound scatters around the room fairly evenly; it is reflected and re-reflected from various surfaces until it is finally absorbed completely. As long as uniform distribution is maintained, the reverberation time of the room is its primary acoustic characteristic. But at about 55 cps the room is a wavelength long, and the wavefront bounces merrily back and forth, from one end of the room to the other, being given a little bump by the loudspeaker cone at exactly the right moment every 1/55th of a second.

Things become even more interesting if we take into account the height and width of the room as well as its length. Standing waves are set up between the various room surfaces, and if one dimension is an even multiple of another, we are in for real trouble. If, for example, our 20-foot room is 10 feet wide and 9 feet high it approaches the shape of two cubes placed together. All three room dimensions combine to set up standing waves at about 55 and 110 cps.

These standing waves naturally introduce discouraging peaks and dips in the response of the system. Not only that, but since stationary patterns of sound pressure are set up, the response of the system changes abruptly, not only with frequency, but depending on the location of the loudspeaker and the listener.

Example: “Why is it that when I play the Popular Psychiatrics Test Record on my Minigon, I don't hear the 40-cycle tone? My old car radio speaker made a nice solid buzz at 40 cycles.”

“Well, it doesn't buzz because it doesn't distort. And the reason you don't hear anything is because you are sitting in a pressure node.”

“I beg your pardon.”

“Let me demonstrate. Move over there into the corner of the room. Now let me put on the 40-cycle tone.”

(The eyes light up, the mouth drops open, and the whole face takes on an expression of amazed rapture which simply cannot be appreciated by the outsider.)

Perhaps the factors involved can be made clearer with a more detailed ex-

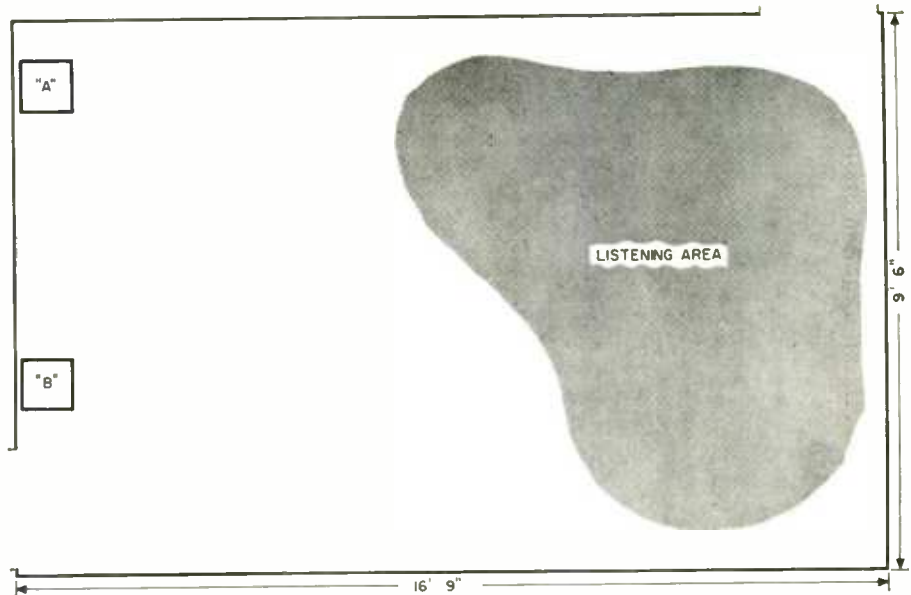


Fig. 1. Author's listening room with two speaker systems located at "A" and "B".

ample. Consider the following case.

### Case History

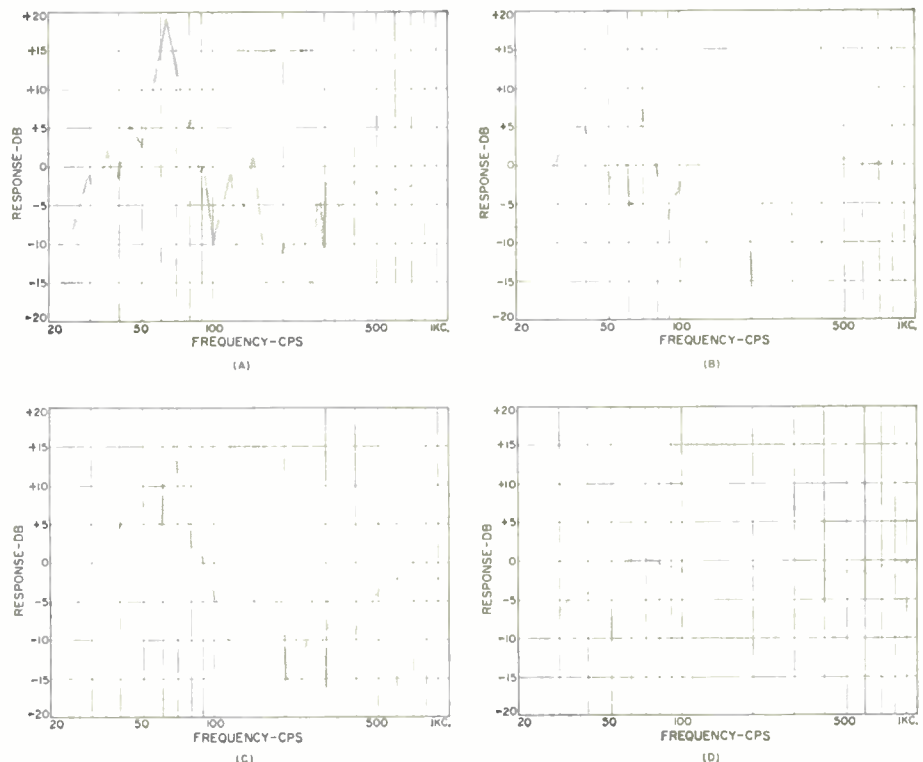
Fig. 1 shows the living room of the author's apartment. The ceiling is about 8 feet high, so the room approaches the double-cube configuration which was just used as a horrible example. The present loudspeaker installation consists of two small identical systems hung on the wall near floor level at locations "A" and "B." Eventually these will be used in stereo—right now they are paralleled and connected to a single 60-watt amplifier.

Despite the fact that high-quality speakers were used, the system sounded bass-heavy and boomy. A sweep through

the low-frequency range with a sine-wave oscillator triggered a strong resonance at about 65 cps. At this frequency the whole room quivered and a heavy crystal ashtray started creeping toward the edge of the table. And there I was, face to face with a standing wave. If I had taken the trouble to measure the living room before moving into the apartment, I could have predicted its unhappy acoustic qualities.

The best thing to do seemed to be to nail down the problem with more detailed information. So, a good microphone and a v.t.v.m. were borrowed, and some curves were plotted. (If you should decide to try this, make sure you get a sensitive meter with an accurate decibel

Fig. 2. Performance of loudspeaker system at location "A" (A), at location "B" (B). Performance of speaker systems at "A" and "B" connected in parallel is shown at (C). The performance of a single loudspeaker system in free space is illustrated at (D).



scale. Also, be sure to use a high-quality condenser or dynamic microphone. If you try to use a ribbon microphone, your curves will be inside-out in the region where standing waves occur.)

It was found that below 300 cps or so, the trick is to measure individual peaks and dips, plotting these points on 4-cycle, semi-logarithmic graph paper. But in the mid- and high-frequency region, the peaks and dips are so close together that it is impossible to chart them all. Instead, you have to take a half-octave at a time, sweeping back and forth in this band, and estimating the average position of the meter pointer.

The procedure is entertaining and it is easy to get carried away. However, readings below 30 and above 5000 cps should be disregarded. Unless fantastically expensive equipment and an individually calibrated microphone are used, such measurements are worthless.

Using this technique, separate curves were drawn for the two loudspeakers. Fig. 2A is a representative curve of speaker "A," and Fig. 2B shows the response of loudspeaker "B." To those who are used to measuring speakers, the picket fence aspect of these curves comes as no surprise. However, there are two things which deserve comment:

(1) In loudspeaker "A," the peak at 65 cps is clearly audible and extremely annoying. We would expect this from a look at the curve even if we had never heard the system. We would also expect the broad depression around 200 cps to be audible too. This is an instance where the microphone doesn't agree with the ear—it isn't audible.

(2) Clearly, if a single monophonic system is used in this room, the corner is *not* the best location. Not only is the

ance of "A" and "B" together should be better than either one alone.

Well, nobody is right all the time.

Fig. 2C shows the performance of the two speakers in parallel. This is obviously worse than either unit by itself. And because of the law of I.C.I.O. ("The Innate Cussedness of Inanimate Objects"), it sounds as bad as it looks. That is, the 65-cps peak is just as pronounced as you'd expect. However, the spatial quality and improved reflected/direct-sound ratio makes the over-all performance of the two parallel systems much more lifelike than either one alone. The problem was to keep this physical arrangement but get rid of the 65-cycle boom.

Since all three curves show a general rise around 60 cps, and a depression around 200 cps, you might suspect that the problem was a function of the loudspeakers themselves. I did, so I managed to steal a free-field curve of the 10-inch woofer as run by the manufacturer.

from a frequency of 35 to 1000 cps.

Well, since the loudspeakers were good (remarkably good really) and placement was not to be changed, how about changing the listening location? The chair which had been used as the "ideal" listening point was moved two feet and the curve of Fig. 4 was obtained. This was better, but additional equalization was required.

Notice that if the loudspeakers were *not* flat things might be considerably easier. A speaker system having a hole at 60 cycles and a little bump around 120 cycles could be used. It would probably sound very good without any electronic equalization at all. Such a speaker wouldn't be too difficult to find, but since I wanted to use the units I already had, equalization seemed to be the best solution.

The dotted line in Fig. 4 gives a fairly good indication of what the system sounds like in operation. It was drawn by connecting mid-points of the ups and

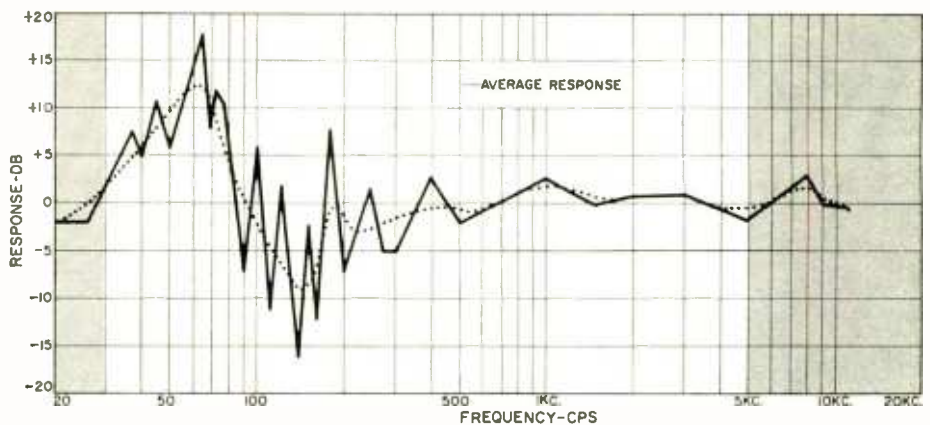


Fig. 4. Performance of two speaker systems in parallel measured at final listening location. Dotted line indicates average response. Shaded areas can be considered reasonably accurate because a laboratory capacitor microphone was used for the tests.

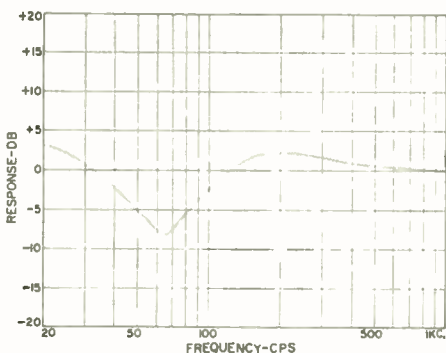


Fig. 3. Response of equalization circuit.

bass response of "B" smoother than that of "A" but its performance in the 30-50 cps range is actually stronger. This is exactly the opposite of what we would expect. It demonstrates the value of experimenting with loudspeaker position . . . a distance of only five feet makes the difference between the results of Figs. 2A and 2B.

After measuring the loudspeakers individually, the next step was to connect them in parallel and check the response of the whole system. The author has explained in previous articles that one of the advantages of separated loudspeaker systems is the tendency to average out peaks and dips caused by room acoustics. Therefore, the perform-

This is shown in Fig. 2D. "Well," I thought, "there is a *little* bump around 60 cycles. Maybe this is one of these curves that has been forcibly smoothed for publication."

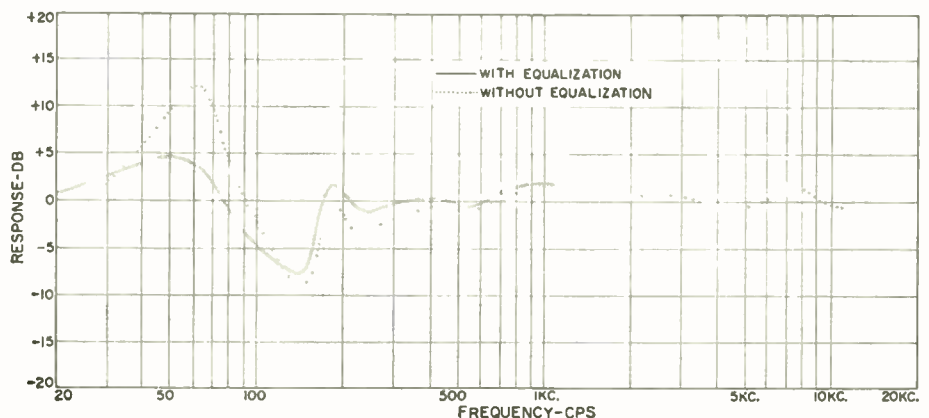
So I went to a lot of trouble to run some free-field curves myself. The results were almost identical with the curve of Fig. 2D. No matter how carefully I tried to find the peaks and dips, the loudspeakers refused to vary their output more than approximately  $\pm 3$  db

downs of the curve that was measured.

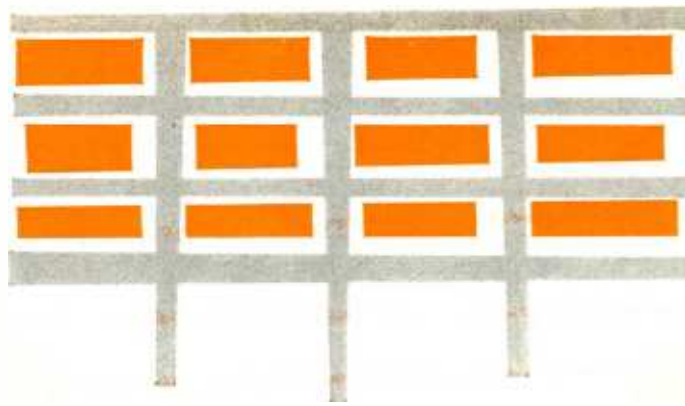
Fig. 3 is the equalization added to the amplifier and Fig. 5 is the averaged response of the equalized system. The bump around 65 cps has been squashed down until it is only about 6 db above mean intensity. I couldn't resist raising the depression around 200 cps to make the curve look nicer even though this refinement doesn't make any audible improvement.

(Continued on page 124)

Fig. 5. Solid line shows average response of speaker system with equalization employed. The dotted line shows the average response of system without equalization.







# PACKAGED-CIRCUIT SERVICE PROBLEMS

By H. R. HOLTZ / Unitized multi-component networks present some special service problems. How to find and fix faults.

**A**MANIA for using single physical elements that include the various components of certain networks seems to have our TV and radio designers in its grip, and not without reason. These integrated combinations are sprouting up all over the chassis of newer-model sets today.

These elements are of various types. In the beginning, they were simply called "printed circuits." In these, instead of using conventional components, resistors and capacitors were literally printed on small, ceramic wafers and kiln-fired inside an insulating sheath, with connecting leads protruding. To avoid confusion with other uses of the term today, these plates or packaged units are no longer called printed circuits. The most common early examples

through orifices on an etched-circuit chassis board and be soldered to the wiring printed on the latter.

At best, it is quite difficult to "see" the circuit from visual inspection of the physical equipment; it is almost always necessary to examine the schematic drawing of the receiver. Since measurements can be made only at the external connections to the module or package, where individual components are not always accessible, precise understanding of the circuit operation is essential if efficient repair is to be achieved.

Such cut-and-try methods as checking components by substitution have obvious limitations. Even substitution of an entire assembly is not simple, because maintaining a stock of all possible combinations already in use may be wasteful and may also be futile, since new types are constantly being added.

However, this does not mean that you can only take a number of measurements and then go into a trance until you arrive at the correct answer by a series of brilliant deductions. We have heard of fabled geniuses who can do this, but the average service technician has learned that he must get most of his answers the hard way.

The most practical approach to checking a package or module seems to be offered by some form of the signal-tracing technique, with or without signal injection. The value of this approach lies in the fact that it can localize a trouble to a given area, between two

specific points in a circuit, although it may not point directly at the defective component. With these multiple-component networks, it is possible to establish at least two such points, which may be considered an input end and an output end. Thus signal tracing can establish whether a defect is indeed inside the compact assembly or not, and we know whether or not a replacement must be ordered.

There are usually other means of checking that can then be used to provide verification of the diagnosis. For example, consider the portion of an FM discriminator circuit used in certain Philco receivers, shown in Fig. 1. The voltage-divider and filter network in the discriminator output, appearing within the broken-line box, is sealed in a single unit. In an actual case of weak audio output, an oscilloscope showed ample signal present at the cathode of the 5T8 that connects to terminal 2, which is the input end of the network. Touching terminal 1, the output end, produced a loud hum in the set's speaker. There was no hesitation in branding the assembly as defective.

Nevertheless, as a further check, a 100,000-ohm resistor was bridged across terminals 1 and 2. The audio came in loud and clear. Using various combinations of terminals and checking with an ohmmeter or with injected signals, other components could be checked. Leakage in the upper 150- $\mu$ f. capacitor

(Continued on page 110)

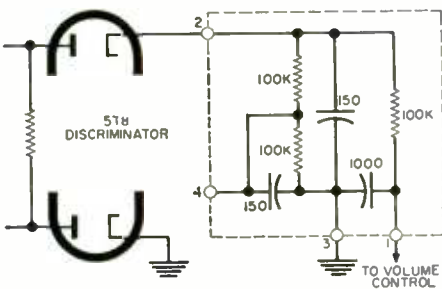


Fig. 1. This FM discriminator output network is used in Philco chassis 7H22.

were standardized vertical-integrating networks.

The newer combinations are a bit different. They will have more depth than the wafers. Standard capacitors, resistors, and possibly other components are mounted on small boards (on the order of 1 x 2 or 2 x 2 inches) and the finished assemblies or modules are dipped in some sealant compound. As is the case with the earlier type, internal connections are sealed in and inaccessible, but external connections are brought out as pigtailed. Usually these leads will go

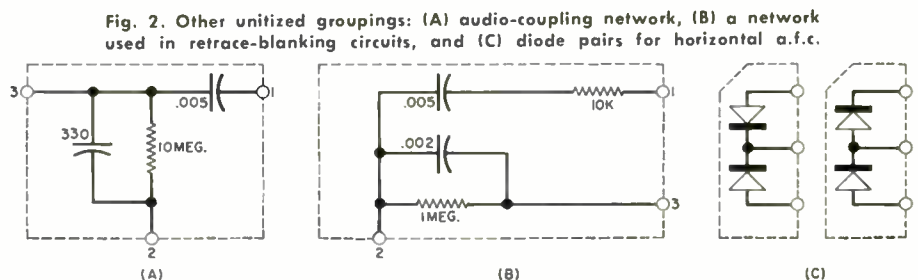


Fig. 2. Other unitized groupings: (A) audio-coupling network, (B) a network used in retrace-blanking circuits, and (C) diode pairs for horizontal a.f.c.

*TV performance losses as sets age, gradual and cumulative, are seldom due to single defects. How to restore old life.*



# Where Did the Gain Go

By  
**KENNETH BRAMHAM**

**R**EMEMBER the new TV receiver of four or five years ago? At that time, when the set was brand new all the available channels were received, including the "hard-to-get" channel in the neighboring city. Now, after a few years of service, only the stronger stations are seen at all and only those in the low band (channels 2 to 6) are usable.

This loss of gain is often so gradual a process that it may not be noticed by the viewer until repairs are made on some other part of the circuit or until comparison is made with another set. On the other hand, gain may be lost due to a component failure and will be immediately noticed by the viewer. This second case of a sudden catastrophic failure presents a relatively simple problem to the service technician. It is the gradual deterioration and its correction which provides something of a challenge.

The cause of reduced gain may be found almost anywhere in the receiver circuit from the antenna to the viewing screen. Gradual deterioration of the antenna connections and lead-in wire will give a weak and snowy picture; poor amplification in the r.f., i.f., or video-

output stages will show on the screen as a weak picture; and most simple of all, yet often not immediately obvious, a dirty screen will result in reduced contrast and brightness. These and other parts of the system where lost gain is likely to be found are shown in Fig. 1.

## Tube Faults Not Obvious

Poor amplification in the receiver is most likely to be caused by tube deterioration. Gradual loss of emission by the tubes will result in reduced gain that is not likely to be restored by the replacement of any single tube. A sensitive tube checker will accurately indicate the condition of each tube and permit the service technician to decide intelligently which tubes must be replaced to restore the receiver to its original performance.

While tube testing is a simple procedure, the technician's familiarity with his tube checker can make the difference between a fast, effective service job and a tedious series of tube substitutions. A dual tube, for example, may read "Good" in a particular checker when, in reality, one half of the tube is weak and the other half is very good.

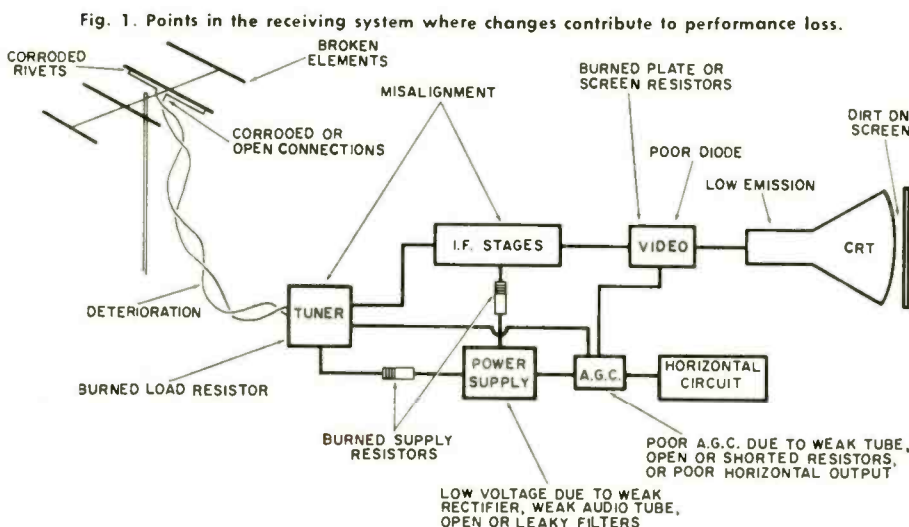
In the testing circuit, the two parts of the tube may average out, but this will not be the case under load conditions in the receiver. A dual tube in this condition, for example, if used as a mixer-oscillator in a TV tuner, may give adequate oscillator output on the low channels, none on the high channels, and inadequate amplification in the mixer stage when the oscillator is working.

Shorted or gassy tubes must be found if the set is to be restored to full gain. This is far more important than determining if a tube is "weak." The "weak" tube may be quite good for the job it is to do in the set, when it is run under correct bias conditions. A "short test" is provided in all useful tube testers, and serves not only to reject shorted or gassy tubes, but also to protect the instrument itself from damage. To give this protection the short test should be applied before going on to emission or conductance testing.

Cascode r.f. amplifier circuits are perhaps the largest single source of tube failure in sets used under poor signal conditions. If little or no a.g.c. voltage is available, the cascode amplifier tube will draw far more current than it can reasonably be expected to handle, and the resulting failure must be expected. The maximum cathode current rating for a 6BQ7, for instance, is 20 milliamperes. If no bias voltage is applied to the grid, due to a lack of a.g.c. voltage resulting from a weak signal and with the normal 125 volts on the plates, the cathode current will be in the region of 30 ma.—50% over the rated maximum.

Similar conditions prevail in the i.f. stages but to a less serious degree. Cathode biasing of these pentodes by resistors insures some negative grid bias at all times. However, under certain conditions of low a.g.c. voltage, cathode and plate current can become excessive.

Lack of a.g.c. voltage is not always caused directly by poor signal conditions. Reduced gain in the r.f. and i.f. stages results in less signal voltage being applied to the detector and a.g.c.



circuit which, in turn, develops less than normal a.g.c. voltage for a given signal strength at the antenna. Thus we have a chain reaction where loss of gain creates a low a.g.c. condition which, in turn, produces tube deterioration, due to lack of bias voltage, causing a further reduction in gain.

This low-gain/low-a.g.c.-voltage spiral can be extended to include the antenna as a likely starting point. A new TV set may be equipped with a new antenna, but deterioration of both antenna and set starts immediately upon installation. As antenna connections corrode, elements possibly break off, and lead-in wires become damaged, so the antenna gain is reduced, placing an unnecessary load on the receiver. Because this condition will remain after the receiver gain is restored, it is always a good idea to make a simple ohmmeter check for faulty antenna conditions when servicing for lost gain. If the ohmmeter shows a resistance of more than a few ohms across the lead-in wires to a folded dipole, when they are disconnected from the set, an antenna system overhaul is indicated.

The primary task of the technician when servicing a TV receiver should always be to restore the receiver to its original condition. Replacement of a tube with a new duplicate will only do this if the tube being replaced is of the correct type. Often a substitute may have been installed in the past, for one reason or another, which may cause reduced gain or mis-alignment. It is therefore essential that all replacement tubes should be checked against the original schematic or tube-layout diagram to make sure that the new tubes are identical or otherwise acceptable types (such as improved versions) of the original manufacturer's types.

Developments in tube design have made available improved tube types which are interchangeable with older ones to provide increases in gain or reliability. The 6BS8, for example, may be used to replace the older 6BZ7 r.f. amplifier and should generally provide an increase of about 3 db in gain and a decrease of about 1 db in noise level—a total improvement of 4 db. It is, however, advisable to re-align the r.f. stage when installing this new tube type. This may give a further improvement of as much as 2 db. In the i.f. stages it is also possible to use improved tube types, but their use is often dependent upon correct re-alignment and may even require circuit changes beyond the limits of normal service.

### Bad-Tube Chain Reactions

Poor gain caused by defective tubes will not always be corrected by tube replacement alone. Often a defective tube will cause some other component to fail, and the latter must be replaced if full gain is to be restored. The most frequent failure of this kind occurs when a tube develops a shorted or gassy condition and, by drawing excessive current, overloads various resistors in series with the tube. The overloading and resultant overheating varies in ef-

fect from a slight change in value of one resistor to the complete burn-out of a whole string of them extending back to the power supply.

The r.f.-circuit dropping resistors in cascade tuners ( $R_1$  and  $R_2$  in Fig. 2A) are possibly the most frequently affected components in this category. In this case the failure will show up, after a shorted tube has been found and replaced, as a loss of sound and picture, or reduced r.f. gain with very weak or snowy pictures. As all the resistors in series with the tube may not be obvious, a voltage check should be made under load after a resistor has been changed.

Similar failures may occur in the i.f. stages, but their effect may be somewhat different. Complete loss of picture will, of course, be the maximum result; but lesser failures will cause a weak rather than a snowy picture. This characteristic of i.f. failures will aid in diagnosis: snow usually denotes tuner trouble but seldom i.f. trouble; a "washed out" picture usually denotes i.f. or video-output trouble.

The i.f. stages, like the ones shown in

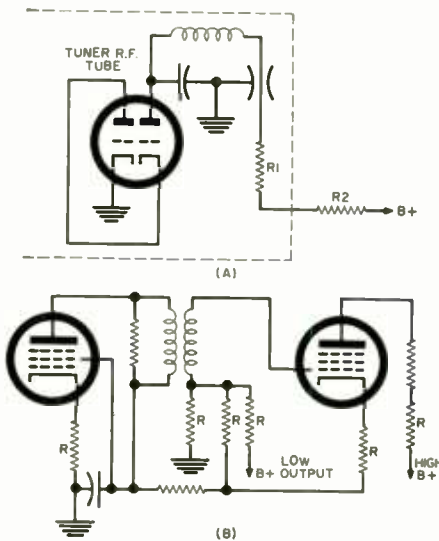


Fig. 2. Shorts in r.f. or i.f. tubes may overload resistors, like (A)  $R_1$  and  $R_2$  in r.f. and (B) resistors  $R$  in i.f.

Fig. 3. Resistor changes in voltage divider (A) of a.g.c. line may cut gain or add snow. Changes in (B) stacked "B+" supply may affect sensitivity.

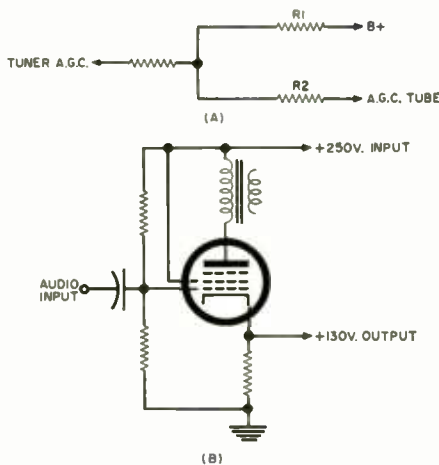


Fig. 2B, are particularly susceptible to burned-out resistors (especially the ones marked  $R$ ). In this circuit, a stacked "B+" arrangement is used that resembles the one found in cascade amplifiers, that is, the two tubes are in series across a high "B+" voltage, with the lower "B+" at the cathode of the second tube serving as plate voltage for the first stage, and possibly some other circuits in the receiver. Thus a leaky or shorted tube in one of these stages could set up a chain reaction that would affect components in both stages and possibly have secondary effects on other circuits using the same source of low "B+." This may mask the true symptoms. Similarly, a defect in another circuit supplied from this voltage point might affect the i.f. system. The possibility of such interrelated and cumulative faults should not be overlooked.

Failures in the a.g.c. circuit will, at times, produce effects similar to tuner or i.f. failures. A snowy picture may result if, for example, an open bias resistor ( $R_1$  in Fig. 3A) allows an excessive negative voltage to be applied to the tuner, thus cutting down the input to the i.f. strip and, in turn, reducing the a.g.c. voltage on the i.f. tubes. If  $R_1$  becomes low in value or  $R_2$  becomes open, the result will be a positive voltage applied to the tuner a.g.c. line, an increase in tuner gain, but increased a.g.c. bias voltage to the i.f. stages from a separate a.g.c. line, and a weak picture. In practice, the r.f. amplifier would probably not survive, which would complicate the service procedure because the direct symptom masked the defect.

Trouble originating in circuits which, at first glance, have little or no relation to tuner or i.f. circuits may be the cause of poor gain. A defective audio-output tube may, in a stacked "B+" supply circuit, cut down the low "B+" voltage and reduce the output of the i.f. strip. In this familiar circuit, shown in Fig. 3A, the audio-output tube is used as a dropping resistor to reduce the 250 volts or so from the power supply to the 100 to 150 volts needed by the i.f. strip. Changed resistor values in this circuit will affect the working conditions of the audio-output tube and produce similar results. Supply voltage reduced by open or leaky capacitors in the power-supply circuit may also show on the screen as reduced gain, as will any other defective component that is "dragging down" the supply voltage.

Sets being serviced on the bench under good signal conditions may not show the same symptoms of lost gain, but such symptoms will recur when the set is returned to the customer's antenna. As all sets are likely to have some loss of over-all gain in time, it is good practice to check all sets undergoing bench repairs with this in mind. A simple test procedure is to check the a.g.c. voltage at both the tuner and the i.f. strip while the set is connected to a "standard" antenna. Once the procedure is adopted, any set showing below-average readings will easily be noticed and can be serviced to restore the gain before it is allowed to leave the bench.

# Reverberation in Principle & Practice

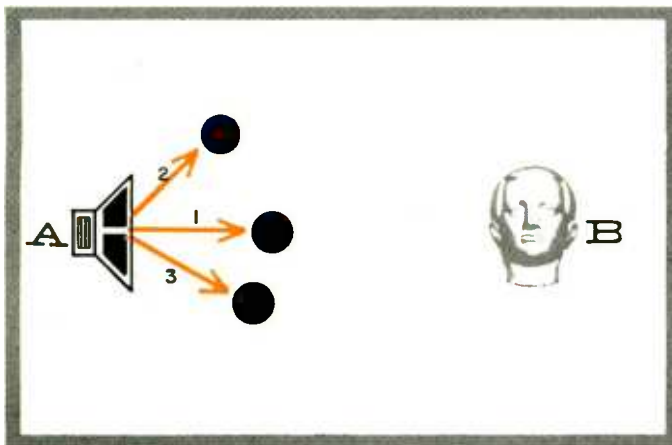


Fig. 1. Sound can be considered as individual bundles of energy, scattering in all directions from the sound source used.

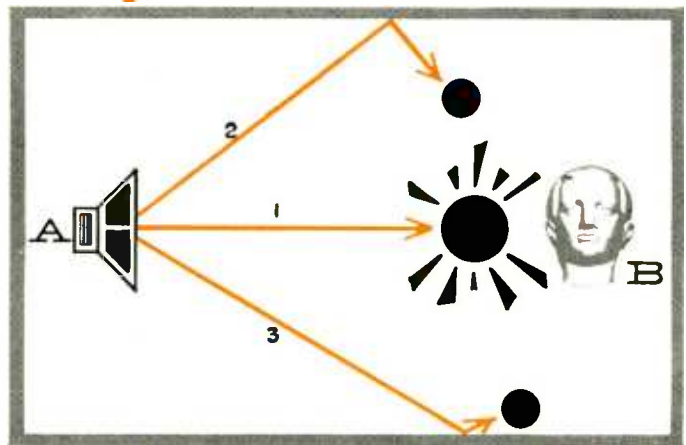


Fig. 2. Parcel 1 is the first to reach the listener. Parcels 2 and 3 arrive later after having been reflected from surfaces.

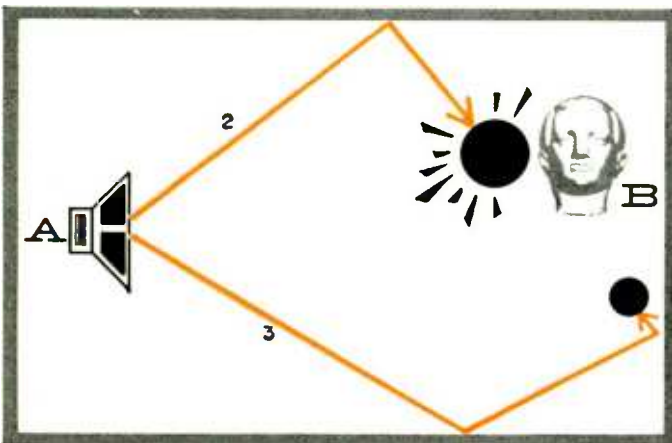


Fig. 3. Parcel 1 has disappeared, while 2 is arriving to cause continuation of sound or echo. Parcel 3 will arrive some time later.

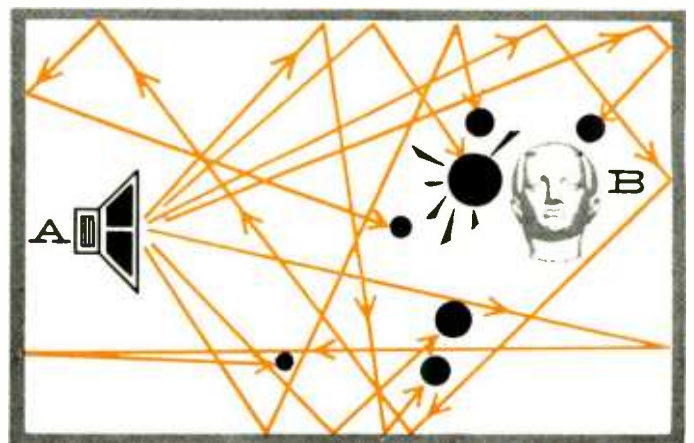


Fig. 4. In a listening room, there are a large number of sound parcels arriving at the listener's location at various times.

By **GEORGE OWEN** / Project Engineer, Motorola Inc.

## Description of the Motorola technique for obtaining the reverberation effect in its packaged stereo units.

**T**HE REPRODUCTION of sound in the living room in much the same way as it is heard in its original state, both as to content and environment, has taxed the energies and imaginations of many who are engaged in the science of sound reproduction.

Advancements in the state of this science have been both psychological and technological for, since we are dealing with the human hearing mechanism, the development of the mechanics of sound reproduction is dependent first on the findings of researchers in the psycho-acoustic field. As an example, the requirements for re-creating an exact sound picture of reproduced music in the home were known for many years before the technical development of stereo recording methods. And now, although the principles and characteristics of reverberation have been covered in dozens of scientific journals for the past 20 years, they have received widespread interest only in the last few

months as technical developments have caught up with earlier research.

Before pursuing these technical developments, let's pause for a moment to consider some of the physical factors pertaining to the causes and effects of reverberation so as to clarify their significance as far as our hearing mechanism is concerned.

### Effects of Reverberation

Imagine that you are looking down into a room and that you are able to see sound energy in the form of particles, or bundles (Fig. 1). The source of this energy might be a short trumpet blast lasting but an instant.

The source is located at position "A" and the listener at position "B." The total sound energy, divided into three particles as shown, is leaving the source by three different paths. At this point, no sound has yet reached the listener.

In Fig. 2, a short instant of time later, particle 1 has reached the listener who

perceives the sensation of hearing a trumpet blast. Particle 2, meanwhile, has struck one of the side walls and has been reflected toward the listener. Particle 3, however has been reflected from the other side wall and is now heading toward the back wall. All three particles have travelled the same distance, but because of the longer paths taken by bundles 2 and 3, these have not yet reached the observer.

You may also note that particles 2 and 3 have decreased in strength. This is due to the fact that some of their energy has been dissipated—absorbed by the walls from which they are reflected.

The amount of energy lost due to absorption depends upon the material of the reflecting surface. A heavily draped wall, for example, would reflect very little energy. The final character of the signal reaching the listener therefore depends, to a large extent, upon the materials in a room.

In Fig. 3, taken still another instant of time later, the second particle has reached the listener and he perceives either a continuation of the original trumpet blast, or an echo, depending upon the difference in arrival time between the first and second particles. In either case, the sound actually received by the listener has undergone a change from the original sound produced by the source—due entirely to the characteristics of the room. It is this characteristic which is known as reverberation. In the instant depicted in Fig. 3, the third particle, having been reflected off the rear wall, is now headed toward the listener to change the sound still more.

Under actual conditions, there will be a large number of particles traversing many different paths. The end result is a gradual decrease of sound from the time the listener first hears the initial blast. The time taken for this sound to decrease to nearly zero is the reverberation time and this, too, is largely governed by the characteristics of the listening room. See Fig. 4.

Obviously, the characteristics of a living room differ vastly from those of a concert hall. While a particularly "live" room may generate a good deal of reverberation, the reverberation time and the time delay between reception of the individual reflected signals in the living room bears no relationship to their counterparts in the concert hall. No matter how "live" a particular room may be, the feeling of spaciousness associated with a concert hall is not duplicated in the home.

Until recently, reverberation in the home has been entirely a function of the techniques employed during the recording process and of the characteristics of the playback room. Now, thanks to a unique development by the *Hammond Organ Company*, we are able to duplicate the reverberation characteristics of a large hall even in the restricted confines of the ordinary living room.

The operation of the basic *Hammond* reverberation unit, together with its associated circuitry as employed by *Philco* and *Zenith*, was described in the August issue of *ELECTRONICS WORLD*. The *Motorola* circuitry for its top-of-the-line reverberation stereo consoles is described in the following paragraphs.

### The Motorola System

For the reproduction of the stereo effect alone, three separate power-amplifier channels are employed. In the preamplifier, the two-channel stereo signal is divided into three portions, each one going to its own power amplifier. The combined bass frequencies from both stereo signals (below 200 cycles) are amplified by the center power amplifier, while the mid-range and high frequencies of each stereo signal are separately amplified and reproduced by individual left and right amplifiers and speaker systems. Because frequencies below 200 cycles contribute nothing to the directional effect of stereo, the three-amplifier system provides a full measure of stereo while offering greater IM-reduction possibilities than the more conventional two-amplifier systems.

At the same time, the extreme bass frequencies have little or no effect on reverberation. In fact, the basic reverberation unit supplied by *Hammond* cuts off at about 200 cycles. Consequently, the signal to be delayed and reverberated is a combination of the stereo signals provided by the two outside stereo amplifiers.

Mixing of the two stereo signals for

subsequent delay and reverberation is accomplished in the input transducer of the reverberation unit. As shown in the partial schematic of Fig. 5, the field coil of this transducer is center-tapped and the center-tap is grounded. With opposite ends of the coil connected to the "hot" terminals of its respective stereo speaker, each half of the field coil is effectively connected in parallel with one of the speaker voice coils. The signal energizing the field coil, however, is a composite of the two stereo signals.

Before being mixed in the reverberation unit, the two stereo signals are passed through individual pilot-bulb limiters which serve as automatic verb compressors at high volume levels. The use of this unique feature is based on the experimentally verified premise that, at high volume levels, the volume ratio between the reverberated and the direct signal should be smaller than at low volume. A little deliberation will point up the reason for this requirement.

At low volume levels, the reverberation due to the acoustics of the listening room, being lower in intensity than the direct sound, might well be masked by the ever-present room noise, thus becoming entirely inaudible. Without the addition of artificial reverberation, the resultant sound becomes relatively uninteresting. At high levels, however, the natural room reverberations contribute a good deal to the total reverberated signal so that the artificial reverberation ratio should be considerably reduced. The pilot bulbs, connected in series with the reverberation unit, automatically accomplish this function by increasing their filament resistance at high signal levels.

### Acoustic vs Electronic Mixing

In an effort to simulate concert-hall conditions as realistically as possible, *Motorola* has elected to blend the reverberated signal with the main signal

(Continued on page 84)

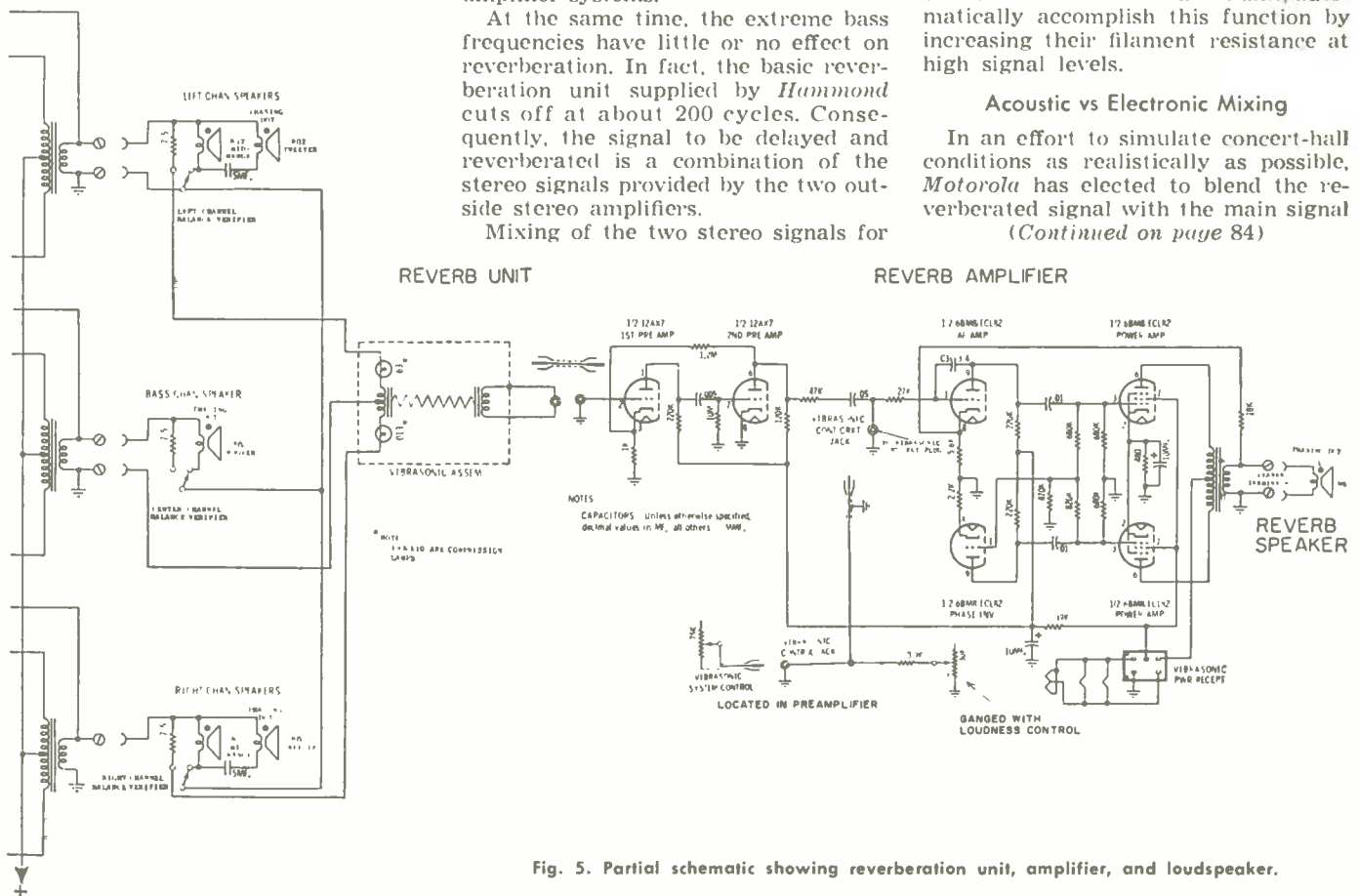


Fig. 5. Partial schematic showing reverberation unit, amplifier, and loudspeaker.

# COMPUTER LOGIC CIRCUITS



By ED BUKSTEIN  
Author, "Digital Counters and Computers"

Function of "decision-making" elements used in computers was described in a preceding article. Here are the actual circuits used in these blocks.

LOGIC circuits are the decision-making elements of the digital computer. Such circuits are designed to "recognize" certain combinations of inputs, and to produce outputs only when these combinations exist at the input terminals. The *and* circuit, for example, will produce an output only when all of its input terminals receive inputs; the *or* circuit will produce output when input is applied to *at least one* of its input terminals; the *not* circuit produces output only when input is not applied; and the *inhibitor* produces output when it receives input if a signal is not present at the inhibit terminal. In a preceding article, logic circuits were considered in terms of block diagrams. This article deals with the actual circuitry.

Fig. 1 shows a number of *and* circuits, including vacuum-tube logic, transistor logic, and diode logic. The circuit of Fig. 1A uses a tube with two input grids, both normally biased below cut-off. A mixer type tube may be used in this application or, as shown, the suppressor of a pentode may be used as a second control grid. Since both input grids are biased below cut-off, a positive input to either one of the two grids will not produce a flow of plate current. Plate current can flow only when both input grids are above cut-off simultaneously, and the circuit therefore produces an output only when positive inputs are applied to both input terminals. This type of *and* circuit is sometimes referred to as a *pentode switch*.

In the circuit of Fig. 1B, the parallel triodes share a common load resistor. Since both tubes are normally at saturation (positive bias) the current flow through the load resistor is sufficient to drop most of the supply voltage. As a result, the voltage at the output terminal is relatively low. If a negative input

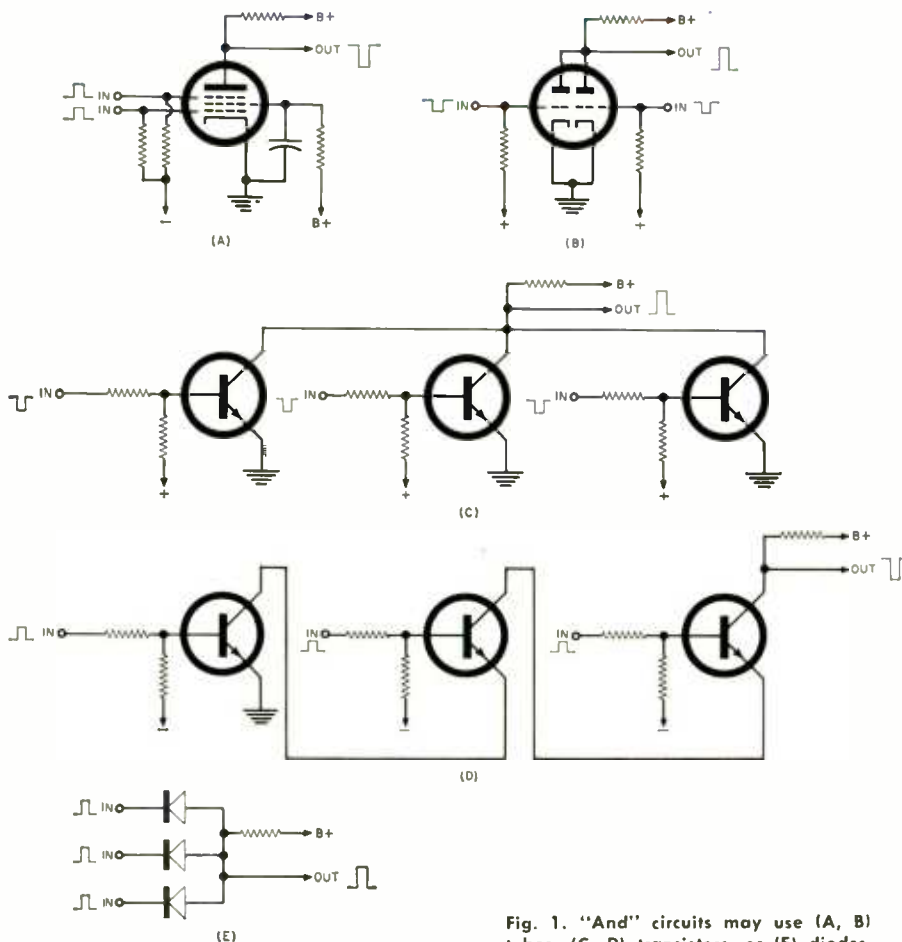


Fig. 1. "And" circuits may use (A, B) tubes, (C, D) transistors, or (E) diodes.

is applied to only one of the two input terminals, the corresponding tube will be driven to cut-off. The other tube, however, is still at saturation and most of the supply voltage is still dropped across the load resistor. Since the internal resistance of the saturated tube is considerably lower than the value of the plate load resistor, the voltage at the output terminal does not change significantly when only one of the tubes

are shown, but *p-n-p* units may be used if all polarities are reversed.

In the *and* circuit shown in Fig. 1D, all transistors are biased below cut-off (negative bias to *p*-type base material). Since the transistors are connected in series, current can flow through the load only if *all* transistors are made conductive. The voltage at the output terminal will therefore decrease when positive inputs are applied to all input terminals.

In the diode *and* circuit shown in Fig. 1E, all diodes are biased in the forward direction. The pathways for current flow are completed through the driving circuits connected to the input terminals. Since all diodes are conducting, most of the supply voltage is dropped across the load resistor. The voltage at the output terminal is therefore relatively low. Because the resistance of even one conducting diode is very low as compared to the value of the load resistor,

one (or both) of the input terminals will produce a flow of plate current. Voltage at the output terminal therefore changes in response to *at least* one input. More triodes may be added in parallel if a greater number of input terminals is desired.

In the transistorized *or* circuit of Fig. 2B, the transistors are all biased below cut-off. A positive input to any one (or more) of the input terminals will therefore cause a decrease of voltage at the output terminal. A simplification of this circuit is shown in Fig. 2C. Here, only one transistor is required, and resistors provide isolation of the input driving circuits. Since the transistor is biased below cut-off, a positive input to any one (or more) of the input terminals will make the transistor conductive and will produce a change of output voltage.

This circuit is representative of a type often referred to as *nor* logic. This name is derived from the polarity-reversing characteristic of the circuit: a positive input pulse produces a negative output pulse. Since inversion represents the *not* function, the circuit may be referred to as a *not or* circuit, which is generally shortened to *nor*.

The diode *or* circuit shown in Fig. 2D consists of a number of diodes sharing a common load resistor. An input to any one (or more) of the input terminals will cause the corresponding diode (or diodes) to conduct, and an output will appear across the load resistor.

The *not or inverter* circuit consists essentially of a conventional amplifier stage. In the circuit shown in Fig. 3, a voltage divider is connected between the plate and a source of negative voltage. The output terminal will therefore be at a potential somewhere between the value of plate voltage and the value

(Continued on page 77)

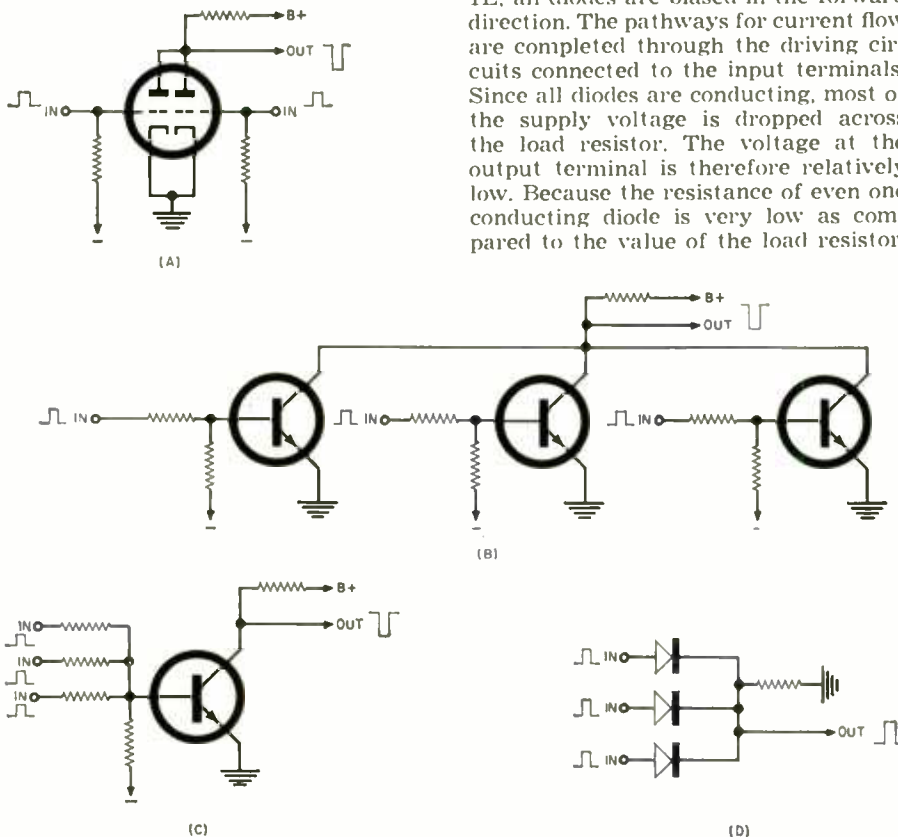


Fig. 2. Four different circuits that act alike. Each provides the "or" function.

is driven into the cut-off condition.

If negative inputs are applied to both of the input terminals however, both tubes will be driven to cut-off and the voltage at the output terminal will rise to the value of the "B" supply. Simultaneous inputs are therefore required to produce a significant change at the output terminal. This type of *and* circuit is sometimes referred to as a *parallel gate* or a *Rossi* circuit. More triodes may be connected in parallel to provide a greater number of input terminals.

The circuit shown in Fig. 1C is a transistorized version of the circuit shown in Fig. 1B. All transistors normally conduct heavily because of the positive bias applied to the *p*-type base material. Since each conducting transistor is practically a short circuit, the voltage at the output terminal will be very low as long as one or more of the transistors are conducting. The voltage at the output terminal will therefore change significantly only when *all* transistors are driven to cut-off (negative inputs to the *p*-type base material). More transistors may be added in parallel if a greater number of input terminals is desired. Type *n-p-n* transistors

most of the supply voltage will be dropped across the load as long as one (or more) of the diodes is conducting. Output voltage will therefore increase significantly only when *all* diodes become nonconductive. Simultaneous inputs are therefore required to produce an output.

By definition, an *or* circuit produces an output when input is applied to at least one of its input terminals. In its simplest form, the *or* circuit would therefore consist of several pieces of wire connecting the input terminals to the common output terminal. In this form however, the *or* circuit would not be practical because it would permit interactions between the driving circuits connected to the input terminals. The *or* circuit must therefore be of such design that it will isolate the driving circuits from each other. For this reason the *or* circuit is also known as a *buffer*. Vacuum-tube, transistor, and diode *or* circuits are shown in Fig. 2.

The triodes in Fig. 2A are biased below cut-off. A positive input to either

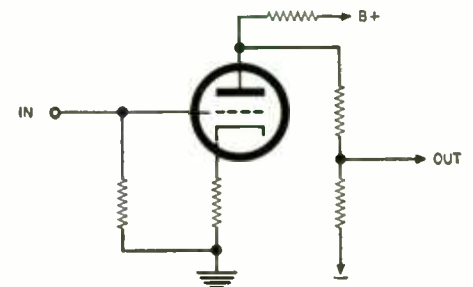


Fig. 3. A "not" circuit. Output can be at either of two different levels. These can represent binary "1" or "0".

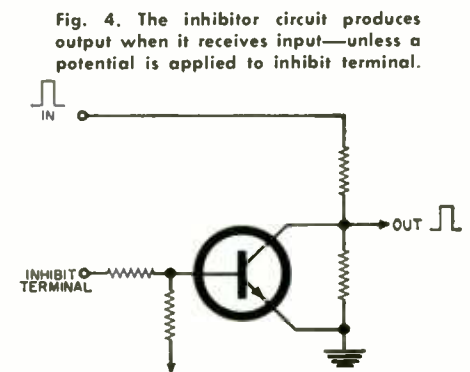


Fig. 4. The inhibitor circuit produces output when it receives input—unless a potential is applied to inhibit terminal.

# Symbols for Symptoms

By WAYNE LEMONS

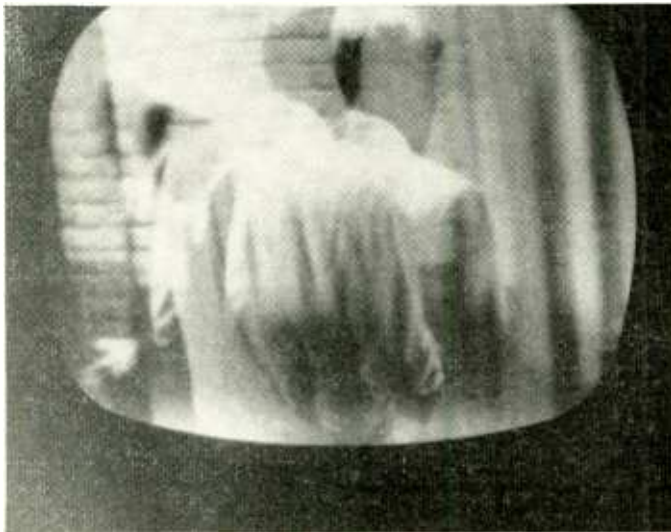
small sticker on the back of every TV set that came into the shop. It has room to write the customer's name, the date, and the trouble. This gave us many advantages. For example, let's say that a set we worked on is brought in again by the customer. We can't recall his name right at that moment, but a quick glance at the sticker (while we are maneuvering the set and engaging him in conversation about the weather) enables us to impress him with the fact that we remember him. This always helps. In the second place, we know for certain when we last worked on the set. This saves no end of trouble when it comes to warranties, complaints that "you just worked on it and it still isn't right," and other matters.

Finally, a specific notation as to the

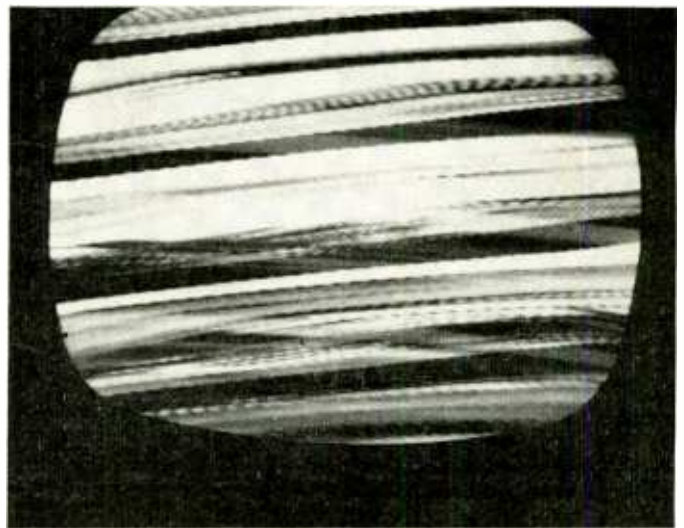
could memorize the entire code reliably. Constant reference to a wall chart for the code would be distracting to technicians and customers. Besides, if someone happened to jot down a wrong digit, there would be no way of knowing this or determining what number should have been written down instead. The code had to use symbols that had meaning, so that it could be remembered almost automatically. This would tend to eliminate errors and make them easier to correct.

We think the alphabetical system presented here fulfills our requirements nicely. After extensive use, we have yet to find a trouble that it cannot cover (although, of course, we are not covering any bets).

Six of the thirteen letters used are



AWP4



ANHY

EDITOR'S NOTE: On first reading, the author's scheme struck us as being wild and improbable. Second reaction: some plan of this sort would be useful in any shop, but we know all too many where this particular one would collapse in a week. Final decision: each shop owner might have to work out his individual variation of the system—but the author's version, which works for him, is as good a starting point as any for a worthwhile method.

**E**VERY SHOP must have some way to note and record the trouble symptoms for which a TV set is brought into the shop. There are many reasons for doing so, not all of them obvious. For one thing, it will clearly prevent anyone from overlooking the primary complaint with which the set was brought in. This "oversight" is far from unlikely, especially when a tough set with more than one defect or intermittent symptoms is on the bench.

Unfortunately, writing out the complete symptoms on a shop ticket is time-consuming. Thus a harried technician might not do a thorough job or he might omit the chore altogether.

Some years ago we decided to put a

trouble lets the technician who handles the set on the bench (and who need not be the one who brought the set in or took it when it was brought in) know exactly where he stands. It also "forces" the person who takes the set to listen to and digest the customer's complaint carefully, usually picking up the sort of helpful information that can help us do a better job.

Everything was fine—except that the stickers just didn't have enough room for the complete story. A bigger sticker would be too conspicuous. Besides we sometimes had trouble interpreting our own scribbles, let alone make them understandable to someone else. It soon became apparent that we would have to develop some kind of a code. It would have to have brevity to fit on the sticker. It would also have to be clear, simple to use, and certainly understandable to all of us.

The first thought was to use numbers arbitrarily to represent symptoms, but there were obvious disadvantages. With so many possible symptoms, nobody

adjectives or descriptive words to clarify the nature of the trouble. The other seven suggest portions of the TV set in which the symptoms exist or appear. Where difficulty occurs only on one or more than one channel, corresponding numbers are used, but no other use of numbers is made. The complete code appears in Table 1. In every case, there is enough connection between the letter and the idea it represents to make remembering easy.

The descriptive letters include *B* for Bending, *D* for Distorted, *I* for Intermittent, *N* for No, *W* for Weak, and *Z* for Noisy or Snowy. Note that all letters used except *Y* and *Z* are the initial letters of the words for which they stand. *Y* is for Sync and *Z* is for Noisy. These two symbols warrant some explanation.

Why not use *S* for Sync? We did for a while, but found it was leading to confusion. It was sometimes taken to mean Sound, Sweep, or Snowy. However, since *Y* is the second letter in Sync rather than the initial, it is easy to re-



member. *N* could not be used for Noisy, because that letter already stands for No. However, if you think of the familiar cartoon depiction for a snoring (noisy) man, which is Z-Z-Z-Z, there is no problem. Or else you may wish to think of a phonetic spelling, *noy-Z*.

Our experience has shown that the best way to write the trouble symptom is to note first the portion of the TV set that is *not* giving trouble, wherever possible. This is followed by a coded notation describing the symptom itself or the portion of the set where the trouble is suspected. This is not as complicated as it sounds, as you will see from some examples.

Suppose a set comes in with a good picture but no sound. You write *PNA* for picture OK but no audio. You

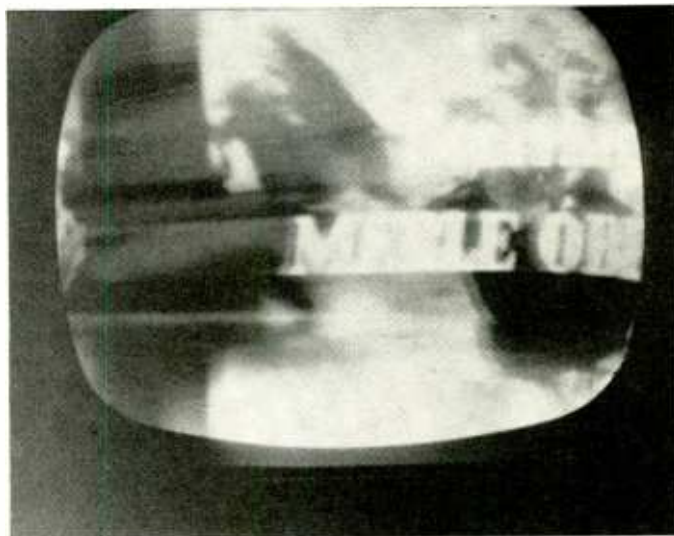
might try to cover the copy and successively uncover the "translations" only after you have tried to interpret each one yourself: *NAR* = no audio or raster (dead set). *ANV* = audio, no vertical (deflection is understood). *ANVY* = audio, but no vertical sync. *AZP* = audio, but noisy (snowy) picture. *PIA* = picture, but intermittent audio. *AIR* = audio, but intermittent raster. *ABP* = audio, but bending picture.

The use of the word "Bending" requires some additional explanation. In the case of a picture or raster, it could mean 60- or 120-cps hum. To represent audio hum, we cannot use *H*, since this already means Horizontal. Thus *B* will stand for hum whenever it is used with reference to audio. For example, *PBA* would mean the picture is OK, but there

Streamline your bench work, prevent servicing errors, and keep your customers happy with this orderly method for making a record of all complaints and defects. It has been time-tested in a successful shop.



ADV



AWHY

would write *PWA* for picture OK with weak audio. What if picture and sound were both weak? In this case, you might skip noting that any portion of the set is not giving trouble, but you would start the notation with one of the six descriptive letters—*WAP* for weak audio and picture. Suppose you had no video (picture) but there was a raster and sound was weak. You write *RNPWA*—raster OK, but no picture and weak audio.

To help you pick up the knack, additional examples of the code follow. You

is hum in the sound. As a final exercise in translating code into English, try this: *AP3NAP10*. Puzzling? Well, it might help to know that the two active channels in the service area are 3 and 10. So the symbols simply mean audio and picture (OK) on channel 3, but no audio or picture on channel 10.

Now let's reverse the procedure. Try to put this fairly complicated symptom into code: there is no vertical deflection and the sound is weak, but the customer also says that the horizontal hold was critical before the set went out. What

do we have? We have a raster (light on the screen, even if it's only a thin line), so we put down *R*. We follow this with *WA* for weak audio and *NV* for no vertical deflection. Then we add *WHY* for the customer's mention of weak horizontal sync. Translated back, *RWANVWHY* becomes, "Raster, but weak audio, no vertical deflection and weak horizontal sync." A complicated fault reduced to eight letters.

Try a few of the recent symptoms you have run into. You'll see how easy it is to master the code and teach it to others. There is another important advantage in adopting it. Putting the complaint into "shorthand" compels you to interpret the customer's complaint logically, so that you're much more likely to get it straight. You can't reduce the symptoms to code unless you understand them yourself. You'll find yourself asking the customer much more intelligent and useful questions. You'll not only know what his complaint is, but also (and often just as vital) what it isn't.

Table 1. Put any fault into "shorthand" with these 13 letters plus channel numbers.

LETTER	MEANING	LETTER	MEANING
A	Audio	R	Raster
B	Bending (or hum in audio)	U	U.h.f.
D	Distorted	V	Vertical
H	Horizontal	W	Weak
I	Intermittent	Y	Sync
N	No	Z	Noisy (or snowy)
P	Picture (video)	2, 3, etc.	Channel numbers

# R-C BRIDGES:

## Operation and Repair

By DAVID R. ANDERSON

Popular service versions use similar circuitry.  
Troubleshooting procedures are also similar.

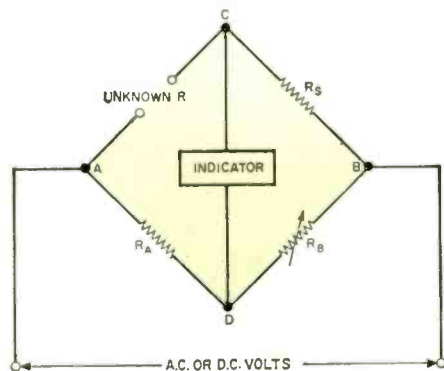
THE R-C BRIDGE, a useful test instrument in the well-equipped shop, has at least one thing in common with other test gear: it may break down. When this happens, although the bridge is not a familiar unit to work on, there is no reason that the owner cannot fix it himself.

The first step in approaching the fault is an understanding of operation and the roles played by specific circuit sections and components. To this end, a simplified diagram of a resistance bridge is shown in Fig. 1.

Assume that, when an unknown resistor is connected where shown, the ratio between its value and that of  $R_s$  is the same as the ratio between  $R_1$  and  $R_2$ ; that is, unknown  $R:R_s = R_1:R_2$ . A voltage applied across points A and B will appear across each series pair of resistors. If the two resistance ratios noted are indeed equal, then voltage division across the upper series pair will be the same as that across the lower pair. Thus the voltages at points C and D will also be equal, and there will be no potential difference across the meter or other indicating device.

In practice,  $R_2$  is made variable so that it can be adjusted for a zero read-

Fig. 1. Basic resistance bridge circuit.



ing or null on the indicator for different values of unknown resistance, and the dial on its knob is calibrated to give readings for the value of the unknown. Also, for indication over a wide range of values, a switch selects different range-

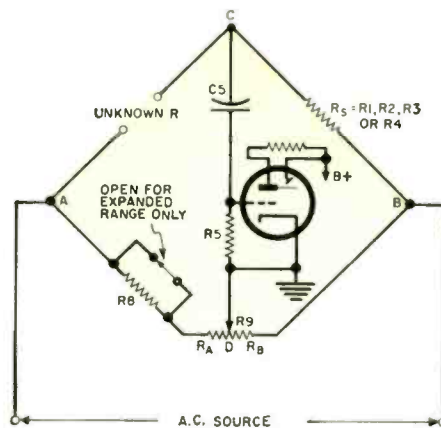


Fig. 2. Typical resistance-measuring circuit used in a commercial bridge.

setting resistors for  $R_s$ . In most commercial R-C bridges, an electron-ray or eye tube is the null indicator (Fig. 2) instead of a milliammeter or voltmeter, because of the tube's low cost and convenience.

The electron-ray tube, a sensitive device that causes very little circuit loading, enables a high degree of accuracy. And, since it can also rectify, a.c. may be used as the test voltage. This makes it possible to measure capacitance too. The only necessary circuit change is the substitution of a range-setting capacitor for  $R_s$ .

Another refinement in Fig. 2 is the grounding of one side of the indicator—in this case, the tube's cathode—to give the instrument greater stability. Also,  $R_1$  and  $R_2$  are both made variable, in the

form of  $R_s$ , greatly increasing range and sensitivity.

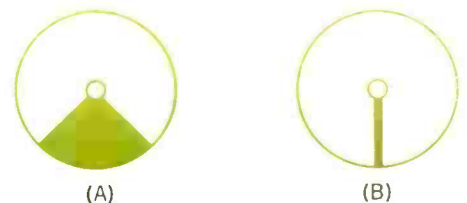
To understand the eye tube's function as a null indicator, assume we are checking the value of an unknown resistor on the bridge of Fig. 2. The unknown is connected where shown. The bridge will probably be unbalanced and the eye tube will be closed, as shown in Fig. 3B.  $R_2$  is then rotated until a null is indicated by maximum eye opening (Fig. 3A).

With the bridge unbalanced, the eye is closed because there is a voltage difference between points C and D of Fig. 2. This a.c. voltage, proportional to the unbalance of the bridge, is fed to the grid through  $C_5$ , then rectified and filtered by the grid,  $C_5$ , and  $R_7$ . The resultant d.c. bias voltage is also proportional to the unbalance of the bridge. When this negative bias is high, the eye of the tube is closed.

As  $R_2$  is rotated toward balance, the voltage difference between points C and D is reduced. This, in turn, causes the grid bias to become less negative and the eye begins to open. With balance achieved, bias voltage is at a minimum and the eye is fully opened.

Changing the value of  $R_s$  to  $R_1$ ,  $R_2$ ,  $R_3$ , or  $R_4$  changes the range over which the bridge operates. There are several ranges to be found in all commercial instruments, including what is known as an expanded range. On the expanded range,  $R_2$  is switched in series with  $R_1$ .

Fig. 3. Indicator tube with (A) bridge balanced (eye open) and (B) eye closed.



(part of  $R_9$ ) in one arm of the bridge to do just what the name implies: increase the highest range of the instrument.

### Capacitance Measurements

The operation of the capacitance bridge, shown in Fig. 4, is essentially the same as that of the resistance bridge. There are, however, a few differences to be noted. First and most obvious is that capacitor  $C_8$  is used to set

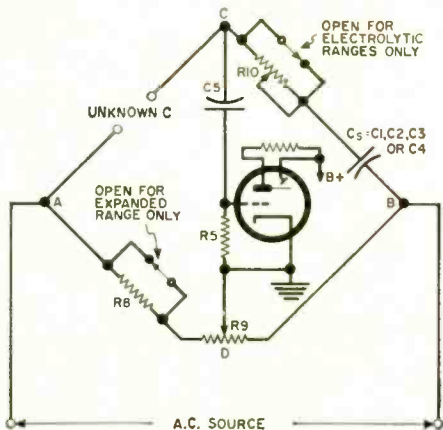


Fig. 4. How bridge measures capacitance.

the range in place of resistor  $R_8$ . Also, when measuring the capacitance of an electrolytic unit, it is necessary to switch potentiometer  $R_{10}$  into the circuit.

$R_{10}$  is necessary to balance out the large leakage resistance of an electrolytic capacitor. It must be adjusted, along with  $R_8$ , to obtain a true null.  $R_{10}$  is usually calibrated in percentage of power factor, which gives a good indication of the condition of the capacitor being measured. In general, a unit with a power factor larger than 15 per-cent should be discarded.

In addition to the bridge circuits, most instruments incorporate a circuit for testing the leakage resistance of capacitors. An example of such a circuit is shown in Fig. 5.

The capacitor to be tested for leakage is connected to the test jacks, and potentiometer  $R_{11}$  is set to the working voltage at which the suspected unit is rated. If the capacitor is leaky, some of the applied negative voltage will be passed to the grid of the electron-ray tube, and the eye will tend to close. If no leakage is present, the capacitor will block any d.c. voltage from reaching the grid of the tube, and the eye will remain open.

The sensitive circuit, shown in Fig. 5A, is used when paper or mica capacitors are being measured for leakage. However, when electrolytic capacitors are being checked, less sensitivity is desirable because of the relatively large leakage resistance normal for this type. To cut down the sensitivity an additional resistor ( $R_{12}$ ) is shunted across grid resistor  $R_5$  in Fig. 5B. Under this condition, a small voltage at the grid of the tube will not develop enough bias to close the eye of the tube. Only when leakage exceeds the normal value for an electrolytic will the developed bias begin to close the eye.

A d.c. power supply that is capable of supplying "B+" for the positive electrodes of the electron-ray tube and a high d.c. voltage for the leakage test is necessary. An example of such a supply is shown in Fig. 6. It consists of a half-wave rectifier and an appropriate filter network. "B+" for the positive electrodes of the eye tube is taken from the cathode circuit, while the high d.c. voltage for the leakage test is taken from the plate circuit of the rectifier.

Also necessary is an a.c. source for operating the bridge, to be connected across points A and B in Figs. 1, 2, and 4. The 50-volt transformer secondary, shown in Fig. 6, supplies this voltage. Resistor  $R_8$  provides safety by limiting current flow to the bridge.

### Troubleshooting

When a failure in this test instrument develops, the first step in determining the cause is to divide the entire unit into functional sections. Based on an understanding of operation, such a division enables a quick determination of the section likely to be at fault. Thus troubleshooting may be confined to a relatively limited area, instead of becoming a hit-or-miss procedure.

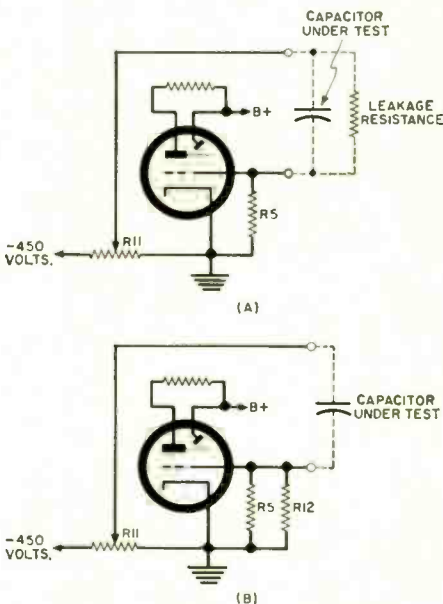


Fig. 5. Capacitor leakage tests for (A) low-value and (B) electrolytic units.

The four basic sections are the resistance bridge, the capacitance bridge, the leakage test circuit, and the power supply. For our purpose, it is not important that certain elements are common to more than one section. In fact, this can be helpful in isolating the problem. For example, examination of the built-in indicator can assist greatly in localization. Let us assume, to illustrate, that the instrument gives normal indications on all capacitance ranges and all resistance ranges but one.

The power supply and the capacitance bridge must be operating normally for such indication to occur. The leakage test circuit, which is not likely to affect the operation of the bridge cir-

cuits, can be kept out of consideration. The defect appears to be in the resistance bridge. An examination of Fig. 2 suggests that the only component that could be involved in this trouble is the range-setting resistor for the defective range—unless the latter happens to be the expanded range, in which case  $R_8$  might also be involved.

The same reasoning would apply if the capacitance bridge failed to operate on one range only. The only exception would be when the defect appeared on the range (or ranges) used for checking electrolytic capacitors. In this case,  $R_{10}$ , the power-factor control shown in Fig. 4, must also be checked for an open or short.

Now, let us assume the eye gives no indication on any bridge range, that is, it remains open no matter what resistance or capacitance range is used, and varying  $R_8$  has no effect on the eye.

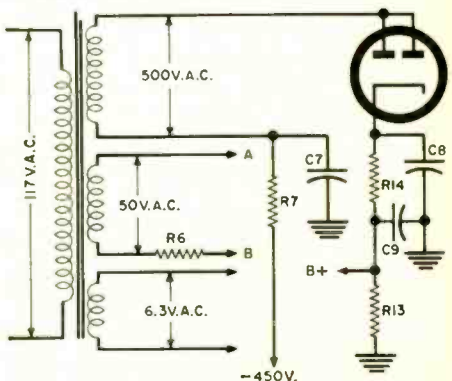
Here again, by observing the eye, we can eliminate a number of components from suspicion. If it is lit, the "B+" supply must be working and we can eliminate it from suspicion. Also, the range-setting resistors and capacitors may be disregarded, since each one is used on one range only and the defect is common to all ranges. The leakage test circuit, of course, does not enter into bridge operation, and it may also be disregarded.

This leaves only those components that are used for all ranges of both bridge sections. As can be seen from Figs. 2 and 4, these are  $R_8$ ,  $C_8$ ,  $R_9$ , the electron-ray tube, and the a.c. source.  $R_8$  and  $R_9$  may be quickly checked with an ohmmeter.  $C_8$  and the tube are best checked by substitution. The a.c. source may be checked with a voltmeter.

With trouble in the leakage section only, the negative high-voltage should be checked first. If it is present, the other components may be checked with an ohmmeter. If it is absent, the power supply is checked in a conventional way.

An important point to consider is that the various sections of the instrument are, of necessity, connected together through switches. These can develop such defects as open, intermittent, dirty, or broken contacts. Since switching in most commercial bridges is important, a visual inspection of the contacts is recommended as the first troubleshooting step. It may save much later time and effort.

Fig. 6. Common R-C bridge power supply.



# "Filing" System for Parts

By J. O. PAINE

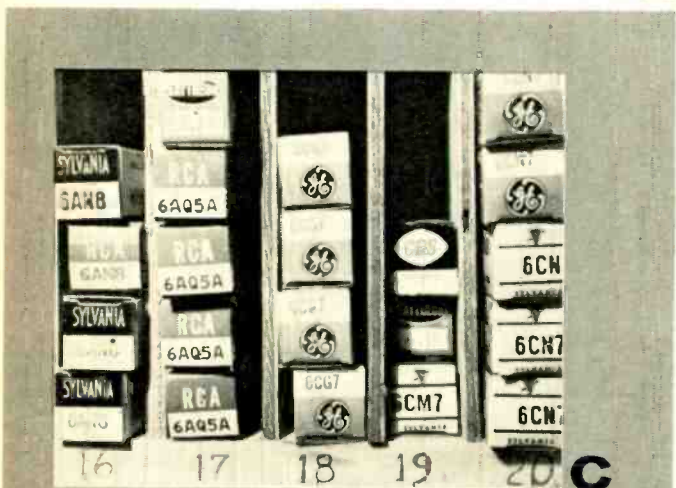
Replacement components are at your fingertips with this tested method.



A

B

6A38	3B-5	6C86	1B-2	6Y6	4C-17
6AT6	3B-3	6C86	1A-6	6Z4	2E-1
6AT8	2B-19	6CE5	6BC5-2B-5	7AU7	3B-14
6AU4	2A-2	6CP6	2B-12	7C5	4D-16
6AU5	3A-4	6CG7	1B-18	7C6	4E-2
6AU6	3A-4	6C88	1B-21	7N7	4E-5
	1B-13	6CL6	1B-22	8A8B	4B-12
6AV5	2A-9	6CL8	4B-9	8B65	1E-5
		6CM6	4B-7	8CG7	4B-14
				8CS7	1E-7
				8CX8	4B-13



C



D

CAPACITORS, Ceramic, 1000W.V. M M F		Resistors 1/2 Carbon			
		Value	File	Value	File
5	50A-Q75	4.7 <sup>o</sup>	A1-1	68 K	B2-5
10	50A-Q1	6.1	A1-1	82 K	B2-6
15	50A-Q15	10	A1-1	100 K	C4-4
22	50A-Q22	12	A1-1	120 K	B3-1
33	50A-Q33	15	A1-1	150 K	B3-2
39	50A-Q39	18	A1-1	180 K	B3-3
47	50A-Q47	22	A1-5	220 K	C4-5
50	50A-Q50	27	A1-6	270 K	C4-6
68	50A-Q68	33	A2-1	330 K	B3-4
		39	A2-2	390 K	B3-5

E

SHORTLY after he opened his TV service shop in Moultrie, Ga., several years ago, Howard DeLaughter learned an important fact: the accumulated time spent looking for replacement parts can take a big bite out of profits. Five unnecessary minutes spent trying to locate a new tube or capacitor, repeated several times a day, had the effect of taking quite a bit of cash out of the register per week.

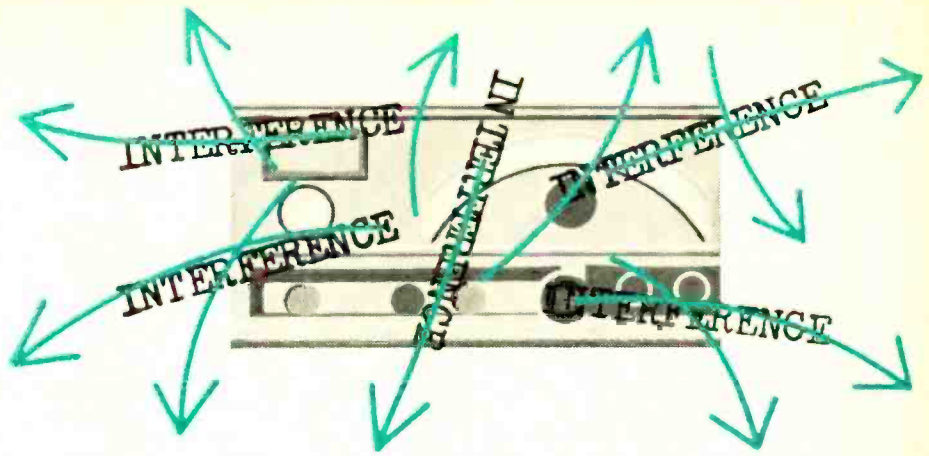
This, plus the fact that DeLaughter is an orderly sort of person anyhow, led him to devise a system for "filing" tubes and small parts. As a result, he says that a new resistor is generally installed in a set in his shop in less time than it would take a technician to find the item in some other establishments. In use for nearly four years, the technique has proved itself not only with tubes and conventional parts, but with the steady flow of new items.

Tubes are stacked in shelves located above and within easy reach of the work benches that line one wall at Ray & DeLaughter TV Co. Stacks are separated (Fig. A) by vertical boards of thin plywood. Each of the five shelves is assigned a letter beginning with A (bottom shelf) and working up to E. Each group of shelves is also assigned a number (section 1, shown in Fig. A, is indicated by the "1" at the top of the photo) and, on each lettered shelf within the group, individual stacks are numbered, from left to right.

The order in which tube types are assigned to various compartments does not have to follow any pattern. This makes it simple, as each new tube comes on the market, to stock it in the very next unoccupied compartment. However, its shelf location is listed on the index chart to the left of the tube shelves, mounted on hinges.

This is how the system works: a technician needs to replace a 6CG7 just found to be defective. He goes to the index, which lists all tubes in conventional numerical-alphabetical order, and finds 6CG7 (Fig. B). Reading across, he finds "1B-18" next to it. This means if he goes to section 1 and sights along shelf B, he will find the type he wants in compartment 18. Fig. C is a detail showing this location.

(Continued on page 127)



# Reducing Transmitter Interference

## Part 1. Harmonics & Spurious Signals

With increasing use of the radio spectrum by police, industrial stations, taxis, hams, and CD, transmitter originated interference must be eliminated. Here are some very practical ways of accomplishing this.

By **JAMES G. ARNOLD**

Surface Communications  
 Defense Electronic Products  
 Radio Corporation of America

**T**RANSMITTERS that do not generate unwanted signals simply do not exist. Unless specific effort is made to reduce these undesirable signals, a transmitter will become a source of radio interference. It is important to every transmitter operator to avoid this situation. It is no secret to the ham operator that once he has been designated as the cause in a single case of interference, he automatically becomes the perpetual community scapegoat. From an over-all point of view, each interfering signal is equivalent to the firing up of an additional transmitter, and eventually all radio spectrum users must suffer from this unnecessary congestion.

While these undesired signals are never absolutely eliminated from a transmitter output, they can be and should be reduced to a level that will not be sufficient to affect even the nearest receiver. Very little, other than conscientious effort, is required to achieve this.

### Harmonics

The most common form of interference generated in a transmitter is harmonics. Harmonics are always gen-

erated in the power amplifier of a transmitter. Harmonics in a power amplifier are produced in precisely the same manner as distortion in an audio amplifier. Tube non-linearity is the culprit. In the case of a power amplifier in a transmitter, however, the tube is purposely operated in a most non-linear fashion in order to achieve a reasonable efficiency. Since it is seldom practical to generate r.f. power with a class A amplifier, the power amplifier in a transmitter must be permitted to generate harmonics. The reduction of harmonics must then be accomplished between the plate of the power amplifier and the radiation of the signals into space. This generally means, as in the transmitter shown in Fig. 1, that the harmonic reduction must be made in the power-amplifier plate circuit, the output coupling circuit, the transmission line, and the antenna.

The power-amplifier plate circuit is extremely important in the reduction of harmonics and the really important characteristic of the circuit is the loaded "Q." The "Q" is a primary consideration in any coil. It is defined as the ratio of inductive reactance to the coil resistance:

Table 1. Design parameters for the construction of practical low-pass filters.

CUT-OFF FREQ. (in mc.)	LINE IMP. (ohms)	L <sub>1</sub>			L <sub>2</sub>			L <sub>3</sub>			C <sub>1</sub> (μμf.)	C <sub>2</sub> (μμf.)
		L (μhy.)	No. of Winding Turns	Type	L (μhy.)	No. of Winding Turns	Type	L (μhy.)	No. of Winding Turns	Type		
6	51	1.45	13	2	2.17	19	2	2.71	23	2	300	1000
6	72	2.03	17	2	3.07	25	2	3.82	30	2	220	750
12	51	.72	12½	1	1.08	11	2	1.35	12	2	150	510
12	72	1.02	10	2	1.54	14	2	1.91	17	2	110	360
23	51	.38	7	1	.57	10	1	.71	12	1	82	270
23	72	.53	9½	1	.80	13½	1	.99	16	1	56	180
55	51	.16	3½	1	.24	5	1	.29	6	1	33	110
55	72	.22	5	1	.33	6½	1	.42	8	1	24	82

Winding Type 1: #16 AWG copper wire wound on standard ½-13NC-2 screw.

Winding Type 2: #16 AWG enameled copper closewound on ½" dia. Bakelite tube.

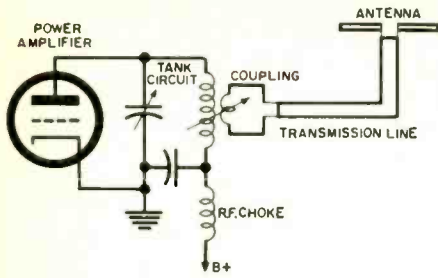


Fig. 1. Typical power-amplifier circuitry.

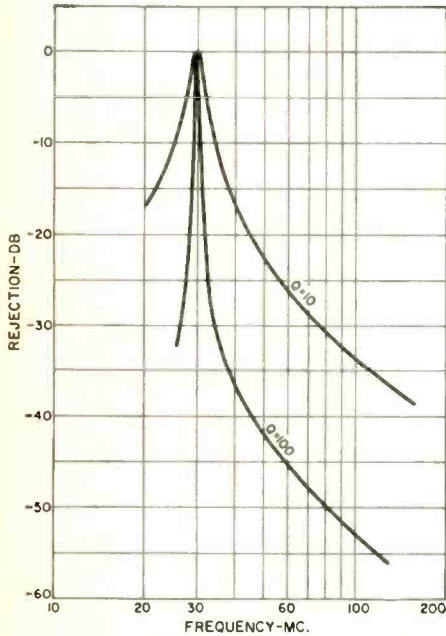


Fig. 2. Response with two values of "Q."

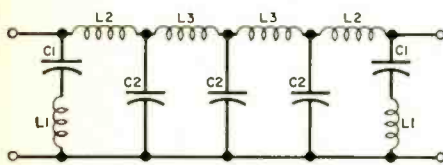


Fig. 3. Circuit for the low-pass filter.

$$"Q" = \frac{6.28 fL}{R}$$

where  $f$  is the operating frequency in megacycles,  $L$  is the coil inductance in microhenrys, and  $R$  is the effective series resistance of the coil. In the case of a power amplifier such as that shown in Fig. 1, the load resistance and the plate resistance of the tube are in parallel with the tank circuit, and are equivalent to a resistance in series with the coil. The lower these resistances are, the greater will be the effective series resistance.

In the case of a parallel resonant circuit that is heavily loaded by an antenna, "Q" equals the value of the parallel load resistance divided by the reactance. Here the "effective Q" increases as reactance decreases. Hence, the tank circuit must have a large capacitance and a small inductance (high  $C/L$  ratio) in order to have a reasonably high "Q."

The "Q" of a power amplifier circuit can also be described as the operating frequency divided by the bandwidth:

$$"Q" = \frac{f_0}{f_1 - f_2}$$

where  $f_0$  is the operating frequency of the circuit and  $f_1$  and  $f_2$  are, respectively, the upper and lower frequencies where the power output drops to one-half the power output at the operating frequency. This is why a high "Q" circuit is important in reducing harmonics. The response of two tuned circuits is shown in Fig. 2. The db scale shows the amount of rejection by the circuit to any frequency injected into it. In the two cases shown, 30 megacycles has been selected as the operating frequency of the circuits. It is readily seen that the higher "Q" circuit rejects (or attenuates) both the second harmonic (60 megacycles) and the third harmonic (90 megacycles) by 20 db more than the low "Q" circuit. This, in terms of power output, means that the harmonic output of the low-"Q" circuit will be 100 times greater than the harmonic output signal of the high-"Q" circuit.

For the purpose of harmonic reduction, it would be best to couple the antenna transmission line very lightly to the power amplifier tank circuit, but since any coupling lighter than "optimum" will result in low efficiency and low power output, it is seldom practical to couple lightly. It is important to realize, however, that overcoupling will seriously degrade the "Q" of the circuit and therefore pass larger amounts of harmonic power into the antenna. By carefully coupling to the "optimum" point, a power amplifier will produce the minimum amount of harmonics consistent with good efficiency. While a pi-network is the most effective coupling means for reducing harmonics, a simple loop, as shown in Fig. 1 is a good coupling method for low harmonic output. Since it is an inductive coupling, the harmonics are not coupled in an optimum manner. At any rate, capacitive coupling should be avoided, since this gives greater coupling at the higher carrier frequency. A considerable reduction in harmonics can be accomplished by the use of a tuned coupling circuit. This is simply a tuning capacitor shunted

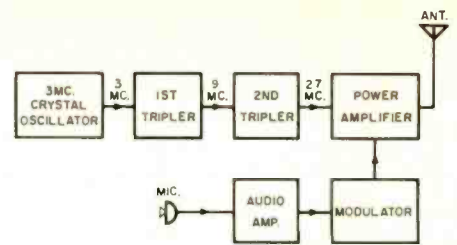


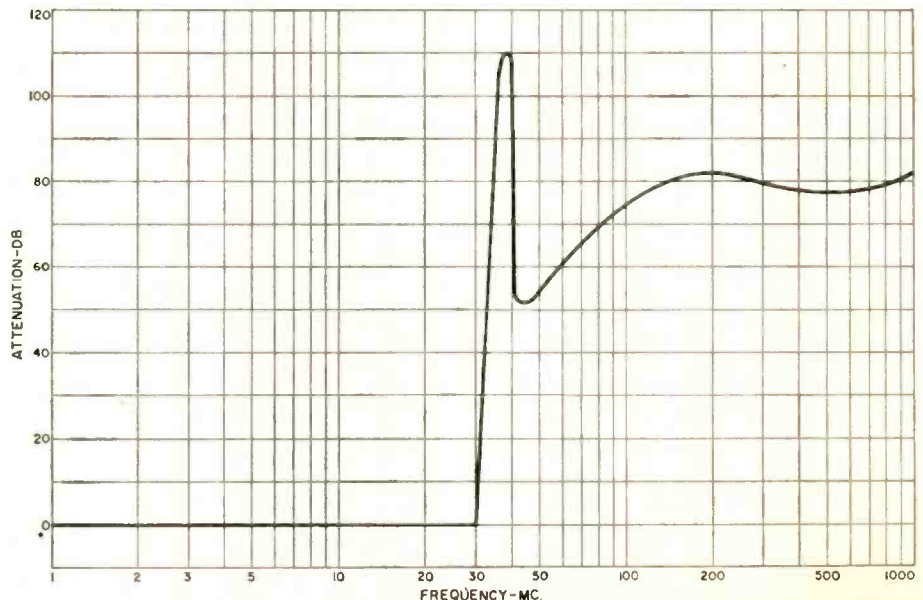
Fig. 5. Typical transmitter block diagram.

across the coupling loop, with the circuit resonated at the carrier frequency. This, in effect, adds another stage of selectivity in the path of harmonics. While it complicates the transmitter with an additional tuning adjustment, it is well worth the trouble.

The transmission line is slightly helpful in rejecting harmonics because the losses of the line are greater at the higher frequencies. From a practical standpoint, however, if the line were lossy enough to give any really significant reduction in harmonics, it would also be a very poor transmission line at the operating frequency of the power amplifier. Similarly, the antenna itself, being cut or tuned to the operating frequency of the power amplifier, generally provides a token amount of rejection at the harmonic frequencies. It is not, however, sufficient to insure that a harmonic-free signal will be radiated by the transmitter.

The best insurance against harmonic radiation is to insert sufficient rejection in the transmission line. Often, where specific cases of interference arise, a simple tuned trap in the transmission line is used to eliminate the particular harmonic that is causing the trouble. The author is vigorously opposed to this approach. In general, if a second harmonic is being radiated at a high enough level to cause interference, then the third, fourth, and higher harmonics are also being radiated at a troublesome level. The fact that the transmitter operator has received complaints only on the second harmonic may indicate that

Fig. 4. Over-all attenuation of the low-pass filter circuit discussed in the text.



there are no receivers in the area presently using the other frequencies, but it is more likely that the receiver users being interfered with on these frequencies have not yet determined who they should accuse of causing the interference.

### Low-Pass Filters

Where a power amplifier is operating over a band of frequencies, a low-pass filter is the most desirable way to achieve high rejection in the transmission line. The low-pass filter causes a very low loss up to its highest operating frequency, but is very lossy at higher frequencies. A typical low-pass filter circuit is shown in Fig. 3. A plot of the response of the circuit is shown in Fig. 4. The response shown is for a filter designed to operate below 30 megacycles. For any frequency below 30 megacycles, the filter cut-off frequency, the loss is very low. However, the filter should not be used below 15 megacycles since the second harmonic of lower frequencies would not fall in the region of high attenuation.

Several sets of values of inductance and capacity are given in Table 1 for the filter circuit of Fig. 3. The table lists values for building filters to operate

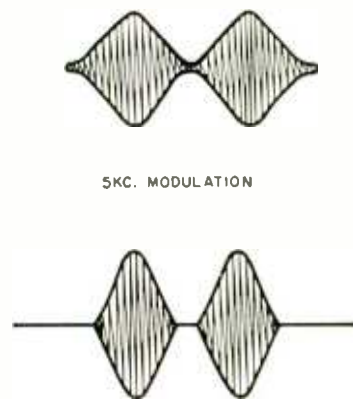


Fig. 6. Waveform and frequency spectrum for (A) proper modulation, (B) overmodulation.

over most of the amateur bands and, as indicated, for lines of 72- and 51-ohms impedance. Details for winding coils for various inductances are also given. In order to accurately wind the proper value of inductance, the windings for the smaller inductances are made on common screw threads. After winding, the coils are unscrewed from the form and are self supporting.

These filters should be constructed in a completely enclosed metal case. The slip cover type of aluminum boxes are widely available and are quite satisfactory. The input and output connectors should be installed on opposite ends of the longest side of the box. Coils  $L_1$  and  $L_2$  should be mounted at right angles to each other to avoid mutual coupling. Partitions should be installed to separate each of the series coils ( $L_2$ ,  $L_3$ ,  $L_4$ ,  $L_5$ ) but these need not be elaborate to be effective. Even without partitions, good results can be obtained if the filter is not constructed in too small a box. A

minimum length of 8 inches is recommended for the 6- and 12-megacycle filters and a minimum length of 6 inches for the 23- and 55-megacycle filters.

The power handling capability of the filter is limited by both the current and the voltage ratings of the capacitors. The standard 500-volt silver mica capacitors will be adequate for up to 200 watts through any of the filters. By using the CM-45 type micas, the 23- and 55-megacycle filters will handle up to 500 watts and the 6- and 12-megacycle filters will be adequate for a kilowatt. For a kilowatt into the 23- or 55-megacycle filter, variable air capacitors, such as the *Hammarlund* MC types, should be used. All the fixed capacitors should be of 5% tolerance.

While harmonics constitute the most common form of interference, these are by no means the only undesirable signals originating from a transmitter. The causes and methods of reducing these other types of interference will be discussed here and in Part 2.

### Spurious Signals

A spurious signal is usually defined as any undesirable signal other than harmonics of the carrier frequency which is emitted by a transmitter. In

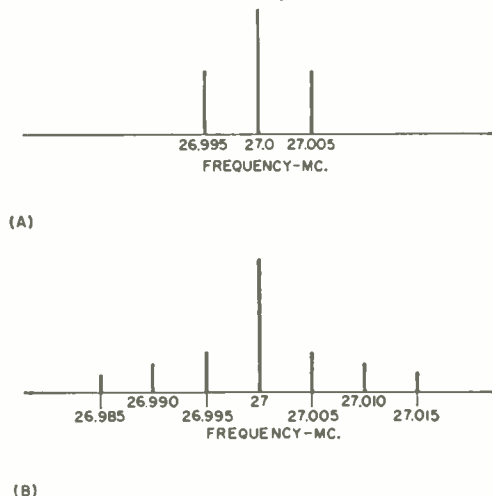


Fig. 7. (A) Output of first tripler. (B) Output of second tripler circuit.

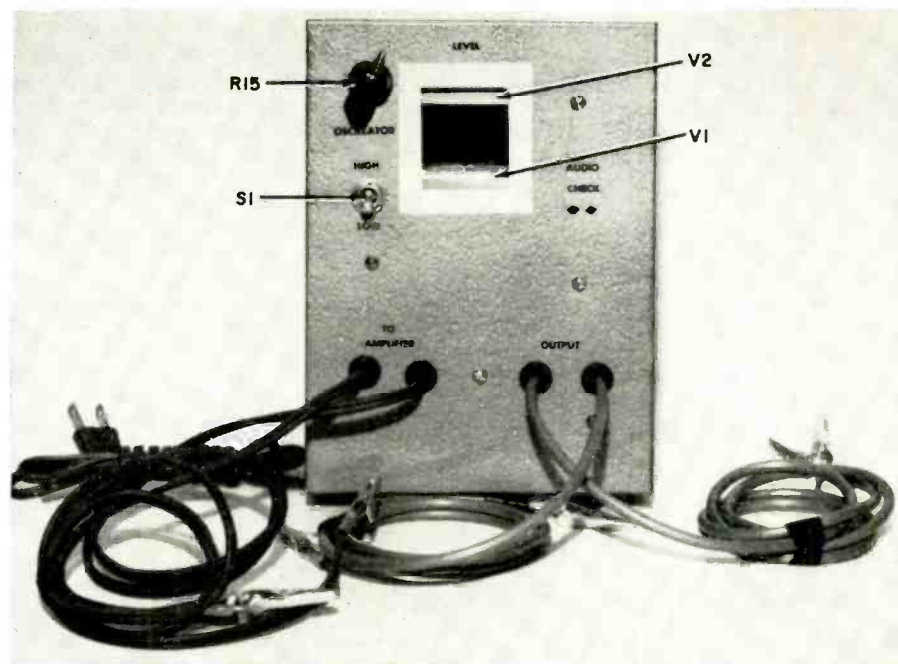
generation of spurious signals cannot be avoided. The important thing is to transmit a signal from the antenna that is free from spurious oscillations.

This should be accomplished by rejecting all unwanted signals at the output of each stage. This, of course, means high- $Q$  circuits. The response of two tuned circuits with  $Q$ 's of 10 and 100 is shown in Fig. 2. Reference to this figure will point out the importance of  $Q$ .

If all the circuits are high- $Q$ , many problems do not occur. For example, in the transmitter described, if the 3-megacycle signal is sufficiently rejected in the first tripler, there will be no 3-megacycle heterodyning in the second tripler. The 3-megacycle sidebands are much more difficult to reject in the second tripler output than is the 3-megacycle signal in the output of the first tripler.

The use of good coils in the tuned circuits is the first requirement for high- $Q$  circuits. It is also extremely helpful to use very light coupling between stages. The power output and efficiency of the lower level stages are not too important compared to the final stages, so that light coupling is practical in the low-level stages. The modulation can also cause spurious output frequencies. It is not news to any ham that overmodulation causes "splatter." This is simply a spreading out of the normal sideband spectrum. Fig. 6 illustrates the sideband spectrum for a properly modulated single audio tone and the spectrum for an overmodulated carrier. The audio component in the second case is distorted considerably and therefore the carrier is not only modulated with the fundamental audio tone but also with the

(Continued on page 115)



Front-panel view showing two tuning-indicator tubes horizontally mounted in window.

# The "Audio Check"

By JOHN POTTER SHIELDS

A simple tester that the audiophile can build checks proper stereo balance and provides audio test signals.

**H**ERE is a little tester that the audiophile will find very handy. It is capable of performing a number of useful and informative checks including:

(1) the visual indication of proper stereo balance by means of two of the new *Amperex* 6FG6/EM84 "wide-angle" tuning indicators. Each indicator is preceded by a stage of voltage amplification so that proper stereo balance can be checked back to the input of the amplifier. These "indicator-amplifiers" possess a very high input impedance, thereby eliminating any circuit-loading problems.

(2) The instrument provides a variable audio-frequency voltage which can be used as a steady-state signal source for simplified balance checking. The output impedance of this signal source is low (1000 ohms) thus simplifying low-impedance measurements such as checking the accuracy of balanced transformer windings.

(3) It offers a source of sharp sub-audio-frequency pulses which are useful for checking the transient response of both amplifiers and speaker systems.

All in all, this instrument will more than repay its small construction cost because of its versatility and simplicity.

### Circuit Details

Basically, the "Audio Check" consists of two sections: the indicator-amplifier section and the audio and sub-audio oscillator section. The indicator-amplifier section consists of two channels, each incorporating a 6FG6 indicator tube and half of a 12AX7. In operation, signals from the two stereo channels are applied through blocking capacitors  $C_5$  and  $C_6$  to the grids of the two halves of the 12AX7,

$V_{2A}$  and  $V_{2B}$ . The amplified signals appear at the plates of  $V_{2A}$  and  $V_{2B}$  and are coupled by  $C_7$  and  $C_8$  to two half-wave rectifiers  $CR_1$  and  $CR_2$ . Fairly high values of cathode-bias resistors are used for  $V_{2A}$  and  $V_{2B}$  in order to obtain large amounts of degenerative feedback, which tends to maintain constant stage gains of the two amplifiers as the tubes and components age. (See Fig. 1.)

The d.c. outputs from the diodes,  $CR_1$  and  $CR_2$ , are filtered by  $C_1$ ,  $C_2$ ,  $R_1$ , and  $R_2$  and applied as a control voltage to the control grids of the two indicator tubes,  $V_1$  and  $V_2$ .

The audio and sub-audio-frequency oscillator section consists of a modified relaxation oscillator made up of  $PL_1$ ,  $R_{11}$ ,  $R_{12}$ ,  $R_{13}$ ,  $C_3$ ,  $C_{10}$ , and the s.p.s.t. toggle switch,  $S_1$ .

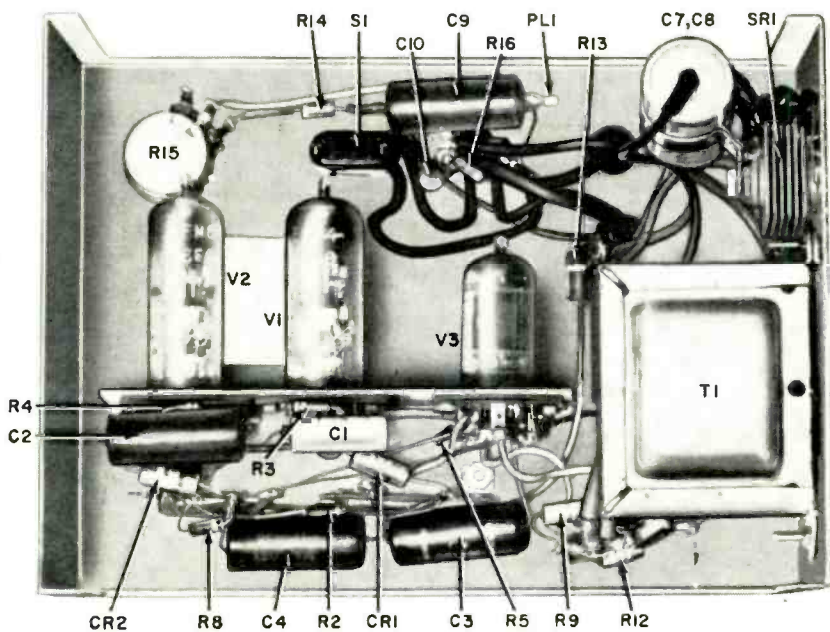
Operation of the oscillator is as follows: When voltage is applied,  $C_{10}$  charges through  $R_{11}$  and the frequency-adjust pot,  $R_{12}$  ( $S_1$  open). When  $C_{10}$  charges to a sufficient value,  $PL_1$  fires through  $R_{13}$ , producing a sharp pulse across  $R_{13}$ . This pulse is coupled through the blocking capacitor  $C_{11}$  to the "To Amplifier" pairs of zip cord, terminated in alligator clips. Unshielded zip cord is OK here due to the low impedance involved. When  $S_1$  is closed, additional capacity ( $C_9$ ), is added to the charging circuit. This greatly increases the  $RC$  time-constant of the oscillator, lowering its operating frequency to about 1 to 25 cps.

The power supply consists of a power/isolation transformer,  $T_1$ , in conjunction with a selenium rectifier,  $SR_1$ , and the two-section  $RC$  filter,  $R_{15}$ ,  $C_5$ , and  $C_6$ .

### Construction

The "Audio Check" was built into a





Under-chassis view. A few of the resistors are hidden under other components.

standard 8" x 6" x 3 1/2" chassis box. As shown in the photograph, a small aluminum angle bracket was used to mount the 6FG6 indicator tubes in the viewing position. In the interests of short leads, the 12AX7 was also mounted on the bracket. Although the cut-out for viewing the indicator tubes could have been made with a square chassis punch, the author used one of the "nibbling" tools to good effect. The finished unit was dressed up by applying decals after which the front panel was given a single coat of plastic spray.

Parts values are not particularly critical so your junk box can be raided to good advantage. For example, a 12AT7 or 12AU7 can be used instead of the 12AX7 with only a slight decrease in sensitivity. The values of the resistors and capacitors may vary as much as 25% without affecting circuit performance. Incidentally, the blocking capacitors  $C_5$ ,  $C_6$ , and  $C_{11}$  were added to the circuit after the photographs were taken.

### Operation

The "Audio Check" is simplicity itself to operate. As an example, to check the over-all balance of your stereo system, connect the two "Output" clip leads to the terminals of the instrument to the terminals of the two speakers. Connect the two "To Amplifier" clip leads to the inputs of the stereo amplifier and adjust the amplifier's stereo "balance control" until the illuminated bars in the instrument's indicator tubes are the same length. If desired, you can use a standard record, tape, or tuner program source for balancing; simply adjust the "balance control" for equal indicator-bar lengths. Although the bars will be fluctuating, they

are easy to see. The "Audio Check" can be kept permanently connected to the amplifier outputs without degrading the stereo system's performance. It can be quite an "eye catcher" as well as a useful adjunct to your hi-fi setup.

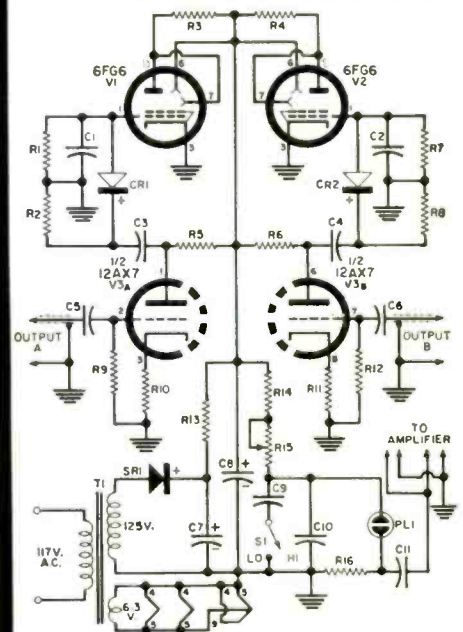
As mentioned earlier, the indicators have good sensitivity so that they can be used for checking balance back to the input of the amplifier. It should be mentioned that the output of the relaxation oscillator has been kept low (300 mv.) to avoid overloading any of the low-level stages.

The sub-audio-frequency output is useful in amplifier and speaker-system "hangover" checks. The "Audio Check" is connected to the system as previously described and  $S_1$  is slipped to the "Low" position. As in the "High" position,  $R_{13}$  is used to vary the frequency. If the indicator tubes "bounce back" rapidly after each pulse, it can be assumed that the system has good damping qualities. To check the amplifier without the speaker, simply connect a resistor of the proper resistance and wattage rating to the amplifier's output terminals and note the action of the indicator tubes. This is an excellent over-all check and is much more informative than aural checks, especially in A-B comparisons since the ear has a notoriously "bad memory."

By placing a simple ruled scale alongside the indicator tubes, the "Audio Check" can be used as a "poor man's a.c. vacuum-tube voltmeter." Such a device is handy for making relative-gain measurements.

That is all there is to the "Audio Check." Why not build one since it is a really useful addition to any audio-ophile's laboratory.

Fig. 1. Two shielded leads with clips on the ends serve as outputs A and B, and two clip-terminated zip-cord leads provide audio signals for testing your amplifiers.



- $R_1, R_2, R_3, R_8, R_{11}$ —2.2 megohm, 1/2 w. res.
- $R_4, R_5$ —170,000 ohm, 1/2 w. res.
- $R_6, R_7$ —150,000 ohm, 1/2 w. res.
- $R_9, R_{12}$ —220,000 ohm, 1/2 w. res.
- $R_{10}, R_{13}$ —6800 ohm, 1/2 w. res.
- $R_{15}$ —680 ohm, 1 w. res.
- $R_{13}$ —10 megohm linear taper pot
- $R_{14}$ —1000 ohm, 1/4 w. res.
- $C_1, C_2, C_3, C_5, C_9$ —1  $\mu$ f., 400 v. capacitor
- $C_4, C_6$ —.05  $\mu$ f., 400 v. capacitor
- $C_7, C_8$ —20/20  $\mu$ f., 150 v. elvc. capacitor
- $C_{10}$ —.001  $\mu$ f., 600 v. capacitor
- $C_{11}$ —.05  $\mu$ f., 600 v. capacitor
- SR1—65 ma. selenium rectifier
- S1—S.p.s.t. switch
- PL1—NE-2 neon bulb
- CR1, CR2—1N38, 1N58, 1N34, etc. crystal diode
- T1—Power trans. 125 v. @ 50 ma.; 6.3 v. @ 2 amps. (Stancor P.A.-8421 or equiv.)
- V1, V2—6FG6/EM84 tuning indicator tube (Amperex)
- V3A, V3B—V2-12AX7 tube

**I**N THIS age of missiles, u.h.f., microwave, radar, etc., there is one important branch of communications about which few people seem fully aware. As a technician for an electric power distribution co-op, the author often encounters a rather general ignorance about one of the interesting phases of communications work, namely power-line carrier (PLC) and telemetering.

If one takes a sensitive receiver close to a power distribution line and tunes between 50 and 200 kc., he will hear a weird assortment of whistles, pulses, clicks, vibrating tones, and speech. This all takes place over power-line carrier systems which are used in conjunction with most power distribution systems. Uses for PLC include voice communication, telemetering, supervisory control, teletypewriter, telegraph, and signalling. FM is usually used because of its immunity to noise, which can run quite high on 69-kv., or more, lines.

In order to investigate the application of such equipment, let's take a look at the system with which the author is most familiar. Power is generated and distributed through more than 1200 miles of 69-kv. lines extending over a large area in central Texas. At various points on these lines there are switching stations and distribution points, com-

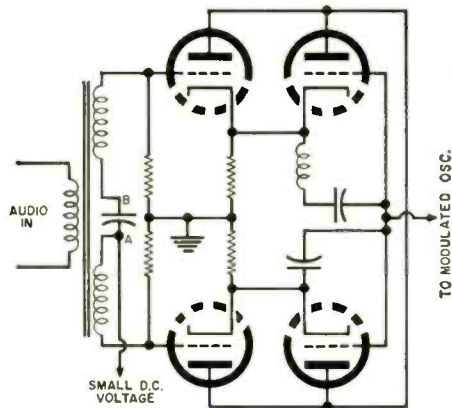


Fig. 1. Balanced reactance modulator used in power-line carrier communications transmitters. A d.c. voltage can be applied to either A or B to reverse frequency shift.

monly called substations. Key stations have PLC connections to a central dispatcher for directions to line personnel regarding switching, generation and voltage control, troubleshooting, etc.

There are four generating plants in the system with a possible peak of 110 megawatts at 69 kilovolts. All pertinent electrical information, including volts, megawatts, and reactive power, is telemetered. There are ties to other dis-

tribution systems which are also telemetered. The system includes eleven telemeter stations measuring twenty-eight quantities. Voice channels go to fourteen points in the system. Everything terminates at Whitney Dam where it is put on microwave and received at the central office in Waco, Texas. This is done because the home office is some 20 miles from our nearest power lines and dependable phone service is not available. The accompanying photos and diagrams should indicate how the system operates.

#### Equipment Employed

The equipment included in the system involves a 10-watt transmitter and associated receiver. Ten watts will give a good signal over about 125 miles of line with a signal loss of about .25 db per mile; more on higher frequencies and less on the lower frequencies. The sets are coupled to the 69-kv. transmission line through coupling capacitors which range from .001 to .005  $\mu$ f. (see Fig. 2). Obviously these won't do for subminiature circuit work as they weigh over 500 pounds and are about 4 feet tall! Series traps (Fig. 4) are inserted at terminal points to keep the line impedance high, to keep signal paths short, and to keep interconnected

**Power companies use their lines for voice communications, telemetering, and signalling. Here is how it is done.**

By R. H. MURRELL

Brazos Electric Power Co-op., Inc.

# Power Line Carrier Communications

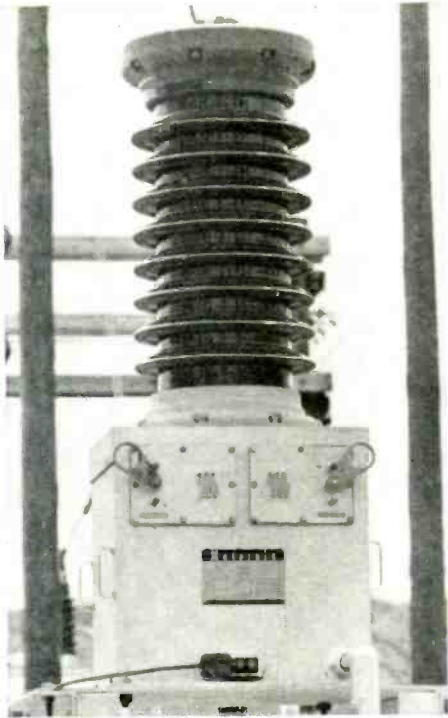


Fig. 2. This is a 69-kilovolt line-coupling capacitor. The unit is made up of a group of capacitors connected in series.

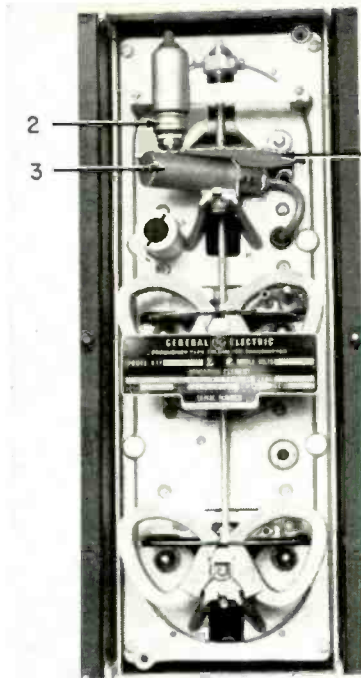


Fig. 3. Telemeter transmitter unit. The serrated disc (1) with associated light source (2) and photoelectric cell (3) can be seen as the top assembly on the shaft.

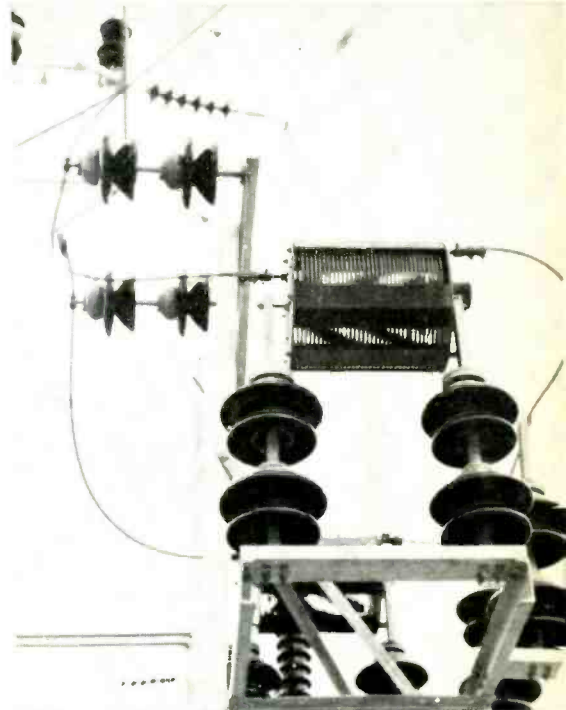


Fig. 4. Series traps used at terminals and at ties with other systems. These are 2 feet in diameter and carry up to 800 amps.

systems isolated at radio frequencies.

The receiver, which will be described for voice communication, is highly selective in the front end, having an input filter which is over 100 db down 20 kc. off center frequency. This is important due to a crowded spectrum in this band. The rest of the receiver is typical of good FM circuitry, including a squelch circuit and keying relay facilities. In addition, a frequency shift circuit is used to energize a ringing relay, this being done in the discriminator circuit. When the receiver is receiving its center frequency, discriminator output is, of course, zero. When a slightly shifted frequency carrier is received, the discriminator output swings from zero, rising in voltage as frequency swing increases. This voltage is applied to a control tube which draws plate current through a relay, causing a telephone to ring or actuate other devices.

The transmitter uses two 6L6 tubes operated class A as the plate amplifier feeding 10 watts into the line through an appropriate matching unit. A crystal

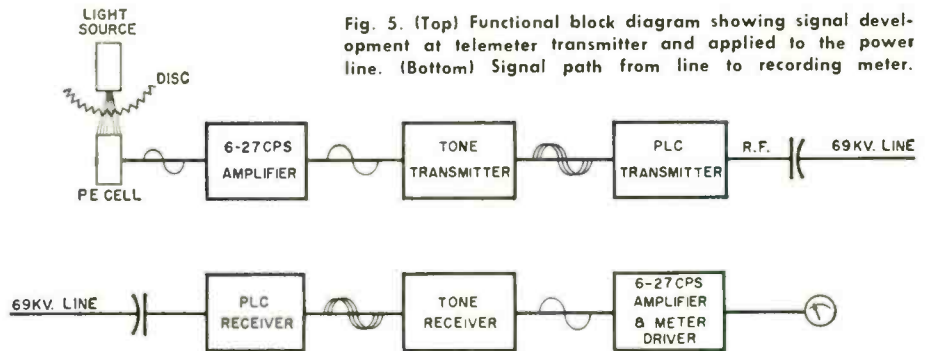


Fig. 5. (Top) Functional block diagram showing signal development at telemeter transmitter and applied to the power line. (Bottom) Signal path from line to recording meter.

oscillator and variable oscillator are beat to give the operating frequency. A balanced reactance modulator is used to give low distortion and close frequency control (Fig. 1). This type of modulator is sensitive to a difference in d.c. voltage on the grids so this feature makes it ideal for shifting the frequency by applying a small voltage to one grid. This shifts the frequency about 2 kc. which actuates the control relay in the receiver, as outlined previously.

Telemetry can be used to meter points anywhere in the system. The same type PLC transmitter and receiver is used as for voice. This can meter voltage, current, reactance, conditions such as "up-down," "open-close," "off-on," etc. Described here is electrical-quantity measuring equipment.

The telemeter transmitter consists of

a wattmeter (Fig. 3) with (1) an added serrated disc, (2) a light source, and (3) a photoelectric cell. As the wattmeter rotates, the teeth on the disc vary the light beam to the photoelectric cell, causing a sine wave to be developed across its load. This signal, ranging from 6 to 27 cps, is then amplified and used to frequency-modulate the tone transmitter which operates between 500 and 3100 cps. This FM tone then modulates the PLC transmitter which is coupled to the 69-kv. line (Fig. 5).

The PLC receiver takes the signal from the 69-kv. line. The audio output couples to the tone receiver which removes the high-frequency component. The remaining original 6-27 cps tone is then applied to the telemeter receiver where it is rectified and applied as a quantity to recording meters. As can be seen, this is a very complex system which contains frequency-modulated FM signals. This technique provides a high immunity to noise.

In addition to the features described, repeater stations may be used for long distance operation or microwave can fill in gaps where wire lines may not be accessible, such as is the case from Whitney Dam to Waco.

By JOHN T. FRYE



## Business Nobody Wants

THINGS were a little slow in the service shop. Christmas was over, everyone was broke, and income-tax-paying-time was already a low cloud on the horizon. Barney had spent all morning giving the service department a thorough cleaning, wiping and waxing the instruments, repairing frayed test leads, and putting the hand tools in order. Now he was perched on a high stool watching Mac, his employer, working carefully and gently on the printed-circuit chassis of a transistor receiver.

"You know something, Mac?" he finally said; "you're getting a reputation I don't envy a bit. In the last few months several people have remarked you're a real hot-shot on transistor sets. That's a compliment like having someone going around telling everybody you're a soft touch for a loan. I've a sneaking hunch some of our competitors are starting the nasty rumor because they don't want to fool with the exasperating, time-wasting, money-losing little sets. I don't blame the boys for feeling that way, but I think it's a nasty trick foisting the transistor jobs off on you. But you—you actually act like you enjoy working on the little cusses!"

Mac reflected a few moments before he answered: "Barney, for a long time now I've tried to keep from thinking about my work in terms of what I like to do and what I don't like to do. It all has to be done, and the less emotional you are about it the better. You can waste more energy dreading a job than it takes to do it.

"I guess I'm kind of simple minded, for it has always been easy for me to become interested in what I'm doing, whether that be running down a cause of audio distortion, curing a case of vertical jitter, stringing a dial cord, or even resuscitating a dead transistor set."

"But you can fix three a.c.-d.c. sets in the time it usually takes to locate trouble in one of these little transistor jobs that has been dropped—and most of them have been, whether the owner admits it or not," Barney pointed out. "Freeing components from the compact

printed circuit in order to test them is about six times as hard as it is in the uncrowded wired chassis of the tube receiver. Most transistor components are special jobs, difficult to obtain except from the manufacturer. It is practically impossible to keep a really adequate stock of replacement transistors without danger of being stuck with a lot of them that will never sell. There are a zillion types out already, and new ones are coming out every day. The new ones are better and quickly make obsolete the old ones. You can't charge on the same time-rate basis you use for a.c.-d.c. receivers, for the original cost of new transistor sets simply will not permit it. If the service charge becomes substantial, the owner simply junks the set and buys a new one. How do you square all that with your Scottish instincts?"

Mac's face crinkled into a grin as he replied, "Hoot, mon! I'll admit I wrestled with that one for quite a spell, and here's how I finally pinned it to the mat: I know I'm making less money working on transistor sets *now* than I could make working on a.c.-d.c. receivers, but I tell myself that part of the pay for the tedious transistor work comes in the way of valuable experience gained. The only reason I can turn out the little tube sets like hotcakes is that I've accumulated years of experience working on them. Little by little, day by day, I'm acquiring the same sort of experience with transistorized receivers. On the average, it doesn't take me as long to locate trouble with one now as it did a year ago. A year from now it will take less time. I'm beginning to know *where to look* for the causes of many symptoms, and that's how you gain speed in servicing."

Mac hesitated for a moment and then continued. "This will be hard for you to believe, but I can remember when many technicians felt the same way about a.c.-d.c. sets as a lot of fellows feel about transistor sets today. After working on the high-quality, roomy console receivers sold during the late 1930's, the boys felt it was quite a come-down to have

to work on the low-cost, comparatively crowded five-tube jobs. They spoke of them disparagingly as 'cracker-box' and 'punch-board' receivers and said you couldn't make any money working on them. After all, when you got a console set in for an overhaul, you usually replaced three or four tubes, several capacitors, and gave it a complete alignment job on all bands. The bill would often run twenty or thirty dollars, especially if you had to replace a power transformer or a dynamic speaker. This was as much as an a.c.-d.c. receiver cost.

"But after a while the smart boys discovered they could locate a bad tube in an a.c.-d.c. set and replace it while they were taking the back off a big console. What's more, the little receivers were harder on tubes. They made two or three trips to the service shop for every one of the console receivers. Most of the troubles with the little radios were easily diagnosed and quickly corrected after you became thoroughly familiar with them. They were easily handled, took up little room in the shop, and were usually brought in and picked up by the owner. You could actually make more money, easier, working on the little sets than on the big transformer jobs; and this was a good thing, for consoles were on their way out."

"And you think you see a parallel," Barney commented.

"That's right. It takes no great seer to predict the transistor receiver will soon become the most popular household radio. The smart technician, realizing this, will stop wasting energy disliking transistor receivers and start learning how to fix them fast."

"If I know you, you have some ideas on how to do that."

"Naturally; want to hear 'em?"

"Since when did I have a choice? I'm your captive audience. Go ahead."

"That's what I like: enthusiasm! Well, the first thing to do is to check the battery voltage *under load*, no matter if the customer assures you he has just installed new batteries. He may have purchased the batteries from a place with a low turn-over, and they may be half exhausted to start with. If they are even a little low, put in new batteries so that the proper source potential will be applied to the voltage distribution network."

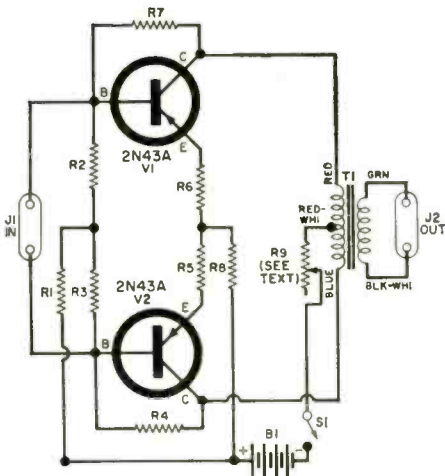
"You mean you can't expect to find proper voltages at the transistor terminals if the battery voltage itself is off."

"Right. If the radio is dead, or if all you can get out of it is a click when it is switched on or off, I suggest you next try the 'looking-and-tapping' technique. Look the printed circuit over carefully under a good light for any signs of cracks in the board or conductors or poorly soldered connections. An illuminated magnifier is very fine for this. Quite often you can spot a hairline crack in a conductor more easily by shining a light through the translucent board from the other side.

"If you can't see anything wrong, start a little gentle pushing, flexing, and tapping of the printed circuit board

(Continued on page 126)

# Transistorized Audio Line Amplifier



- R<sub>1</sub>*—10,000 ohm, ½ w. res. ±5%  
*R<sub>2</sub>, R<sub>4</sub>*—1,000 ohm, ½ w. res. ±5%  
*R<sub>3</sub>, R<sub>5</sub>*—16,000 ohm, ½ w. res. ±5%  
*R<sub>6</sub>, R<sub>7</sub>*—160 ohm, ½ w. res. ±5%  
*R<sub>8</sub>*—330 ohm, ½ w. res. ±5%  
*R<sub>9</sub>*—5000 ohm pot (see text)  
*S<sub>1</sub>*—S.p.s.t. toggle switch  
*J<sub>1</sub>, J<sub>2</sub>*—Banana jack, phono jack, etc. (optional with builder)  
*T*—Low-level audio output trans. 15,000 ohms c. k. to 500/600 ohm sec. (Triad A65J or equiv.)  
*B<sub>1</sub>*—22½ volt battery  
*V<sub>1</sub>, V<sub>2</sub>*—2N43A transistor

Circuit diagram of the balanced two-transistor audio line amplifier unit.

**T**HIS transistorized audio line amplifier, dubbed "Trans-Line" by the author, is particularly useful to the serious audio hobbyist, the public-address system service technician, and the broadcasting or recording studio engineer. It is a compact, battery-operated, highly gain-stable amplifier which can be used to boost low-level signals over a 600-ohm audio transmission line.

This versatile unit can be used between many types of preamplifiers or tuners to drive a wide variety of power-amplifier systems, or it can be used as a general-purpose preamplifier in applications where a fixed amount of dependable and constant amplification is needed.

Two inexpensive transistors, nine resistors, and a good quality audio transformer provide the "Trans-Line" with a frequency response that is ±2 db from 20 to 20,000 cps. It supplies from 3 to 10 times voltage gain, depending upon the supplied battery voltage. The line amplifier can handle a maximum input level of approximately 200 millivolts across the 600-ohm input impedance and delivers a maximum undistorted output of 1.5 volts across the 600-ohm output impedance.

## Circuit

The "Trans-Line" amplifier's uncomplicated circuit uses two 2N43A audio transistors arranged as a balanced amplifier to drive an output transformer in class AB operation. Resistors *R<sub>1</sub>* through *R<sub>7</sub>* provide shunt and series feedback for utmost stability, and the remaining resistors set the biasing and operating level.

The input signal is fed directly to each base from any low-impedance balanced or unbalanced source. Either base input



Front-panel view of the 600-ohm line amplifier, dubbed "Trans-Line" by author.

By **DAVE STONE**

**Build the "Trans-Line," a compact, battery-operated, highly stable amplifier that may be used to boost low-level audio signals over a 600-ohm audio line.**

can be grounded, as well as either side of the secondary output winding, and either output or input can operate as a balanced pair when the other side is unbalanced.

Resistor *R<sub>9</sub>* sets the voltage level applied to the transistors and, in turn, the amount of gain obtainable from the circuit. It can be either a fixed or a variable resistance, depending on the constructor's need for a fixed or variable gain amplifier. A higher applied voltage will produce higher gain at the expense of higher battery current drain. In the unit shown in the photographs, *R<sub>9</sub>* is 2000 ohms which allows 14 volts at 4 ma. drain for a fixed gain of 14 db or 5 times voltage gain.

Power is furnished by a standard 22½-volt battery which, for intermittent use, can be the miniature type shown mounted within the amplifier en-

closure. If the line amplifier is to be used for long periods of time, a larger battery can be used and mounted external to the unit. Note that the positive terminal of the battery is not connected to the chassis ground.

## Construction and Use

The resistors, transistors, transformer, and small battery are all mounted on a 4½" x 2½" perforated board which is fastened inside a 2" x 3" x 5" "Minibox" with small angle brackets. The power switch, *S<sub>1</sub>*, and the input and output jacks are mounted in one wall of the enclosure. There is absolutely nothing critical about the construction or layout so any enclosure or signal jacks can be used. If the constructor desires, the standard phono jack or phone plug with one permanently grounded side can

(Continued on page 96)

# A Sensitive Electronic Relay

By LOUIS E. GARNER

**Build this simple, reliable circuit that is so sensitive that a breath can operate it. Can also be used to make games, for industrial control, as intrusion alarm.**

**R**EALLY sensitive magnetic-type relays are expensive and delicate. In addition, even the most sensitive of electromagnetic relays requires that a comparatively low resistance be placed across the energizing contact terminals if sufficient current is to flow to close the relay.

An electronically operated relay, on the other hand, can be built quite inexpensively, while maintaining high standards of ruggedness and reliability of operation. With a comparatively simple circuit, an electronic relay can be made so sensitive that, quite literally, the human breath can be used to set it off.

The electronic relay shown in Fig. 1

uses only four resistors, one tube, one capacitor, and one inexpensive plate-circuit relay. The average technician should be able to assemble the entire unit in a few hours at a cost not exceeding ten dollars for materials. Irrespective of the simplicity of the circuit, this relay is so sensitive that the moisture condensation from the breath is sufficient to operate it. For example, in Fig. 1, the relay has been operated by a pencil line that has been drawn on a piece of paper.

A current on the order of microamperes is all that is necessary and thus any resistance between zero ohms and twelve megohms placed across its input terminals is enough to operate the unit

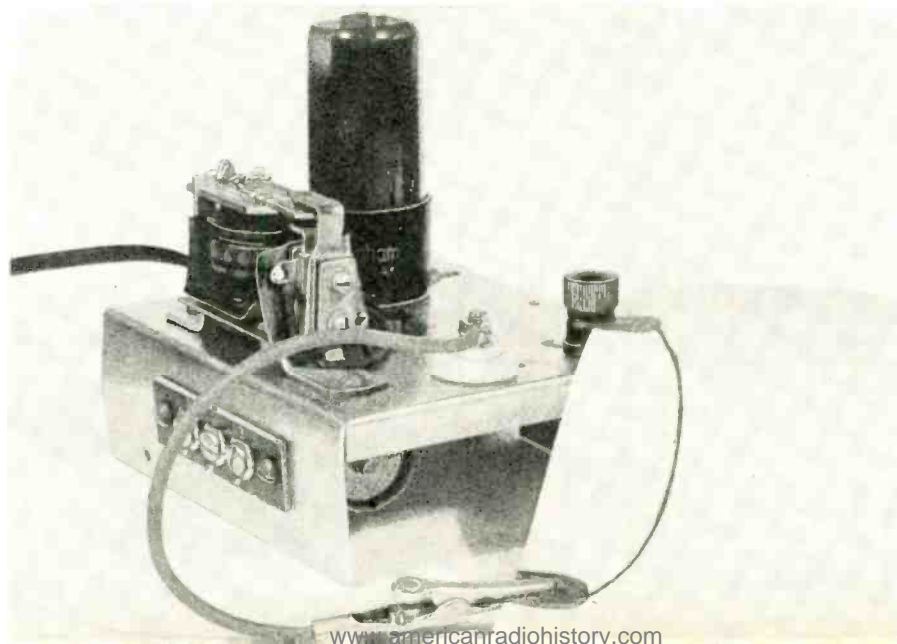
(to close or open the contacts). In fact, even connecting the input leads of a d.c. vacuum-tube voltmeter across the actuating contacts will cause the relay to operate.

With such sensitivity, the applications of the electronic relay are almost limitless. It may be used for experimental work, in the home, as an interesting game, in industrial control applications, as an effective intrusion alarm, or as an auxiliary circuit for other electronic devices.

## The Circuit

A conventional half-wave rectifier ( $V_{110}$ ) is used to supply a d.c. voltage, with capacitor  $C_1$  providing adequate

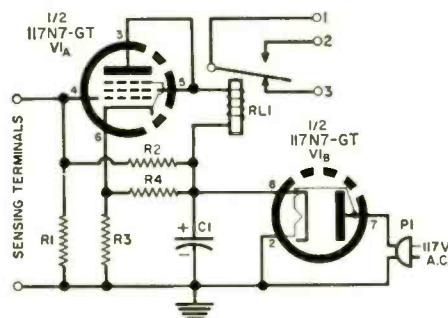
Fig. 1. The electronic relay uses only four resistors, one tube, one capacitor, and one inexpensive plate-circuit relay. The entire unit can be assembled in just a few hours. Here relay is being operated by pencil line drawn on piece of paper.



filtering of a.c. ripple. In order that the input terminal will be sensitive with respect to ground (needed for some applications), the d.c. supply is obtained directly from the a.c. line, rather than using an isolation transformer. Because of this, a polarized line plug,  $P_1$ , should be used to reduce or eliminate danger of shock and short-circuits.

$V_{1A}$  is a beam-power tube which is housed in the same envelope with  $V_{1B}$ . For purposes of relay operation, a triode is satisfactory and, therefore, the screen grid is tied to the plate of the tube.

The plate-cathode current of  $V_{1A}$  flows through  $R_2$  and the plate-circuit relay ( $RL_1$ ).  $R_2$  is purposely made large in value so that a comparatively high bias voltage is developed across it. This bias



- $R_1$ —10 megohm,  $\frac{1}{2}$  w. res.
- $R_2$ —20 megohm,  $\frac{1}{2}$  w. res.
- $R_3$ —2700 ohm, 2 w. res.
- $R_4$ —10,000 ohm, 2 w. res.
- $C_1$ —50  $\mu$ f., 150 v. elec. capacitor (see text)
- $RL_1$ —S.p.d.t. plate-circuit relay, 2500-ohm coil
- $P_1$ —Polarized line plug
- $V_1$ —117N7-GT tube (see text)

Fig. 2. Circuit of the sensitive electronic relay. Tube selection is not at all critical. Refer to the text for a complete discussion of substitutions.

voltage is increased still further by a bleeder current from the "B" supply, obtained through  $R_4$ . The bias obtained in this manner is usually sufficient to reduce the plate current of  $V_{1A}$  until the relay is open.

This bias is, however, partially cancelled by a positive voltage applied to the grid of the tube from a voltage divider made up of  $R_1$  and  $R_2$ . Thus, with the input or "sensing terminals" open, sufficient current flows to keep  $RL_1$  closed in the position shown.

The relay is a s.p.d.t. model, permitting the unit to be used to either "open" or "close" an external circuit, depending on the needs or preferences of the user. Normally, terminals 1 and 3 in Fig. 2 are closed while terminals 1 and 2 are open.

The resistors in the voltage divider,  $R_1$  and  $R_2$ , are purposely made extremely high in value. Under these conditions, shunting even a high resistance across  $R_2$  will reduce the positive voltage applied to the grid of the tube, thus reducing plate current and permitting  $RL_1$  to open. This opens terminals 1 and 3 and closes terminals 1 and 2.

Because of the high degeneration in the circuit, tube characteristics are not critical and a wide variety of tubes may be employed. In addition, the circuit is almost self-regulating, so that the relay

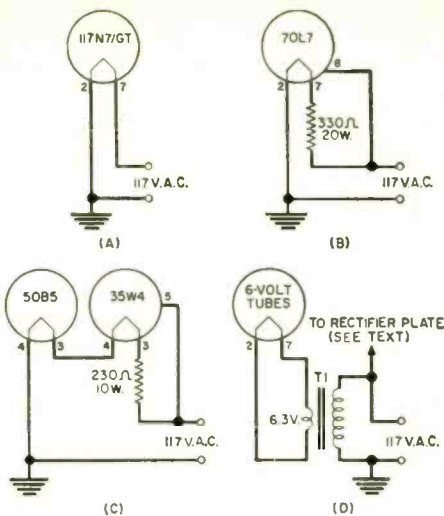


Fig. 3. Here are some of the possible circuit variations for the heater supply that may be used for substitute tubes.

will tolerate fluctuations and changes in line voltage.

### Construction Hints

The only critical item to consider when building this unit is the insulation between grid and ground. A good-quality tube socket should be used while the input terminals should be moisture-resistant ceramic feedthrough insulators. As far as the rest of the wiring, layout, distributed capacities, etc. are concerned, they are strictly up to the builder.

The author's model, shown in Fig. 1, was intended primarily for experimental work and hence was built on a small aluminum chassis. However, the unit may just as well be built in a standard metal utility box, inside an intercom cabinet, or, for industrial or commercial applications, inside a stand-

ard electrical fuse box or switch box.

Where the tube used by the author is employed, heater connections are as shown in Fig. 3A. However, as we shall see later, quite a number of substitutions may be made in the circuit without appreciably affecting the operation of the circuit.

### Parts Substitutions

Even though very few parts are used in this device, parts which are standard and for the most part easily obtainable, it is possible to make a number of substitutions. In this sense, then, this electronic relay is almost an experimenter's "dream" since no difficulties should be encountered in obtaining suitable parts.

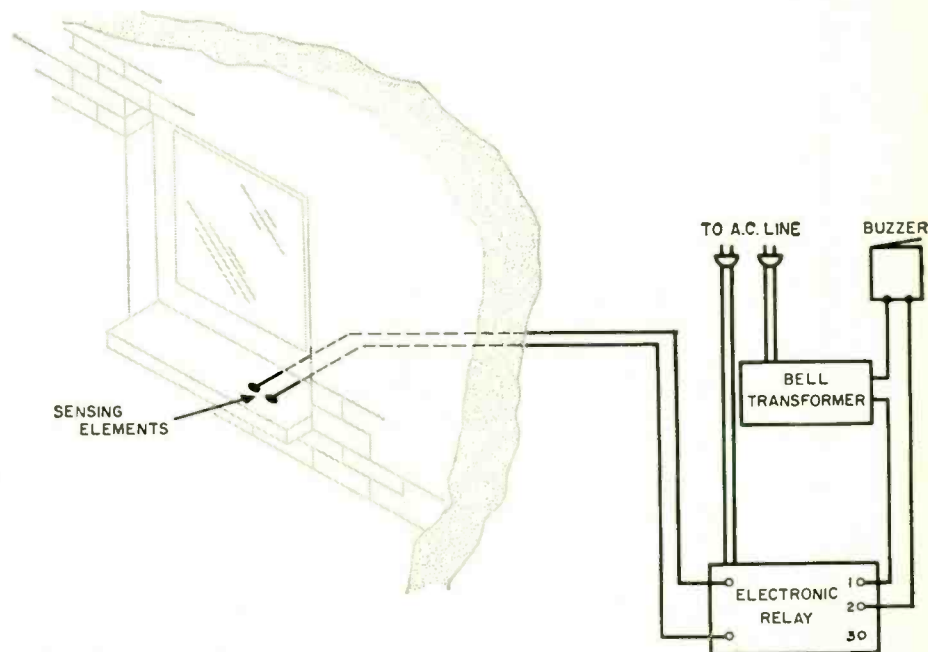
Let us first consider the tube. The author used a 117N7-GT, simply because he had such a tube available. By using a heater resistor or line cord, a type 70L7-GT could be substituted directly. Or, again using an appropriate heater resistor or line cord, a 50B5 and 35W4 may be used. See Figs. 3B and 3C for correct heater connections. Other suitable tubes are 50L6, 35L6, and 35B5 for the relay tube and 35Z4, 35Z5, or a selenium rectifier for the rectifier tube.

If six-volt tubes are available, or preferred by the builder, a 6-volt, 1-amp. filament transformer may be used, as shown in Fig. 3D. Under such conditions, the relay tube may be a 6K6, 6F6, 6V6, 6AQ5, etc., while the rectifier may be a 6X4, 6X5, selenium rectifier, or even another power tube diode-connected.

Almost any plate-circuit relay having a coil resistance of from 2500 to 10,000 ohms will be suitable. The author used a *Potter & Brumfield* Type LB5.

The size of capacitor  $C_1$  is not critical. Use any electrolytic with at least a 150-volt rating and a capacity of from 20

Fig. 4. A very satisfactory rain or dampness alarm may be made by using this setup. Author tried out the unit by using two conductors on a piece of linoleum about 6 inches apart. Breathing on the linoleum produced enough moisture to operate relay.



to 80  $\mu$ f. Either a tubular or upright capacitor may be employed.

$R_1$  and  $R_2$  may be made up by using series-connected resistors if the proper sizes are not available.

As far as  $R_3$  and  $R_4$  are concerned, the values are reasonably critical and should be determined experimentally by the builder for the particular tube and relay he is using in his model. If it is found that the relay does not open when the "sensing terminals" are lightly touched with the fingers, increase the size of  $R_3$  or reduce the size of  $R_4$  (or both). If it is found that the relay remains open at all times, reduce  $R_3$  or increase  $R_4$  (or both).

Should the builder use exactly the same tube and other parts as the author, the values given in the parts list for  $R_3$  and  $R_4$  are satisfactory.

### Applications

To attempt to describe or illustrate all or even the majority of the possible applications of this electronic relay would require too much space, thus only a few of the more typical uses will be discussed in the hope that these applications will serve as a guide to the builder or experimenter.

**Capacitor Checker:** This unit makes an excellent tester for leakage in paper, mica, or ceramic capacitors. To use, connect the capacitor's leads across the input terminals. If the capacitor is good, the relay will first open and remain opened until the capacitor has charged through the 20-megohm resistor,  $R_3$ , after which the relay will close. If the capacitor is leaky, the relay will remain open.

The time necessary for the capacitor to charge is determined by the size of the capacitor since  $R_3$  is fixed. Hence, with practice it is possible to estimate the approximate value of the capacitor (.01  $\mu$ f. and larger) by noting the time interval between the relay opening and then reclosing.

**Dampness or Rain Alarm:** A very satisfactory rain or dampness alarm may be made by using the connections shown in Fig. 4. As a test of its sensitivity, the author placed two conductors, about 6 inches apart, on a piece of linoleum. The relay remained closed. Breathing on the linoleum caused enough moisture condensation to operate the relay.

**Burglar or Intrusion Alarm:** An extremely thin (#32 or smaller) copper wire or metal foil may be cemented around windows or strung across openings. The free ends are connected to the input terminals of the relay. With these connections, the relay will normally remain open. Should the conductor be accidentally broken at any point, the relay will close. This may be used to operate a buzzer, light, alarm bell, or other signalling device.

**Game:** A very interesting game of skill may be made by drawing a maze on a piece of paper, using a soft pencil or carbon India ink. See Fig. 5. Two square blocks are drawn on the paper to serve as contact terminals and these, in turn, are connected to the input ter-

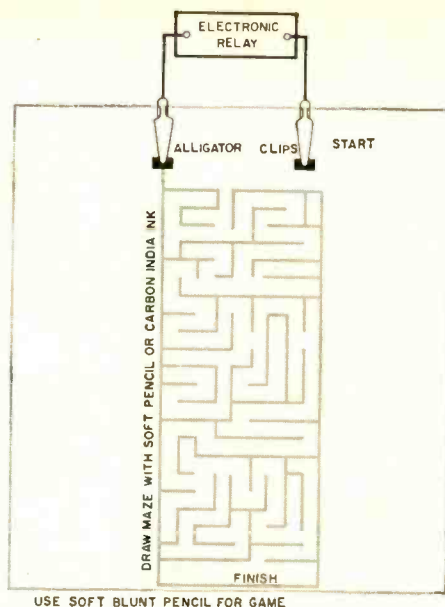


Fig. 5. The electronic relay is used to play games too. If any of the walls or lines in this maze are touched by the player, then the alarm will be set off.

minals of the electronic relay. One of the squares is connected through a heavy line to the maze.

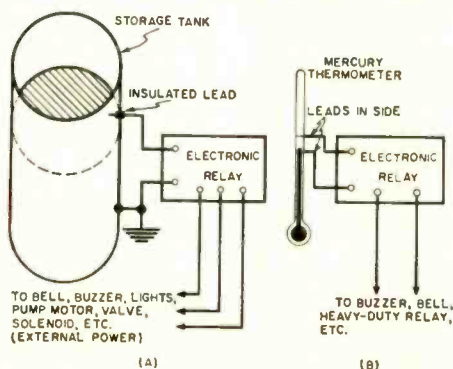
The electronic relay may then be connected to operate a buzzer, doorbell, light, or other indicating device.

To play the game, a soft-lead, blunt-pointed pencil is used to draw a continuous line from the "Start" square through the maze to the "Finish" line. Not only is it necessary to correctly trace through the maze but care must be taken not to touch any of the "walls," otherwise the alarm will be set off.

Any maze design preferred by the builder may be used. However, care should be taken that all "walls" and "partitions" are interconnected electrically so that the relay will work, irrespective of which wall is touched. Reasonably thick lines should be used to insure a continuous circuit throughout the maze.

If desired, several electronic relays may be built and duplicates of the maze prepared. Each player can be identified by a different buzzer tone or a different colored light. A time limit can be set on

Fig. 6. (A) The level of any conducting liquid in a metallic tank may be controlled or indicated as shown here. (B) Typical temperature-controlled setup employing a mercury thermometer with "built-in" leads.



solving the maze without setting off the alarm.

The degree of skill required is dependent on the complexity of the maze and the spacing permitted between walls and partitions. By using a fairly complex maze, together with very narrow passageways, the game can be made interesting even to adults.

**Another Game:** Still another game involves placing extremely small holes in a thin metal sheet, connecting the sheet to one of the relay input terminals. Next, connect a small needle or probe to the other terminal of the relay through a thin, flexible, insulated wire. The trick here is to pass the needle through the small hole without touching the sides.

The closer the needle size is made to the diameter of the hole, the more difficult the game becomes. If the tolerances are sufficiently close, only those with the steadiest hands and the greatest skill will be successful.

**Floatless Liquid-Level Control:** The level of any conducting liquid in a metallic tank may be easily controlled or indicated without employing a mechanical float by adopting the system shown in Fig. 6A.

The grounded input lead from the electronic relay is connected to the tank while the ungrounded lead is attached to a "sensing probe" in the side of the tank at the desired level. A feedthrough insulator must be used to isolate the "sensing probe" from the tank.

The relay may be used to operate an indicating light, bell, buzzer, or similar device. Or it may be used to control a solenoid valve or pump motor.

For satisfactory operation, the liquid in the tank should be a conductor, even if a poor one. This, however, includes a wide variety of liquids such as water, milk, brine, or acidic or salt solutions.

**Temperature Control:** Often it is desirable to be able to check or control temperatures electrically if for some reason or another a thermostat of the bi-metallic type is not suitable. Such applications might include rooms where there is explosive vapor, controlling the temperature of liquids in a tank, etc. For such applications, the electronic relay, together with a specially designed mercury thermometer make an ideal combination.

Fig. 6B shows a typical setup suitable for this application. The relay may be used to control an indicating device such as a light, bell, or buzzer when the desired temperature is reached or, if preferred, may be used to switch a heating element on or off to maintain the desired temperature (through an auxiliary heavy-duty relay).

### Other Applications

An effort has been made to list typical applications of the electronic relay in the home, in games, and in industrial fields. In so doing, it is hoped that many additional applications will have occurred to the builder. Such applications may include the use of the relay as a pressureless switch, in sorting, as a limit switch, or for insulation testing.



# DOUBLES YOUR EFFECTIVE MANPOWER



Fix "Tough Dogs" Fast!

Save Half Your Time!

Step Up Your Profit!

**B&K** NEW  
MODEL 1076

## TELEVISION ANALYST

for Black & White and Color



Check all circuits—Pinpoint any TV trouble...in minutes

**By Easy Point-to-Point Signal Injection,  
You See the Trouble on the TV Screen and  
Correct it—Twice as Fast and Easy!**

There's no longer any need to "lose your shirt" (and customers)—and worry about the lost hours you never recover—on "tough dogs" or even intermittents. *The remarkable B&K Analyst* enables you to inject your own TV signal at any point and watch the resulting test pattern on the picture tube itself. *Makes it quick and easy to isolate, pinpoint, and correct TV trouble in any stage* throughout the video, audio, r.f., i.f., sync, and sweep sections of black & white and color television sets—including intermittents. Makes external scope or wave-form interpretation unnecessary. Most useful instrument in TV servicing! Its basic technique has been proved by thousands of successful servicemen the world over.

The Analyst enables any serviceman to cut servicing time in half, service more TV sets in less time, really satisfy more customers, and make more money.

Model 1076. Net, \$299<sup>95</sup>

Available on Budget Terms. As low as \$30.00 down.

Combines all the features of both the Model 1075 and Model A107

COMPLETE R.F. and I.F.

VIDEO TEST PATTERN

COMPOSITE SYNC

FM MODULATED AUDIO

COLOR PATTERNS

HORIZONTAL and VERTICAL  
PLATE and GRID DRIVE

B+ BOOST INDICATOR

HI-VOLT INDICATOR

YOKE and HI-VOLTAGE  
TRANSFORMER TEST

**Also Now Provides:**

SWITCH-TYPE TUNER

NEGATIVE BIAS SUPPLY

AGC KEYING PULSE

PICTURE TUBE MODULATION



**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.

See Your B&K Distributor or Write for Bulletin AP16-N

THERE are many occasions when it is necessary to know the peak voltage of an a.c. signal accurately. A case in point is the measurement of intermodulation distortion produced by a high-fidelity amplifier. Determination of peak power output is usually made by measurement of the peak a.c. voltage developed across a load resistance, and peak power is computed from the well-known relationship,  $P = E^2/R$ .

Many a.c. voltmeters, even some rated as peak-reading instruments, introduce serious errors. To continue with the example of the intermodulation measurement, the test signals usually used consist of a 60-cycle signal mixed with another signal higher in frequency, usually 6000 or 7000 cps, whose amplitude is one-fourth that of the low-frequency a.c. A peak-reading instrument may respond differently to different frequencies. This article is concerned with accurate measurement of the peak value of complex waveforms, especially when

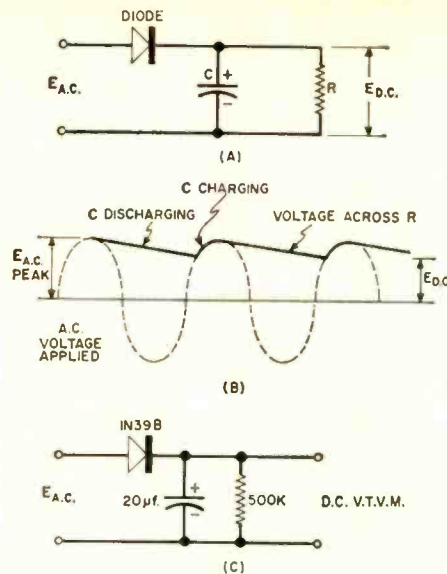


Fig. 1. (A) Basic peak-reading voltmeter circuit. (B) Waveform across R. (C) Test circuit. See text.

open, both resistors are in series. A full-scale meter current of 100 μa. will be obtained when the peak a.c. voltage is 100 volts, making the meter a direct-reading instrument on this range. (Of course, a 0-50 μa. meter may be used with a series resistance of one megohm to obtain a direct-reading instrument with 50 volts maximum range.) For most audio measurements the 50-volt range will be used, since a peak voltage of 50 volts across a 16-ohm load resistance corresponds to a peak power of 156 watts, or an equivalent sine-wave power of 78 watts. Only the very largest power amplifiers would require the use of the 100-volt range.

Microammeters of the 0-100 μa. range tend to have an internal resistance of around 600 ohms. This value is sufficiently low so that only a very small error (a fraction of 1 per-cent) is caused by not reducing the external resistance R by this amount. Likewise, the voltage drop across the diode is on the order of

# Accurate Peak A.C. Measurements

By L. W. BORN  
Plaza TV & Hi-Fi

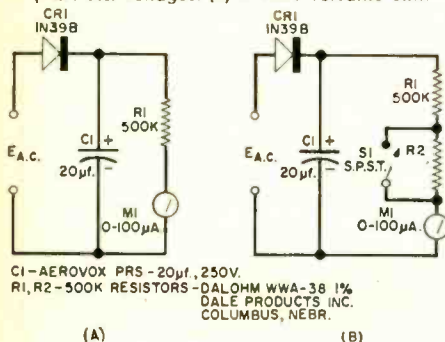
Techniques for obtaining highly accurate readings and details for a circuit with laboratory precision.

developed across low resistances, such as those normally used as amplifier loads. In addition to the considerations involved and some basic configurations for measurement, a refined circuit for very precise measurement will be presented.

Basically, the peak-reading voltmeter consists of a diode rectifier with adequate inverse voltage rating, operating in series with a parallel combination of resistance and capacitance, as shown in Fig. 1A. The voltage developed across the resistance has a waveform like that shown in Fig. 1B, with the d.c. component approaching closer and closer to the a.c. peak value as the product  $\omega RC$  (where  $\omega = 2\pi f$ ) becomes larger and larger. The d.c. component is about 5 per-cent lower than the peak a.c. voltage when  $\omega RC = 50$ ; 1 per-cent low when  $\omega RC = 180$ ; and 1/2 per-cent low when  $\omega RC = 628$ . As an approximation, we may say

$$E_{d.c.} = E_{peak} \left(1 - \frac{\pi}{\omega RC}\right) \dots \dots \dots (1)$$

Fig. 2. (A) Circuit for independent check of peak a.c. voltages. (B) A more versatile unit.



C1—AEROVOX PRS—20 μf., 250V.  
R1, R2—500K RESISTORS—DALOHM WWA-38 1%  
DALE PRODUCTS INC.  
COLUMBUS, NEBR.

For a frequency of 60 cycles, a resistance of one-half megohm and a capacitance of 20 μf.,  $\omega RC$  is equal to 3768 and the d.c. voltage across the resistance is within one-tenth of one per-cent of the peak a.c. voltage being measured. By using a d.c. vacuum-tube voltmeter of adequate accuracy, the peak a.c. voltage is measured simply by measuring the d.c. voltage across the resistance R.

The input resistance of the v.t.v.m., usually about 11 megohms, will introduce no serious error in the measurement since its only effect will be to alter the product  $\omega RC$  almost imperceptibly. This simple arrangement, shown in Fig. 1C, may be used to check the performance of an a.c. voltmeter to ascertain whether it does in fact indicate the peak voltage of a complex wave. If there is substantial agreement between the peak value as read by the a.c. voltmeter and the peak value as indicated by the d.c. vacuum-tube voltmeter as per Fig. 1C, when using a complex wave, then the a.c. voltmeter is suitable for such use as IM measurements.

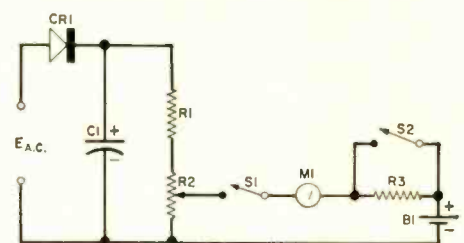
If, however, there is an appreciable discrepancy noted, or if an independent meter is desired for measurement of peak a.c. voltages, a d.c. microammeter may be inserted in series with resistance R, as shown in Fig. 2A. With R equal to 500,000 ohms, a peak voltage of 50 volts will produce a full-scale current of 100 μa. Using a 0-100 μa. meter, the indicated scale reading is divided by two to obtain the actual peak a.c. voltage.

Versatility may be increased by adding another half-megohm resistor in series with the first, with a toggle switch to short out one of the resistors, as shown in Fig. 2B. When the switch is

0.12 volt for an indicated reading of 50 volts; the error caused by neglecting this drop is considerably less than that produced by the usual meter accuracy of 2 per-cent.

Two notes of caution are in order. First, if a steel panel is used to mount the microammeter, the meter must be specifically designed and calibrated for use on a steel panel. If the meter is not so labeled, it must be used on a copper, aluminum, or other non-magnetic panel. Errors on the order of 8 per-cent may be introduced in the meter indication if this precaution is not taken. Second, the electrolytic capacitor (C<sub>1</sub>) must be of the highest quality and in top condition

Fig. 3. Circuit for a precise instrument using the null method and a standard cell.



R—900,000 ohm precision res. ±0.05% (Dale Products WFA-38)  
R<sub>2</sub>—100,000 ohm ten-turn pot ±0.1% (G. W. Borg Model 205 micropot with Model 1320 ten-turn micradial)  
R<sub>3</sub>—27,000 ohm, 1 w. res. ±10%  
C—20 μf., 200 v. paper capacitor (Twenty Sprague 2TM-M1 in parallel. see text)  
M—25-0-25 μa. microammeter  
B—Unsaturated-cadmium standard cell (Leeds & Northrup Co. Model 7308 ±0.01% accuracy; Model 7310 ±0.1% accuracy)  
CR—Crystal diode (1N39B)  
S—Normally open push-button switch  
S<sub>2</sub>—S.p.s.t. toggle switch

otherwise the leakage through it will produce erroneous results. This problem may be avoided by the use of a sufficient number of 1- or 2- $\mu$ f. paper capacitors in parallel.

The accuracy of this peak a.c. voltmeter will depend largely on the accuracy of the microammeter and the precision of the resistances used. With  $\pm 1\%$  resistors and the usual 2% meter accuracy, an over-all error of about 3% may be expected at full-scale reading. This error may be reduced by increasing the accuracy of the resistors and hand calibrating the meter.

In some instances where increased precision is required and cost is a secondary factor, the convenience of a direct-reading instrument may be exchanged for added accuracy by using null methods of measurement. Null methods simply compare a known fraction of the d.c. voltage developed across the RC-parallel combination to a highly precise voltage established by a standard cell of the unsaturated-cadmium type. Cells such as these maintain their open-circuit voltage over long periods of time and show negligible variation with temperature.

Fig. 3 shows such an arrangement.  $R_1$  is a precision resistor of 0.05% tolerance and low temperature coefficient. It is made equal in value to nine times the value of  $R_2$ . Thus  $R_1$  and  $R_2$  establish a voltage divider with precisely one-tenth of the applied voltage developed across  $R_2$ .  $R_2$  is a precision, ten-turn potentiometer, equipped with a dial, which allows reading 100 divisions per turn or 1000 divisions total;  $B_1$  is an *Eppley* unsaturated-cadmium standard cell whose potential difference (on open circuit) is certified to an accuracy of 0.01%.  $M_1$  is a 25-0-25  $\mu$ a. meter to indicate null or balance when the normally open push-button switch  $S_1$  is depressed. Resistor  $R_3$ , in series with the standard cell, is necessary to protect the cell against excessive current drain while the potentiometer is being adjusted. Maximum

allowable current from the standard cell is 100  $\mu$ a., and even this value should be permitted for only a few seconds. As balance is approached, resistance  $R_2$  is shorted by toggle switch  $S_2$  to permit full sensitivity. When the meter indicates zero current with  $S_1$  closed, the potential difference of the standard cell and the peak a.c. voltage is therefore

$$E_{a.c. \text{ peak}} = \frac{10 \times B_1}{\text{dial ind.}} \dots \dots \dots (2)$$

where  $B_1$  is the potential difference of the standard cell, and "dial ind." is the indication of the dial on the potentiometer expressed as a decimal fraction of the total number of dial divisions. For example, if balance is obtained with a potentiometer dial reading of 373, this represents 0.373 of the total number of 1000 divisions. With a standard cell of potential difference of 1.01938 volts, the peak a.c. voltage would be  $(10 \times 1.01938)/0.373$  or 27.327 volts.

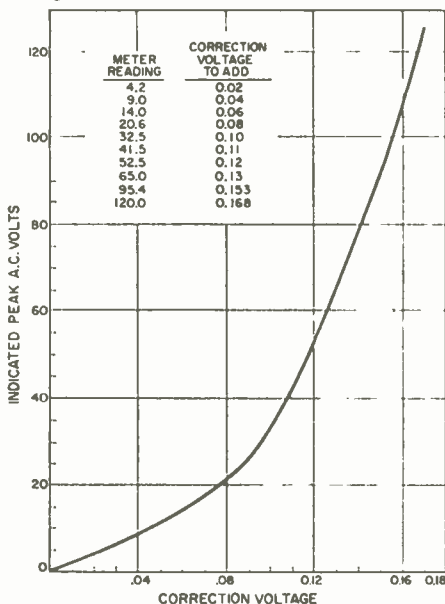
For the most precise measurements, the d.c. drop across the diode can no longer be neglected. Fig. 4 shows the voltage correction to be added to the value computed from Eq. (2) for a type 1N39B diode for the various values of computed voltage. Using a multi-turn potentiometer ( $R_2$ ) of 0.1% linearity, a calibrating resistor ( $R_1$ ) of 0.05% accuracy, and with reasonable care in adjustment, measurements may be made within an over-all accuracy of 0.2%.

Where the required precision will not justify the expense of the standard cell, mercury batteries may be used for the reference voltage. For this purpose, straight mercuric-oxide batteries are to be preferred to those containing small amounts of manganese dioxide, inasmuch as the latter type have relatively poor voltage stability compared to the former. Although the straight mercuric-oxide cells will vary in terminal voltage between different lots or batches, cells such as the *Eveready* E-12, E-122, or E-502 will retain their open-circuit voltage to within 0.5% over a twelve-month period, and to within 0.1% over a thirty-day period. (Equivalents of these three types made by *Mallory* are, respectively, RM-12R, TR-133R, and RM-502R.)

If possible, the mercury cell should be calibrated or measured by potentiometer methods in a physics lab of a college or university or other suitably equipped laboratory. If calibration is not feasible, the E-502 cell may be used with assumed terminal voltage of 1.345 volts. Measurements made on a large number of these cells over a considerable period of time indicate the terminal voltage to vary within limits of 0.5% of the value given.

The 1N39B diode, used in the circuits shown, is rated at 190 volts inverse voltage. In circuits of this type, the inverse voltage applied to the diode is twice the peak a.c. voltage being measured. Since the breakdown voltage is subject to some manufacturing variation, it is recommended that two diodes be used in series if voltages in excess of 75 volts peak are to be measured. In this case, double the correction values shown in Fig. 4.

Fig. 4. Values to be added to the indicated peak voltage to correct readings obtained with Fig. 3.



# NOW! YOU CAN Master Mathematics



At Home — Only Minutes a Day!

PREPARE yourself NOW for a good future and higher paying job by learning mathematics this amazingly simple way—at home, in your spare time!

Can You Spare 10 Minutes a Day?

That's all it takes with this simplified home-study Course. Thompson's MATHEMATICS FOR SELF STUDY. 5 big volumes. 1533 pages. Hundreds of charts, graphs, diagrams, formulas. Basic "know-how." Time and money-saving short-cuts. Common-sense tips. You master every type of practical mathematical problem quickly and easily.

A "Must" for Men Who Want to Get Ahead

Clearly explains all basic principles, equations, probabilities, roots, powers, slide rule, etc. You solve any problem in geometry, surveying, mechanics, navigation, architecture, designing. You compute speed velocity, rates, integral formulas; analyze sales, production charts; figure statistics, insurance, physics, electricity, radio, TV. MUCH MORE!

**FREE IF YOU SEND COUPON NOW**  
Simplified Accounting—58-page book tells how to keep books, figure balances, profit and loss, collections, depreciation, interest, inventories, credit, etc. Contains 31 sample forms. Give for \$1, but yours to keep without obligation.

Send no money. Just mail coupon today for FREE 10-day examination of all five home-study books. If not convinced this great set will let you write your own ticket to a higher paying job, return and owe nothing. But mail No-Risk Coupon NOW to: D. VAN NOSTRAND COMPANY, INC., Dept. 371, 120 Alexander Street, Princeton, New Jersey. Est. 1848



MAIL THIS COUPON TODAY

D. VAN NOSTRAND COMPANY, INC., Dept. 371, 120 Alexander St., Princeton, N. J.

Please send me, for FREE examination, the 5-volume set of Thompson's MATHEMATICS FOR SELF STUDY (plus my FREE copy of Simplified Accounting). If not delighted I may return the 5-volume set within 10 days and owe nothing. Otherwise, I will send you \$1.85 (plus small postage) as first payment, and \$3 per month for three months thereafter.

Name..... (Please Print Plainly)

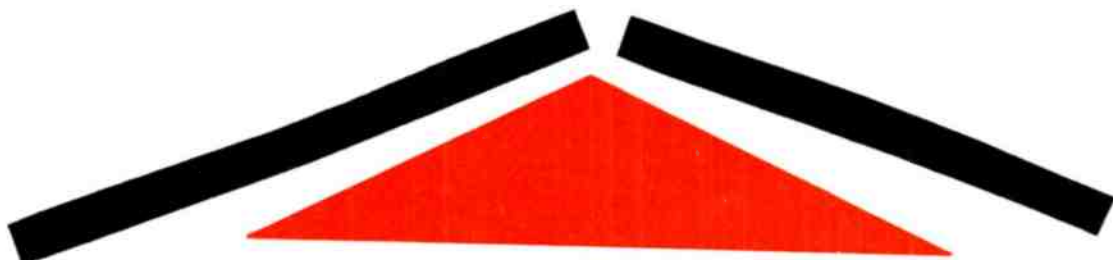
Address.....

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

SAVE! Send full payment of \$11.85 WITH this coupon and WE pay all delivery costs. Return privilege and refund guaranteed.

(In Canada: 25 Hollinger Road, Toronto 16. Price slightly higher.) Foreign and A.P.O.—please send \$11.85 with order.

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



*fits both space and dollar budgets!*

## COMPLETE STEREO-PHONO CONSOLE WIRED OR KIT

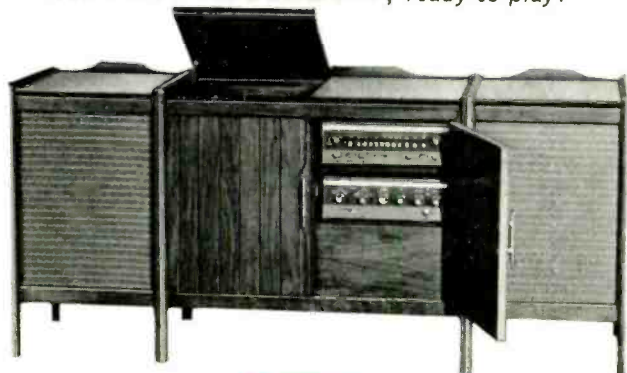
Less than 3' long and end-table height, yet its six speakers assure rich, room-filling stereo! Smooth "lows" are delivered by two 12" woofers, "mid-range" and "highs" are sparkingly reproduced by two 8" speakers and two 5" cone-type tweeters mounted at wide dispersal angles in the cabinet. The "anti-skate" 4-speed automatic stereo/mono record changer has diamond and sapphire styli. Concentric volume and separate dual bass and treble tone controls are within easy reach. Superbly styled with solid genuine walnut frame, walnut veneer front panel, and matching "wood-grained" sliding top, the cabinet measures just 31 3/4" L x 17 3/8" W x 26 3/4" H. Whether you buy the ready-to-play or kit form, the cabinet is factory assembled and finished; to build the kit, just wire the amplifier and install the changer and speakers. 70 lbs.

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



## INTRODUCING

*... a superb new line of Stereo Hi-Fi Consoles ...*  
**FACTORY ASSEMBLED, ready to play!**



## COMPLETE 28-WATT AND 50-WATT STEREO CONSOLES

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

Cabinets available separately, write for information.

Model HFS-26 (wired) ... 215 lbs. ... \$47.50 dn. .... **\$475.00**

Model HFS-27 (kit) ... \$37.00 dn. .... **\$370.00**

Model HFS-28 (wired) ... 264 lbs. ... \$75.00 dn. .... **\$675.00**

Model HFS-29 (kit) ... \$55.00 dn. .... **\$550.00**



**HEATH COMPANY** / Benton Harbor, Michigan

NOW ONLY  
**HEATH**  
 BRINGS YOU  
**ALL 3!**



1.  
HEATHKIT  
for  
do-it-yourself  
hobbyists.
2.  
HEATHKIT  
factory-built,  
ready to use.
3.  
HEATHKIT  
learn-by-doing  
Science Series  
for youngsters.



**PORTABLE 4-TRACK STEREO  
 TAPE RECORDER KIT**

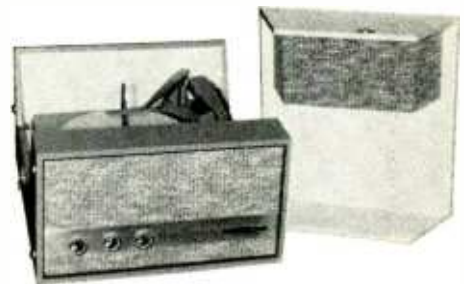
Delight to the vast treasures available to you in popular 4-track pre-recorded stereo tapes . . . make your own 4-track stereo home recordings . . . (you can even use it as a hi-fi center to amplify and control hi-fi tuners, record players, etc.) Has "record," "play," "fast-forward" and "rewind" functions, 2 speeds (3¼ and 7½" per second). Controls include: individual tone balance controls for each channel; level controls; monitoring switch for each channel to let you hear programs as they are being recorded; and a pause button for tape editing. Two "eyetube" indicators provide control of recording levels. Speaker wings may be detached. Cabinet and tape mechanism are completely preassembled. A storage compartment is provided for tape and accessories. 49 lbs.

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

**STEREO/MONO  
 PORTABLE PHONO KIT**

From jazz to classics, the younger set will have stereo wherever they go! Plays either stereo or mono records on its top quality 4-speed automatic changer with diamond and sapphire styli. Has detachable stereo speaker wing and complete tone and stereo balance controls. Record changer and cabinet are factory-assembled, the kit is a "snap" to build. 15½" x 18" x 8¾". 28 lbs.

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



**ACOUSTIC SUSPENSION SPEAKER SYSTEM KIT**

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

Model AS-10U (unfinished) . . . \$6 dn., \$6 mo. . . . . **\$59.95**

Model AS-10M (mahogany) . . . \$6.50 dn., \$6 mo. . . . . **\$64.95**

Model AS-10W (walnut) . . . \$6.50 dn., \$6 mo. . . . . **\$64.95**

**DELUXE AM/FM STEREO TUNER**

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

Model AJ-30 (kit) . . . \$9.75 dn., \$9 mo. . . . . **\$97.50**

Model AJW-30 (wired) . . . \$15.30 dn., \$13 mo. . . . . **\$152.95**

**DELUXE 50-WATT STEREO AMPLIFIER**

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

Model AA-100 (kit) . . . \$8.50 dn., \$8.00 mo. . . . . **\$84.95**

Model AAW-100 (wired) . . . \$14.50 dn., \$13.00 mo. . . . . **\$144.95**



8 new, exciting Heathkit® products on following pages



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

NOW... BUY YOUR HEATHKIT FOR as low as \$2.50 DOWN! Yes, under the new, easy Heath Time Payment Plan, orders of \$25.00 or more can be purchased for just 10% down... and up to 18 FULL MONTHS ON BALANCE for orders of \$300 to \$500.

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



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

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

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



## DELUXE SERVICE BENCH VTVM KIT

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

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



## NEW ISOLATION TRANSFORMER KIT

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

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



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

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

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

HEATH COMPANY / Benton Harbor, Michigan

# electronics—always the leader!

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



## 2, 6 & 10 METER TRANSCEIVER KITS

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

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



## HEATHKIT BASIC RADIO COURSE

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

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

# FREE CATALOG



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

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



be your own  
"tune-up" specialist!

## NEW ELECTRONIC IGNITION ANALYZER KIT

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

- Model 10-20 . . . \$8.95 dn., \$9.00 mo. . . . . **\$89.95**

## MONEY BACK GUARANTEE

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

ORDER DIRECT BY MAIL OR SEE YOUR HEATHKIT DEALER



**HEATH COMPANY**  
Benton Harbor 15, Michigan

## ORDERING INSTRUCTIONS

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

Please send the following HEATHKITS:

ITEM	MODEL NO.	PRICE

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

( ) SEND MY FREE COPY OF YOUR COMPLETE CATALOG

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_

Dealer and export prices slightly higher.

**AMAZING OFFERS...SELDOM SEEN!**

**TRACK STATIONS AN/TRC 8-11-12**  
**RADIO RECEIVERS R 48/TRC-8.** FM. For communications; freq. range 230 to 250 mc. input 115/230 v. 50-60 cyc. 120 W. **\$45**  
**RADIO TRANSMITTERS T 30/TRC-8.** FM. freq. range 230 to 250 mc. output 5 w. input 115/230 v. 50-60 cyc. 350 w to rectifier power units PP115/TRC-8. **\$50**  
**RECTIFIER POWER UNITS PP 115/TRC-8** Full wave electronic type rectification. Output 475 v. dc 350 ma; 6.3 v. 8 amp ac. 105 to 125 v or 207 to 253 v. 60 cyc sine wave phase. **\$45**  
**ANTENNA ASSEMBLY AS 52/TRC-8** with cables, connectors and tape. **\$25**  
**ACCESSORY KIT #1 & 2** for TRC 8-11-12. Brand new. Complete of CY64 and **\$60 ea.** components.

COMPONENTS FOR		COMPONENTS FOR	
SCR 193		SCR 508	
BC 191 TRANSMITTERS, 800w. used	<b>\$25</b>	BC 603 FM RECEIVER, 20 to 30 mc.	<b>\$17</b>
RA 34 H RECTIFIERS, 105/125 v or 210/230 v.	<b>\$85</b>	BC 604 FM TRANS. MITTER, 20 to 30 mc.	<b>\$7.25</b>
AS 58 DUMMY ANTENNA, ORIGINAL	<b>\$4.50</b>	FT 237 MOUNTING, New. For BC 603 & 604.	<b>\$6.25</b>

**AN/APA-17B COMPLETE RADAR SETS**  
 Detect, locate, identify radio, radar & other signals bet. 140-12000 mc. Consists of IP 94 APA-17B Azimuth Indicator, PP 580 APA-17B 150 v ac. AS 545 APA-17B Antenna Assembly, AS 186 APA-17B Antenna Assembly, AS 247 APA-17B Antenna Drive, TG 10 APA-17B Antenna Drive, MK 182 B/APA-17B Control Box, Manual Copy. Complete. **\$350**  
 AN/APA-11 TEST SCOPE, synchroscope pulse analyzer, 3 BP1 TUBES. Like new **\$15**

**DYNAMOTORS (all brand new!)**

DM 34, 12v for BC 603	<b>\$3.95</b>	DM 37, 24 v for BC 604	<b>\$3.50</b>
DM 35, 12 v for BC 604	<b>7.25</b>	DM 41, 24 v	<b>3.00</b>
DM 36, 24 v for BC 603	<b>2.50</b>	DM 42	<b>3.00</b>

**—TELEPHONES, HEAD SETS & CORDS—**  
 EE 8B, Field Telephone. New. **\$17.00**  
 RM 39, Remote Control Units, like new. **9.50**  
 T30 Throat Microphone. New. **.40**  
 H 63/U Headsets, Exc. Cond. **4.50**  
 H 16/U Headsets, 8000 ohms. **3.50**  
 H 30/U Headsets, New. **1.25**  
 T 45 Microphone, New. **.95**  
 CD 604 Cord for HS 30/U W/ transformer and PL 54 **.20**  
 CD 605 Cord for HS 30/U W/ transformer and PL 55 **.30**  
 PL 55 & PL 68, for FH **.40**  
 (PL 55 alone 20c; PL 68 alone 30c)  
 TD 4 complete of T 51 Switch 4 cond. cord w/PL 55 & 68 and strap **4.00**

**•••••Scoop on ANTENNAS**  
 MS 50, MS 52, MS 53, MS 54, New! **.40**  
 MS 117, 118, New! **1.00**  
 AB 15/GR Mast Base, New! **3.50**

**★ ★ ★ EXTRA SPECIALS! ★ ★ ★**  
 JUNCTION BOX C-666 VIA-1 **\$1.50 ea.**  
 EE 101 RINGING EQUIP. **\$10**  
 GOVT cost \$350  
 TS 352 MULTIPLE TESTER, New. (ME 9) **\$65**  
 Prices net, FOB Bronx, N.Y. Min. Order \$5.00  
 Send cash, check or money order with purchase order. 25% of purchase on COD orders, balance on delivery. Rated firms sold on 30 days.

**MICHAEL COLUCCI EXPORT AND IMPORT**  
**EMCO ELECTRONIC SUPPLY CO.**  
 1990 BIRCHALL AVE. BRONX 62, N. Y.  
 TEL: TAlmadge 8-2199 or TAlmadge 8-3182  
 Cable: "EMCOTRONIC" New York

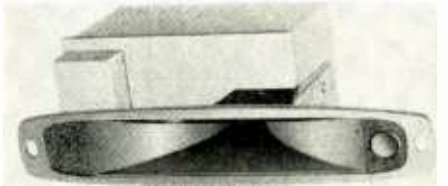


**STEREO AMPLIFIER KIT**  
 H. H. Scott, Inc., Dept. P, 111 Powdermill Road, Maynard, Mass. has brought out a 72-watt stereo amplifier, with controls, in kit form.  
 Designated as the LK-72, it provides



36 watts output on each channel, with IHFM power band extending down to 20 cps. Specified total harmonic distortion at 1 kc. is less than 0.4 per-cent at full power; amplifier hum level, better than 70 db below full power output. All stereo controls are provided, including a "center channel" level control, scratch filter, tape recorder monitor, and separate bass and treble on each channel. Tube heaters are d.c. operated.  
 Like the firm's earlier kit, the LT-10 FM tuner, the present model comes in the newly developed "Kit-Pak" container that opens up to a work table. Wires come pre-cut and pre-stripped. Mechanical parts are pre-riveted to the chassis. All parts are mounted on cards in the order the kit-builder will use them.

**NEW IONIC SPEAKER**  
 DuKane Corp., St. Charles, Ill. has introduced a new version of the "Iono-vac" high-frequency loudspeaker. The



present unit covers the audio range from about 3500 cps to beyond audibility. It employs an improved electrode and sound-generating cell which is guaranteed unconditionally for 1200 hours of use.  
 Using no moving parts, this type of speaker produces sound by electrically charging the air with modulated signals that enter from the amplifier and are fed through an r.f. oscillator. The system consists of two chassis. It is available as an add-on tweeter for use with

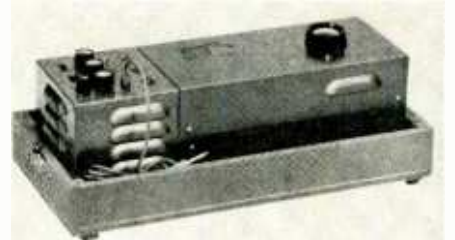
existing speaker systems, as well as part of a new line of full-range systems offered by the company.

**STEREO CARTRIDGE**  
 Pickering & Co., Plainview, N.Y. has made available for general use its Model 381 stereo cartridge, known as the "Stanton Calibration Standard." According to the manufacturer, this pickup was produced "specifically for the professional level of the recording and broadcast industry."

Response is claimed to be flat within 1 db from 20 to 10,000 cps, and within 2 db from 10 kc. to 17 kc. Output is 5 mv. per channel. Channel separation is 35 db. Recommended tracking force in professional arms is 2 to 3 grams.

The Model 381 is available in a high-impedance (47,000 to 100,000 ohms) version, or in a low-impedance (250 to 500/600 ohms) type.

**REVERB CHAMBER**  
 Ecco-Fonic, Inc., 905 S. Vermont Ave., Los Angeles 6, Calif. has brought out its Model 109B portable "Echo-Reverb Chamber" designed for use by musi-

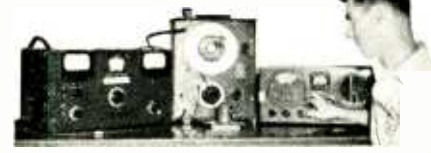


cians and vocalists. The unit attaches to a microphone or musical instrument and provides reverberant effects which, says the manufacturer, were hitherto possible only in recording studios.

The device uses a variable dial which allows the performer to adjust the delay time before the echo begins, from 0 to 0.7 second. A reverberation dial provides from 0 to a multitude of echo repeats. A playback switch re-plays 14 seconds of whatever was being played, and continues to do so until switched to "normal" position. Thus the unit can serve as an "accompanist."

**DUAL 50-WATT AMPLIFIER**  
 Lafayette Radio, 165-08 Liberty Ave., Jamaica 33, N.Y. has introduced its Model KT-550, a dual 50-watt power amplifier in kit form. Capable of 50 watts per channel for stereo or 100 watts for mono operation, the new amplifier boasts response from 2 to 100,000 cycles within 1 db, without evidence of ringing or instability. The circuit uses a "multiple loop" design to increase the

**GET INTO ELECTRONICS**

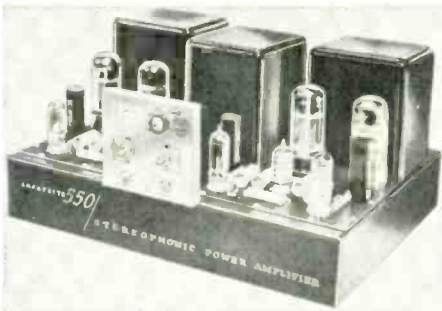


V.T.I. training leads to success as technicians, field engineers, specialists in communication, guided missiles, computers, radar and automation. Basic and advanced courses in theory and laboratory. Associate degree in electronics in 29 months. B.S. in electronic engineering obtainable. E.P.P. accredited. G.I. approved. Graduates in all "branches" of electronics with major companies. Start February, September, January campus. High school graduate or equivalent. Catalog.

**VALPARAISO TECHNICAL INSTITUTE**  
 Dept. RD Valparaiso, Indiana



amount of feedback and achieve very low distortion, said to be less than 0.5% at 50 watts and less than 0.1% below 10 watts, from 20 to 20,000 cps. Hum

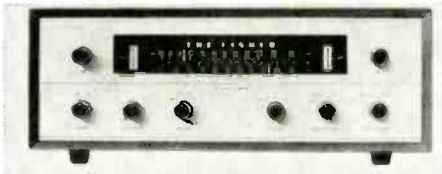


and noise are better than 90 db below 50 watts, according to the manufacturer.

The KT-550 uses two printed circuit boards to facilitate assembly by the kit builder.

#### NEW FISHER STEREO TUNER

Fisher Radio Corp., 21-21 44th Drive, Long Island City 1, N.Y. has announced its Model 202-R stereo FM-AM tuner,



said to provide precise, automatic tuning. When the FM tuning knob is touched, the a.f.c. automatically clicks off, permitting precise tuning for maximum signal. When the knob is released, the a.f.c. clicks back on, automatically adjusting tuning errors and locking in at the point of maximum noise suppression and minimum distortion.

The FM tuner uses the company's "Golden Cascode" front-end and six i.f. stages. Sensitivity is stated as .5  $\mu$ v. for 20 db of quieting with a 72-ohm antenna. Electronic switch-muting eliminates inter-station noise. This noise suppression functions during multiplex operation as well.

The AM section features a four-position bandwidth switch, a rotatable ferrite antenna, and a high-gain, low-noise r.f. stage for maximum suppression of image and i.f. signals.

#### CERAMIC MICROPHONE

Sonotone Corp., Elmsford, N.Y. has introduced a low-impedance ceramic microphone, the Model CM-12.



Designed for public-address work or any installation that requires long leads, it has an impedance of 150 ohms, an output of minus 63.5 db, and a frequency response that extends to 8000 cps. An easy-to-reach interrupter button cuts off the mike with a touch of the finger.

According to the manufacturer, a substantial increase in the low-frequency range, plus control in the flat-



## New kind of KIT from H. H. Scott...

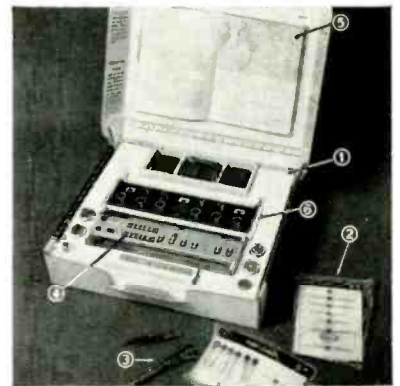
**EASY-TO-BUILD 72 WATT  
STEREO AMPLIFIER KIT  
LOOKS AND PERFORMS  
LIKE FACTORY- \$149<sup>95</sup>\*  
BUILT UNITS!**

Here's the kit that makes *you* a professional. Beautifully designed, perfectly engineered, and so easy to wire that you can't go wrong. In just a few evenings you can build a professional 72 watt H. H. Scott stereo amplifier . . . one so good it challenges factory-assembled units in both looks and performance.

H. H. Scott engineers have developed exciting new techniques to ease kit-building problems. The Kit-Pak® container unfolds to a self-contained worktable. All wires are pre-cut and pre-stripped. Parts are mounted on special cards in the order you use them. All mechanical parts are pre-riveted to the chassis.

Build a new H. H. Scott LK-72 for yourself. You'll have an amplifier that meets rugged IHFM specifications . . . one that delivers sufficient power to drive *any* speaker system . . . one that's professional in every sense of the word.

**TECHNICAL SPECIFICATIONS:** Full Power Output: 72 watts, 36 watts per channel • IHFM Power Band: extends down to 20cps • Total Harmonic Distortion: (1kc) under 0.4% of full power • Amplifier Hum Level: better than 70db below full power output • Tubes: 4 - 7591 output tubes, 2 - 7199, 4 - 12AX7, 1 - 5AR4 • Weight of Output Transformers: 12 pounds • Amplifier fully stable under all loads including capacitive • Dimensions in accessory case: 15½ w. 5¼ h, 13¼ d. Size and styling matches H. H. Scott tuners.



**IMPORTANT FEATURES OF THE NEW H. H. SCOTT LK-72 COMPLETE AMPLIFIER** 1. Unique Kit-Pak® container opens to a convenient worktable. Folds up at night like a suitcase. 2. Part-Charts®— All parts mounted in order of installation. No sifting through loose parts. 3. All wires pre-cut, pre-stripped to cut assembly time. 4. Mechanical parts all pre-mounted. Tube sockets and terminal strips riveted to chassis. 5. Easy-to-follow full color instruction book. 6. Special features include: Center Channel Level control; Scratch Filter; Tape Recorder Monitor; Separate Bass and Treble on each channel; DC operated heaters for lowest hum.

*\*Slightly higher west of the Rockies.*

**H. H. SCOTT**

H. H. SCOTT INC., DEPT. EW-1  
111 POWDERMILL ROAD • MAYNARD, MASS.

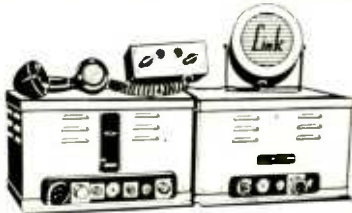
Rush me complete details on your new LK-72 Complete Amplifier Kit, LT-10 FM Tuner Kit, and Custom Stereo Components for 1961.

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

Export: Telesco International Corp.  
36 W. 40th St., N. Y. C.

## PLATT saves you DOLLARS!

A complete inventory of parts is available for all types of LINK MOBILE EQUIPMENT. (Listed mobile equip., reconditioned, excellent)



2-PIECE MODEL FMTR 30-50 MC ED. 7 FM MOBILE TRANS. & REC.—6 OR 12 VOLTS

Fitt complete with Link Modulation control head, mike, antenna, cables & crystals ground to your specific frequency. Modified.

6 Volt—\$109.95 12 Volt—\$149.95

2-PIECE MODEL FMTR 152-174 MC ED. 7, 25 W, FM MOBILE TRANS. & REC.—6 OR 12 VOLTS

Supplied as illustrated above.

6 Volt—\$134.95 12 Volt—\$174.95

MODEL 2210 152-162 MC FM MOBILE TRANS. & REC. 6 OR 12 VOLTS



Antenna, cables, control head, mike, crystals. Complete for immediate installation. Specially priced.

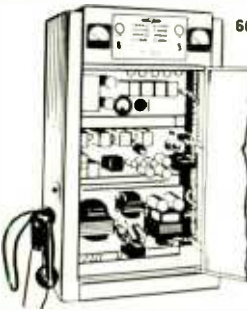
6 Volt \$139.50  
12 Volt \$162.50

MODEL 2365 25-40 OR 30-50 MC FM MOBILE TRANS. & REC.—6 OR 12 VOLTS

Supplied as illustrated above. Complete for immediate installation.

6 Volt—\$119.50 12 Volt—\$149.50

MODEL 50 UFS 60 WATT 30-50 MC BASE STATION



Housed in a 31" upright cabinet. Operates on 110 AC. Reconditioned, checked out, complete with accessories. \$249.50

MODEL 1907 60 WATT FOR HIGH FREQ. OPERATION 152-174 MC, 110 V. Reconditioned, checked out, complete with all accessories. \$299.50

### REMOTE CONTROL UNITS

Model 1890—for operation in the 27-54 megacycle band. Used for Link Base Station operation & can be adapted for any other type. Brand New



\$169.50

### BRAND NEW SIMPSON METERS 3 1/2" SQUARE

0—250 mil ..... \$4.95  
0—750 DC Volts ..... \$5.95  
0—150 AC Volts ..... \$4.95



### FIELD TELEPHONES



Army surplus, completely reconditioned and electrically tested, using 2 flashlight cells and a pair of interconnecting wires. GUARANTEED, NEW.

\$19.95 each, \$35.00 pair

While They Last!

### T-17 HAND-HELD CARBON MIKE



For use in voice communication. Effectively covers the audio frequency range from 300 to 2500 cps, 200 ohms, with press-to-talk switch, 5 ft. rubber cord & plug, NEW. \$3.95

### MINIMUM ORDER \$5.00

Immediate Delivery. Include 20% deposit with order—balance C.O.D. All shipments F.O.B. our warehouse, N. Y. C. (N. Y. C. residents add sales tax to your remittance.)

## PLATT ELECTRONICS CORP.

20 MURRAY ST., NEW YORK 7, N. Y.  
Telephone: COrtland 7-2575

ness of the response without loss of high frequencies, has been obtained in the CM-12 by a finely controlled acoustic port between the microphone chamber and a sealed chamber in the handle.

### STEREO CARTRIDGE

Audio Dynamics Corp., 1677 Cody Ave., Ridgewood, N.Y. has announced a stereo cartridge that can track at less than one gram and also provide what is claimed to be the highest lateral and vertical compliance available today— $10 \times 10^{-6}$  cm./dyne. Reduced record wear and distortion combined with improved tonal response are said to result with the use of this pickup.

Designated as Model ADC-1, the new device reportedly uses a dynamic mass for its moving system that is smaller

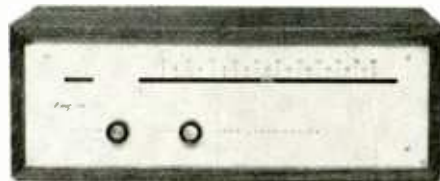


than that of any cartridge now available. Excellent channel separation at all frequencies is claimed. Stylus replacement is said to be easy and fast, requiring no special skills or tools. Sensitivity at 1000 cycles is given as  $7 \text{ mv.} \pm 2 \text{ db.}$

### FM TUNER

Kary Laboratories, Inc., South Norwalk, Conn. has introduced a new FM tuner, the "Primata" Model CT-3.

The tuner has a sensitivity of  $.8 \mu\text{v.}$  for 20 db of quieting. Distortion is stated as under .7 per-cent at 100 per-cent modulation. The 8-tube circuit uses printed r.f. coils for stability, a dual-function gated-beam detector, wide-band Foster-Seeley discriminator, and is factory aligned. Flywheel tuning is



featured and a multiplex jack is provided.

### DUAL 12-WATT AMPLIFIER

Stromberg-Carlson, division of General Dynamics, Rochester 3, N.Y. has announced a 24-watt stereo amplifier (12 watts per channel) with controls. Designated as Model ASR-2-20C, the new unit features low distortion, low hum and noise levels, and inputs and controls that have been, in the words of the company, "human engineered."

Separate clutch-type bass and treble adjustments are provided for each channel. Also included are: scratch filter; rumble filter; A + B center speaker terminals; channel reverse switch;



stereo-mono switch; program selector; loudness control; and an a.c. convenience outlet.

### NEEDLE STOCK SYSTEM

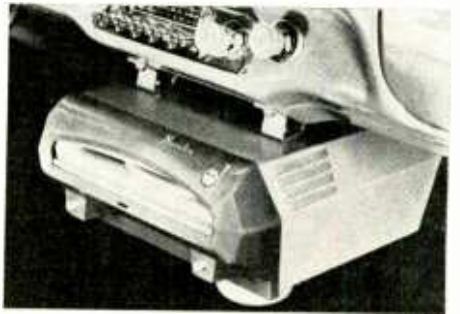
Astatic Corp., Conneaut, Ohio is offering a new system called "Asta-Stock" to simplify the distributor's job of maintaining a balanced stock of its line of phono needles.

Included in the "Asta-Stock" are small cabinets with drawers, a custom-designed package for each needle, complete cross-reference material with each needle package, and similar data on the index tabs of the stock cabinet.

### PHONO FOR AUTOS

North American Philips Co., Inc. (Norelco). High-Fidelity Products Division, 230 Duffy Ave., Hicksville, Long Island, N.Y. has announced its "Auto Mignon," a fully automatic record player designed for use in automobiles.

The "Mignon" plays 45 rpm records with the large center hole. To operate it, the user pushes a record into a slot.



After the record is played, it slides out of the slot for removal.

According to the manufacturer, the "Mignon" is compact enough to be installed readily in any car. It plays through the car radio; operating power is supplied by the car battery. Switching from phono to radio is done by pressing a push-button on the front panel.

### STYLUS INSPECTOR

Robins Industries Corp., 36-27 Prince St., Flushing 54, N.Y. has announced a new stylus inspection device, called "Syl-A-Scope." Claimed to be a precision instrument, it shows stylus wear by magnifying the contours of a stylus and reflecting the image upon an illuminated screen.

It can be used without removing the stylus or the cartridge from the tone arm. Designated as Model No. SG-66, the new instrument also is said to be useful for examining small parts, tools, and instruments.

### NEW CROSBY COMPONENTS

Crosby Electronics, Inc., Syosset, Long Island, N.Y. has brought out the first two models of its new line of hi-fi

stereo components. These are the Model 690 FM tuner, shown here, and the Model 680 28-watt stereo amplifier with controls.

Both models are identical in size and are designed to form a matched pair for the "heart" of a stereo system. The amplifier features push-button program selection, individual channel bass and treble controls, mono/stereo blend control, and "center channel" output. It furnishes 14 watts (music-power rating) output per channel.

The tuner, for FM reception and with



a multiplex output, boasts a sensitivity of 1  $\mu$ v. for 20 db of quieting. It features variable a.f.c. and variable inter-station muting. Distortion is listed as less than 1 per-cent for 100 per-cent modulation with a 50-microvolt signal.

#### OUTPUT TRANSFORMER

Chicago Standard Transformer Corp., 3501 W. Addison St., Chicago 18, Ill. has recently added a 65-watt output unit to its line of audio transformers.

Designated as No. BO-15, it can be used with tube types 6550, 6L34, or KT88 for construction of a 40-watt or 60-watt amplifier with tertiary feedback.

High performance and very low distortion are claimed for the amplifiers utilizing this output transformer. Complete details for constructing either model, including illustrations, schematics, and parts lists are contained in Bulletin CT-47 which is available either from the manufacturer direct or any of the firm's authorized distributors.

#### NEW AMPEX RECORDER

Amper Products Div., 934 Charter St., Redwood City, Calif. has brought out its Model PR-10, described as a compact, studio-quality recorder.

The PR-10 comes as either a stereo/



mono machine or a mono model in either full- or half-track versions. A four-position head assembly permits repositioning heads for special requirements, or adding a four-track stereo playback head. The "electronics" of the unit is designed on a modular basis.

Complete remote control of all func-

## Add New Sounds to Ham Radio and Hi-Fi...



### with Koss Stereophones

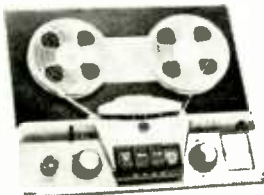
Koss Stereophones give you all the deep, full base tones your hi-fi-stereo gear will produce or add new clarity to ham equipment. ■ You'll actually be adding sounds you never heard before with Koss Stereophones. They add a new flexibility to any sound reproduction system.



Ask your hi-fi dealer for a demonstration or write

2227 N. 31st STREET, MILWAUKEE 8, WIS.

NEW



ARKAY-HARTING  
HM-4/MS-5  
STEREO  
RECORD-PLAYBACK  
TAPE DECK  
\$129<sup>95</sup>

Records and plays back in STEREO and 4 track monaural

Now you can afford the satisfaction and pride of owning a professional quality tape deck. The MS-5 features amazing simplicity of design and operation, yet is engineered to broadcast standards. Compare it to tape deck costing over \$200!

- 5 push button operation and drop-in loading
- Automatic interlock prevents accidental erasure
- Double shoe brakes for split-second non-slip stops
- All metal tape fingers for longer tape life
- Oversized capstan insures constant tape speed
- 2 speed Stereo and monaural operation

RPA-7 Record-Playback amp-preamp for use with HM-4/MS-5 Tape Deck

wired and tested: \$79<sup>95</sup>



2 Hi imp. mike inputs for live recording.  
2 radio phono jacks, mixing facilities with mike inputs  
74 KC bias osc. for record and erase bias voltages.  
Transistorized record stage for low noise.

• Audio output—4 watts channel • Freq. resp.—50 15,000 cps  $\pm$  2 db • Sep. loudness, balance, tone controls • Record level indicator • 7 tubes • 2 transistors • DC on preamp filaments.

See and hear ARKAY Kits at your dealer.  
FREE! Stereo booklet and catalog. Write Dept EW

arkay  
88-06 Van Wyck Expressway Richmond Hill 18, N.Y.

**CROWN**  
Professional Tape Recorder

GUARANTEED PERFORMANCE

"800" Series  
"SUPRA" PROFESSIONAL

World's most magnificent recorder and greatest performance value per dollar!

FEATURES: Crown "X" All-Electric Control — Micro Queing — Third Head Monitor — Full Remote Control — Photo-Cell Automatic Stop — Standard Rack Mount.

Some dealer franchises available. Write Box 261, or phone JA 2-8583 for full information.

**CROWN INTERNATIONAL**  
Division of  
INTERNATIONAL RADIO & ELECTRONICS CORP.  
ELKHART, INDIANA

# CITIZEN BAND



## CLASS "D" CRYSTALS

All 22 Frequencies in Stock

3rd overtone .005% tolerance—to meet all FCC requirements. Hermetically sealed HC6/U holders. 1/2" pin spacing—.050 pins. (.093 pins available, add 15c per crystal.) **2<sup>95</sup>** each

We can supply matched sets for Globe, Conset, Citizen and Hallicrafters units at \$5.90 per set. Specify transmitting frequency and make of equipment.

Following frequencies in stock (frequencies listed in megacycles): 26.965, 26.975, 26.985, 27.005, 27.015, 27.025, 27.035, 27.055, 27.065, 27.075, 27.085, 27.105, 27.115, 27.125, 27.135, 27.155, 27.165, 27.175, 27.185, 27.205, 27.215, 27.225.

**RADIO CONTROL CRYSTALS** in HC6 U holders in stock for immediate delivery—all channels. Pin diameter .050. \$2.95 ea. .093 pin spacing, add 15c. **SEALED OVERTONE CRYSTALS** Supplied in metal HC6 U holders.

Pin spacing .486, diameter .050  
 15 to 30 MC .005 tolerance \$3.85 ea.  
 30 to 45 MC .005 tolerance \$4.10 ea.  
 45 to 60 MC .005 tolerance \$4.50 ea.



## QUARTZ CRYSTALS for every service

All crystals made from Grade "A" imparted quartz—ground and etched to exact frequencies. Unconditionally guaranteed! Supplied in:

FT-243 holders MC-7 holders  
 pin spacing 1/2" pin spacing 3/4"  
 pin diameter .093 pin diameter .125

DC-34 holders FT-171 holder  
 pin spacing 3/4" pin spacing 1/4"  
 pin diameter .156 banana pins

### MADE TO ORDER CRYSTALS

1001 KC to 2600 KC:  
 .01% tolerance \$2.00 ea. .005% tolerance \$2.75 ea.  
 2601 KC to 9000 KC: .005% tolerance \$2.50 ea.  
 9001 KC to 11,000 KC: .005% tol. \$3.00 ea.  
 Specify holder wanted

### ANY AMATEUR, NOVICE, TECHNICIAN BAND CRYSTALS

80 meters 3701-3749 KC .01% tolerance  
 40 meters 7152-7198 KC  
 15 meters 7034-7082 KC  
 6 meters 8335-8650 KC  
**1.50 ea.**  
 within 1 KC)

**MARINE FREQUENCY CRYSTALS**—All marine frequencies from 2000-3200 KC .005 tolerance \$2.50 ea. (supplied in either FT-243, MC-7 or FT-171 holders)

**STOCK CRYSTALS** in FT-243 holders from 5675 KC to 8650 KC in 25 KC steps 75c each or 3 for \$2.00

FT-241 Lattice Crystals in all frequencies from 370 KC to 540 KC (all except 455 KC and 500 KC) 50c ea. Pin spacing 1/2" Pin diameter .093

Matched pairs—15 cycles \$2.50 per pair  
 200 KC Crystals \$2.00 ea.  
 455 KC Crystals \$1.50 ea.  
 500 KC Crystals \$1.50 ea.

100 KC Frequency Standard Crystals in HC6/U holders \$4.50 ea.

Socket for FT-243 crystal 15c ea.  
 Dual socket for FT-243 crystals 15c ea.  
 Sockets for MC-7 and FT-171 crystals 25c ea.  
 Ceramic socket for HC6/U crystals 20c ea.

**FREE!** Write for Catalog #860 with oscillator circuits.

**ASK YOUR PARTS DEALER FOR TEXAS CRYSTALS**  
 See big red display . . . if he doesn't stock them, send us his name and order direct from our factory.

**NOW!** Engineering samples and small quantities for prototypes now made either at Chicago or at Ft. Myers Plant. 24 Hour Service!  
 IN CHICAGO, Phone Gladstone 3-3555

**ORDER FROM OUR NEW FLORIDA PLANT**  
 Use coupon below for 1st Class shipment  
**TEXAS CRYSTALS**  
 Dept. R-11, 1000 Crystal Drive, Fort Myers, Fla.  
 For Fastest Service, Phone WE 6-2100

**FILE OUT AND ATTACH THIS COUPON TO YOUR ORDER FOR SHIPMENT VIA 1ST CLASS MAIL AT NO EXTRA COST!**

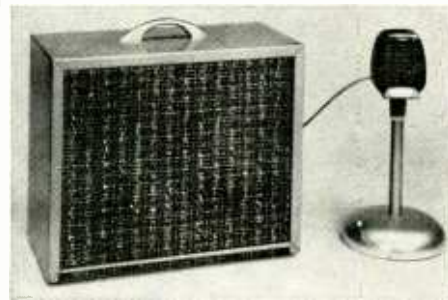
NAME.....  
 ADDRESS.....  
 CITY.....ZONE.....STATE.....  
 TERMS: All items subject to prior sale and change of price without notice. All crystal orders must be accompanied by check, cash or M. O. with **PAYMENT IN FULL. NO COD'S.** Dept. R-11

tions is provided. An exclusive automatic tape-threading accessory enables "no hands" tape handling for greater speed and convenience.

### PORTABLE P.A. SYSTEM

Checker Electronics Corp., Grayslake, Ill. has introduced a low-cost, single-unit, portable public-address system.

Called the "Raven 401," the new equipment comprises a combination amplifier-speaker unit, with microphone.



Power output is 8 watts peak. Three tubes are used. The microphone is a controlled-reluctance type; the speaker, an eight-inch driver.

Additional information is available from the manufacturer.

### AUDIO CATALOGUES

#### GOODMANS SPEAKER DATA

Rockbar Corp., 650 Halstead Ave., Mamaroneck, N.Y. has issued a 16-page catalogue on Goodmans loudspeakers.

Entitled "For the Discerning Listener," the booklet describes the speakers and includes plans for recommended enclosures.

### NEW SHURE PUBLICATIONS

Shure Brothers, Inc., 222 Hartney Ave., Evanston, Ill. has issued three new

publications of interest to audiophiles.

The first is a handsomely illustrated 20-page booklet on "The Art of Selecting, Playing, and Preserving Recordings." It is priced at 25 cents.

The company's general catalogue, available free, lists more than 30 microphone models and accessories, and related components.

Finally, there is a revised edition of "For the Critical Ear," which is a brochure describing the company's high-fidelity components, with emphasis on new pickups and arms. This brochure is also available without charge.

### CABINETS AND ENCLOSURES

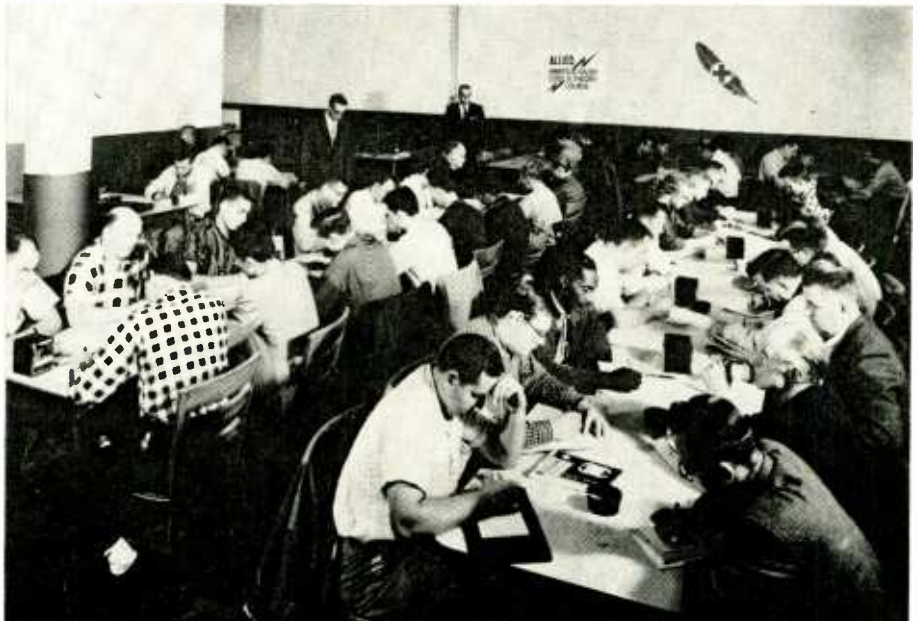
Rockford Special Furniture Co., 1803 W. Belle Plaine, Chicago 3, Ill. has announced the availability of its Bulletin R-16 which describes this manufacturer's line of high-fidelity equipment cabinets and speaker enclosures. Console and chairside types are included. —30—

### NOMINATIONS OPEN FOR EDISON AWARD

**T**HE Ninth Annual Edison Radio Amateur Award competition is now under way with nominations being solicited on behalf of the licensed radio amateur who has performed the most outstanding public service during 1960. To the winner will go the coveted 1960 Edison Award—a \$500 cash prize, the trophy cup, and guest-of-honor status at the banquet to be held in Washington next February.

Nominations may be submitted by anyone familiar with the public service performed by a licensed U.S. radio amateur who resides in any of the 50 states. They should be addressed to the secretary, Edison Radio Amateur Award Committee, General Electric Co., Owensboro, Ky. —30—

Allied Radio Corp., Chicago, has expanded its Novice Amateur Radio Course to meet the increased demand for Novice Amateur training. This course, offered free of charge, trains students to pass the FCC exams for the Novice Amateur license. The program, launched more than six years ago, had an initial enrollment of 50 students in a single 14-week course. It was later expanded to three 14-week courses per year with a total enrollment in excess of 400. Now, with the latest expansion to three additional classes per year, an annual enrollment of over 500 is anticipated.



## Computer Logic Circuits

(Continued from page 47)

of the negative supply. Assume, for example, that the plate potential is 120 volts, the negative supply is -100 volts, and the two resistors of the voltage divider are equal in value. Under these conditions, the voltage at the output terminal will be midway between plus 120 and minus 100 volts, or plus 10 volts. The circuit therefore produces an output of 10 v. with no input applied.

Now assume that a positive voltage is applied to the input terminal and that, as a result, the plate voltage decreases to 100 volts. The output terminal will now be at zero potential. The circuit therefore fulfills the requirements of the *not* function because it produces an output (10 volts) when input is not applied, and produces no output when input is applied.

It is characteristic of the *not* circuit that its output terminal can be at either of two different voltage levels depending upon whether or not an input is applied. In the above example, the two output levels were zero and 10 volts. With other values of resistance in the voltage divider the two output levels could be made +5 and -5, or +3 and -7, or 0 and -10, etc. The absolute values of these levels are not important except that they must be correct to drive the circuits which follow the *not* circuit. More important is the fact that the cir-

cuit is capable of two output levels. In practice, one of these levels represents binary 1 and the other level represents binary 0. From this point of view, it may be stated that the *not* circuit produces a 1 output when it receives a 0 input, and produces a 0 output when it receives a 1 input.

The *inhibitor* circuit shown in Fig. 4 consists of a voltage divider with a transistor connected across the lower resistor. This transistor is biased below cutoff. When an input pulse is applied to the voltage divider, a pulse will ordinarily appear at the output terminal. The lower resistor of the voltage divider is much larger than the upper resistor, and the output pulse is therefore almost as large in amplitude as the input pulse.

However, the transistor in this circuit functions as a switch to short out the lower resistor of the voltage divider. A positive pulse applied to the inhibit terminal will make the transistor conductive and will reduce the amplitude of the output pulse to an insignificant value. The circuit therefore produces an output (when it receives an input) only if there is no input to the inhibit terminal.

Logic circuits comprise the heart of the digital computer: the arithmetic section in which the actual calculation is performed. They are also used for channeling the flow of information between the various sections of the computer. These applications of logic circuits, however, merit separate treatment in another article.

Ask By Name For  
**GENUINE**  
your assurance  
of brand name  
quality

**"NO NOISE"**  
PRODUCTS



**NO-NOISE**  
VOLUME CONTROL and  
CONTACT RESTORER

• Lubricates • Protects  
• Cleans • Not a Carbon Tet. Solution  
2 Oz. Bottle \$1.00  
6 Oz. Spray Can \$2.25  
Net to Servicemen

**NO-NOISE**  
TUNER-TONIC  
With PERMA-FILM

- Cleans, lubricates, restores all tuners, including wafer type.
- Non-toxic, non-inflammatory.
- For TV, radio and FM use.
- Economical — a little does a lot.

6 Oz. Aerosol Can  
**\$3.25**  
Net to Servicemen



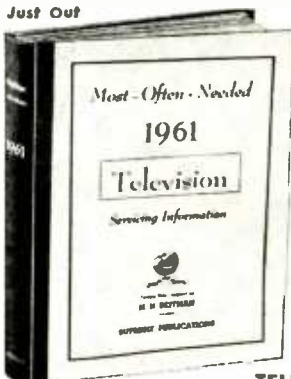
**FREE** At Your Jobbers  
**5" PLASTIC**  
**EXTENDER**

- Push Button Assembly
- For Pin-Point Applications
- Does Not Cause Shorts

**ELECTRONIC CHEMICAL CORP.**

813 Communipaw Avenue Jersey City 4, N. J.

Just Out



# New SUPREME 1961 TV Manual

## AMAZING BARGAIN

The new 1961 TV manual is the bargain of the year. Covers all important sets of every make in one giant volume. Your price for this mammoth manual is only \$3. This super-value defies all competition. Other annual volumes at only \$3 each. Factory service material simplifies repairs. Includes all data required for quicker TV servicing. Practically tells you how to find each fault and make needed repair. More pages, more diagrams, more service data per dollar of cost.

## TELEVISION SERVICING COURSE

Let this new course help you in TV servicing. Amazing bargain, complete, only \$3. full price for all lessons. Giant in size, mammoth in scope, topics just like a \$200.00 correspondence course. Lessons on picture faults, all circuits, adjustments, short-cuts, alignment facts, hints, UHF, antenna problems, trouble-shooting, test equipment, and video analysis. Special, only **\$3**



## SIMPLIFIED RADIO SERVICING (Introduction to TV)

Explains how to use comparison method to find most radio faults in minutes. Many practical tests without any equipment. Also several sets of service hints. Job sheets cover all sets. New edition, only **\$1.50**

RADIO VOLUMES

## RADIO DIAGRAMS

Your best source for all needed RADIO diagrams and service data. Covers everything from most recent 1960 radios to pre-war old-timers: home radios, stereo combinations, transistor portables, FM, auto sets. Only \$2 for many volumes. Every manual has large schematics, all needed alignment facts, printed boards, voltages, trimmers, dial stringing, and hints. Volumes are big, 8 1/2 x 11 inches, about 190 pages. See coupon for list of these popular radio manuals. →



## COVERS ALL POPULAR SETS

Here is your service data for faster, easier TV repairs. Lowest priced. Best by comparison. *Supreme TV* manuals have all needed service material on every popular TV set. Helpful, practical, factory-prepared data that will really make TV servicing easy for you. Benefit and save with these amazing values in service manuals. Only \$3 per large volume. Used by 174,000 wise servicemen for faster repairs.



The repair of any TV set is made simple with *Supreme TV* service manuals. Every set is covered in a practical manner to simplify trouble-shooting and repair. This is the help you need to find toughest faults in a jiffy. Most \$3 TV volumes cover a whole year. Be wise, buy *Supreme Manuals* only once each year instead of spending dollars every week.

## SIMPLIFIES TV REPAIRS

These giant TV manuals have complete circuits, needed alignment facts, printed boards, servicing hints, production changes, voltage charts, waveforms, and double-page schematics. Here are your authentic service instructions to help you do expert work quicker; and priced at only \$3 per large annual manual. Repair any TV model ever made by having in your shop all 15 volumes as listed in coupon. Your special price for all, only \$40. Or try the new 1961 TV manual to see what an amazing bargain you get for \$3. Send no-risk trial coupon today.

## NO-RISK TRIAL ORDER COUPON

SUPREME PUBLICATIONS, 1760 Balsam Rd., Highland Park, ILL.

Rush today TV manuals checked  below and Radio manuals at left. Satisfaction guaranteed.

New 1961 TV Manual, \$3.  1960 TV, \$3.  
 Additional 1959 TV, \$3.  Early 1959 TV, \$3.  
 1958 TV Manual, \$3.  Additional 1957 TV, \$3.  
 Early 1957 TV, \$3.  1956 TV Manual, \$3.  
 Additional 1955 TV, \$3.  Early 1955 TV, \$3.  
 1954 TV, \$3.  1953 TV, \$3.  1952 TV, \$3.  
 1951 TV, \$3.  1957-58 RCA TV Manual, \$1.50  
 New Television Servicing Course, complete... \$3.

I am enclosing \$..... Send postpaid.  
 Send C.O.D. I am enclosing \$..... deposit.

Name: .....  
 Address: .....

**Supreme Publications**  
Sold by All Leading Parts Jobbers



**83 YX 929. Stereo Tape Record-Play Preamp Kit. \$79.95 (less case)**

One of the many great Knight-Kit stereo component kits. Professional quality; superb performance with virtually any tape transport; separate dual-channel recording and playback preamps; permits tape monitoring, sound-on-sound and echo effects. Packed with quality features for every possible stereo and monophonic function...



**83 YX 928. FM-AM Hi-Fi Tuner Kit. \$49.95**

Typical Knight-Kit hi-fi value—incomparable at the price. With AFC, tuned RF stage on FM, multiplex jack. Straight FM tuner kit also available at \$38.95. For deluxe Stereo FM-AM and FM tuner kits, see the Allied catalog...



**83 YX 927. 20-Watt Stereo Hi-Fi Amplifier Kit. \$39.95**

Biggest bargain in quality Stereo hi-fi. Has special clutch-type dual-concentric level control; simplified control facilities; DC preamp filaments. Similarly styled 32-Watt Stereo Amplifier Kit with full frequency center channel available at a low, low \$59.95...

**83 YU 934. Deluxe 70-Watt Stereo Hi-Fi Amplifier Kit. \$119.95**



Super-power to drive any of today's speakers, a do-it-yourself stereo masterpiece, featuring: special "blend" control; full-range center channel; tape-source monitor; dual phasing switches; Stereo paralleling switch. For deluxe 40-watt Stereo amplifier at only \$76.95, and 60-watt Stereo amplifier, see the Allied catalog...

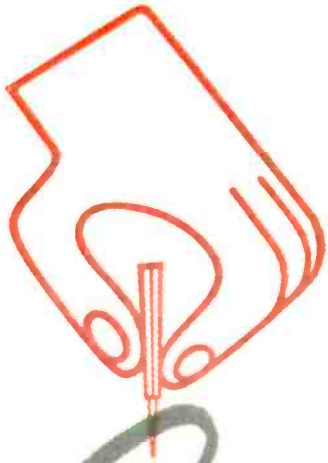
*Simply*

these and 59

**knight**  
A PRODUCT

a pleasure to build...

The most satisfying do-it-yourself experience awaits you when you build a Knight-Kit! You'll marvel at the sheer ease of assembly, absolutely assured by exclusive "show-how" manuals, wall-sized picture diagrams, step-by-step do-and-check instructions, pre-cut wire, "visi-packed" parts and an engineering perfection that eliminates guesswork. You'll get perfect results. You'll enjoy with pride a true custom-built electronic product, professionally engineered and styled—the best you can own. And to top off your pleasure, you'll save substantially at the unbeatable Knight-Kit price...



83 YX 712-2. Superhet  
Citizen's Band  
Transceiver Kit.  
\$79.95



Dual-conversion for highest sensitivity and selectivity; crystal-controlled operation on any 2 channels, plus manual tuning. Another Knight-Kit Citizen's Band Transceiver is available at an amazing low \$39.95—see the Allied catalog for full details...

*Great!*

other money-saving

**-kits**<sup>®</sup>

OF ALLIED RADIO

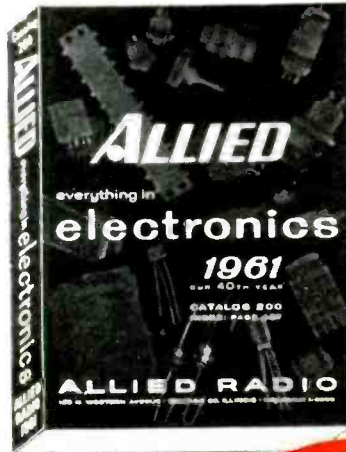
and you own the best

**money back guarantee**

Every Knight-Kit is unconditionally guaranteed to meet our published specifications for performance or your purchase price is refunded in full.

**only \$2 down**

It's easy to buy any Knight-Kit: only \$2 down on orders up to \$50; \$5 down up to \$200; \$10 down over \$200—up to 24 months to pay.



*Featured*

IN THIS VALUE-PACKED 1961  
**444-PAGE ALLIED CATALOG**

Send coupon today for the 1961 Allied electronics catalog (the world's biggest), featuring the complete Knight-Kit line. See the best in electronic kits—save on *everything* in Electronics. Send for your FREE copy now!

sold exclusively by

**ALLIED RADIO**

*pioneer in electronic kit development*

our 40th year



also available  
in Canada



83 YX 258. 4-Band "Span Master"® Receiver Kit. \$25.95

Fabulous performer for world-wide reception; thrilling shortwave adventures, plus fine Broadcast; band-switching, 540 KC to 30 MC; with cabinet. For additional receiver kits, radio-intercom, clock-radio, transistor radios, intercom systems, electronic labs and other great hobbyist Knight-Kits, see the Allied catalog...

83 Y 125. Electronic VTVM Kit. \$25.75

High sensitivity general-purpose VTVM; 11 meg input resistance; balanced-bridge circuit; 4½" meter. One of many fine instrument kits including 5" scopes, AC VTVM, tube checkers, signal tracer, audio generator, sweep generator, and others, described in detail in the Allied catalog...



**send coupon today!**

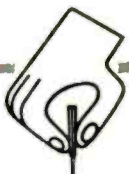
ALLIED RADIO, Dept. 10-A1  
100 N. Western Ave., Chicago 80, Ill.

Send Free 1961 Allied Catalog No. 200

Name \_\_\_\_\_  
PLEASE PRINT

Address \_\_\_\_\_

City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_



**SEND  
ELECTRONICS WORLD  
EVERY  
MONTH**



name \_\_\_\_\_  
address \_\_\_\_\_  
city \_\_\_\_\_ zone \_\_\_\_\_ state \_\_\_\_\_

Check one:

3 years for \$12  2 years for \$9  
 1 year for \$5

In the U. S., its possessions, and Canada  
 Payment enclosed  Bill me

Foreign rates: Pan American Union  
countries, add .50 per year; all  
other foreign countries, add  
\$1.00 per year.

Mail to: **ELECTRONICS WORLD**  
Dept. EW 161H, 434 S. Wabash Ave.,  
Chicago 5, Ill.

**WHO NEEDS**

**MILES OF WIRE?**

**GET  
HOME ELECTRICITY  
IN CAR, BOAT,  
PLANE, with a**

*terado*

**CONVERTER**

Change battery current to  
110 volt, 60 cycle A.C.

No Installation—Just plug into  
cigarette lighter of car, truck,  
or boat, and it's ready to go!

Operate tape record-  
ers, electric shavers,  
dictation machines,  
record players, small  
electric tools, port-  
able TV, and testing  
equipment.

**Models from 15  
to 200 watts,  
priced as low as \$1295**



See Your Electronic Parts Dealer or Jobber  
**terado COMPANY**  
DESIGNERS & MFRS. OF ELECTRONIC EQUIPMENT SINCE 1927  
1058 RAYMOND AVE., ST. PAUL 8, MINNESOTA  
In Canada: ATLAS RADIO CORP. LTD.—Toronto, Ont.

# New Tube Tester Data

Recent listings with which owners of Triplett  
tube checkers can keep roll charts up to date.

## TRIPLETT MODEL 3423

TUBE TYPE	A	B	CDEFG	UP	DOWN	READS
3C24/24G	6.3	40	6XOY4	1	4X	330
3DG4	3.15	13	60056	1	3	Good
3DG4 Test 2	3.15	13	60076	1	3	Good
5GH8	4.7	17	52362	5	247	3900
5GH8 Test 2	4.7	17	59012	5	489	4500
6AL3/EY88	6.3	13	60096	4	5X	Good
6CD6	6.3	54	458Y2	7	1235	3750
6CL8	6.3	0	51022	4	135	5200
6CL8 Test 2	6.3	0	59762	4	589	3770
6EH7/E183F	6.3	17	52872	4	1259	8200
			(Pin 3 also shows short)			
6EJ7/E184F	6.3	0	52872	4	1259	9750
			(Pin 3 also shows short)			
6EV7	6.3	18	62012	4	235	3400
6EV7 Test 2	6.3	18	67062	4	578	3400
6EW7	6.3	55	67063	4	578	1300
6EW7 Test 2	6.3	57	52012	4	259	4250
			(Pin 3 also shows short)			
6FG5	6.3	0	61652	3	1247	3200
6GC6	6.3	58	554Y2	7	235	3750
			(Pins 4 and 8 show short)			
6GH8	6.3	17	52362	5	247	3900
6GH8 Test 2	6.3	17	59012	5	489	4500
6GM6	6.3	0	51652	3	124	8500
			(Set "Special-Normal" switch in "Special" position)			
6GM8/ECC86	6.3	0	32012	4	235	5000
6GM8 Test 2	6.3	0	37062	4	578	5000
6GN8	6.3	22	57892	4	567	7500
			(Set "Special-Normal" switch in "Special" position)			
6GN8 Test 2	6.3	18	62033	4	125	1750
7DJ8/PCC88	7.5	18	57062	5	478	8200
7DJ8 Test 2	7.5	18	52012	5	234	8200
8ET7	7.5	14	57892	4	567	5700
			(Set "Special-Normal" switch in "Special" position)			
8ET7 Test 2	7.5	76	30026	4	15	Good
8ET7 Test 3	7.5	76	30036	4	15	Good
8GN8	9.45	22	57892	4	567	7500
			(Set "Special-Normal" switch in "Special" position)			
8GN8 Test 2	9.45	18	62033	4	125	1750
12GA6	12.6	17	31654	3	1247	845
12GA6 Test 2	12.6	17	37654	3	1247	845
12GC6	12.6	58	554Y2	7	235	3750
			(Pins 4 and 8 show short)			
14GT8	12.6	27	68094	4	578	650
14GT8 Test 2	12.6	13	60026	4	35	Good
14GT8 Test 3	12.6	13	60066	4	15	Good
16AQ3/XY88	19.6	13	60096	4	5X	Good
35EH5	32.0	21	52672	4	123	9500
			(Pin 5 also shows short)			
35GL6	32.0	37	52572	3	124	4875
5751	6.3	7	42014	9	2345	780
5751 Test 2	6.3	7	47064	9	4578	780
5842/417A	6.3	8	54012	3	469	12000
			(Set "Special-Normal" switch in "Special" position)			
			(Pins 4, 7, —5, 8 also show short)			
5920/E90CC	6.3	24	56012	3	467	3900
5920 Test 2	6.3	24	55022	3	457	3900
6688/E180F	6.3	8	52972	4	1258	10500
			(Set "Special-Normal" switch in "Special" position)			
			(Pin 3 also shows short)			
6689/E83F	6.3	0	52162	4	235	5300
7247	6.3	22	67064	9	4578	1050
7247 Test 2	6.3	53	62013	9	2345	1450
7355	6.3	53	56833	2	567	3800
7408	6.3	16	45433	7	258	2665
7543	6.3	15	51653	4	1237	2550
7551	12.6	43	52363	4	1257	2650
			(Pins 1, 3—8, 9 also show short)			
7558	6.3	43	52363	4	1257	2650
			(Pins 1, 3—8, 9 also show short)			
7581	6.3	36	55433	7	258	3250
CK6659/CK1042	OFF	25	60016	—	5	Good
CK7576	6.3	10	52032	1	268	6800
			(Set "Special-Normal" switch in "Special" position)			
			(Pin 7 also shows short)			



# FREE!

## LAFAYETTE'S 1961 CATALOG 324 GIANT SIZED PAGES

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

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

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

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

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



### Our 40th Year

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



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



RK-400 2-Speed  
Portable Tape Recorder  
49.50



TE-15 Tube Checker  
19.95



RW-50 20,000 Ohms Per  
Volt Multitester  
13.50



TM-14  
Radio Field Indicator  
6.95



HE-800WX  
Citizen Band Mobile Antenna  
6.95

## LAFAYETTE RADIO

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



**Lafayette Radio Electronics Corp.**  
Dept. RA-1, F. O. Box 190  
Jamaica 31, N. Y.

Send me the FREE Lafayette 324 page  
1961 catalog 610

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_

# FROM

# LAFAYETTE

America's Citizens Band Headquarters

## 3 GREAT NEW CITIZENS BAND TRANSCEIVERS

CITIZENS BAND — The New Two-Way Personal Communications Method For Everyone. Fill out the FCC form enclosed with each Lafayette Transceiver. No examination or technical knowledge required—Any citizen 18 years or older is eligible for a license.

IDEAL FOR BUSINESS, CAR, BOAT, FARM, INDUSTRY, PERSONAL & SPORTS USE



Trucking



On the Farm



Boating

## LAFAYETTE 9 TRANSISTOR PORTABLE CITIZENS BAND "WALKIE-TALKIE"



HE-29

Complete Portable Two-Way Communication — with No License Required!

- Pocket Size — 6 3/8" x 3 1/4" x 1 1/8"
- Fully Transistorized—9 Transistors plus 1 Diode
- Transmits & Receives Up To 10 Miles (Under Favorable Conditions)
- Uses Inexpensive Penlight Batteries
- Telescoping Antenna — 3 ft. 9 in.
- Complete With Earphone For Private Listening
- Supplied With Attractive Leather Carrying Case & Crystals For Channel 10

# 49<sup>50</sup>

2.00 Down

Two for 96.50

Constructed with the care and precision of a fine watch. This new transceiver combines a portable transmitter and superheterodyne receiver designed for short range communication in the 27 mc Citizens Band. Advanced circuitry and design utilizes 9 transistors plus 1 diode to achieve a range of from 1.5 miles to 10 miles depending upon conditions. Low input power of 100 MW permits operation without FCC license or permit. Easy-to-use speaker serves as microphone, controls include push-to-talk switch and on-off volume control. Housed in sturdy aluminum case. Supplied with 8 miniature penlight batteries, earphone and attractive leather case with shoulder strap.

## LAFAYETTE HE-20 DELUXE CITIZENS BAND TRANSCEIVER

MADE IN U.S.A.



HE-20

- Foolproof Dependable Relay Switching
- 14 Tube Performance, plus 3 Diodes
- 4 Crystal-Controlled Transmit Positions

- 4 Crystal-Controlled Receive Positions Plus Tuneable Receiver over all 23 channels
- "S" Meter with Switch To Measure Signal Strength and To Check on Wattage Input to Final
- Dependable Push-To-Talk Ceramic Microphone & Relay
- Adjustable Squelch Control
- Highly Effective Automatic Series Gate Noise Limiter
- Illuminated Dial
- Built-In 12 Volt Power Supply For Mobile Use
- Comes Complete with Matched Crystals for Channel 9

COMPLETELY WIRED!

NOT A KIT!

# 99<sup>50</sup>

5.00 Down

The sensitivity and selectivity of this new transceiver equals that of the finest units available. Two or more of these transceivers will serve as an effective communications system over a distance of up to 20 miles, depending upon terrain and antenna height. Tunable Superheterodyne receiver section covers all 23 assigned channels with a sensitivity of 1 microvolt and provides for 4 crystal controlled receiving channels. 5-watt crystal-controlled transmitter operates on any 4 of 23 channels. Complete with rugged push-to-talk ceramic mike. Special bracket-handle allows installation in any location and any position. Size 12x5x8 1/2"D with 115V AC/12V DC Power Supply.

## LAFAYETTE HE-15A CITIZENS BAND TRANSCEIVER

Not Superregenerative but SUPERHET!  
THE GREATEST VALUE in The CITIZENS BAND FIELD



HE-15A

Completely Wired

# 57<sup>50</sup>

Made in U.S.A.

5.00 Down

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

- 5 Crystal-Controlled Transmitting Positions
- Superheterodyne Tuneable Receiver Over Full 23 Channels
- 4 Dual Function Tubes, 2 Single Function Tubes plus 2 Rectifiers for 12 Tube Performance
- Planetary Vernier Tuning
- Effective Full-Wave Variable Noise Limiter
- RF Jack on Front Panel
- High Output Crystal Microphone
- 5-Prong Microphone Jack for Easy Relay Addition
- Complete with Transmitting Crystal for Channel 9

# LAFAYETTE RADIO

PLEASE INCLUDE SHIPPING CHARGES WITH ORDER

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

NEW YORK, N. Y.  
100 6th Avenue

NEWARK, N. J.  
24 Central Avenue

BRONX, N. Y.  
542 E. Fordham Rd.

PARAMUS, N. J.  
182 Route 17

BOSTON, MASS.  
110 Federal Street

PLAINFIELD, N. J.  
139 W. 2nd Street

# LAFAYETTE HI-FI KITS

## Build A Path to A New World of Entertainment



**KT-250A**  
**30-WATT STEREO AMPLIFIER** ... 74.50



**KT-500A**  
**FM-AM STEREO TUNER** ... 74.50



**KT-600A** **STEREO**  
**PREAMPLIFIER** ... 79.50



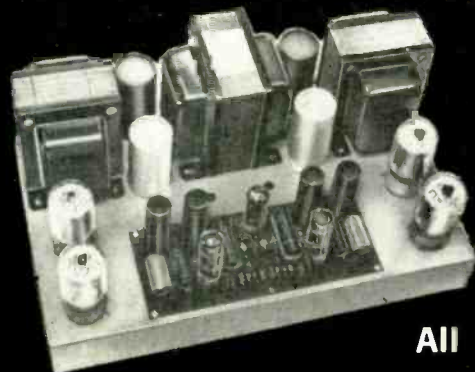
**KT-650**  
**FM TUNER** ... 54.50



**KT-236A** **36-WATT**  
**STEREO AMPLIFIER** ... 59.50

### MONEY-BACK GUARANTEE

*Lafayette Kits are exclusive products of Lafayette Electronics. Each Lafayette Kit must meet or exceed its published specifications, or your money is refunded in full.*



**KT-270** **70-WATT**  
**BASIC STEREO**  
**AMPLIFIER** ... 89.50



**KT-550** **100-WATT**  
**BASIC STEREO AMPLIFIER** ... 134.50

#### ENGINEERING:

Created with the non-technical builder in mind. There's much more fun in assembling your own kit ... and it's so easy.

#### DESIGN:

Each kit has the fine professional-looking touch. Styled to blend with every decor.

#### VALUE:

You can't get better buys at these money-saving prices.

#### QUALITY:

Top performance due to high quality parts and engineering.

**All Lafayette Kits are Available on the Easy Pay Plan.**  
**All Lafayette Kits Made in U.S.A.**

# COYNE'S New Complete Pin-Point TROUBLE SHOOTING Series

See All 4  
Books On 7-Day  
FREE TRIAL!

Takes Headaches Out Of  
All Servicing Problems!



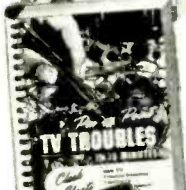
## Pin-Point TRANSISTOR TROUBLES IN 12 MINUTES!

Trouble-shoot every type of circuit in ALL transistorized equipment! 525 pages; hundreds of illustrations; 120 check charts! \$5.95



## Pin-Point RECORD CHANGER TROUBLES IN 5 MINUTES!

Locate mechanical and electronics troubles fast. Covers all makes. 320 pages; 450 photos; 58 check charts! \$3.95



## Pin-Point TV TROUBLES IN 10 MINUTES!

Find the exact sound or picture trouble in any TV set from 700 possibilities! 300 pages; 300 diagrams, check charts! \$4.95



## Pin-Point COLOR TV TROUBLES IN 15 MINUTES!

Covers every type of color TV and picture tube! 550 pages; 362 check charts, diagrams, picture patterns! \$5.95

### Simple Check Chart System Saves Time

These amazing practical handbooks with an ENTIRELY NEW METHOD, show you how to find the trouble in ANY tv, record changer or transistor circuit FAST! Index tells you where to look; famous Check-Charts help you pin-point the exact trouble in minutes! These on-the-job books quickly pay for themselves in profitable new business and valuable time saved!

#### SEND NO MONEY!

Just mail coupon for 7 DAY FREE TRIAL. If you keep all 4 books, pay only \$3.00 per month until \$21.35 plus postage is paid. Cash price for Set only \$18.95. Or return books and pay nothing. Either way, FREE BOOK IS YOURS.

**VALUABLE FREE GIFT!**  
Send for FREE TRIAL OFFER of all 4 Pin-Point books and get FREE book, "Bigger Profits in TV" whether you keep series or not!

### FREE TRIAL OFFER...Mail Coupon Now!

Educational Book Publishing Div.  
COYNE ELECTRICAL SCHOOL, Dept. 11-RT  
1455 W. Congress Pkwy., Chicago 7, Ill.

- Rush 4-Book PIN-POINT Series for 7-day FREE TRIAL per offer. For individual books, check below.
- TV (\$4.95 plus postage)
- RECORD CHANGER (\$3.95 plus postage)
- COLOR TV (\$5.95 plus postage)
- TRANSISTORS (\$5.95 plus postage)

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

Address.....

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

- \$18.95 Cash Price enclosed for 4 books.
- Send 4 books C.O.D. for \$18.95 plus M.O. fee. COYNE PAYS POSTAGE ON ALL CASH & C.O.D. ORDERS. 7-Day money-back guarantee on Cash or C.O.D. orders

## Reverberation in Practice

(Continued from page 45)

acoustically rather than electronically. This involves the use of a completely separate amplifier and speaker for the reverberation signal. While this method is somewhat more expensive than the electronic mixing process, it provides at least two important advantages.

With electronic mixing, the same amplifiers and speakers are employed for both the main signal and the reverberation. Since the latter often represents an appreciable portion of the total signal, the power output capabilities of the main amplifiers are correspondingly reduced. With acoustic mixing, the power output of the reverb amplifier actually adds the total available power.

The second, and perhaps most important, advantage of acoustic mixing concerns the fidelity of re-creating concert-hall conditions. When two signals are combined, either electronically or acoustically, a series of peaks and nulls appear in the sound reaching the listener. When the reverb signal is mixed with the main stereo signal in a single amplifier, these peaks and nulls have a fixed relationship which is not affected by the position of the listener with respect to the sound source. In the concert hall, however, this is not the case. Here, because the total sound reaching the listener actually appears to come from a number of different sources, the listener can change the

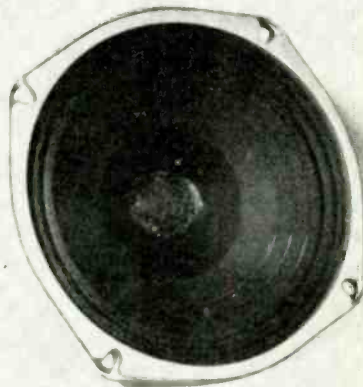
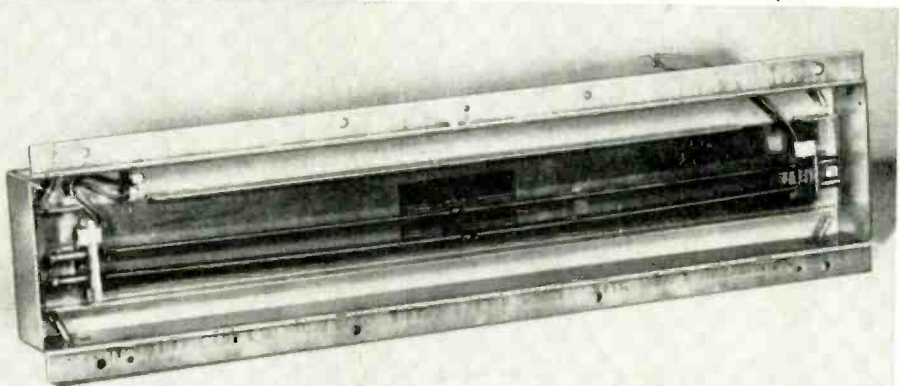
pattern of peaks and nulls often by only a slight movement of his head. Although the introduction of artificial reverberation is not identical to the conditions found in the auditorium, the use of a separate sound source for the reverb signal certainly simulates actual conditions far more closely than electronic mixing.

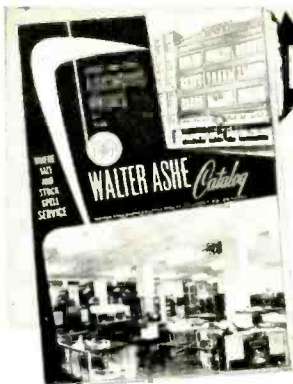
In the *Motorola* system, the 7-watt reverb amplifier complements the combined 50-watt output (music-power rating) of the main stereo amplifier channels. Cost of this additional amplifier can be held to a minimum because the absence of extremely low frequencies permits the use of a less expensive output transformer than used in hi-fi applications, without deterioration of sound quality.

The available 7 watts of reverberation is considerably more than that required for most listening rooms or program material. A special reverberation volume control, called the "Vibrasonic System" control (Fig. 5), permits adjustment of the reverberation effect from zero to maximum. As shown in the diagram, a portion of the reverberation control system is ganged with the loudness control of the main amplifier. This limits the maximum amount of reverberation available for any specific setting of the loudness control to a level which, although greater than desirable for optimum results, does not overshadow the main signal. The separate "Vibrasonic System" control can then be employed for a more precise adjustment of the reverberation intensity level.

-30-

Inside of reverb unit showing delay springs, along with reverb speaker, amplifier.





# FREE NEW 1961 WALTER ASHE CATALOG!

Exclusively Amateur Equipment, Parts and Supplies—144 Pages!

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

**MAIL COUPON FOR YOUR COPY—TODAY!**

3 Big Reasons Why Walter Ashe is

## hallicrafters HEADQUARTERS!

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

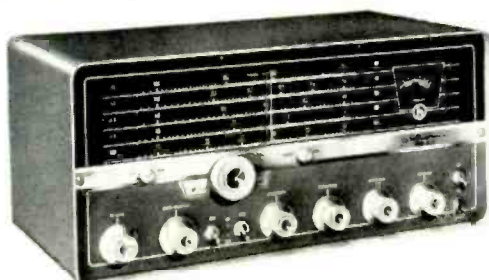
If cash is short you can still get your new ham equipment at once, thanks to Walter Ashe's easier terms. You can use your trade as a down payment!

### 2 SERVING THE AMATEUR FOR OVER 38 YEARS

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

### 3 GUARANTEED SAME DAY SHIPMENT OF YOUR EQUIPMENT

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



**Hallicrafters SX-111 Receiver**

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

Shipping Weight 40 lbs.

Amateur net **\$249.50**

*Walter Ashe—  
Where Size and Stock Spell Service*



**Hallicrafters HT-37 Transmitter**

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

Shipping Weight 80 lbs.

Amateur net **\$450.00**

**YOUR PRESENT  
XMITTER  
or RECEIVER  
IS WORTH  
BIG MONEY**

### Get Our "Surprise" Allowance

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

**ALL HALLICRAFTERS  
EQUIPMENT  
IN STOCK READY  
FOR IMMEDIATE  
DELIVERY**

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

All prices f.o.b. St. Louis

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

### "SURPRISE TRADE-IN" COUPON

**WALTER ASHE RADIO CO.  
YOUR ONE-STOP SUPERMARKET**

Dept. R-1-61 • St. Louis 1, Mo.

In Our 38th Year

- Rush New Catalog
- Send latest lists of guaranteed Used Equipment
- Rush "Surprise Trade-in" offer on my\_\_\_\_\_

For \_\_\_\_\_  
(Show make and model of equipment desired)

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_

# Checking Tape Recorder Heads

By ROBERT JAMES

Direct tests for continuity and other electrical properties are hazardous. Use this safe technique.

THE SYMPTOMS exhibited by a faulty tape recorder may sometimes indicate the possibility that one of the heads is defective. Inability to record, inability to erase, distortion introduced during recording, or absence of the playback signal, for example, may indicate that a record, bias-erase, or playback head is open or otherwise faulty. It would appear logical that the coil in the head could be checked for continuity before more elaborate tests are used on the circuitry itself. However, this is not as simple as it seems.

What could be more straightforward than placing an ohmmeter across the coil? Danger lurks, however. The test instrument sends d.c. through the coil. To begin with, the current may be excessive for the head. This can be overcome, however, if the ohmmeter's highest resistance scale is used, keeping current down to a low value. However, even a relatively low d.c. may magnetize the head. In addition, the transients produced when the ohmmeter is connected or disconnected may induce magnetization. If this effect should be strong enough, it may not be easy to reverse it by normal degaussing.

There is a method for checking continuity safely that also has other advantages. Even with continuity, there may be some change in characteristics of the head. Specifications generally available for tape recorder heads include d.c. resistance, impedance, and inductance. The suggested technique can be expanded to determine these characteristics, with some calculation.

Basis of the method is the application of a.c. to the coil. This has certain hazards too, but they can be avoided by proper use of the circuit in Fig. 1. The voltage source may be any that is low in value. A bell transformer, filament transformer, or the filament winding of any conventional electronic device, including the recorder's own a.c. heater supply, should do. Connect this source in series with the head, a potentiometer, and the a.c. voltmeter as shown.

To protect the head and also provide usable indication, maximum value of the potentiometer should not be less than one megohm. However, the closer it is to the meter's input resistance, the better. Furthermore, it should be set so that its full resistance is in the series circuit before the a.c. is applied. The voltmeter scale used should be the lowest one on which the maximum voltage of the source may be read without slamming the pointer. If you have any doubts, check the secondary's open-circuit voltage first.

Now decrease the resistance of the potentiometer *slowly*, until the meter reading begins to increase—or until it is

apparent that it is not going to rise. If no indication can be obtained, the coil is open and the test is over. In this case, the a.c. source can be disconnected at once. If continuity is indicated, the check is also over, but the connection should not be broken at once. Instead, rotate the potentiometer slowly back to its maximum-resistance position and then disconnect the a.c. This precaution, which provides a gradual decay of the a.c. field surrounding the coil, suppresses any transients that might produce residual magnetization.

With an additional resistor and a slight change in the hook-up, we may determine impedance, resistance, and/or inductance. The voltmeter is removed from the series circuit and a resistor (Fig. 2) is inserted in its place. Value of the latter should be such that the current through it, if it were placed directly across the source voltage, would be only a few milliamperes. A 10,000-ohm resistor should be satisfactory for any case, while also simplifying calculations.

The potentiometer is fully in the circuit when power is applied, but it is slowly rotated to zero resistance. The voltmeter is then used to read voltage across the inserted resistor. With both the resistor and the voltage drop across it known, Ohm's Law may now be used to calculate the current. Since the head coil is in series, this is also the current through the latter. By moving the meter to read voltage across the head, we can now use this value and the

known current to determine impedance.

However, this value is not directly usable, since it is taken at 60 cps. Impedance of record-playback heads is generally given at 1000 cps. For erase heads, the frequency is that of the bias oscillator, which may be from 25 to 100 kc. Furthermore, the d.c. resistance cannot be directly derived from a single-frequency impedance reading. The next step then, using the same basic arrangement as that of Fig. 2 except that an audio oscillator adjusted to 1000 cps takes the place of the 60-cps source, is to take another impedance reading. Once more, the potentiometer is used for a gradual build-up and then decay of the applied voltage. The generator's output level should be adjusted to be approximately that of the original line-frequency source.

From the two figures now available for impedance, it is possible to determine the d.c. resistance by using the following formula:  $R = \sqrt{\frac{279Z^2 - z^2}{278}}$ , where

$R$  is the d.c. resistance,  $Z$  is the impedance at 60 cps, and  $z$  is the impedance at 1000 cps. This formula is based on the fact that there is a fixed ratio, 16.7:1, between the inductive reactance a coil will have at 1000 cps and the reactance it will have at 60 cycles.

Now that d.c. resistance is known, this value can be used in combination with total impedance, at either frequency, to determine inductance. This is done by first finding the inductive reactance. Calculation is still necessary, but the worst is over. The formula is  $X_L = \sqrt{Z^2 - R^2}$ , where  $X_L$  is inductive reactance (either frequency may be used) and  $Z$  is the impedance measured at the same frequency.

From this, inductance may be found from  $L = X_L / 2\pi f$ , where  $L$  is the inductance in henrys and  $f$  is the same frequency at which  $X_L$  was calculated. At this point, virtually all the information needed to check the head for changes, by comparing against available specifications, is at hand—or for determining these specifications on a good head for which they are not readily available. A possible additional figure may be wanted: impedance at the erase-bias frequency. The method has already been discussed. With an oscillator at that frequency acting as the a.c. source, the voltage measurements in the test of Fig. 2 are made and impedance is easily calculated.

This method may seem like the long way round. Yet it is seldom that all calculations will be desired, and a slide rule can save much time while preserving high accuracy. Finally, the possible results of using an ohmmeter can be far more troublesome. —30—

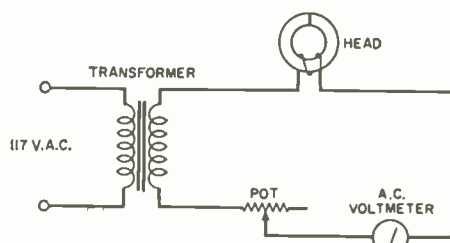


Fig. 1. A continuity check that avoids coil damage or permanent magnetization.

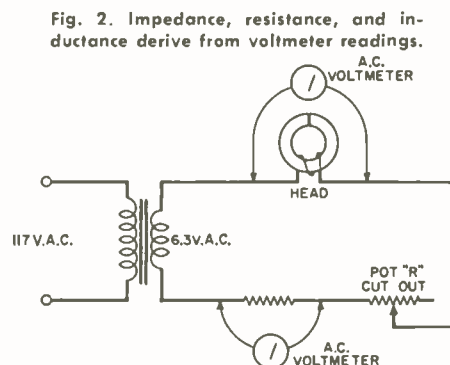


Fig. 2. Impedance, resistance, and inductance derive from voltmeter readings.

# RAD-TEL

## GUARANTEED



# RAD-TEL'S FIRST QUALITY

WHY PAY MORE? - BUY  
DIRECT FROM RAD-TEL  
FOR SAVINGS AND  
PERFORMANCE  
IN RADIO AND  
TV TUBES



### 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 TUBE INDIVIDUALLY AND ATTRACTIVELY BOXED

Qty.	Type	Price	Qty.	Type	Price	Qty.	Type	Price	Qty.	Type	Price	Qty.	Type	Price	Qty.	Type	Price	Qty.	Type	Price						
—	0Z4M	.79	—	4B07	.96	—	6AR5	.55	—	6CG7	.60	—	6SA7GT	.76	—	8EB8	.94	—	12B4	.63	—	12EL6	.50	—	198G6	1.39
—	1AX2	.62	—	4BS8	.98	—	6AS5	.60	—	6CG8	.77	—	6SK7	.74	—	100A7	.71	—	12BA6	.50	—	12EG6	.54	—	19T8	.80
—	1B3GT	.79	—	4B08	.71	—	6AT6	.43	—	6CM7	.66	—	6SL7	.80	—	11CY7	.75	—	12BD6	.50	—	12EZ6	.53	—	21EX6	1.49
—	10N5	.55	—	4B26	.58	—	6AT8	.79	—	6CN7	.65	—	6SN7	.65	—	12A4	.60	—	12BE6	.53	—	12F5	.66	—	25B06	1.11
—	1G3	.73	—	4B27	.96	—	6AU4	.82	—	6CR6	.51	—	6SQ7	.73	—	12AB5	.55	—	12BF6	.44	—	12F8	.66	—	25C5	.53
—	1J3	.73	—	4C56	.61	—	6AU6	.50	—	6CS6	.57	—	6T4	.99	—	12AC6	.59	—	12BH7	.73	—	12FM6	.45	—	25CA5	.59
—	1K3	.73	—	4DE6	.62	—	6AU7	.61	—	6CU5	.58	—	6U8	.78	—	12A06	.47	—	12BL6	.56	—	12K5	.65	—	25C06	1.44
—	1L6	1.05	—	4DK6	.60	—	6AU8	.87	—	6CU6	1.08	—	6V6GT	.54	—	12AE6	.43	—	12BQ6	1.06	—	12SA7M	.86	—	25CU6	1.11
—	1LN5	.59	—	4OT6	.55	—	6AV6	.40	—	6CY5	.70	—	6W4	.75	—	12AF3	.73	—	12BY7	.74	—	12SK7GT	.74	—	25ON6	1.42
—	1R5	.62	—	5AM8	.79	—	6AW8	.89	—	6CY7	.71	—	6W6	.69	—	12AF6	.49	—	12BZ7	.75	—	12SN7	.67	—	25EH5	.55
—	1S5	.51	—	5AN8	.86	—	6AX4	.65	—	6O44	.68	—	6X4	.39	—	12A16	.46	—	12C5	.56	—	12SQ7M	.73	—	25L6	.57
—	1T4	.58	—	5A05	.52	—	6AX7	.64	—	6OB5	.69	—	6X5GT	.53	—	12A15	.45	—	12CA5	.59	—	12U7	.62	—	25W4	.68
—	1U4	.57	—	5AT8	.80	—	6BA6	.49	—	6OE6	.58	—	6X8	.77	—	12A18	.95	—	12CN5	.56	—	12V6GT	.53	—	25Z6	.66
—	1U5	.50	—	5BK7A	.82	—	6BC5	.54	—	6OG6	.59	—	7AU7	.61	—	12A05	.52	—	12CR6	.54	—	12W6	.69	—	35C5	.51
—	1X2B	.82	—	5BQ7	.97	—	6BC7	.94	—	6OO6	1.10	—	7A8	.68	—	12AT6	.43	—	12CU5	.58	—	12X4	.38	—	35L6	.57
—	2AF4	.96	—	5BR8	.79	—	6BC8	.97	—	6OT5	.76	—	7B6	.69	—	12AT7	.76	—	12CU6	1.06	—	17AX4	.67	—	35W4	.52
—	3AL5	.42	—	5C8	.76	—	6B06	.51	—	6OT6	.53	—	7Y4	.69	—	12AU6	.50	—	12CX6	.54	—	17BQ6	1.09	—	35Z5GT	.60
—	3AU6	.51	—	5CL8	.76	—	6BE6	.55	—	6EU8	.79	—	8AU8	.83	—	12AU7	.60	—	12C85	.69	—	17C5	.58	—	50B5	.60
—	3AV6	.41	—	5EAB	.80	—	6BF6	.44	—	6EA8	.79	—	8AW8	.93	—	12AV5	.97	—	120E8	.75	—	17CA5	.62	—	50C5	.53
—	3BA6	.51	—	5EUB	.80	—	6BG6	1.66	—	6H6GT	.58	—	8BQ5	.60	—	12AV6	.41	—	120L8	.85	—	17D4	.69	—	50DC4	.37
—	3BC5	.54	—	5J6	.68	—	6BH6	.65	—	6J5GT	.51	—	8C7	.62	—	12AV7	.75	—	120M7	.67	—	170Q6	1.06	—	50EH5	.55
—	3BE6	.52	—	5T8	.81	—	6BH8	.87	—	6J6	.67	—	8CM7	.68	—	12AX4	.67	—	120Q6	1.04	—	17L6	.58	—	50L6	.61
—	3BN6	.76	—	5U4	.60	—	6B16	.62	—	6K6	.79	—	8CN7	.97	—	12AX7	.63	—	120S7	.79	—	17W6	.70	—	117Z3	.61
—	3B08	.78	—	5U8	.81	—	6BK7	.85	—	6S4	.48	—	8CX8	.93	—	12A27	.86	—	120Z6	.56	—	19AU4	.83	—		

### TRANSISTORS — AT FABULOUS DISCOUNTS

PRICE	TYPE	RATING	ELECTRICAL CHARACTERISTICS		hfe
<input type="checkbox"/> RF 49¢	GE PNP ALLOY JUNCTION GENERAL PURPOSE RF/AF	200 MW	1CB0 max.	1E80 max.	VCE — -1.5 lb = 5 ma 20 min
<input type="checkbox"/> AF 39¢			20 µa VCB = -3V	20 µa VEB = -3V	
<input type="checkbox"/> 80¢ ea.	Power AF Med. Freq. to -3	MIN. POWER OUTPUT 2.25 W	20 ma VCB = -16V	20 ma VEB = -16V	VCE — -1.5 lb = 1 ma 40 min
<input type="checkbox"/> 140¢ ea.	Hi Power 15 AMP to 36		40 ma VCB = -100	40 ma VEB = -100	VCE — -1.5 lb = 1 ma 30 min
			Series 830 OHMS		

SEND FOR FREE TROUBLE SHOOTER GUIDE AND NEW TUBE & PARTS CATALOG.

NOT AFFILIATED WITH ANY OTHER MAIL ORDER TUBE COMPANY

# RAD-TEL TUBE CO.

55 Chambers Street

Newark 5, 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. Dept. EW-161.





Indianapolis. 96 pages. Price \$1.00. Soft cover.

Expanded coverage is featured in this third edition of a manual intended for use by service technicians. Now listed are 26,970 television and 1072 car radio models produced since 1946. The currently available and recommended replacement controls are shown.

"DIGITAL COMPUTER FUNDAMENTALS" by Thomas C. Bartee. Published by McGraw-Hill Book Co., Inc., N. Y. 342 pages. Price \$6.50.

Intended for readers with a knowledge of basic algebra and electronic fundamentals, this volume comprises a thorough-going introduction to the general subject of digital computers. Computer functions, applications, problem preparation, and typical circuitry all are covered.

"THE A.R.R.L. ANTENNA BOOK" by ARRL Headquarters Staff. Published by The American Radio Relay League, Inc., W. Hartford, Conn. 320 pages. Price \$2.00. Soft cover.

This new and revised edition of a well-known work is a complete treatise on the theory and practice of antennas for use by amateur radio operators. It covers the subject from fundamentals through an extensive discussion of antenna theory to descriptions of simple and complex antenna designs.

"TELEVISION TUBE LOCATION GUIDE" by Sams Staff. Published by Howard W. Sams & Co., Inc., Indianapolis. 96 pages. Price \$1.25. Soft cover. Vol. 10.

Positions and functions of tubes in 1959-1960 TV receivers are indexed and illustrated in this compact volume. Over 100 diagrams, each with a tube-failure check chart giving common symptoms and likely tubes producing them, are included.

René Snepvangers (left) receives congratulations from Dr. Harry F. Olson, incoming president of the Audio Engineering Society, upon receiving the Society's Emile Berliner Award, presented to Mr. Snepvangers for his development of the Long Playing record. Mr. Snepvangers, now vice-president and director of engineering for Electrosonic Laboratories, Inc., was project leader for CBS Recording Laboratories during the original development of the 33 1/3 rpm microgroove disc.



Class D (27 mc) Citizens' Band

# Rutherford "400"

two-way RADIOPHONE

OFFERS YOU  
**MORE**

HIGHLY SENSITIVE  
SUPERHETERODYNE  
RECEIVER

FOR THE MONEY!



**Specifications:**

Superheterodyne receiver.  
Sensitivity - 1 microvolt (for 6 db S+N/N ratio).  
Selectivity - at 10 KC adjacent channel spacing, down 38 db.  
Image Rejection - 60 db or more.  
Transmitter - Crystal controlled.  
Power Input - 5 watts (FCC maximum).  
Power Output - Approx. 3 watts into 50-ohm load.  
Extra feature: Capable of increased power (10-12 watts) for industrial applications outside but adjacent to Citizens' Band.



**Rutherford ELECTRONICS CO.**  
COMMUNICATIONS DIVISION  
8930 Lindblade St., Culver City, Calif.

Built by a leading manufacturer of  
Electronic Test Instrumentation

SIX  
CHANNEL  
OPERATION  
EFFICIENT  
TRANSMITTER



UNIVERSAL POWER SUPPLY  
ONE UNIT OPERATES ON  
115VAC, 6 and 12VDC

DIRECT  
READING  
DIAL  
CORROSION  
PROOF  
FINISH



CRYSTALS MAY BE  
CHANGED WITHOUT REMOVING  
SET FROM CABINET



Beautiful styling, maximum operating range, high efficiency, rugged construction, extraordinary dependability... features normally found only on more expensive sets, are built into the Rutherford "400".

Please send me the illustrated brochure on Rutherford "400":

NAME \_\_\_\_\_  
ADDRESS \_\_\_\_\_  
CITY \_\_\_\_\_ STATE \_\_\_\_\_

## PURCHASING A HI-FI SYSTEM?

TIME PAYMENTS AVAILABLE  
Up to 2 years to pay!

Send Us  
Your List Of  
Components  
For A  
Package  
Quotation

Jim Lansing\*  
Altec Lansing  
Electrovoice  
Hartley  
University  
Acoustic Research  
Janszen • Jensen  
Wharfedale  
USL Citizen Band  
Gonset • Mallicrofter  
Texas Crystals  
Concertone • Viking  
Bell • G.E.  
Weathers  
Harman-Kardon  
Eico • Pilot  
Sherwood\*  
Acrosound  
Quad Ampl-Spkr\*  
Dual Changer  
Bogen • Leak  
Dynakit • Fisher  
H. H. Scott  
Thorens\*  
TEC Transistor Amps  
Amplex • DeWald  
Superscope  
Sony • Roberts  
Challenger  
Wallensak  
Garrard • Norelco  
Miracord  
Glaser-Steers  
Rek-O-Kut  
Components  
Tandberg\*  
Fairchild  
Pickering • Gray  
Audio Tape  
Magnecord\*  
Rockford Cabinets  
Artizan Cabinets  
\*Fair Traded

WE WON'T BE  
UNDERSOLD!

All merchandise is  
brand new, factory  
fresh & guaranteed.

Free Hi-Fi Catalog

# AIREX RADIO

CORPORATION

64-R Cortlandt St., N. Y. 7, CO 7-2137

## Guaranteed! Crystals!

BUY NOW AND SAVE!!

OVERTONES: 10 to 30 Meg. Tol. .005%	\$2.50
AMATEUR & NOVICE Fundamental Tol. .005%	\$1.60
HC-6 Herm. Sealed	\$2.50
HC-6-6 Meters (5th Overtone)	\$3.75
MARINE FREQ. HC-6 (Herm. Sealed) Tol. .005%	\$3.50

ALL MARINE FREQ.-FT-243, DC-34 Hold Tol. .005	\$2.00
PD LICE, C.A.P., CD, MARS. Tol. .01%	\$1.60
CITIZENS BAND-11 METERS-.005% TOL.	
26.965 to 27.225 MC, 3rd Over. Herm. Seal. or FT-243	\$2.50
13.4825 to 13.6125 MC, 2nd Harm. Herm. Seal. or FT-243	\$2.50
6741.25 to 6806.25 Kc, 4th Harm. FT-243 only	\$2.00

SPECIAL!  
STOCK CRYSTALS



FT-243 Holders 5700 KC to  
8650 KC in steps of 25 KC's  
DC-34 Holders 1690 KC to  
4440 KC steps of 10 KC

SEND FOR FREE CATALOG

NOVICE BAND FT-243 Fund. ca. **86¢**

80 Met. 3701-3740-Steps of 1 KC. FT-243	
40 Met. 7150-7190-Steps of 1 KC. FT-243	
Dbl. to 40 Met. 3576-3599. Steps of 1 KC. FT-243	
15 Met. 5276-5312-7034-7083 Steps of 1 KC. FT-243	
FT-243-2 Meters (Steps of 1 KC)	\$.93
FT-243-6 Meters (Steps of 1 KC)	\$.93
FT-243-From 3000-4000	\$.93
FT-243-From 1005-2999 (Steps of 5 KC)	\$2.39
FT-243-.005% Tol. From 3000-8750	\$2.00
FT-243-.01% Tol. From 3000-8750	\$1.60
FT-241 SSB Low Xtals 370 to 540 KC (Steps of 1.852 and 1.388)	\$.49
FT-241 SSB Matched Pairs	\$.95
FT-241-AN/TRC-1-721.167 KC-1040-625 (Steps of 1.042 KC-Except 1000 KC)	\$.65

Include 5¢ per crystal postage. (U.S. only). Calif. add 4% tax. No C.O.D. Prices subject to chg. 1st. 2nd choice, sub. may be necess. Min. Order \$2.50

Open Friday Evenings until 9 P.M.

"The House of Crystals"  
**U. S. CRYSTALS, Inc.**  
1342 S. La Brea Ave. Los Angeles 19, Cal.

# America's Most Popular, Most Authoritative Books on High Fidelity, Stereo and Tape

Here are some of the world's greatest hi-fi books... chosen carefully by Ziff-Davis Electronics Book Service as among the best in their field.

Right now, one or more of these great books will be sent to you for 7 days FREE! Simply write your choices on the

coupon below and mail it today. When your books arrive, read and enjoy them for seven full days. If, after that, you don't agree that they are everything you need and want, return them and owe nothing.



**2751. HI-FI GUIDE-STEREOPHONIC SOUND, Hoefler**

A "how-to" book on hi-fi, written in simple language. Will help you buy the right equipment and see that you get the most out of your stereo or monaural investment. \$2.50



**2752. HIGH QUALITY SOUND REPRODUCTION, Moir**

The perfect manual for both the professional engineer and the serious amateur interested in high fidelity. The "why" and "how" of sound reproduction is covered in complete detail. \$15.00



**2753. LOW-COST HI-FI, Hoefler**

Hundreds of hints for budget hi-fi will be found in these fourteen chapters with over 300 detailed photographs, drawings and diagrams. Will save you money in starting or improving your system. \$2.50



**2755. THE PRACTICAL HI-FI HANDBOOK, King**

A guide to high fidelity sound reproduction for the service engineer and amateur. Chapters on amplifiers, loudspeakers, pickups, microphones, record players, disc, tape and stereo. \$5.95



**2756. REPAIRING RECORD CHANGERS, Ecklund**

A practical manual on repair of mechanical elements of record changers, including pickups, needles, changer actions, motors, drives, tripping, dropping and shut-offs. Also magnetic recorder repairs. \$5.95



**2760. HI-FI STEREO FOR YOUR HOME, Whitman**

Tells what stereo is, how it differs from hi-fi, how it works, how it affects home listening habits, and how to install and maintain it. Complete list of terms defined. Generously illustrated. \$3.50



**42. REVERE TAPE RECORDER GUIDE, Tydings**

The first non-technical book to provide useful information on the Revere Tape Recorder. Also a basic guide to the entire field of tape. Will show you new uses and add to your enjoyment. \$1.95



**49. TAPE RECORDING GUIDE, Marshall**

Designed to help you get the most out of your tape recorder, whether for business, pleasure or professional use. A handy guide to have around, no matter what equipment you own. \$1.95



**2750. ELEMENTS OF MAGNETIC TAPE RECORDING, Haynes**

Here's how to get professional results with tape the way the experts do. Complete nomenclature, basic techniques, how to splice and edit, how to repair and maintain your recording equipment. \$7.95



**2754. MAGNETIC TAPE RECORDING, Spratt**

Designed to give principles of magnetic recording and to enumerate characteristics of both the medium and the machines. Excellent for adapting magnetic recording to special needs and wider applications. \$8.95



**2757. RIBBONS OF SOUND, Barleben**

A handbook on the fundamentals of magnetic tape recording simply and interestingly presented. Factual information you can use no matter what type or make of recorder you own. Paper. \$2.50. 2772. Cloth. \$3.50



**2758. TAPE RECORDERS AND TAPE RECORDING, Weiler**

An ideal sourcebook of information on all aspects of tape recording. Covers all fundamentals necessary to realize full potential of your tape equipment. Special sections on accessories. \$2.95



**2000. STEREO HI-FI GUIDE, 1960, Ziff-Davis**

1960 edition features 60-page exclusive by Joseph Marshall on components and how they work. Includes "what you should know before buying stereo". Complete, interesting, invaluable! \$1.00



**2002. ELECTRONIC KITS DIRECTORY, 1960, Ziff-Davis**

New 1960 edition lists over 750 kits, latest models, prices and features for hi-fi kits—preamps, amplifiers, tuners, speakers—ham radio, SWL, Citizens Band. Fun and education. \$1.00



**2004. HI-FI ANNUAL & AUDIO HANDBOOK, Ziff-Davis**

1960 edition. Prepared by the editors of Electronics World. An excellent advanced guide to theory, construction and circuitry. Over 40 pages on stereo amplifiers and equipment. \$1.00



**2010. AUDIO YEARBOOK, 1961, Ziff-Davis**

Brand new edition. By the editors of Electronics World. Advanced discussions and instructions on every phase of audio. Special features make this an excellent guide for the advanced audiophile. \$1.00



**2006. ELECTRONIC EXPERIMENTER'S MANUAL, Findlay**

With a few dollars worth of basic tools and this book to guide you, you can explore the wonderful world of electronics experimentation more completely than ever before. 10 big sections. \$4.95



**2769. THE ELECTRONIC MUSICAL INSTRUMENT MANUAL, Douglas**

Covers every design phase of the modern electronic musical instrument—including theory, schematics of organ circuits, the science of sound as well as the art of music. \$7.50





# FREE Catalog of The WORLD'S FINEST GOV'T SURPLUS ELECTRONIC BARGAINS

## PANORAMIC RECEIVER

18-50 MC & 48-80 MC  
R-61/ARQ-5

Double superhetrodyne Receiver with two antenna inputs and motor driven capacitor tuning for accurate AM, FM, CW, and WB video signals in the 18 to 50 MC and 48 to 80 MC ranges on a 50PH cathode ray tube that is calibrated as to frequency presentation in the low and high bands. Selection of band to be viewed, selectivity & calibration controls are all on the front panel. Set employs 21 tubes and is of unitized chassis construction. Operating voltage required: 24 VDC 8 A. and 80 or 115 Volts 100-2000 cycles, 120 Watts. Schematic included. Size: 10 1/2" x 8 1/2" x 2 1/2". Wt.: 51 lbs. Price—Used: \$6500

**\$6500**

Power Plug Connector: \$2.00 Maintenance Instruct.: \$5.00

BC-603 \$16.25 RE-NEW	BC-683 \$34.95 RE-NEW	BC-923 \$34.95 RE-NEW
-----------------------------	-----------------------------	-----------------------------

BC-603 FM Rec. 20 to 27.9 MC. Re-New: \$16.25  
BC-683 FM Rec. 27 to 39.1 MC. Re-New: \$34.95  
BC-923 FM Rec. 27 to 39.1 MC. Re-New: \$34.95  
BC-604 FM Transmtr. 20-27.9 MC. U: \$4.95  
BC-684 FM Transmtr. 27-39.1 MC. Re-N: \$ 7.05

Re-New: \$14.00 Used: \$ 6.95  
FT-346 MOUNTING for Receiver only. Re-New: \$ 1.95  
DM-34 DYN. 12V. 1 BC-603-683-U: \$6.95-R-N: \$ 0.95  
DM-35 DYN. 12V. 1 BC-604-684-U: \$6.95-R-N: \$ 0.95

AC POWER SUPPLY — F BC-603-683 — Output: 220 VDC 80 MA & 24 VAC 2 Amps. Transformer & Tube type. Chassis not hot. Mounts on rear Plug of BC-603-683. Can be adapted to other Receivers. WIRE: \$14.95

BC-620 \$12.95 RE-NEW	BC-659 \$14.95 RE-NEW	PE-120 \$7.95 RE-NEW
-----------------------------	-----------------------------	----------------------------

BC-620 FM Rec.-Transmtr. 20 to 27.9 MC. Re-New: \$12.95  
BC-659 FM Rec.-Transmtr. 27-39.1 MC. Re-New: 14.95  
PE-120 Power Supply for BC-659 or BC-620 with Vibrator for 12 volt operation. Re-New: 7.95  
BA-41 Bias battery for BC-659-620. New: 4.05  
AN-29 Telescoping Antenna F BC-659. New: 2.95  
AN-25 Telescoping Antenna F BC-620. 1.95  
FT-250 Shock Mounting F BC-659-PE-120. Used: 4.95

Address Dept. EW • All Prices F.O.B., Lima, Ohio. \$5.00 Minimum Order. 25% Deposit on all C.O.D.'s.

## FAIR RADIO SALES 2133 ELIDA RD. • P.O. Box 1105 • LIMA, OHIO

## NEW LOW PRICES:

### COMMAND TRANSMITTERS, RECEIVERS

**R-23/ARC-5 RECEIVER—  
190 to 550 KC. . . . . Used: \$12.95**

BC-454 RECEIVER—3 to 6 MC. . . . . New: \$14.95  
BC-455 RECEIVER—6 to 9 MC. . . . . Used: 8.95

**R-77/ARC-3 RECEIVER—  
100 to 156 MC. . . . . Used: \$14.95**

**T-17/ARC-5 TRANSMITTER—  
1.3 to 2.1 MC. . . . . New: \$14.95**

T-18 ARC-5 TRANSMITTER—2.1 to 3 MC. New: \$ 8.95  
T-19 Navy TRANSMITTER—3 to 4 MC. . . . . Used: 5.95

T-20 ARC-5 TRANSMITTER—4 to 5.3 MC. New: 8.95  
T-21 ARC-5 TRANSMITTER—5.3 to 7 MC. New: 9.95  
T-22 ARC-5 TRANSMITTER—7 to 9.1 MC. New: 12.95

**T-23 ARC-5 TRANSMITTER—  
100 to 156 MC. . . . . New: 16.95**

**T-67/ARC-3 TRANSMITTER—  
100 to 156 MC. . . . . Used: \$16.95**

### RECEIVERS

NAVY ARB CRV 46151—190 to 9050 KC. . . . . U: \$18.95  
ARC-3 AM RECEIVER—100 to 156 MC. . . . . U: 14.95

BC-733—Localizer REC.—108.3 to 110.3 MC U: 1.95  
R-4/ARR-2 REC.—540-830 KC. . . . . Re-N: 6.95  
230-258 MC. . . . . Re-N: 6.95  
BC-1206 Beacon Receiver—200 to 400 KC. Re-N: 0.95  
BC-652 Receiver—2 to 6 MC—Less Dyn. . . . . U: 19.95

### TELEPHONES, HEADSETS, MICS., Etc.:

TS-9 Handset. . . . . Used: \$2.95—New: \$ 3.95  
TS-13 Handset. w/PL-55 & PL-68. . . . . U: \$2.95—N: 3.95  
T-17 Microphone. . . . . New: 6.95  
EE-8 Field Telephone. . . . . Used: \$12.95—Recond: 16.95  
BD-71 Switchboard—6 Line. . . . . U: \$14.95—New: 24.95  
RM-29 Control Unit. . . . . New: \$6.95—W/Handset: 8.95  
RM-52 Control Unit (Patch Found.) U: \$1.95 N: 2.95  
H-16/U Headset—8000 ohm. . . . . New: 2.95  
HS-33 Headset—300 ohm. . . . . U: \$4.95—New: 7.95

SEND FOR FREE CATALOG!

## An Impedance Checker

(Continued from page 33)

To measure the input impedance of the same amplifier, the voltmeter and the ohmmeter are connected to appropriate binding posts, as already explained. The amplifier input is connected across the "Test" terminals, and a variable resistor of suitable value is connected across the R terminals. However the audio oscillator is connected to the "Oscillator" binding posts in this test, so that it feeds into the amplifier through the added resistance. Adjust the oscillator to produce a 1000-cycle signal at an amplitude that will produce a convenient but low reading on the v.t.v.m. The indication on the latter will be the signal amplitude fed to the amplifier, rather than the total output of the oscillator, part of which is being dropped across the resistor.

Now depress switch S<sub>1</sub> and hold it down. The voltmeter now reads the voltage across the resistor only. The purpose of this test is to obtain the same voltage reading across the resistor and the amplifier input; in other words, the voltmeter reading should be the same whether S<sub>1</sub> is depressed or released. To achieve this, the resistor is progressively adjusted while the switch is alternately depressed and released. This procedure is repeated as many times as necessary until the desired condition of equal readings is obtained. When the readings are equal, resistance in the circuit is equal to the actual impedance seen at the amplifier input.

Now the oscillator must be disconnected. The Z switch, S<sub>2</sub>, is depressed to shunt the ohmmeter across the resistor. The desired impedance is now read directly.

Some further words about choosing the resistor and measuring it. Although its exact value is not critical, it should be of such an order that it is not likely to be set to either of its extremes during the test, for greatest convenience. If the anticipated impedance reading is likely to fall, say, somewhere between 50 and 250 ohms, a 500-ohm potentiometer would be suitable.

Where impedance seen at a low-impedance output (rated at 4, 8, or 16 ohms) of an audio amplifier is to be found, the actual value may be less than 1 ohm. Since the center-scale reading of the lowest resistance range on conventional v.o.m.'s and v.t.v.m.'s is in the order of 10 to 20 ohms, accuracy in the vicinity of 1 ohm or less is not always dependable. Fortunately some ohmmeters read about 1 ohm near the center of the scale on the lowest range. Resistance bridges or other devices using a nulling method against an accurate standard will also give reliable low-resistance readings. It may also be possible to use a calibrated, variable, precision resistor of low value.

Using the procedure for amplifier input impedance measurement, such other devices as speakers, headphones, and transformers can be checked.

## BUILD THE BEST HI-FI save 1/2 with EICO KITS

Model HFT94 AM Tuner



Model HFT90 FM Tuner

### AM TUNER HFT94

Kit \$39.95 Wired \$65.95

INCLUDES COVER & FET

- monaural AM reception, and/or
- STEREO AM-FM reception with matching EICO FM Tuner HFT90 or equivalent

NO technical experience is necessary. Each EICO kit comes complete with easy step-by-step instructions and picture diagrams — plus exclusive LIFETIME guarantee for service adjustment.

Come in for a no-obligation demonstration.

NOW AVAILABLE AT

**Almo RADIO CO.**  
913 ARCH ST., PHILADELPHIA, PA.  
201 CALHOUN ST., TRENTON, N. J.  
219 LANDIS AVE., VINELAND, N. J.  
1122 FRENCH ST., WILMINGTON, DEL.

## ...for BEST Citizens' Band Operation and MAXIMUM

TRANSMITTER POWER OUTPUT

Rutherford Model M-100

RELATIVE R-F

## POWER METER

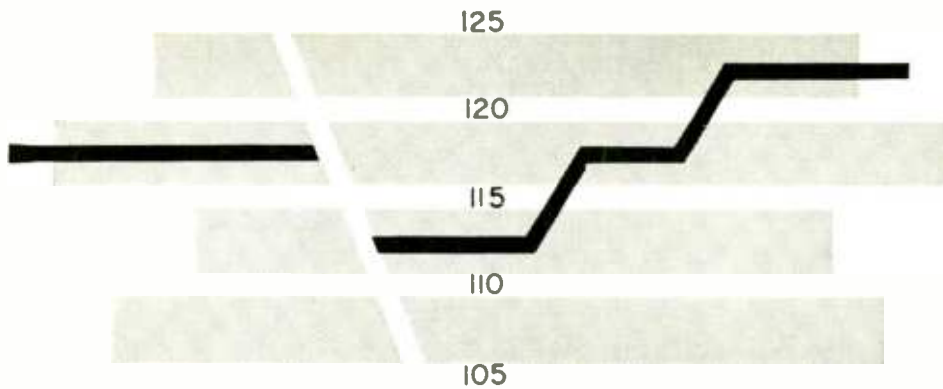


Consumes no power!  
Helps you tune for best performance!  
Calibrated for operation into a 50-ohm load, will indicate maximum transfer of radio frequency energy into a Citizens' Band antenna having 50-ohm input impedance. Will indicate output power readings for transmitters of up to 5 watts output into a 50-ohm load.  
Supplied complete with PL-259 and SO-239 50-ohm coaxial connectors.  
List price \$24.50.



...for dummy antenna test purposes, use the 50-ohm RUTHERFORD TERMINATION T-101 with your Citizens' Band Class D equipment.  
List price \$4.95

**Rutherford ELECTRONICS CO.**  
COMMUNICATIONS DIVISION  
Dept. EW1, 8030 Lindblade Street  
Culver City, California



# A Variable Line-Voltage Isolator

By WALTER L. STONE

Three output-voltage steps and isolation at low cost—plus indication and protection for shorts.

PERHAPS you are a member of that large group of technicians who are still looking for that isolation transformer which, for safety's sake, should always be available to the bench. Since one with real current capacity comes high, you may have one that can take care of a single television set. However, you may have found that there are times when another like it would come in handy for a second set. The only problem is that these things cost, and they are not cheaper by the dozen.

If you have an old, junked TV chassis around the shop, with a good power transformer on it, you are nearly half way to solving this problem at low cost and also providing yourself with some other conveniences that the ordinary isolation transformer won't give you. The other half of the job involves picking up another similar transformer, which can come from a similar source, and doing a small amount of assembly.

Generally speaking, the older the sets from which these transformers are salvaged, the better. Older sets used more tubes, drew more current, and had to have bigger power transformers. Thus if they are used to make up the isolator, you have no worries about carrying any TV set or other electronic gear that draws no more current than a TV set. For example, how many chassis are you

likely to come across that draw as much as did some of those early, 30-tube affairs?

The pair of transformers need not be identical. The important thing is that their high-voltage secondaries carry the same voltage rating. The current ratings should also be close to each other. If there is any doubt about the latter point, simply check the current or wattage ratings for the two receivers. If they are close, the transformer capacities will be close. Making sure that the two transformers are about the same in size and weight will also indicate that they are reasonably matched as to current capacity.

The suggested set-up is shown in the accompanying schematic. The arrangement is a little bulky, but it will get in nobody's way if you slip it under the bench. If you do this, it will also give you room to use the old chassis on which one of the transformers is already mounted. Mount the second one near it and use the old socket for the 5U4 rectifier to provide tie points for the secondary voltages. The lamp socket, outlets, fuse holder, and switches should be convenient to the bench.

Just to make sure, you will note that the circuit actually isolates line voltage twice, once through each transformer. The optional resistor-capacitor network

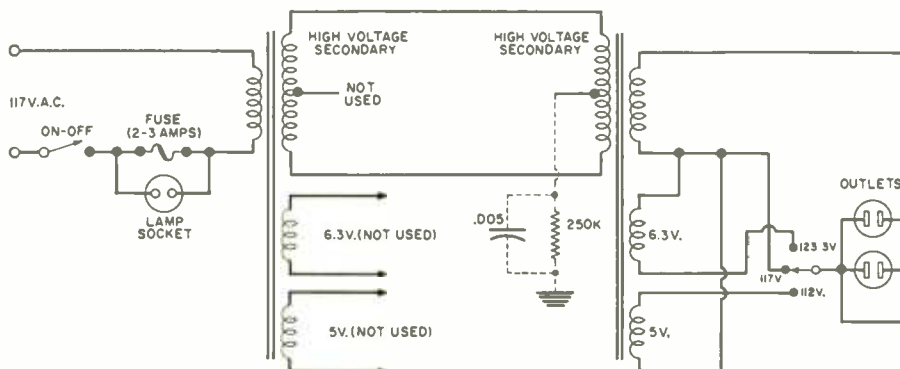
from the center tap of one secondary to ground will take care of any residual charge that may be left after the device is turned off.

One of the extras provided is the use of the two filament windings of the secondary transformer, one series-aiding with normal output and the other series-bucking. As fed through the switch (virtually any single-pole, triple-throw unit will do) to the a.c. receptacles, they will let you select line voltage or else a slightly reduced (112 volts) or slightly boosted (123.3 volts) source instead. Although this is not a wide, continuously variable range, the three steps will be adequate for most cases where some flexibility is needed. An ordinary a.c. voltmeter is all you need to make sure that the two filament windings are wired in the desired phase.

The fuse holder is kept accessible so that you can change the rating of the fuse for individual cases. For example, you might want to put in a ½-ampere fuse when dealing with a radio or some other equipment that draws less current normally, but which has a hidden or intermittent short. You could also pull the fuse altogether and put in a bulb whose rating is such that it will safely limit current when the short shows up. When using a regular 2- or 3-ampere fuse, you can shunt it with a 7½-watt bulb in the socket. The latter lights up to let you know when you've popped a fuse. It will also limit current and voltage to the set after the fuse goes. In fact, the lamp socket provides some additional possibilities. You can drop output voltage to lower levels than 112 volts by using lamps of different wattages as dropping resistors.

Although it has its own "on-off" switch, you may want to wire the entire unit so that it is turned on or off by the switch that operates the bench light. This makes sure that the unit is off when the bench is not in use. If you have ever worked in a shop with a cement floor in damp weather, you will particularly appreciate this isolator.

A pair of transformers salvaged from retired TV sets are the chief components.



# NEW IMPORTANT SAMS BOOKS



**SOLVES YOUR HORIZONTAL- SWEEP PROBLEMS**

## 101 Key Troubleshooting Waveforms for Horizontal-Sweep Circuits

by Bob Middleton



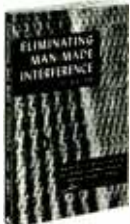
Second volume in the new series by this popular writer. Covers the four most typical horizontal-sweep circuits: 90°, 110°, direct-drive and primary-secondary transformer. Shows the normal waveform at key check-points; then shows 101 abnormal waveforms (and voltage changes) and ties them directly to specific component defects. By comparing

the waveforms you obtain at various circuit points with those shown in the book, you can spot the defective component in minutes! Also included are circuit symptoms, tests, evaluations of results, and valuable supplementary notes. Keep this book near your 'scope, and you'll never again be baffled by horizontal-sweep troubles. 128 pages; 136 illustrations; 5½ x 8½". Only... **\$2.00**

**NEWEST LIGHT ON A TOUGH PROBLEM**

## Eliminating Man-Made Interference

by Jack Darr



Noise and interference often play havoc with radio and TV reception, causing customer dissatisfaction. Here, at last, is the book that gives you the proper corrective know-how. It covers the entire subject of man-made interference—what it is, how it originates, how it is transmitted, how to track it to a source, and how to eliminate or minimize its disturbing effects. Ten chapters cover in detail what to do about noise and interference in home radios and TV sets; audio amplifiers; two-way mobile radio systems; auto, aircraft, and marine radios; electro-mechanical and geophysical apparatus, etc. Two other chapters include actual case histories, illustrated with many photos showing TV picture interference. This book is the first to guide you to the root of practically any man-made interference problem—pays for itself over and over again. Invaluable also in the industrial electronics and ham fields. 160 pages; 5½ x 8½". **\$2.95**

Only... **\$2.95**

**JUST PUBLISHED—NEW VOLUME 8**

## Dial Cord Stringing Guide



Dial cord stringing got you tied up in knots? You can sidestep the problem with this handy workbench guide. Latest Volume 8 includes 214 diagrams showing how to string dial cords in 1959-60 radio and TV receivers. Cumulative index included, covering Vols. 5 through 8. 80 pages; 5½ x 8½". **\$1.00**

Vols. 1-7 are also available at \$1.00 each.

### HOWARD W. SAMS & CO., INC.

Order from your Sams Distributor today, or mail to Howard W. Sams & Co., Inc., Dept. A-11 1720 E. 38th St., Indianapolis 6, Ind.

Send me the following books:

- 101 Key Troubleshooting Waveforms for Hor.-Sweep Circuits (WFM-2)  
 Eliminating Man-Made Interference (MMD-1)  
 Dial Cord Stringing Guide, Vol. 8 (DC-8)

\$.....enclosed.  Send Free Book List

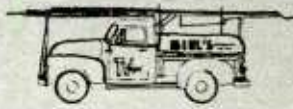
Name.....

Address.....

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

(Outside U.S.A. priced slightly higher)

# SERVICE INDUSTRY



# NEWS

**T**HE EVALUATION of licensing in general and of such pertinent legislation as may come before the next session of the New York State Legislature was the main business of an open forum sponsored by the Empire State Federation of Electronic Technicians Associations in Albany, the state capital. At the request of Irving Toner, ESFETA president, Sidney C. Silver, service editor of *ELECTRONICS WORLD* served as impartial moderator.

Since individuals and groups affiliated with ESFETA are largely in favor of licensing legislation, the chief purpose of the forum was to bring together representatives of other interests, with whom pros and cons could be ironed out. Of special concern was representation by distributors, since many in this category had voiced opposition to an earlier attempt to establish licensing. Of the many distributors invited, only three appeared. These, like Mr. Clifford Allanson, of the New York State Council of Retail Merchants, pointed out that they could not act as official spokesmen for the groups with which they were affiliated or even for other individuals in their classification, but were rather present as observers.

Although an attempt had been made to obtain at least one representative of TV-owning consumers, none was present. Although no legislators in the state were present, a spokesman from the office of the New York State Attorney General did appear.

From some of the informal statements made, it appeared that at least some of the distributors whose names were listed as being in opposition to the bill did not know that they were so listed. Their names had evidently been used without their knowledge or permission. Although they were cautious about either endorsing or opposing any particular bill, depending on its provisions, they did acknowledge that, to an ethical distributor who wished to adhere to a wholesale-only policy, at least one aspect of licensing could assist them. This had to do with the fact that, even with the best intentions, it is difficult to determine which would-be distributor customers are legitimate service dealers. If licensing were in force, possession or non-possession of a license would be a simple, determining criterion.

Mr. Allanson pointed out that he is basically opposed to government intervention and discussed its possible drawbacks. However, he indicated that he might not oppose a particular bill if it were so written as to avoid these draw-

backs as much as possible. He felt that the ultimate effect of such laws was not always easy to anticipate before they were put in force and that, once they were in effect, the chances for correcting defects that showed up later were not always good.

Mr. Tynan of the Attorney General's office spoke briefly. He pointed out that his office had supported the McClosky Bill—which had been presented and defeated at the last legislative session—and that this agency would doubtless support any similar bill that would be put before the forthcoming session.

Some evidence was presented to allay distributor fears that their business volume might suffer if licensing reduced the number of service dealers who could legally continue in business. The experience of distributors in areas where licensing is now in force was brought up. It was pointed out that, although distributors suffer a loss in the number of customers, dollar volume is not affected, since the amount of materials needed for service is not reduced. Rather, the same volume is maintained through a smaller number of dealers, which may be more convenient.

Another forum of this kind has been scheduled for February 5, in Albany, while the legislature is in session. It is hoped that, at this one, some legislators, more distributors, and consumer representatives will be present, as well as possible representation by set manufacturers or the service committee of the Electronic Industries Association.

## "Used-Tube" Bill

Beginning with October (see "Service Industry News," November), manufacturers, distributors, and service dealers have been required to clearly identify the nature of any receiving or picture tube that is not completely new or made of parts not all of which are new. A problem for the dealer is that he is not always in a position to know himself, especially in the case of a CRT. *General Electric* is the first tube manufacturer to issue a public clarification.

Says this source, "the label on the carton and the tube states that all materials and parts used in the manufacture of a G-E replacement picture tube are new except for the envelope which, prior to re-use, has been inspected and tested to the same standards as a new envelope . . . No one can make a better tube simply because he might use new glass . . . The use of a new glass envelope contributes absolutely nothing except a substantially higher cost to the ultimate

user without improvement in quality or performance."

To assist dealers, G-E is making available through its franchised distributors stickers that the dealers can affix to customer invoices, with a statement intended to satisfy legal requirements.

#### Missouri Certification

The Electronic Association of Missouri, leaders in the fight against licensing within the ranks of organized service groups, is ready to go into action with a program it feels is more satisfactory. This bonding and certification plan has been worked out in cooperation with the local Better Business Bureau and the Adult Education Division of St. Louis University. Participation, which is voluntary, entitles a dealer to use identifying cards and a shield indicating that he is taking part.

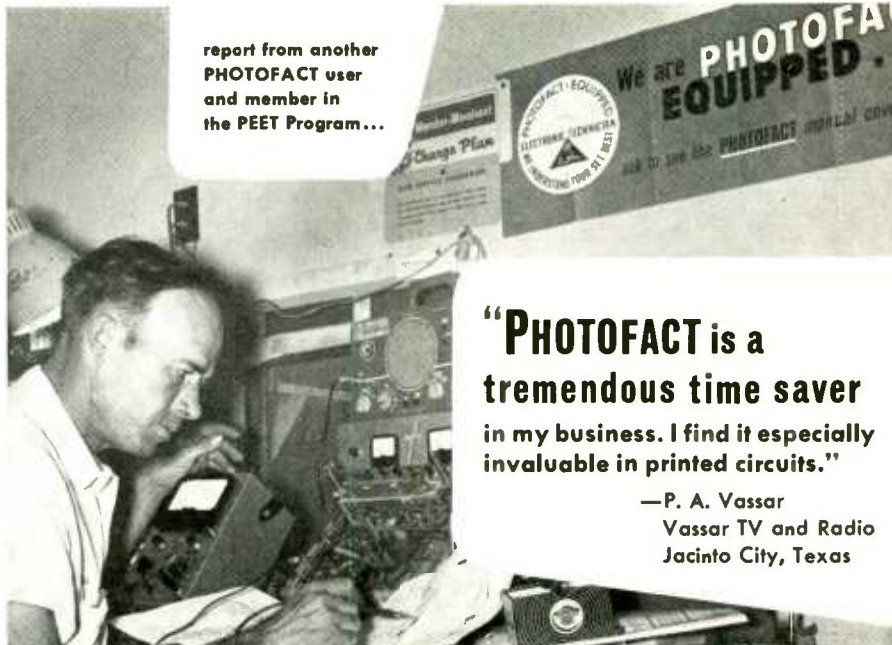
Dealers must adhere to standards of advertising and ethics prescribed by the BBB, pass a test to certify technical proficiency given by the university, and post surety bonds. An employed technician may be certified only if he is in the hire of a bonded dealer. The bonding committee, which will consist of five members and one alternate, is to be appointed by the TEAM president. All actions of the committee are subject to approval by a majority vote of TEAM. Any service dealer who wishes to take part in the program who is not now a member of that association must join TEAM in order to be eligible.

#### NBBB & Service Problems

Kenneth B. Willson, president of the National Better Business Bureau, had some comments to make about electronic service problems in an address before the service committee of the Electronic Industries Association. As far as volume of complaints to various BBB offices throughout the nation is concerned, he said, TV service ranks third among all fields of endeavor. It follows closely on the heels of the home-improvement business, which ranks first, and service on non-electronic home appliances, which comes in second. Interestingly enough, not all of the complaints involving TV service were those made by set owners against service dealers and technicians. Others included owner gripes against makers, and dealer complaints against other dealers, makers, distributors, and customers!

Mr. Willson also had some things to say about licensing. He pointed out that a chief aim of the NBBB is to promote self-regulation by business in place of government regulation. However, he noted that there was strong, widespread support for licensing throughout the service industry and passed this sentiment on to the EIA committee without comment of his own for consideration.

He also suggested that manufacturers might improve their own public relations as well as those of the service industry by undertaking joint sponsorship, with the NBBB, of a public-service film explaining the nature of the product and service needs, for use by such media as TV, schools, and clubs. —30—



**"PHOTOFAC is a tremendous time saver in my business. I find it especially invaluable in printed circuits."**

—P. A. Vassar  
Vassar TV and Radio  
Jacinto City, Texas

## Service Technicians! YOU EARN MORE... YOU RATE with the public when you own the PHOTOFAC® service data library!

You enjoy maximum earnings as the owner of a complete PHOTOFAC 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 PHOTOFAC Library, you know your customers' sets *best*. You can actually show each customer you have the PHOTOFAC Folder covering his very own set. Result: You command public respect and acceptance which paves the way to more business and earnings for you.

#### HOW TO STAY AHEAD...

Yes, the truly successful Service Technicians are those who own the complete PHOTOFAC Library, who can meet and solve any repair problem—faster and more profitably. And these men *keep ahead* because they're on a Standing Order Subscription with their Distributors to receive all new PHOTOFACS as they are released monthly. (They're eligible for the benefits of membership in PEET, too—see below!)

**ONLY \$10 DOWN** puts the complete PHOTOFAC Library in your shop—and you have up to 30 months to pay. See your Sams Distributor today, or write to Howard W. Sams

**NOW IS THE TIME TO JOIN**

**"PEET"**

#### THE POWERFUL NEW PROGRAM FOR QUALIFIED TECHNICIANS

If you now own a PHOTOFAC 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.

**HOWARD W. SAMs & CO., INC.**  
1724 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 \_\_\_\_\_

### MICROMETER BARGAIN

2 1/2" 100-0-100 Microamps.  
Excellent Null Indicator ..... ea. **\$2.95**  
2 for \$5.00

### CARDWELL TRANSMITTING VAR. COND.

Dual Section 211 UUF per  
section. 5700 Volts AC ..... Each **\$5.95**

### SPECIAL MICROAMMETERS

TRIPLETT 3" 0-50 Microamps (Scale  
0-100) Special ..... **\$4.50**

### DYNAMOTOR SPECIALS

12 Volts Input-Output 44V. @ 200Ma. 12 Volts  
Input-Output 225V. @ 100Ma. All in  
one Dynamotor. BRAND NEW. Ea. .... **\$5.95**

### BRAND NEW CARTER DYNAMOTOR

INPUT 5.9 VOLTS. OUTPUT 405 V. @  
270 MA. SMALL SIZE ..... Ea. **\$4.95**

### NEW VACUUM CAPACITORS

50 MMF-5KV	.....	.95
25 MMF-10KV	.....	2.25
EIMAC VC 12 MMF-32KV	.....	ea. 6.95
EIMAC VC 25 MMF-32KV	.....	ea. 7.95
EIMAC VC 50 MMF-32KV	.....	ea. 9.95
JENNINGS JNC-150 MMF-50KV	.....	ea. 12.95
JENNINGS JNC-150 MMF-50KV	.....	ea. 24.95

### POWER TRANSFORMER

Primary 110V. 60 cy. Sec. 385-0-385V. @ 300  
Ma., 5 V. @ 6 Amps., 6.3V. @  
7.5 Amps. 6.3V. @ 2.5 Amps. .... Ea. **\$5.95**

Write for quantity prices

### CHOKE—FULLY CASED

5 HENRY @ 200 Ma	.....	1.95
5 HENRY @ 250 Ma	.....	2.25
10 HENRY 300	.....	3.00
4 HENRY 400 Mil	.....	3.95
12 HENRY 500 Mil	.....	5.95
4 HENRY 900 Mil	.....	8.95
6 HENRY 1 AMP.	.....	7.95
4 HENRY—1 AMP.	.....	11.95

### BRAND NEW OIL CONDENSERS

2 MFD 600 VDC	.50	4 MFD 2000 VDC	3.50
2 MFD 800 VDC	.60	6 MFD 2000 VDC	4.95
4 MFD 800 VDC	.75	6 MFD 2000 VDC	4.95
8 MFD 800 VDC	.85	2 MFD 2500 VDC	2.50
8 MFD 800 VDC	.85	1 MFD 3000 VDC	1.85
8 MFD 800 VDC	.95	2 MFD 3000 VDC	3.50
10 MFD 800 VDC	1.19	1 MFD 3000 VDC	3.25
12 MFD 800 VDC	1.50	2 MFD 4000 VDC	6.25
15 MFD 800 VDC	1.70	3 MFD 4000 VDC	8.95
3x8 (24 MFD)	.....	4 MFD 4000	12.95
600 VDC	2.50	1 MFD 5000 VDC	4.50
1 MFD 1000 VDC	.50	2 MFD 5000 VDC	8.50
2 MFD 1000 VDC	.70	15 MFD 5000	39.50
4 MFD 1000 VDC	1.35	5 MFD 7500 VDC	2.95
8 MFD 1000 VDC	1.95	1 MFD 7500 VDC	6.95
10 MFD 1000 VDC	2.50	2 MFD 7500	17.95
12 MFD 1000 VDC	2.95	1 MFD 10,000	29.95
15 MFD 1000 VDC	3.50	1 MFD 12,500	19.95
1 MFD 1200 VDC	.45	2 MFD 12,500	34.50
1 MFD 1300 VDC	.75	1 MFD 15,000	42.50
2 MFD 1500 VDC	1.10	5 MFD 25,000	34.95
4 MFD 1500 VDC	1.95	1 MFD 25,000	69.95
8 MFD 1500 VDC	2.95	10 MFD 3000 AC	1.95
1 MFD 2000 VDC	.85	20 MFD 330 AC	2.95
2 MFD 2000 VDC	1.50	8 MFD 680 AC	2.95

### RELAYS

WARD LEONARD Heavy duty relay coil  
220V 60Cy., 2 phase, 3P. .... Ea. **\$6.95**  
3 Pole 57. 25 Amp contacts ..... Ea. **\$2.49**

SIGMA SENSITIVE SF Relay H6 800 Ohm coil  
SPDT, operates on as little as 2.5V Ideal:  
Burglar Alarms, Transistor Control. Ea. **\$2.49**

GUARDIAN 110V AC, 2 Pole Single Throw  
(1 N.O. & 1 N.C.) Repl. #610 ..... **\$2.50**

Potter-Brumfield SMLS 5000 ohm,  
4 Ma. Sens ..... Ea. **\$2.25**

110 Volt AC Relay-DPST 60 cy.,  
10 Amp. Contacts ..... Ea. **\$1.50**

6 Volt DC DPDT H.S. .... Ea. **99¢**

12 Volt DPDT DC Relay ..... Ea. **\$1.35**

SIGMA type 22RJC 8,000 ohm  
SPDT, small sealed relay ..... **\$2.49**

Sealed Relay, SPDT, 6,000 ohm  
coil ..... **\$1.95**

G.E. Relay Control, contains 8000 ohm  
relay, sensitivity 2 mils. 10 for \$9.25 ea.  
SIGMA SF—16,000 ohm SPDT, operates  
on 500 Microamperes or less. .... Ea. **\$3.95**

### PANEL METERS

STANDARD BRANDS	DC	.....	5.95
1 1/2" METERS	0-1 Mil DC	.....	3.95
0-1 Mil	0-10 Mills DC	.....	3.95
0-100 Micro	0-500 Mills DC	.....	3.95
	0-100 V. DC	.....	3.95
2" METERS	0-15 Amps RF	.....	4.50
0-1 Ma	0-50 Micro Amps	.....	6.95
100-0-100 Micro	0-15 Volts AC	.....	3.95
0-50 Micro (0-5 scale)	REED Freq. Meter	.....	
0-10 Amps DC	—110V. AC, 57.	.....	
0-20 Volts DC	63 cy	.....	9.95
18-36 Volts DC	Reed —110 V. AC—	.....	380.
0-150 V. AC	420 Cy	.....	10.95
3" METERS	4" METERS	.....	
100-0-100 Micro Amps	0-100 Microamps	.....	6.50

### MISCELLANEOUS SPECIALS

EIMAC TRANS. TUBE-450 TL BRAND NEW  
Fully Guaranteed ..... Ea. **\$39.50**

SPERTI Vacuum switch used in ART13 ea. **\$1.50**

3-12 MMF Erie Ceramic Trimmers ..... 21¢

CUTLER-HAMMER TOGGLE SWITCH  
SPDT (ST42D) 4 for \$1.00 ..... ea. **29¢**

WILLARD STORAGE CELL—2V. 28 Amp  
hrs. Clear plastic case. Shipped dry. .... Ea. **\$2.50**

Write for quantity prices on all special items

All merchandise sold on a 10 day money back guarantee  
Min. Order \$3.00—25% with Order—F.O.B. New York

# PEAK

ELECTRONICS COMPANY  
66 W. Broadway, New York 7, N. Y., WO-2-2370

## Audio Line Amplifier

(Continued from page 61)

also be used. The output transformer can be another type than the one specified provided it is a good quality unit with the same impedance and frequency response characteristics. The resistors must be 5% tolerance or better for best balance and equal amplification on both sides of the amplifier.

Complete the construction of the entire amplifier except for wiring in  $R_6$ . To determine the resistance of  $R_6$ , temporarily wire in a 5000-ohm potentiometer, hooked up as a rheostat, between the transformer's primary center-tap connection and  $S_1$ . Insert a 10-ma. meter in series with the negative battery lead and  $S_1$ , rotate the potentiometer shaft to put maximum resistance in the circuit, and switch  $S_1$  to the "on" position. The milliammeter will indicate about 2 ma. if the wiring and transistors are properly connected. If appreciably more current is indicated, check the wiring for wrong connections or test for a possibly defective transistor. If all seems well, obtain an audio signal generator and audio r.m.s. voltmeter to calibrate the "Trans-Line" amplifier's gain.

Place a 600-ohm resistor across the input terminals and connect the audio voltmeter and signal generator, set at 1000 cycles, to the same terminals. Adjust the generator's output level control for exactly 0.1 volt input to the line amplifier. Transfer the audio voltmeter leads to the output terminals and rotate

the potentiometer shaft to obtain the desired gain. If 20 db is desired, adjust the pot for a 1-volt meter reading or, if a 14-db gain is needed, adjust the pot for a 0.5-volt reading. Recheck the input level for the 0.1-volt level and re-adjust the potentiometer, if necessary, for the desired output level. Monitor the output with an oscilloscope to make sure the output signal is undistorted.

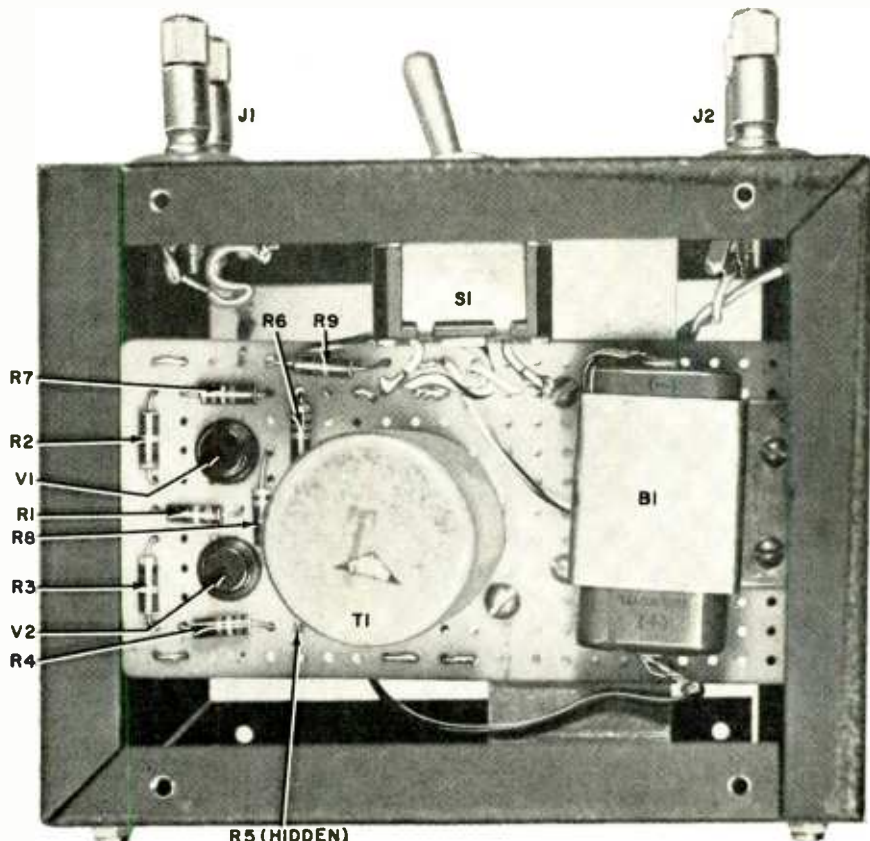
When this procedure is completed, replace the potentiometer with a fixed resistance of equal value, or leave the potentiometer permanently mounted in the enclosure. The line amplifier is now ready to be put to work.

If the line amplifier is to be fed from a signal source containing d.c. as well as a.c., like the cathode of a vacuum-tube cathode-follower stage, insert a blocking capacitor between the cathode and line-amplifier input. Most preamps with cathode-follower outputs have a built-in capacitor.

Many applications requiring signal boosting over long audio lines going from a central studio to a remote amplifier can be handled by this "Trans-Line." It can also be used as a standard fixed-gain preamplifier for audio signal-level measurements, to drive an oscilloscope or r.m.s. voltmeter.

Several of these units can be mounted in a single enclosure for installations requiring more than one transmission line, or they can be cascaded for greater amplification, one feeding the other, if the signal levels are low. Despite its simplicity and ease of construction, the "Trans-Line" provides versatile and dependable performance.

Inside view of the audio line amplifier. Photograph was taken with the top cover removed. All parts except jacks and switch are mounted on piece of perforated board.





# Transistorized Phono Oscillator

By BRONSON M. POTTER

**Circuit makes battery-operated phono possible. Used with portable radios.**

WITH at least two makes of six-volt turntables on the market, a battery-operated phonograph is well within the reach of most music enthusiasts. Electrical governors, low battery drain, and reasonable cost of these imported turntables provide an easy solution to many of the earlier problems encountered with battery-operated portable phonos.

The modulated oscillator circuit shown in the diagram permits the use of a portable radio in place of an amplifier and loudspeaker. The oscillator is, in effect, a transmitter with a range of a few feet. It is modulated by the output of a conventional crystal pickup. Placing a receiver two or three feet from the oscillator permits reception of the phono output through the radio's loudspeaker.

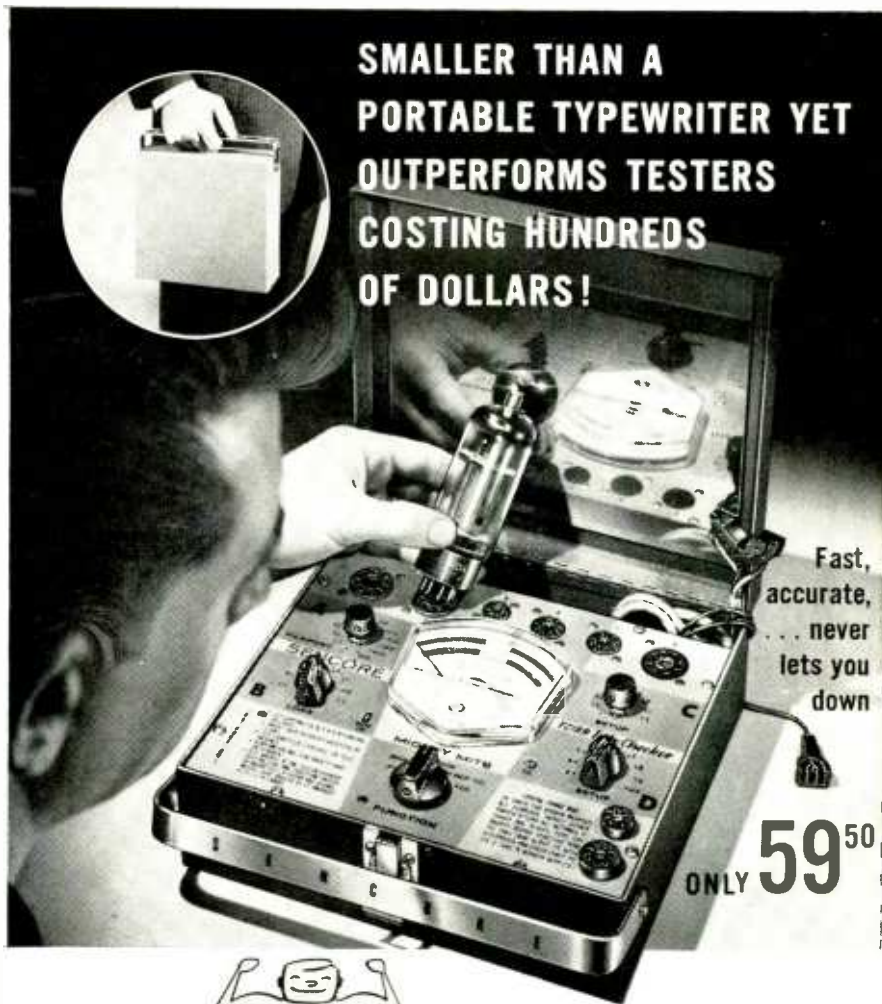
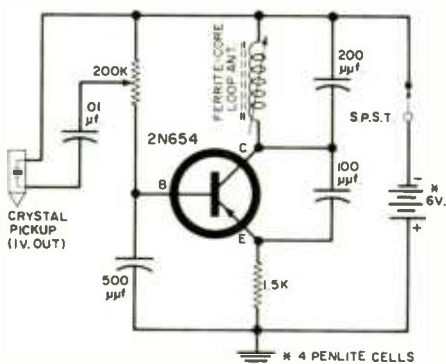
Construction is relatively simple. First mount the pickup and turntable. The turntable should have its own batteries and switch to minimize hash. Four "D" cells in series can provide the current for many hours of listening.

The oscillator parts can be mounted in any convenient arrangement. The transistor leads should be held with pliers while soldering to dissipate heat. The penlite cells, four 1.5-volt units in series, provide one milliampere of current. Be sure to orient the cells correctly.

To operate the oscillator, tune the receiver to a dead spot on the broadcast band. Place a record on the turntable and switch on the oscillator. Set the oscillator's modulation control somewhere near the middle and adjust the slug of the ferrite-core antenna to give the loudest signal at the receiver. Adjust the modulation control for minimum distortion.

This circuit has the advantage of being inexpensive, easy to build, and practical. It can be used at home as well as on the beach or at the summer camp.

Home-built AM broadcast-band oscillator.



## The MIGHTY MITE by SENCORE

The TC109 Tube Checker is a real money maker for the serviceman and a trusty companion for engineers, maintenance men and experimenters. Even students and hobbyists can afford the Mighty Mite for their own use or to service an occasional Radio or TV set. This small complete tester is a tremendous performer that spots bad tubes missed by costly mutual conductance testers.

**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 1300!) plus picture tubes, foreign, five star and auto radio tubes (without damage). As easy to set up as a "speedy tester" from easy to follow tube booklet. New tube charts free of charge. Simple operating instructions are screened on the front panel.

**Check these plus Sencore features** • Meter glows in dark for easy reading behind TV set • Stainless steel mirror in cover for TV adjustment • Rugged, all steel carrying case and easy grip handle • Smallest complete tester made • Inner chassis can be easily transferred to tube caddy, bench or counter. • Only 9" x 8" x 2½". • Wt. 8 lbs.

See your  
Distributor...  
if he cannot help  
you, Pat will



## SENCORE, ADDISON 8, ILLINOIS

Dear Pat: Will you please . . .

- Send me \_\_\_\_\_ Mighty Mite  
 Check or M.O. enclosed (PP Prepaid.)  Send C.O.D.

Distributor's Name (if any) \_\_\_\_\_

Your Name \_\_\_\_\_

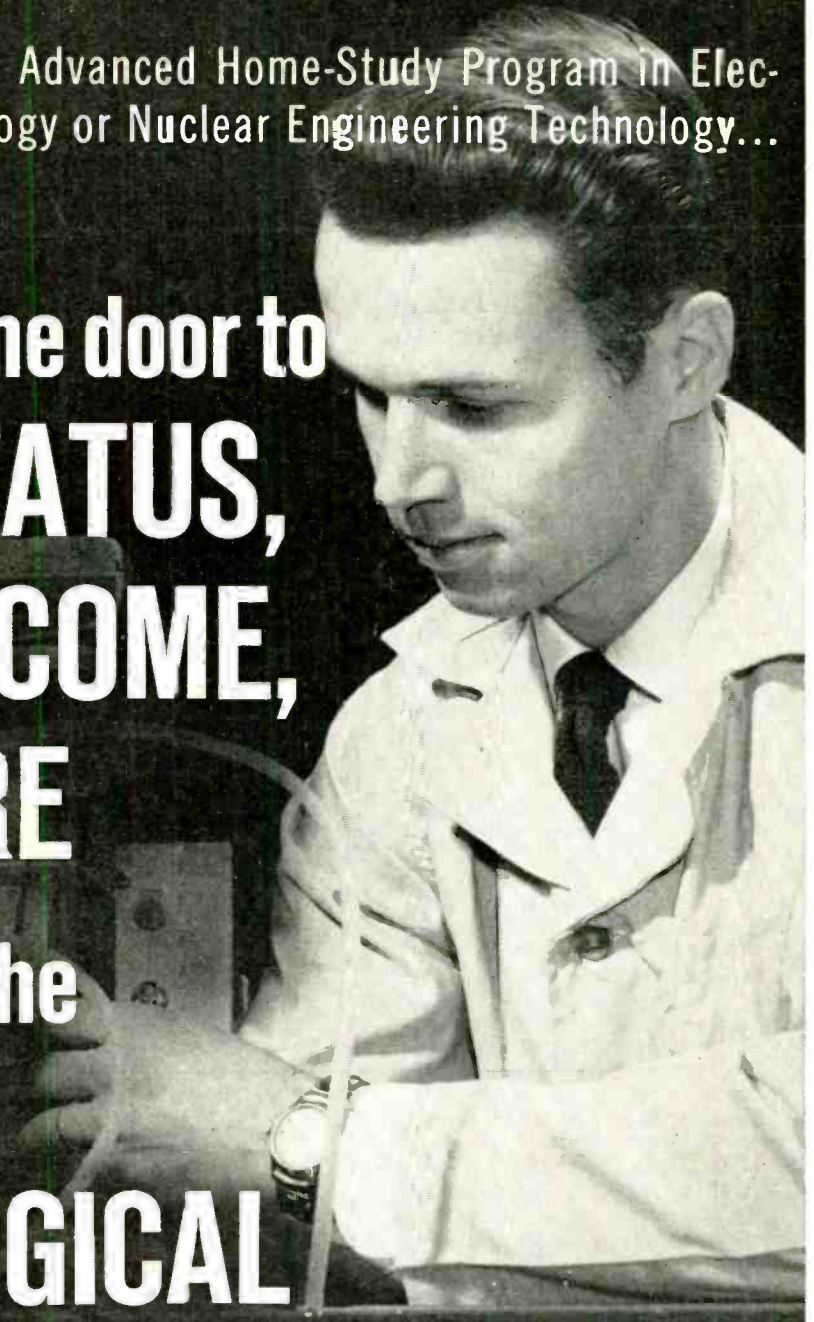
Street \_\_\_\_\_

City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_

ALL UNITS FULLY GUARANTEED OR MONEY BACK WITHIN 10 DAYS

For the Man Who Wants an Advanced Home-Study Program in Electronic Engineering Technology or Nuclear Engineering Technology...

**CREI opens the door to  
HIGHER STATUS,  
BETTER INCOME,  
and a SECURE  
FUTURE in the  
forefront of  
TECHNOLOGICAL  
ADVANCEMENT**



The world of science is the world of the future. There is no career more stimulating, challenging, or rewarding than that of working with topflight scientists and engineers to develop deep space probes and orbital satellite systems . . . package nuclear power reactors to provide economical, long-lasting power anywhere in the world . . . electronics and radioisotopes for use in medicine, agriculture and industry . . . missile systems for the Armed Forces . . . computers and data processing systems which

will become accepted necessities by finance, industry and government . . . to develop a thousand and one concepts that will make our world a better and safer place for all. You can have a career—or speed up your present career—in one or more of these areas if you are eligible to enroll in a CREI home-study program . . . a program recognized everywhere as excellent insurance for a secure future, high professional stature, and better income.

## CREI's Extension Division now offers you college-level programs combining the technological content of advanced residence courses with convenience and economy of home study.

The quality of a CREI education may be gauged by the fact that the demand for CREI graduates and students at the CREI Placement Bureau has far exceeded the supply for several years. Many leading companies and Government agencies send representatives to CREI every year to hire graduates and students for their technical staff. The CREI educational programs were developed in conjunction with leading industrial concerns and government agencies directly interested in the nation's scientific and technological future.

There are now more than 20,000 CREI students in all the 50 states and most countries of the free world. You, too, can follow your CREI program while you remain in your present job. You study at home, when and as you choose . . . and you avoid the time and expense of commuting to a residence school. Within two to four years, depending upon the courses you select and the time you have to apply, you can complete a CREI program in engineering technology. The courses are written in easy-to-understand format, and your personal progress is carefully guided by CREI's competent faculty.

### CREI programs bring you the latest technical advances and breakthroughs.

Recent advances and new techniques have placed great importance on how modern and up-to-date the individual's education is. Recognizing this, CREI maintains a large staff of engineers, educators and scientists who occupy prominent positions in government and industry. These men continuously revise the CREI courses and incorporate all new technical information. CREI courses are the most modern you will find . . . anywhere.

### The CREI program is designed to meet your present and future employment needs and to increase your professional status and earning power.

CREI students frequently gain promotions and increases in pay long *before* they complete the program. As a graduate you will find that you gain stature and respect among your professional colleagues and supervisors, and

### NEW 56-Page Catalog Gives Important Facts About Electronics, Nucleonics . . . and CREI. Send Post-Paid Card Attached For Your Free Copy.

Just published to include new courses being offered by CREI, this informative catalogue discusses the electronic and nuclear industries and answers searching questions about future manpower requirements and career opportunities. The catalogue describes all the courses, the alternative programs . . . it introduces the faculty who will be carefully guiding your progress . . . and it points

that you enjoy a personal satisfaction that comes from working and communicating intelligently with your associates. CREI graduates are important members of the engineering team. Your employer will recognize the assets of your up-to-date education . . . to your personal advantage.

### Officials of private industry and government approve CREI for their own personnel.

The National Broadcasting Company . . . Radio Corporation of America . . . Pan American Airways . . . The Martin Company . . . Canadair Limited . . . Canadian Marconi . . . the Voice of America . . . the British Air Force, Navy and Army . . . and some 50 other electronic and nuclear organizations actually *pay all or a substantial part of the tuition* for employees taking a CREI home-study program. Right now, there are 5,240 U. S. Navy personnel enrolled in the CREI extension program.

### Official accreditation and recognition.

Founded in 1927, CREI is one of the oldest technical institutes in America. CREI co-founded the National Council of Technical Schools, and was one of the first three institutes whose curricula was accredited by the Engineer's Council for Professional Development. The U. S. Office of Education lists CREI as an "institution of higher learning."

### CREI conducts a residence school

in Washington, D. C., for those who wish to attend classes. The regular program of 27 months leads to an AAS degree. No previous technical experience or training is necessary for the residence school.

### Qualifications for enrollment.

You qualify for CREI enrollment if you have a high school diploma or equivalent, and if you have had basic technical training or practical experience. Send for free catalogue for details. Tuition is reasonable, and veterans can take advantage of the G.I. Bill.

out how the courses are especially laid out for home study. *The catalogue is yours without cost or obligation, and it is of vital importance to every man desiring to further himself in the expanding world of science and technology. Mail this card today for your copy of "Your future in Electronics and Nuclear Engineering Technology."*

ECPD ACCREDITED TECHNICAL INSTITUTE CURRICULA • FOUNDED 1927

# The Capitol Radio Engineering Institute

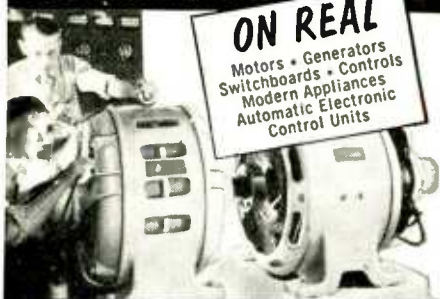


Home Office:  
3224 16TH STREET, N.W.,  
WASHINGTON 10, D.C., U.S.A.,  
Dept. 1101H

England:  
CREI LONDON, GRANVILLE HOUSE,  
132-135 SLOANE STREET, LONDON,  
S.W. 1, ENGLAND

These men are getting practical training in...

## ELECTRICITY ELECTRONICS



**ON REAL**

Motors • Generators  
Switchboards • Controls  
Modern Appliances  
Automatic Electronic  
Control Units

## TELEVISION RADIO ELECTRONICS



**ON REAL**

TV Receivers  
Black & White and Color  
AM-FM and Auto Radios  
Transistors • Printed  
Circuits • Test Equipment

## Train in NEW Shop-Labs of COYNE

In Chicago—Electrical and Electronic Center of the World. Prepare for a better job and a successful future in a TOP OPPORTUNITY FIELD. Train on real full size equipment at COYNE where thousands of successful men have trained for 60 years—largest, oldest, best equipped school of its kind. Professional and experienced instructors show you how, then do practical jobs yourself on more than a quarter of a million dollars worth of equipment. No previous experience or advanced education needed. Employment Service to Graduates.

**Start Now—Pay Later**—Liberal Finance and Payment Plans. Pay most of tuition after graduation. Part-time employment help for students. Choose from nine yearly Starting Dates.

**Mail Coupon or Write to Address Below for Free Book**—"Guide to Careers." Whether you prefer ELECTRICITY, TELEVISION-RADIO or COMBINED ELECTRONICS, which includes both fields, this book describes all training offered.

Information comes by mail. No obligation and NO SALESMAN WILL CALL.

B. W. Cooke, Jr., Pres. Founded 1899  
**COYNE ELECTRICAL SCHOOL**  
Chartered as an Educational Institution Not For Profit  
1501 W. Congress Pkwy., Chicago 7, Ill., Dept. 11-6C

**MAIL COUPON** OR WRITE TO ADDRESS BELOW

**COYNE ELECTRICAL SCHOOL**  
New Coyne Building Dept. 11-6C  
1501 W. Congress Pkwy., Chicago 7, Ill.

Send BIG FREE book and details of all the training you offer. I am especially interested in,

Electricity     Television     Both Fields

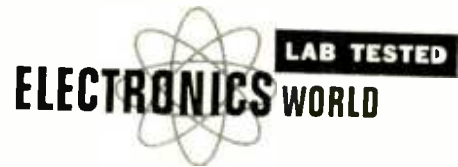
Name: .....

Address: .....

City: ..... State: .....

*(I understand no Salesman will call)*

# Product Report



**"Knight-Kit" Model C-27 CB Transceiver**  
**Sencore "Mighty Mite" TC109 Tube Checker**  
**PACO Model ST-45 AM-FM Stereo Tuner**



**"Knight-Kit" Model C-27 CB Transceiver**

ONE of the most attractive CB transceivers that we have checked recently, both from the viewpoint of appearance as well as performance, is Allied Radio's "Knight-Kit" Model C-27. This smartly styled unit has the look and feel of quality from the minute you turn it on, and the entire edge-lighted plastic front panel is illuminated. The transceiver is fairly large and spread out, and this, coupled with the use of two well-marked printed boards, make the construction of the kit fairly simple and straightforward. The clearly presented, well illustrated assembly manual should make it easy for the inexperienced builder to put together the transceiver with little difficulty.

The transmitter section is a two-channel, fixed-tuned rig with a plate input power of 5 watts—the maximum allowed on the Citizens Band. The unit comes with one transmitter crystal, but extra crystals are available for other channels. A single 6AW8A makes up the entire r.f. portion, with the triode section of the tube used as a crystal oscillator and its pentode section used as the power amplifier. Simple link coupling is used to the antenna, with a second-harmonic trap inserted in the output line to kill any 54-mc. signal that might interfere with channel 2 on a nearby TV set.

The receiver portion of the transceiver is worthy of special comment. In using the unit, we were very pleased with the high sensitivity and extremely good selectivity of the dual-conversion circuit. The receiver is continuously tunable over the entire band, but there is also provision for inserting one or two crystals for 2-channel fixed-tuned operation. The set actually uses two separate second local oscillators, one tunable and the other crystal-controlled to accomplish this. The first local oscil-

lator is crystal-controlled in either case. Plate voltages to both local oscillators, by the way, are regulated in order to get the utmost in frequency stability.

The diode noise limiter is unusually effective. We found this out by operating the unit in our office building, surrounded by noise-generating business machines. With the noise limiter switched in, the signals were wiped clean of all interfering noise. The squelch circuit also operated effectively and smoothly.

The transceiver uses its built-in speaker as a microphone when transmitting. Under these conditions, a bar-switch on the front panel provides press-to-talk operation. An optional press-to-talk ceramic microphone or telephone handset is available for use with the unit. In comparing the use of the speaker as a mike with the separate ceramic mike, we found somewhat more talk-power produced with the ceramic mike. This is because the ceramic unit probably has somewhat greater output and you can get your lips quite close to it conveniently.

The transceiver operates from the 117-volt a.c. line, from which it draws 85 watts. An EZ81 full-wave rectifier is used along with an LC filter; an OA2 voltage regulator supplies a constant 150 volts to the receiver's local oscillators. A separate mobile power-supply kit is also available for the unit that permits it to operate from either a 6- or 12-volt storage battery. Still another available accessory is a mounting bracket for mobile use that permits convenient under-dash mounting for the transceiver.

The Model C-27 is available from Allied Radio at a price of \$79.95. Extra transmitting and optional receiving crystals are also available at a cost of \$1.99 each.



**Sencore "Mighty Mite"  
TC109 Tube Checker**

THE service technician in the market for a new tube tester may face a dilemma even though he knows exactly what he wants. The trouble is that some of his varied requirements are likely to conflict with each other. He wants something safe and simple to use, small, light, and inexpensive. On the other hand, he hopes for reliable indication of quality on all tubes he encounters, physical sturdiness, and reasonable immunity from obsolescence.

Determined to reconcile these qualities in a single instrument, Service Instruments Corp. has come up with a new addition to its line of Sencore test equipment, the "Mighty Mite" TC109 Tube Checker. The unit reflects an interesting and original approach.

Measuring 9 inches wide (maximum dimension) in its carrying case and weighing under 7 lbs., the handy TC109 accepts over 1300 radio and TV tube types, including picture tubes. To make sure the checker "gets them all," reliance is placed on three distinct tests: shorts-leakage testing, cathode emission, and grid leakage. In the first, a selector switch is rotated through 9 positions, in each of which one tube electrode is checked for leakage (sensitivity of 50,000 ohms, neon indication) against all other electrodes tied together.

Cathode emission is checked by applying a pulsating d.c. whose value is close to the normal operating value for the particular tube type. Conditions established by the set-up controls are such that normal emission is indicated by a merit reading of 100 on the emission scale, which is safely below full-scale deflection on the meter. However, it is no secret that many otherwise defective tubes will exhibit normal emission.

The final trap for the "sneaky" defect is the grid test. Experience shows, according to some investigators, that many diverse tube malfunctions, whatever the specific cause, will show up as abnormal activity in the grid circuit. This includes gassiness, grid emission, high-resistance leakage, and other deviations, some of which may permit normal indication even on transconductance tests although tube operation in actual use is improper. In a sense, the configuration that makes the grid test may be regarded as an ultra-sensitive ohmmeter that applies 50 volts between the grid and all other electrodes tied together to indicate leakage in the order of hundreds of megohms. The meter's

January, 1961



**NEW  
BLONDER-TONGUE  
TRANSISTOR 4-SET  
BOOSTER—MODEL IT-3**

*All the gain you need from one antenna for 4 TV or FM sets!*

This new transistor-operated 4-set booster provides higher gain and lower noise than any comparable vacuum tube unit. There are no tubes to replace, lower power drain and negligible heat — all contributing to lower cost, longer maintenance-free operation than any unit on the market. List price of model IT-3, \$32.50.

**SUPERB 1, 2, 3 or 4 SET PERFORMANCE**

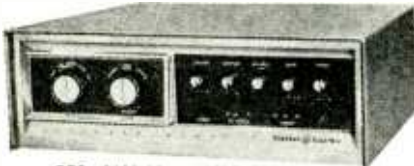
- **1 SET**—B-T 'straight thru' circuit provides full gain without isolation losses (Gain: 9 to 14 db, TV; 8 to 12 db, FM).
- **2, 3 OR 4 SETS**—splitting circuit provides gain and inter-set isolation necessary to provide top performance on 2, 3 or 4 sets. Gain two sets—each set 4 to 8 db; Gain three sets—each set 3 to 4 db; Gain four sets—each set 2 to 3 db.

*Sold through distributors. For details write: Dept. EW-1  
engineered and manufactured by*

**BLONDER-TONGUE**  
9 Alling St., Newark, N. J.

Canadian Div.: Benco Television Assoc. Ltd., Toronto, Ont. • Export: Morhan Export Corp., N. Y. 13  
home TV accessories • UHF converters • master TV systems • Industrial TV systems • FM/AM radios

**SAVE OVER 50% AT McGEE  
GENERAL ELECTRIC STEREO AMPLIFIER**



REG. \$169.95 — SALE PRICE \$79.95

MS-4000A General Electric 56 watt (28 watt per channel) stereo amplifier. Save over 50%. Regular net is \$169.95. Price includes grey vinyl covered metal case 15x12x5 1/2 high. Input selector for tape heads, monaural or stereo phono or tuner. Bass and treble tone controls, volume control and rumble filter. Output matches 4, 8 and 16 ohms. Push-pull 6973 output tubes for each channel. 12 tubes in all. Response 20 to 20,000 cps. Shpg. wt. 31 lbs. Regular audio net. . . . . \$79.95

**STEREO  
AM-FM TUNER  
-AMPLIFIER  
COMBINATION  
\$119.95**



New, STA-330 imported "All-in-One" Stereo AM-FM tuner and full 2 channel 30 watt stereo amplifier (15 watts per channel). Attractive gold finish metal case, approx. 18x13x6 1/2 high. Response 20 to 17,500 cps. Add any record player or changer with either crystal or magnetic stereo cartridge and two speakers and you have a complete high fidelity stereo music system. Receives AM broadcast and FM, 88 to 108 mc. Full bass and treble tone controls and stereo balance control. . . . . \$119.95

**HIGH FIDELITY CORNER  
SPEAKER SYSTEM  
50.00 VALUE \$229.95**

UTAH BUILT  
12" WOOFER  
4" TWEETER



MODEL COR-12, 29" high, 21" wide, 11 1/2" deep. Choice of simulated Mahogany, Limed Oak, Walnut or Fruitwood. Shpg. wt. 29 lbs. Response: 30 to 15,000 cps. SALE PRICE \$22.95, 2 for \$44.00. Combination offer: 2 for \$40.00 when purchased with either of the above amplifiers.

Write for McGee's 160 page 1961 catalog  
**McGEE RADIO CO.**  
1901 McGee St., Kansas City 8, Missouri

**MOVING?**

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

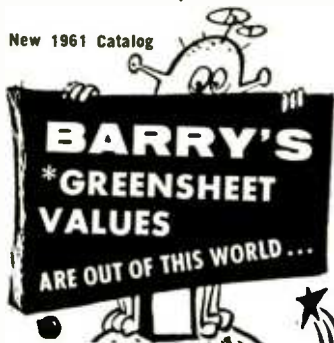
**ELECTRONICS WORLD**

434 South Wabash Avenue Chicago 5, Illinois

Tremendous and varied stock of unused special purpose and receiving tubes. Write for quotation.

Microwave Components. Write.

New 1961 Catalog



\*A complete new 1961 catalog of specialized Industrial Electronic TUBES and COMPONENTS . . . featuring Barry Electronics savings to Industry, Hams & Experimenters.  
Prove these values to yourself! Complete and mail the coupon below for your copy of the "Greensheet." We'll also purchase your equipment and unused tubes.  
Send details: BARRY ELECTRONICS CORP., 512 Broadway, New York 12, N. Y. Dept. EW-1.  
Please send me a copy of the "Greensheet and add my name to your mailing list.  
(EW-1)

Name ..... Title .....  
Company .....  
Address .....  
City ..... State .....

grid-leakage scale begins to indicate into the "Bad" region when leakage resistance (or other defect reflected as such) falls to 100 megohms.

The meter itself is in the cathode of the 6C4 that is the heart of the checker's circuitry. In this arrangement, a dead short through the suspect tube or gross misadjustment of controls will not send excessive current through the meter. Thus the tester is protected against damage, even in the hands of an inept customer.

To check the instrument's reliability, we reversed the customary test procedure, observing performance of the TC109 on some two dozen tubes known to be defective. Originally accumulated for another purpose, these had been marked with known or probable defects or the symptoms they had produced in their original circuits. Many had been passed as "good" by other testers. Each failed at least one of the three tests provided by the TC109. On the other hand, every new tube previously known to be in good condition scored very close to 100 on the "Mighty Mite's" emission test and clearly normal on the other tests.

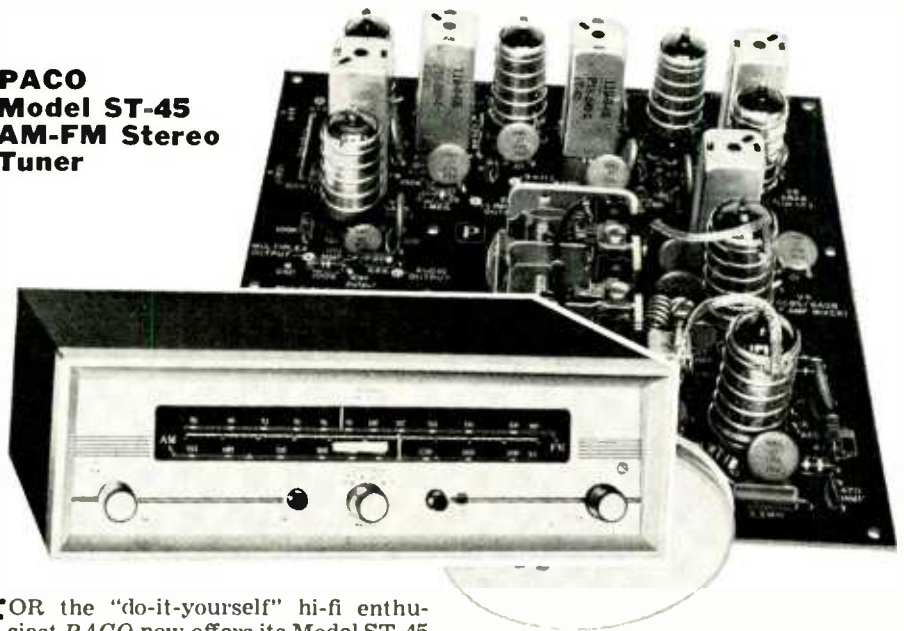
Tube set-up—the adjustment of four switches—is achieved easily and quickly by technicians or laymen. A fifth switch is rotated through the various test posi-

tions. The various sections of multi-purpose tubes are checked separately. The tube chart is in the form of a compact loose-leaf book that fits into the tester case to which it is attached and permits easy insertion of new data. Owner registration insures a continuing flow of test data for new tubes, as they appear, at no additional charge. *Scincore's* reputation for supplying such follow-up information is good. This is the chief factor in the prevention of tube-tester obsolescence.

A clear instruction manual includes circuit analysis, schematics, a troubleshooting chart, and delineates added tasks (such as life-expectancy test, open-element test, rejuvenation) achieved with additional, minor manipulation. The "Mighty Mite" uses heavy-duty sockets and switches, plus a sturdy chassis on which parts are well-supported. The meter face lights up in use, for those dark, back-of-the-set spots. Concise instructions are printed on the front panel, which also includes two tube-pin straighteners.

Convenient for carry-about or counter use, the TC109 may also be removed from its case for easy mounting (instructions included) in a tube-tool caddy or on a bench panel. Dealer net price is \$59.50.

**PACO  
Model ST-45  
AM-FM Stereo  
Tuner**



FOR the "do-it-yourself" hi-fi enthusiast PACO now offers its Model ST-45 combination AM-FM tuner, intended for stereo reception, which includes some very fine features. The kit itself contains printed wiring boards which are clearly labeled on the top so that the assembler knows exactly which part goes where. A total of 13 tubes provides completely separate AM and FM receivers and two separate audio-output cathode-followers. A tuning indicator, in addition to a.f.c., which can be switched in or out, helps on all FM settings of the selector switch. When AM only is selected, then the tuning eye works on AM. Separate pointers are moved along the slide-rule dial and each of the ganged tuning capacitors is driven through a gear mesh as well as

by the dial string from the front control.

The unit under test had been constructed and aligned according to the instruction manual, without a signal generator, and showed a discrepancy of 1 mc. at the low end of the FM band and it was 2 mc. off at the 108-mc. dial reading. This was later corrected in a signal-generator alignment by careful trimming so that the dial reading was only 0.4 mc. off, at the worst point.

Performance tests on the FM portion were made according to the IHFM (Institute of High Fidelity Manufacturers, Inc.) standards, and yielded the following results:

Volume sensitivity for a 20-db output reduction is 1.8  $\mu$ v. at 90 mc., 1.5  $\mu$ v. at

98 mc., and 2.2  $\mu$ v. at 106 megacycles. Sensitivity for 30-db quieting is 2.5  $\mu$ v. at 90 mc., 2  $\mu$ v. at 98 mc., and 3  $\mu$ v. at 106 mc.

Over-all i.f. response is 320 kc. at the 3-db points, while the peak-to-peak separation of the FM detector is 410 kc., with a linear portion of 330 kc.

The a.f.c. pull-in range at 98 mc. is +550 kc. and -600 kc., and there is no discernible drift when a.f.c. is on.

Maximum audio output of the FM section is 1.5 volts r.m.s.

Audio response is within  $\pm 1$  db from 40 cps to 15,000 cps—the limits of our test. This takes into account the standard de-emphasis curve.

The AM portion of the Model ST-45 has an r.f. amplifier, a pentagrid converter, one i.f. stage, and a crystal diode as detector and a.v.c. source. All measurements were made with a 200- $\mu$ f. dummy antenna.

Tuning range of the unit is 550 kc. to 1640 kc.

Frequency calibration is -15 kc. at 1000 kc.

Usable sensitivity is 3  $\mu$ v. at 600 kc., 5  $\mu$ v. at 1000 kc., and 2.5  $\mu$ v. at 1500 kc.

Selectivity is -6 db at  $\pm 3.5$  kc.

Audio response is within  $\pm 3$  db from 40 to 7800 kc.

The 10-kc. whistle filter effectively eliminates all whistle interference that may be produced.

From the above data it becomes apparent that the unit tested certainly performs very well. Actual listening tests in a difficult location with a minimum of antenna (3 feet of 300-ohm twin-lead) confirmed the effectiveness of the FM portion, while the AM tuner, with its built-in ferrite-core antenna, also operated very satisfactorily as was expected.

The price of the unit is \$84.95 in kit form or \$99.95 in semi-kit form, in which the printed boards are completely constructed and aligned by the manufacturer. The tuner is also available completely factory-wired at a price of \$134.95.

Leo I. Meyerson, president of World Radio Laboratories of Council Bluffs, Iowa, presents the winning certificate to Gene Conley, Columbia TV Service, as WRL's Omaha representative, Rich Switzer, looks on. The certificate entitles Mr. Conley—an Omaha resident—to a week in Hawaii. The trip, based on total purchases of Hitachi tubes from WRL, was entered by 250 dealers. Present plans call for making the travel contest an annual event, according to Mr. Meyerson, who was both surprised and pleased by the enthusiastic dealer response.



# FREE GIANT 1961 204 PAGE CATALOG

**B-A 1961**  
ANNUAL CATALOG #11

**SAVE UP TO 50% ON 8-A SELECTED KITS**

**TOP VALUES IN POWER AND HAND TOOLS**

**HI-FI AND STEREO SYSTEMS & COMPONENTS**

**30 PAGES OF BARGAINS NOT IN ANY OTHER CATALOG**

**100'S OF NEW ITEMS LISTED HERE FOR 1st TIME**

**Guarantee**

**SINCE 1927**

*A Complete Buying Guide for Everything in*  
**RADIO TV ELECTRONICS**

for DEALERS, SERVICE MEN, SCHOOLS, BROADCASTERS, INDUSTRIALS, THEATRE, MANUFACTURERS, CHURCHES, HOTELS, PUBLIC UTILITIES, LABORATORIES, ENGINEERS, EXPERIMENTERS, AMATEURS

INDICE PAGE 161-202 PHONE BARRINGTON 3-1193

**BURSTEIN-APPLEBEE** 1012-14 McGEE ST., KANSAS CITY 6, MO.

BURSTEIN-APPLEBEE CO. Dept. M,  
1012-14 McGEE St., Kansas City 6, Mo.

Send Free 1961 B-A Catalog No. 611

**RUSH COUPON TODAY!**

NAME \_\_\_\_\_

ADDRESS \_\_\_\_\_

CITY \_\_\_\_\_ STATE \_\_\_\_\_

**LOWEST PRICED ELECTRONIC ASSORTMENTS IN AMERICA!**

**RADIO-TV PARTS BY THE POUND IN NEW... JUMBO PAKS!**

SPECIAL TRUCK-LOADS of manufacturers' over-runs at a fraction of their original cost!	ONE POUND PRECISION RESISTORS WORTH \$100	ONE POUND DISC CONDENSERS WORTH \$50	ONE POUND CERAMIC CONDENSERS WORTH \$85	\$ <b>3</b> <sup>00</sup> per pound
	ONE POUND DISCS & CERAMICS WORTH \$75	ONE POUND Discs, Ceramics PRECISIONS WORTH \$70	BUY 4 PAKS for \$11.00	

Clip out & mail

HOW TO ORDER: include check or M.O. with sufficient postage; excess returned. C.O.D. orders. 25% down; rated, net 30 days. INCLUDE POSTAL ZONE in address.

**LEKTRON** 243 Everett Ave. CHELSEA SO. MASS.

FREE GIANT BARGAIN CATALOG WRITE FOR YOURS!

# EXAMINE ANY OF THESE TESTERS BEFORE YOU BUY!!

Yes, we offer to ship at our risk one or more of the testers described on these pages.

SUPERIOR'S NEW MODEL 770-A

## VOLT-OHM MILLIAMMETER



### FEATURES:

- Compact—measures 3 1/8" x 5 7/8" x 2 1/4".
- Uses "Full View" 2% accurate 850 Microampere D'Arsonval type meter
- Housed in round-cornered, molded case.

### SPECIFICATIONS:

- 6 A.C. VOLTAGE RANGES: 0-15/30/150/300/1500/3000 Volts.
- 6 D.C. VOLTAGE RANGES: 0-7.5/15/75/150/750/1500 Volts.
- 2 RESISTANCE RANGES: 0-10,000 Ohms, 0-1 Megohm.
- 3 D.C. CURRENT RANGES: 0-15/150 Ma., 0-1.5 Amps.
- 3 DECIBEL RANGES: -6 db to +18 db, +14 db to +38 db, +34 db to +58 db.

The Model 770-A comes complete with test leads and operating instructions. Price is \$15.85. Terms: \$3.85 after 10 day trial then \$4.00 monthly for 3 months.

SUPERIOR'S NEW MODEL 77

## VACUUM TUBE VOLTMETER

WITH NEW 6" FULL VIEW METER

Compare it to any peak-to-peak V.T.V.M. made by any other manufacturer at any price!



### SPECIFICATIONS:

- DC VOLTS—0 to 3/15/75/150/300/750/1500 volts at 11 megohms input resistance.
- AC VOLTS (RMS)—0 to 3/15/75/150/300/750/1500 volts.
- AC VOLTS (Peak to Peak)—0 to 8/40/200/400/800/2000 volts.
- ELECTRONIC OHMMETER—0 to 1000 ohms/10,000 ohms/100,000 ohms/1 megohm/10 megohms/100 megohms/1,000 megohms.
- DECIBELS—10 db to +18 db, +10 db to +38 db, +30 db to +58 db. All based on 0 db = .006 watts (6 mw) into a 500 ohm line (1.73v).
- ZERO CENTER METER—For discriminator alignment with full scale range of 0 to 1.5/7.5/37.5/75/150/375/750 volts at 11 megohms input resistance.

Model 77 comes complete with operating instructions, probe and test leads and carrying case. Price is \$42.50. Terms: \$12.50 after 10 day trial then \$6.00 monthly for 3 months.

SUPERIOR'S NEW MODEL 70 UTILITY TESTER

## FOR REPAIRING ALL ELECTRICAL APPLIANCES MOTORS \* AUTOMOBILES



Written in simple, easy-to-understand style.

### INCLUDED FREE

64 page condensed course in electricity. Profusely illustrated.

As an electrical trouble shooter the Model 70:

- Will test Toasters, Irons, Broilers, Heating Pads, Clocks, Fans, Vacuum Cleaners, Refrigerators, Lamps, Fluorescents, Switches, Thermostats, etc.
- Measures A.C. and D.C. Voltages, A.C. and D.C. Current, Resistances, Leakage, etc.
- Incorporates a sensitive direct-reading resistance range which will measure all resistances commonly used in electrical appliances, motors, etc.
- Leakage detecting circuit will indicate continuity from zero ohms to 5 megohms (5,000,000 ohms).

As an Automotive Tester the Model 70 will test:

- Both 6 Volt and 12 Volt Storage Batteries • Generators • Starters • Distributors • Ignition Coils • Regulators • Relays • Circuit Breakers • Cigarette Lighters • Stop Lights • Condensers • Directional Signal Systems • All Lamps and Bulbs • Fuses • Heating Systems • Horns • Also will locate poor grounds, breaks in wiring, poor connections, etc.

Model 70 comes complete with 64 page book and test leads. Price is \$15.85. Terms: \$3.85 after 10 day trial then \$4.00 monthly for 3 months.

SUPERIOR'S NEW MODEL 79

## SUPER-METER

WITH NEW 6" FULL VIEW METER



### SPECIFICATIONS:

- D.C. VOLTS: 0 to 7.5/15/75/150/750/1,500.
- A.C. VOLTS: 0 to 15/30/150/300/1,500/3,000.
- D.C. CURRENT: 0 to 1.5/15/150 Ma. 0 to 1.5/15 Amperes.
- RESISTANCE: 0 to 1,000/100,000 Ohms. 0 to 10 Megohms.
- CAPACITY: .001 to 1 Mfd. 1 to 50 Mfd.
- REACTANCE: 50 to 2,500 Ohms, 2,500 Ohms to 2.5 Megohms.
- INDUCTANCE: .15 to 7 Henries, 7 to 7,000 Henries.
- DECIBELS: -6 to +18, +14 to +38, +34 to +58.

The following components are all tested for QUALITY at appropriate test potentials. Two separate BAD-GOOD scales on the meter are used for direct readings.

All Electrolytic Condensers from 1 MFD to 1000 MFD.  
All Selenium Rectifiers. All Germanium Diodes.  
All Silicon Rectifiers. All Silicon Diodes.

Model 79 comes complete with operating instructions, test leads and carrying case. Price is \$38.50. Terms: \$8.50 after 10 day trial then \$6.00 monthly for 5 months.

SUPERIOR'S NEW MODEL 80

## 20,000 OHMS PER VOLT ALLMETER



6 INCH FULL-VIEW METER provides large easy-to-read calibrations. No squinting or guessing when you use Model 80.

MIRRORED SCALE permits fine accurate measurements where fractional readings are important.

### SPECIFICATIONS:

- 7 D.C. VOLTAGE RANGES: (At a sensitivity of 20,000 Ohms per Volt) 0 to 15/75/150/300/750/1500/7500 Volts.
- 6 A.C. VOLTAGE RANGES: (At a sensitivity of 5,000 Ohms per Volt) 0 to 15/75/150/300/750/1500 Volts.
- 3 RESISTANCE RANGES: 0 to 2,000/200,000 Ohms. 0-20 Megohms.
- 2 CAPACITY RANGES: .00025 Mfd. to .3 Mfd., .05 Mfd. to 30 Mfd.
- 5 D.C. CURRENT RANGES: 0-75 Microamperes. 0 to 7.5/75/750 Milliampers. 0 to 15 Amperes.
- 3 DECIBEL RANGES: -6 db to +18 db, +14 db to +38 db, +34 db to +58 db.

NOTE: The line cord is used only for capacity measurements. Resistance ranges operate on self-contained batteries.

Model 80 Allmeter comes complete with operating instructions, test leads and portable carrying case. Price is \$42.50. Terms: \$12.50 after 10 day trial then \$6.00 monthly for 5 months.

## DID YOU EVER?

- ▶ Order merchandise by mail, including deposit or payment in full, then wait and write... wait and write?
- ▶ Purchase anything on time and sign a lengthy complex contract written in small difficult-to-read type?
- ▶ Purchase an item by mail or in a retail store then experience frustrating delay and red tape when you applied for a refund?

Obviously prompt shipment and attention to orders is an essential requirement in our business... We ship at our risk!



# NO

CONTRACT TO SIGN

CO-MAKERS

EMPLOYER  
NOTIFICATION

The simple order authorization included in this offer is all you sign. We ask only that you promise to pay for or return the goods we ship in good faith.

EXAMINE ANY ITEM YOU SELECT  
IN THE PRIVACY OF YOUR OWN HOME

Then if completely satisfied pay on the interest-free terms plainly specified. When we say interest-free we mean not one penny added for "interest" for "finance" for "credit-checking" or for "carrying charges." The net price of each tester is plainly marked in our ads—that is all you pay except for parcel post or other transportation charges we may prepay.

SUPERIOR'S NEW MODEL 82A  
MULTI-SOCKET TYPE

## TUBE TESTER

**SPECIFICATIONS:**

- Tests over 1000 tube types.
- Tests OZ4 and other gas-filled tubes.
- Employs new 4" meter with sealed air-damping chamber resulting in accurate vibrationless readings.
- Use of 22 sockets permits testing all popular tube types and prevents possible obsolescence.
- Dual Scale meter permits testing of low current tubes.
- 7 and 9 pin straighteners mounted on panel.
- All sections of multi-element tubes tested simultaneously.
- Ultra-sensitive leakage test circuit will indicate leakage up to 5 megohms.



Model 82A comes housed in handsome, portable, saddle-stitched Texon case. Price is \$36.50. Terms: \$6.50 after 10 day trial then \$6.00 monthly for 5 months.

SUPERIOR'S NEW MODEL TW-11

## STANDARD PROFESSIONAL TUBE TESTER



- Uses the new self-cleaning Lever Action Switches for individual element testing. Because all elements are numbered according to pin-number in the RMA base numbering system, the user can instantly identify which element is under test.
- Free-moving built-in roll chart provides complete data for all tubes. All tube listings printed in large-easy-to-read type.
- **NOISE TEST:** Phono-jack on front panel for plugging in either phones or external amplifier will detect microphonic tubes or noise due to faulty elements and loose internal connections.
- **SEPARATE SCALE FOR LOW-CURRENT TUBES**—Previously on emission type tube testers, it has been standard practice to use one scale for all tubes. As a result, the calibration for low-current tubes has been restricted to a small portion of the scale. The extra scale used here greatly simplifies testing of low-current tubes.

The Model TW-11 comes housed in a handsome, portable, saddle-stitched Texon case. Price is \$47.50. Terms: \$11.50 after 10 day trial then \$6.00 monthly for 6 months.

SUPERIOR'S NEW MODEL 83A

## C.R.T. TESTER

Tests and Rejuvenates  
ALL PICTURE TUBES

**ALL BLACK AND WHITE TUBES**  
From 50 degree to 110 degree types—  
from 8" to 30" types.

**ALL COLOR TUBES**  
Test ALL picture tubes—in the carton  
—out of the carton—in the set!

Model 83A provides separate filament operating voltages for the older 6.3 types and the newer 8.4 types.

Model 83A properly tests the red, green and blue sections of color tubes individually—for each section of a color tube contains its own filament, plate, grid and cathode.

Model 83A will detect tubes which are apparently good but require rejuvenation. Such tubes will provide a picture seemingly good but lacking in proper definition, contrast and focus.

Rejuvenation of picture tubes is not simply a matter of applying a high voltage to the filament. Such voltages improperly applied can strip the cathode of the oxide coating essential for proper emission. The Model 83A applies a selective low voltage uniformly to assure increased life with no danger of cathode damage.

Model 83-A comes housed in handsome portable Saddle-stitched Texon case—complete with socket for all black and white tubes and all color tubes. Price is \$38.50. Terms: \$8.50 after 10 day trial then \$6.00 monthly for 5 months.

SUPERIOR'S NEW MODEL TV-50A

## GENOMETER 7 Signal Generators in One!



- ✓ R.F. Signal Generator for A.M.
- ✓ R.F. Signal Generator for F.M.
- ✓ Audio Frequency Generator
- ✓ Bar Generator
- ✓ Cross Hatch Generator
- ✓ Color Dot Pattern Generator
- ✓ Marker Generator

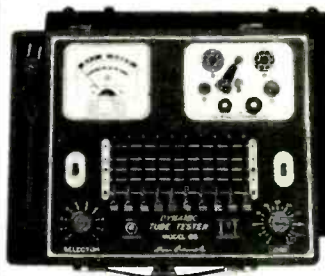
A versatile all-inclusive GENERATOR which provides ALL the outputs for servicing:

A.M. Radio • F.M. Radio • Amplifiers  
• Black and White TV • Color TV

The Model TV-50A comes absolutely complete with shielded leads and operating instructions. Price is \$47.50. Terms: \$11.50 after 10 day trial then \$6.00 monthly for 6 months.

SUPERIOR'S NEW MODEL 85

## TRANS-CONDUCTANCE TYPE TUBE TESTER



- Employs latest improved TRANS-CONDUCTANCE circuit. Test tubes under "dynamic" (simulated) operating conditions. An in-phase signal is impressed on the input section of a tube and the resultant plate current change is measured as a function of tube quality. This provides the most suitable method of simulating the manner in which tubes actually operate in radio, TV receivers, amplifiers and other circuits. Amplification factor, plate resistance and cathode emission are all correlated in one meter reading.

• **SYMBOL REFERENCES:** Model 85 employs time-saving symbols (\*, +, ●, ▲, ■) in place of difficult-to-remember letters previously used. Repeated time-savers proved to us that use of these symbols will be met with approval by the manufacturers increase the release of new tube types, this time-saving feature becomes necessary and advantageous.

scientifically selected symbols speeded up the element switching step. As the tube manufacturers increase the release of new tube types, this time-saving feature becomes necessary and advantageous.

• **"FREE-POINT" LEVER TYPE ELEMENT SWITCH ASSEMBLY** marked according to RETMA basing, permits application of test voltages to any of the elements of a tube.

• **FREE FIVE (5) YEAR CHART DATA SERVICE.** Revised up-to-date subsequent charts will be mailed to all Model 85 purchasers at no charge for a period of five years after date of purchase.

Model 85 comes complete, housed in a handsome portable cabinet with slip-on cover. Price is \$52.50. Terms: \$12.50 after 10 day trial then \$8.00 monthly for 5 months.

SUPERIOR'S NEW MODEL 88

## TESTS ALL TRANSISTORS AND TRANSISTOR RADIOS



AS A TRANSISTOR RADIO TESTER

An R.F. Signal source, modulated by an audio tone is injected into the transistor receiver from the antenna through the R.F. stage, past the mixer into the I.F. Amplifier and detector stages and on to the audio amplifier. This injected signal is then followed and traced through the receiver by means of a built-in High Gain Transistorized Signal Tracer until the cause of trouble is located and pinpointed.

AS A TRANSISTOR TESTER

The Model 88 will test all transistors including NPN and PNP, silicon, germanium and the new gallium 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!

Model 88 comes housed in a handsome portable case. Complete with a set of Clip-on Cables for Transistor Testing; an R.F. Diode Probe for R.F. & I.F. Tracing; an Audio Probe for Amplifier Tracing and a Signal Injector Cable. Complete—nothing else to buy! Price is \$38.50. Terms: \$8.50 after 10 day trial then \$6.00 monthly for 5 months.

Try any of the Instruments on this or the facing page for 10 days before you buy. If completely satisfied then send down payment and pay balance as indicated on coupon. No interest or Finance Charges Added! If not completely satisfied return unit to us, no explanation necessary.

MOSS ELECTRONIC, INC., Dept. D-847, 3849 Tenth Ave., New York 34, N. Y.

Please send me the units checked on approval. If completely satisfied I will pay on the terms specified with no interest or finance charges added. Otherwise, I will return after a 10 day trial positively cancelling all further obligations.

- Model 770-A Total Price \$15.85 \$3.85 within 10 days. Balance \$1.00 monthly for 3 months.
- Model 79 Total Price \$38.50 \$8.50 within 10 days. Balance \$6.00 monthly for 5 months.
- Model 77 Total Price \$42.50 \$12.50 within 10 days. Balance \$6.00 monthly for 5 months.
- Model 80 Total Price \$42.50 \$12.50 within 10 days. Balance \$6.00 monthly for 5 months.

- \$11.50 within 10 days. Balance \$6.00 monthly for 6 months.
- Model 83-A Total Price \$38.50 \$8.50 within 10 days. Balance \$6.00 monthly for 5 months.
- Model 70 Total Price \$15.85 \$3.85 within 10 days. Balance \$1.00 monthly for 3 months.
- Model 82-A Total Price \$36.50 \$6.50 within 10 days. Balance \$6.00 monthly for 5 months.
- Model TW-11 Total Price \$47.50

- Model 85 Total Price \$52.50 \$12.50 within 10 days. Balance \$8.00 monthly for 5 months.
- Model TV-50A Total Price \$47.50 \$11.50 within 10 days. Balance \$6.00 monthly for 6 months.
- Model 88 Total Price \$38.50 \$8.50 within 10 days. Balance \$6.00 monthly for 5 months.

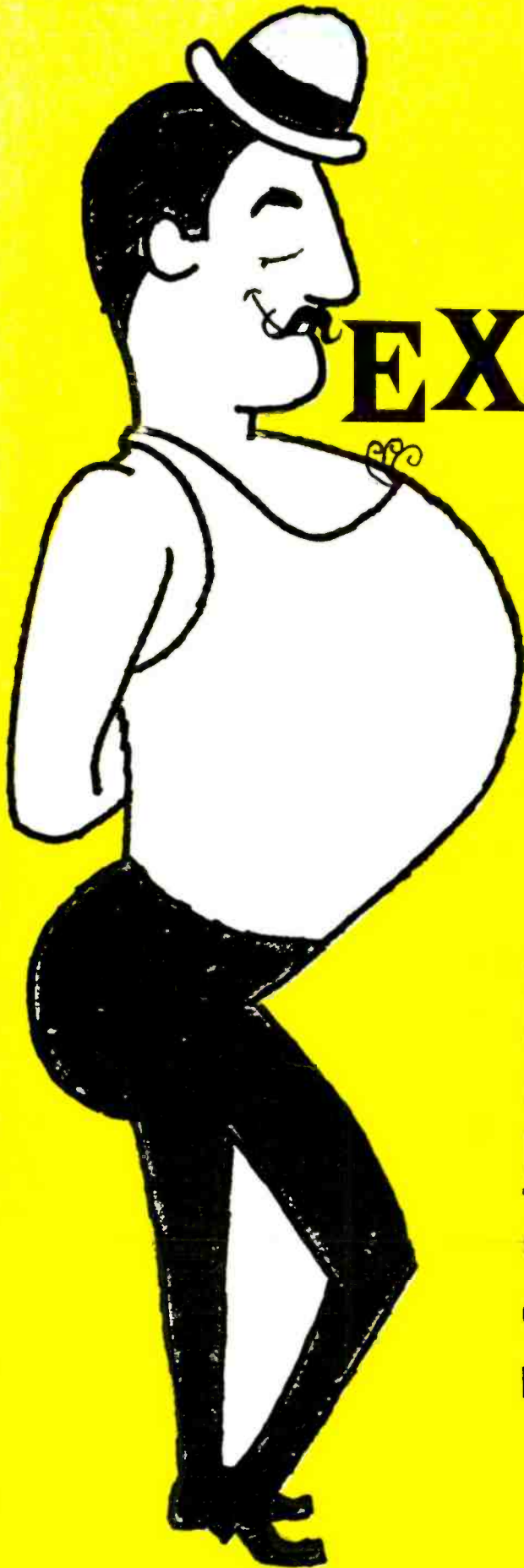
Name .....

Address .....

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

All prices net. F.O.B. N.Y.C.

Export Division: Rocke International Corp.,  
13 East 40th St., New York 16, N. Y.



# START EXPANDING, MISTER!

you make more with

***CHANNEL  
MASTER***

because

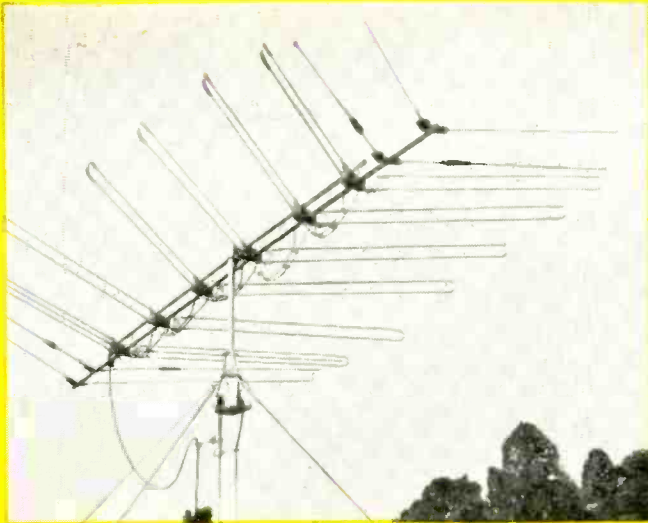
Channel Master

builds in more

of what your

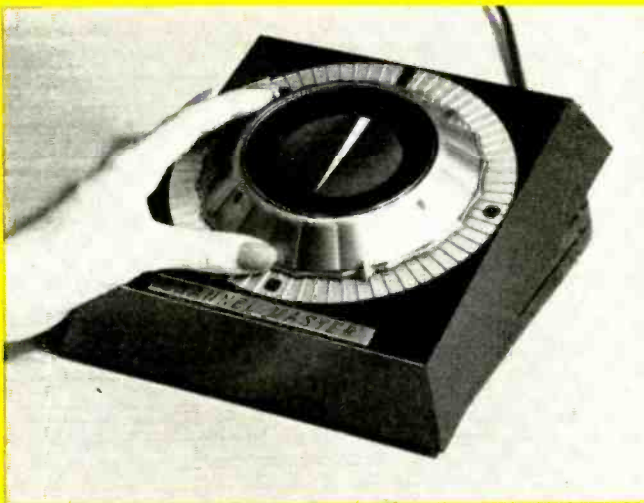
customers

need and want!



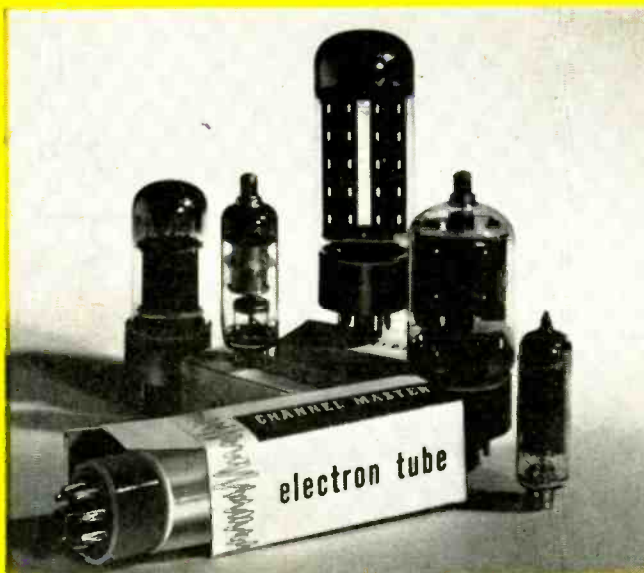
## 78% more Picture-Power in CHANNEL MASTER

**T-W ANTENNAS!** The unique Traveling Wave principle—already fully proved and approved in deep-fringe areas—is now further improved! The new Super 10, with 10 elements, pushes the fringes back even farther—provides unsurpassed super-fringe performance for "picture-poor" homes. Up to 78% more gain than the famous 7-element T-W. Greater front-to-back ratio, exceptional mechanical strength. Another fringe-area powerhouse is the new Super 8—with 4 driven elements, 4 parasitic elements.



## More accuracy in CHANNEL MASTER

**AUTOMATIC ROTATORS!** For best reception, an antenna must be aimed accurately—not in jumps of 10 or 15 degrees. The Channel Master Tenn-A-Liner is the only automatic rotator that can be aimed within ONE DEGREE of the required direction. And is so easy to operate even a child can do it! Greater turning power, fool-proof control box, elimination of solenoids means quieter operation. No other rotator compares with this one!



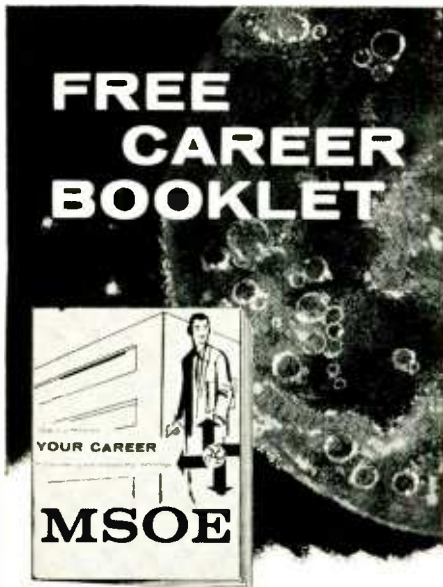
## Extra Dependability in CHANNEL MASTER PREMIUM QUALITY TUBES!

Longer life, unfailing uniformity, completely dependable performance—are what your customers expect of their tubes. And Channel Master Premium Quality Tubes give them all three of these qualities to spare! The Channel Master tube line also takes care of over 75% of your service calls. America's fastest-growing line?...You bet!

**CHANNEL MASTER**

works wonders in sight and sound

Eltenville, New York



to guide you  
to a  
successful future  
in

**ELECTRONICS**  
**RADIO-TV**  
**COMPUTERS**  
**ELECTRICAL**  
**ENGINEERING**

This interesting pictorial booklet tells you how you can prepare for a dynamic career as an Electrical Engineer or Engineering Technician in many exciting, growing fields:

**MISSILES • RADAR • RESEARCH**  
**ELECTRICAL POWER • ROCKETRY**  
**AUTOMATION • AVIONICS**  
**SALES • DEVELOPMENT**

Get all the facts about job opportunities, length of study, courses offered, degrees you can earn, scholarships, part-time work — as well as pictures of the Milwaukee School of Engineering's educational and recreational facilities. No obligation — it's yours free.

**MILWAUKEE SCHOOL OF ENGINEERING**

**MAIL COUPON TODAY!**

**MILWAUKEE SCHOOL OF ENGINEERING**  
Dept. EW-161, 1025 N. Milwaukee  
Milwaukee, Wisconsin MS-113

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 .....

**Packaged Service Problems**

(Continued from page 41)

could have been noted between terminals 2 and 3; an increase in value of the resistor at the upper left could have been noted between terminals 2 and 4; the 1000- $\mu$ f. capacitor could have been checked between 1 and 3; and so on. Similar techniques could be used with such other common combinations (Fig. 2) as the audio-coupling network (A), a retrace-blanking network (B), and two different configurations involving a pair of encapsulated selenium diodes (C), as phase detectors in horizontal a.f.c. circuits. In the twin-diode combinations, it is possible to check each unit separately for forward and back resistance.

With the fault mentioned for the discriminator network of Fig. 1, it would have been possible to solder the external resistor across terminals 1 and 2 as a permanent repair, if necessary. However, this was not done because the trouble was intermittent. In general, it is wise to replace an entire assembly rather than solder in additions.

It may happen that an exact replacement is not readily available and the customer is unwilling to wait until one can be obtained. You may or may not want to use the bridging technique then, and it may not be at all possible in some cases. There is still another expedient: make up your own network. Fortunately, most of combinations in use include only a few components, and it is generally possible to put together standard components that will fit into the available space. In some cases, it may be advisable to mount them on a small piece of plastic board; in others, they can be interconnected by stiff bus wire for rigidity.

The phase-comparator horizontal circuit, having retained its popularity for many years, is still in widespread use today. The most significant change has been in the replacement of the 6AL5 dual diode with a pair of miniature selenium diodes seated in a small plastic block (Fig. 2C). This unit, too, can be

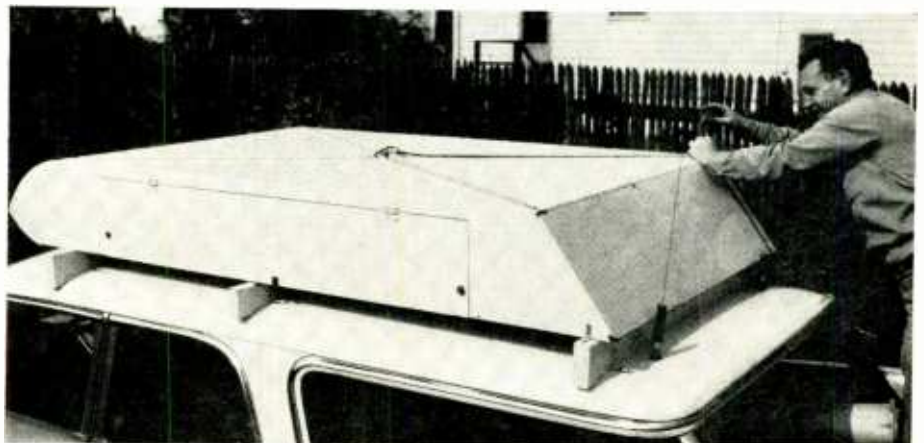
replaced by a pair of separate semiconductor diodes. You are not likely to find selenium units available in a small enough size, but commonly available silicons will do nicely. Available types can easily handle the nine or ten volts, peak-to-peak, developed in this circuit; at the low frequency involved, 15,750 cps, response problems should not crop up. Theoretically, it is possible to use germanium rectifiers too. In fact, some G-E sets incorporate these. However, the miniature units will probably not last very long and those that combine satisfactory voltage rating with small size are not readily available.

Thus the silicon diodes, in this case, are the most practical expedient. The important point is that, as with other types of combination units, practical methods for constructing the equivalent networks do exist when the exact replacements are not available. —50—

Raymond E. Meyers, W6MLZ, (left) of San Gabriel, Calif. and B. S. Angwin, Los Angeles area sales manager for General Electric, with the citation Meyers received during the Western Electronic Show and Convention in connection with G-E's Edison Radio Amateur Award program. Meyers was cited for his operation of amateur radio service during last year's Ninth Plenary Assembly of the Consultative Committee on International Radio in Los Angeles. A special radio station, K6USA, planned and organized by Meyers, handled some ten-thousand contacts.



Four brass strips placed on the luggage carrier on the top of a car or station wagon can be connected as two paralleled dipoles, fed by twin-lead, to permit FM or TV reception in a car. Of course, the TV set should only be used when car is not in motion. Length of strips is not critical and reception was excellent.



WHILE THE QUANTITY of tapes coming in for review hasn't increased noticeably, the quality of performance and selection of repertoire is certainly on the "plus" side, as witness this month's batch of good things for the tape-o-phile.

#### POPOVERS

Eastman Rochester Pops Orchestra conducted by Frederick Fennell. Mercury Stereo STB90222. Price \$6.95.

After a surprisingly long drought, Mercury has seen fit to release more tape in the four-track format. For some reason, they turned out a few four-trackers and then stopped. This was especially true of the classical material. This tape qualifies as a "classical" release, even though it consists mainly of material encountered at "Pop" concerts.

It is to be hoped that this tape signals Mercury's intention to re-enter the tape field on the scale which made them such a potent factor in the old two-track days. This tape has such diverse items as the "Russian Sailors' Dance," "Liebestraum," "The Golden Age Polka," "Clair de Lune," "Hora Staccato," and others of similar persuasion.

Fred Fennell gives all of them readings appropriate to their natures, tamping with them very little and letting the music stand on its own merits. In other words, unlike some "Pop" conductors, he does not try to garnish the works with interpretive mannerisms. There is fine sound throughout, with a special nod to the smooth string tone and the brilliant, weighty brass and sharply accurate percussion.

Very good stereo balance here, with directivity and depth in equal measure and a particularly good center "ghost" channel. An outstanding tape of its type.

#### CARAMBA!

Richard Hayman and his Orchestra. Mercury Stereo STB60103. Price \$6.95.

This was an outstanding success as a stereo disc and now we can enjoy it even more fully on this tape. Sure, it is corn, but it is good corn.

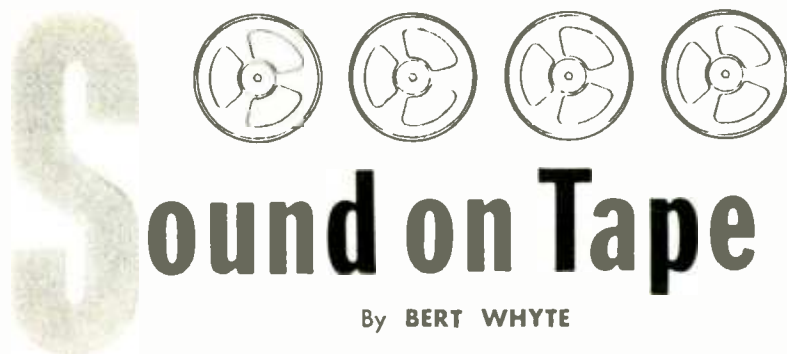
Subtitled "Day of the Bullfight," it is a potpourri of works supposed to depict the taurine spectacle. Every possible source has been milked for appropriate music . . . from the more or less classic "Maids of Cadiz" to the traditional pasodoble "La Virgen de la Macarena," to music from the picture "Captain from Castile." In fact, the "Conquest" theme from the movie is a rather big, overblown march, but is most effective in this usage.

Add to this the very big and bright sound, with some highly artificial but nonetheless clever stereo effects and you have a tape which generates a lot of excitement. Some huge brass and percussion sounds in "Conquest" and, as an added bonus, the tape was exceptionally low in hiss.

#### BERLIOZ

REQUIEM ("Grande Messe des Morts")

David Lloyd, tenor; Hartford Symphony Choral, Hartt Schola Cantorum with



By BERT WHYTE

Hartford Symphony Orchestra conducted by Fritz Mahler. Vanguard Stereo VTP1610. Price \$11.95.

This is one of the most monumental works ever written and by far the biggest thing to appear on tape thus far. The forces required for this score are staggering . . . a full symphony orchestra, four special brass bands which Berlioz stipulated should be located at the four corners of the hall in which it is performed, sixteen tympani, and a chorus of one-thousand voices! I don't believe quite that many choristers were employed in this recording but it was a very sizable group, nonetheless.

It is fitting that the conductor of such a large-scale work should be Fritz Mahler, who is the nephew of the great Gustav Mahler—no stranger to big works himself. This recording first appeared on stereo disc very early after this medium was introduced. It was very courageous of Vanguard to attempt a recording of this work in this country and even more courageous to issue this work on the stereo disc of that period, in which many lessons had to be learned as to cutting techniques and how to cope with a work of such enormous dynamics.

Thus, on the relatively primitive stereo disc of the early days, this was something less than a success. Now it is possible to really appreciate this great work and to revel in the glory of its vast sound. It has faults to be sure . . . the chorus is not always as steady as it might be and while the sound in general is quite clean, when the massed forces are at the height of the dynamic scale, there is quite a bit of "fusion" and an obscuring of some of the elements.

In all fairness, I must admit I have never heard this work when complete articulation was achieved. Mahler does very well in marshalling all these forces and in maintaining some degree of cohesion, but he is somewhat lacking in insight and fails to penetrate the score as deeply as have some others. But what he lacks in understanding he makes up for in enthusiasm and no one can deny that he creates a lot of excitement. When all those vast forces are unleashed in the "Dies Irae" and played at a good loud level which this music, above all, demands, the effect and impact are stupendous.

It goes without saying that stereo is the very essence of life for a work like

this and here it comes off very well, the brass bands resounding from the four corners and the interplay between the choruses easily discernible. As a passing thought, maybe some day we will have the ultimate recording of this work. Imagine, if you will, a home set-up consisting of a three-channel stereo recorder playing back through three frontally located speakers and then another three-channel stereo playback, wherein the left and right channels feed a speaker to the left and right, located behind your back in the proper spatial relationship of the rear brass bands in the "Requiem." The center track of the second machine could be used to sync the two machines for exact playback. In this way you could finally and fully realize Berlioz' intent. (You could also catch a performance in the concert hall —Editor)

So an "A" for effort to Vanguard and thanks for a thrilling listening experience.

#### BIZET

SYMPHONY IN C

GOUNOD

SYMPHONY #1 IN D MAJOR

New York City Ballet Orchestra conducted by Robert Irving. Kapp Stereo KT19001. Price \$7.95.

Gounod's work, which has been used as a ballet score, is known in this context as the "Gounod Symphony." Bizet's work has been treated similarly and they both lend themselves very well to balletic use. As ballets they have been staples of the New York City Ballet for some time.

Robert Irving is one of the top ballet conductors today and his reading of these works is the very essence of the dance . . . beautifully paced and carefully modeled so that one can envision the dancers having no difficulty whatsoever in maintaining rapport with the music.

Unfortunately, all of Irving's good work here goes for naught because of the poor sound pickup. A fairly distant miking was used and then the effects of this were compounded by using a hall with a long decay period. The result may be a striving for a so-called "concert hall sound," but in truth all they succeeded in doing is in blurring the entire audio perspective and the music sounds very formless and disembodied. Too bad, for the conducting and playing are so well done.

—30—

**COYNE offers  
LOW COST  
TELEVISION**  
Training in  
Spare Time **AT HOME**

The future is YOURS in  
TELEVISION—RADIO  
COLOR TV!

A fabulous field—good pay—fascinating work—a prosperous future! Good jobs, or independence in your own business!



Coyne brings you MODERN—QUALITY Television Home Training; training designed to meet Coyne standards. Includes RADIO, UHF and COLOR TV. No previous experience needed. Practical Job Guides to show you how to do actual servicing jobs—make money early in course. You pay only for your training, no costly "put together kits."

Send coupon or write to address below for **FREE Book**

and full details including easy Payment Plan. No obligation, no salesman will call.



B. W. Cooke, Jr., President



Coyne — the Institution behind this training... the largest oldest, best equipped residential school of its kind now in its new home pictured here... Founded 1899.

**COYNE  
ELECTRICAL SCHOOL**

1501 W. Congress Pkwy., Chicago, Dept. 11-H6  
Chartered as an Educational Institution  
Not For Profit

COYNE Television, Home Training Division  
Dept. 11-H6—New Coyne Building  
1501 W. Congress Pkwy., Chicago 7, Ill.  
Send Free Book and details on how I can get  
Coyne Quality Television Home Training at  
low cost and easy terms.

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_

(It is understood no salesman will call)

**Manufacturers' Literature**

**SUPERIOR CATALOGUE**

*Superior Electric Co.*, Bristol, Conn. has issued a ten-page "Product Guide" to the most frequently ordered items in its line.

The catalogue covers ratings and other technical data on transformers, voltage regulators, connectors, binding posts, motors, reactors, and power supplies. Write to Dept. PG at the company for a copy.

**MULLARD TUBES**

*International Electronics Corp.*, 81 Spring St., N. Y. 12, N. Y. has announced a new bulletin listing *Mullard* preferred receiving tubes for high-fidelity, radio, television, and industrial applications.

Complete specifications and base diagrams for more than 60 tube types are listed. Copies are available at local *Mullard* distributors or by writing to the U. S. distributor at the above address.

**COMPONENTS PRICE LIST**

*Electronics Publishing Co., Inc.*, 180 No. Wacker Dr., Chicago 6, Ill. has issued a new edition of "Dave Rice's Official Pricing Digest."

Available from distributors at \$2.50 a copy, the volume gives list or resale prices on over 63,000 components. It also includes a table of flat rate and hourly service charges based on and showing regional and national averages.

Price data is arranged alphabetically by manufacturers and products, and numerically by part number.

**ANECHOIC CHAMBERS**

*Emerson & Cuming, Inc.*, Canton, Mass. announces a new "Eccosorb" microwave anechoic chamber brochure.

The 32-page illustrated booklet describes the simplest box type anechoic chamber as well as the transverse baffle type, aperture type, and the latest longitudinal baffle type. Included are details of construction together with illustrations of each type of chamber designed and built to meet specific requirements of frequency range, working conditions, and the like.

**SPECIALIZED HAND TOOLS**

*Xcelite, Inc.*, Orchard Park, N. Y. has issued a colorful bulletin describing a series of new hand tools designed for use in unusual assembly or servicing work. For a copy, request Bulletin 660 from the manufacturer.

**HOFFMAN SEMICONDUCTORS**

*Hoffman Electronics Corp.*, Semiconductor Div., 1001 Arden Drive, El Monte, Calif. has published a catalogue listing its line of solar devices, tran-

sistors, tunnel diodes, uni-tunnel diodes, controlled rectifiers, general purpose diodes, special purpose diodes, zener devices, reference units, and regulators. Physical and electrical properties are given.

The booklet, in addition, contains a list of sales offices and industrial distributors and an explanation of the company's terms and conditions of sale.

**NEW EIA STANDARDS**

The Engineering Department, Electronics Industries Association, 11 W. 42nd St., New York 36, N. Y. has announced publication of two new standards.

Standard No. RS-233 is entitled "Phasing of Receiver Loudspeakers" and sells for 25 cents a copy. Standard No. RS-154-B covers "Polarized Dry Aluminum Electrolytic Capacitors for General Use" and is priced at \$1.20 a copy.

Either or both of these standards may be ordered from the Association. Payment must accompany the order.

**STANCOR REPLACEMENTS**

*Chicago Standard Transformer Corp.*, 3501 W. Addison St., Chicago 18, Ill. has released Form YFX, a cross-reference index showing *Stancor* equivalents for other brands of replacement yoke and flyback transformers.

The new publication is available from the company's distributors or by writing direct to the manufacturer in Chicago.

**FLEXIBLE SHAFT HANDBOOK**

*S. S. White Industrial Division*, 10 E. 40th St., New York 16, N. Y. has published the fourth, revised edition of its "Flexible Shaft Handbook."

This 89-page spiral-bound volume is available to design engineers and potential users of flexible shafts. It embodies a simplified approach to the selection of flexible shafting and provides descriptive material, charts, tables, and drawings.

Hitherto unpublished data includes information on a new, simplified engaging system based on integral formed square drives, and the new, improved Series 7 (remote control) and Series 9 (power drive) shafts.

The handbook is available on letter-head request to Department P of the company.

**WIRE STRIPING**

*Alpha Wire Corp.*, 200 Varick St., New York 14, N.Y. has issued a 4-page, 2-color brochure designed to help the engineer draw up color-coded wire specifications. The publication covers

several areas of wire striping and lists the 100 clearest military-approved color combinations, along with other color combinations that should be avoided.

A feature of the brochure is a chart which breaks down the two most commonly used military specifications covering hook-up wire (MIL-W-76A and MIL-W-16878C). The chart relates the military part number to physical construction, temperature rating, conductor size, stranding specification, and voltage rating.

Also included is a chart relating wire footage and number of pieces per thousand feet for lengths from 1/8-inch through 12 inches in 1/16-inch increments.

#### DIALCO BROCHURES

Dialight Corp., 60 Stewart Ave., Brooklyn 37, N.Y. is offering two brochures describing its new developments in indicator lights and pilot-light assemblies.

"Datalites" (Form L-160B) is an 8-page booklet that discusses these ultraminiature lights and their use singly or in multiples as a "Data Strip" or "Data Matrix." Also described are the new "Data Cap" series No. 250 as well as cartridge connectors and speed clips. The brochure gives complete lamp data (neon and incandescent), features, specifications, illustrations, and schematics.

"Lights That Enlighten" (Form L-163) is a 4-page brochure which surveys the subject of read-out indicator lights, the company's assemblies which illuminate digits, letters, symbols, or words. This pamphlet is divided into seven concise sections and is illustrated with a number of full-size photos.

For copies of either or both brochures, write R. E. Greene at the company address.

#### EICO CATALOGUE

Electronic Instrument Co., Inc., 33-00 Northern Blvd., Long Island City 1, N.Y. has issued a 28-page catalogue describing its kit and wire versions of stereo and mono high-fidelity components, test instruments, ham equipment, portable transistor radio, and Citizens Band transceiver. All models are illustrated and fully described. The catalogue is available directly from the manufacturer.

#### POWER TRANSISTORS

Motorola Semiconductor Products Inc., 5005 E. McDowell Rd., Phoenix, Ariz. has published a 200-page handbook on the theory, design, and applications of power transistors. Supplemented by more than 200 drawings and charts, the volume can serve as a reference work as well as an introduction to the subject.

Copies are available for \$2.00 each from the company's semiconductor distributors, or from the Technical Information Center, at the manufacturer.

#### RCA PENCIL TUBES

Radio Corporation of America, Electron Tube Division, Harrison, N.J. has published a booklet entitled "RCA Pencil Tubes."

Designated as Form No. 1CE-219, the 28-page booklet provides information on the design features of pencil tubes, their application to systems, and electrical and mechanical circuit design considerations.

A tube data section covers the full line of available commercial and military types. Copies of the booklet may be obtained from the company's tube distributors, or by sending fifty cents to Commercial Engineering, at the company.

#### ELECTRO SALES CATALOGUE

Electro Sales Co., Inc., 50-58 Eastern Ave., Boston 13, Mass. has issued its 1961 catalogue of items for electronic and industrial laboratories.

The 176-page illustrated brochure covers rotating equipment, including motors, blowers, reducers, and electronic components. New lines have been added and up-to-the-minute items have been included.

Over 5000 industrial motors and gear reducers and over 25,000 industrial electronic parts are listed. The catalogue is available to purchasing agents or engineers who request it on their company letterhead, specifying their position.

from **EICO**  
... a completely new  
**CITIZENS BAND TRANSCEIVER**

that meets  
FCC regulations\*



Model 760: 117 VAC  
Kit \$59.95 Wired \$89.95  
Model 761: 117 VAC & 6 VDC Kit \$69.95  
Model 762: 117 VAC & 12 VDC Kit \$99.95  
Incl. mtg. bracket (Pat. Pend.)

\*EICO premounts, prewires, pretunes, and seals the ENTIRE transmitter oscillator circuit to conform with FCC regulations (Section 19.71 subdivision d). EICO thus gives you the transceiver in kit form that you can build and put on the air without the supervision of a Commercial Radio-Telephone Licensee!

Highly sensitive, selective SUPERHET (not regenerative) receiver with 5 1/2 dual function tubes and RF stage. Continuous tuning over all 23 bands. Exclusive Super-Hush® noise limiter. AVC 3" x 5" PM speaker. Detachable ceramic mike. 5-Watt crystal-controlled transmitter. Variable "pi" network matches most popular antennas. 12-position Posi-Lock® mounting bracket. 7 tubes and 1 crystal (extra xtals \$3.95 each). Covers up to 20 miles. License available to any citizen over 18—no exams or special skills required, application form supplied free. Antennas optional.

#### TOPS IN DESIGN . . . QUALITY



All-Transistor Portable RA-6  
Kit \$29.95 Wired \$49.95  
High sensitivity & selectivity. New type plug-in transistors. 4" x 6" speaker; push-pull audio. Prealigned RF & IF transformers. Less battery. Incl. FET.



High-Level Univ. Mod-Driver #730  
Kit \$49.95 Wired \$79.95  
Delivers 50W undistorted audio. Modulates transmitters having RF inputs up to 100W. Unique over-modulation indicator. Cover E-5 \$4.50.



New! 60-Watt CW Transmitter #723  
Kit \$49.95 Wired \$79.95  
Ideal for novice or advanced ham needing low-power, stand-by rig. 60W CW, 50W external plate modulation. 80 through 10 meters.



Grid Dip Meter #710  
Kit \$29.95 Wired \$49.95  
Includes complete set of coils for full band coverage. Continuous coverage 400 kc to 250 mc. 500 ua meter.



90-Watt CW Transmitter\* #720  
Kit \$79.95 Wired \$119.95  
\*Top quality!—ELECTRONIC KITS GUIDE. Ideal for veteran or novice. 90W CW, 65W external plate modulation. 80 through 10 meters.  
\*U.S. Pat. No. D-184,776

Compare — judge for yourself — at your neighborhood EICO distributor. For FREE catalog on over 70 models of easy-to-build professional test instruments, hi-fi and ham gear, fill out coupon on Page 27

Most EICO distributors offer budget terms.

**EICO**

3300 N. Blvd., L.I.C. 1, N. Y.  
Add 5% in the West



# NEW STEREO SONY STEREO TAPE DECK

Now, for less than the cost of a good record changer, you can add a versatile new dimension to your hi fi system. ■ The Sony 262-D tape deck has a 4-track stereo erase head and 4-track stereo record/playback head. Heads are wired to six output and input facilities for connection of external electronics to play and record four track stereo. This is the same quality mechanism used in the most expensive Sony Superscope tape recorders.

**\$89<sup>50</sup>**

Other tape recorders in the remarkable Sony line include the dual track bantam at \$99.50, the Sterecorder 300, a complete portable stereo portable stereo system at only \$399.50, and the 262-SL parallel and sound-on-sound recorder at \$199.50. ■ For literature or nearest dealer, write: Superscope, Inc., Dept. M, Sun Valley, Calif.

## SONY SUPERSCOPE The tapeway to Stereo

# FREE!

**RADIO SHACK'S famous Electronics CATALOGS for 12 full months**

See over 100,000 items like these

- Stereo, hi-fi
- LP records
- New hi-fi kits
- New tester kits
- Recorded tapes
- Accessory tools
- Electronic parts

Yes! Mail coupon for 12 months of savings on electronic equipment! Finest quality, tremendous selection! Easiest terms—up to 2 years to pay. Satisfaction guaranteed.

**RADIO SHACK Corp.**  
730 Commonwealth Ave., Boston 17, Mass.

RADIO SHACK CORP. Dept. 61A6  
730 Commonwealth Ave., Boston 17, Mass.

Please send me Radio Shack's catalogs for next 12 months FREE and POSTPAID.

Name \_\_\_\_\_  
Address \_\_\_\_\_  
City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_

### CRYSTAL CONTROLLED CONVERTERS

- POLICE • FIRE • COMMERCIAL  
• CITIZENS' BAND •

For use with  
12 V. Transistor type  
car radios  
26-50 MC  
**\$24.95**

Complete with crystal and tubes. Requires no high voltage supply. Operates on 12 volts DC. Can be self installed in seconds. Other models for 108-162 MC available.

A practical converter for emergency use with powered home or auto sets. Tunable over 12 Mc' 26-54 MC or 108-174 MC. **\$13.95**

Also available crystal controlled up to 54 MC. **\$19.95**

Full line of converters & receivers for every application.

ORDER TODAY or WRITE for LITERATURE

**KUHN ELECTRONICS**  
20 GLENWOOD CINCINNATI 17, OHIO

### NEVER FAIL — ZONE YOUR MAIL

The Post Office has divided 106 cities into postal delivery zones to speed mail delivery. Be sure to include zone number when writing to these cities; be sure to include your zone number in your return address —after the city, before the state.

# Five-Minute CB Timer

By LEO MORGAN, K1LRX, 1W1612

FCC rules limit duration of CB contacts. This timer will help.

HERE IS an electronic device which should be of interest to those readers who operate on the Citizens Band. Since FCC regulations state that calls between CB stations (that are not different units of the same station) shall not exceed 5 minutes, a timer is needed.

A diligent search for a 5-minute timer, electronic or mechanical, that would operate just by throwing a switch, failed to reveal a suitable unit. There are many mechanical timers but they are clumsy and awkward to use since it is necessary to reset the dial after every time cycle.

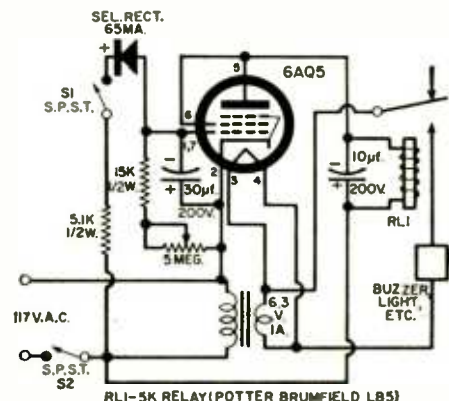
The circuit shown in the schematic below is a modification of a photo-timer. The design calls for a minimum of parts and, if the unit were to be built from scratch, parts would run less than \$7.00. This figure can be considerably reduced if a well-stocked "junk box" is available. It will be noted that no power supply, as such, is required. It is necessary, of course, to use an insulated terminal strip for tie points and no components or leads should go to chassis ground.

Operation of the unit is as follows. When switch S<sub>1</sub> is closed, the filament heats up and the tube begins to draw current and the relay is energized. Close switch S<sub>2</sub>. This places a high negative voltage on the grid of the tube and charges the capacitor. The tube stops conducting and the relay is de-energized.

When ready to start the time cycle, open switch S<sub>1</sub> and the capacitor will start to discharge. When the minus voltage drops to approximately -3 volts d.c., the tube will conduct and the relay will energize. The 5-megohm pot will set up the 5-minute time cycle. Other time cycles can be selected if desired.

The entire unit can be housed in a 3" x 4" x 5" "Minibox," using an "L"-shaped chassis. Placement of parts and wiring is not critical.

Schematic diagram and parts values for a simple, easily built timer for your CB station.



RL1-5K RELAY (POTTER BRUMFIELD LB5)



## Reducing Xmtr. Interference

(Continued from page 55)

harmonics of the tone. Now if the transmitter is not overmodulated but the modulating signal contains distortion, the same condition occurs. Therefore, the distortion in the modulator can cause the same unwanted sidebands as can audio distortion in any of the audio amplification prior to the modulator. The peak levels in normal speech are about 20 db above the average level. It is readily seen that overmodulation can easily occur in a transmitter if a fair degree of modulation is used. It has been determined, however, that speech can be quite intelligible when these excessive peaks are clipped. However, if the clipping is done by overdriving the modulating stage, the harmonics caused by the clipping will be modulated on the carrier and the result will be "splatter."

It has also been determined that intelligible speech can be transmitted with an audio passband of 500 to 2500 cps. This is doubly important since if the speech bandwidth is reduced the ratio of the peak-to-average power is also reduced. A system taking advantage of both these factors is shown in Fig. 8.

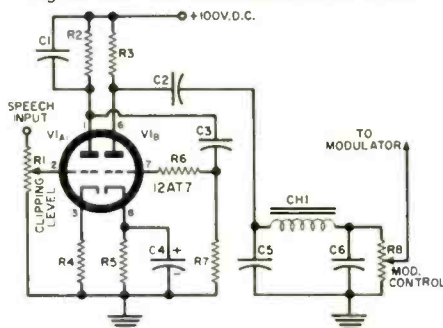
The first stage,  $V_{1A}$ , is a band-limiting amplifier with 3-db points at 400 and 2800 cps. The second stage,  $V_{1B}$ , is a clipper which will limit the output peaks to 30 volts. After clipping it is necessary to remove the higher harmonics produced by clipping. This is accomplished by the low-pass filter  $CH_1$ ,  $C_5$ , and  $C_6$ .

In operation, the modulation-level control,  $R_8$ , is adjusted to produce 100% modulation with the 30-volt peak output (21 volts r.m.s. for a single tone) and the clipping level is adjusted by the input potentiometer.

In the concluding article next month, we will delve into the role played by proper shielding in reducing interference. We will also consider r.f. intermodulation as another source of interference.

(Concluded next month)

Fig. 8. Peak and bandwidth limiter circuit.



- $R_1$ ,  $R_7$ —100,000 ohm pot
- $R_2$ ,  $R_3$ —22,000 ohm,  $\frac{1}{2}$  w. res.  $\pm 10\%$
- $R_4$ ,  $R_5$ —470 ohm,  $\frac{1}{2}$  w. res.  $\pm 10\%$
- $R_6$ ,  $R_7$ —33,000 ohm,  $\frac{1}{2}$  w. res.  $\pm 10\%$
- $C_1$ —2700  $\mu$ f., 200 v. capacitor
- $C_2$ —.01  $\mu$ f., 200 v. capacitor
- $C_3$ —.001  $\mu$ f., 200 v. capacitor
- $C_4$ —10  $\mu$ f., 10 v. elec. capacitor
- $C_5$ ,  $C_6$ —620  $\mu$ f., 200 v. capacitor  $\pm 10\%$
- $CH_1$ —Smoothing choke, 13 hy. @ 65 ma. (Stancor C-1708)
- $V$ —12AT7 tube

only for those who really need them...

# CADRE



Only a short time ago, the FCC opened 22 channels for Citizens Band operation. Licensing was radically simplified. Where formerly two-way radio licenses were granted only to public safety agencies and certain other special groups, **SUDDENLY, EVERYBODY COULD HAVE 2-WAY RADIO!**

...providing, of course, he could afford the bulk and cost of the equipment that was then available.

Yet in spite of the bulk and the cost, nearly two million Citizens Band transceivers have been purchased to date! A tremendous demand has developed!

*You can imagine what will happen now that compact, professional-quality instruments like the CADRE '500' and the CADRE '100' are available!*

These CADRE units are built to the highest standards of the electronics industry, by a company that has been long established as a prime manufacturer of precision electronic research equipment and computer assemblies. CADRE transceivers are 100% transistorized—compact, lightweight...engineered for unparalleled performance and reliability.

The CADRE 5-Watt Transceiver, at \$199.95, for example, for offices, homes, cars, trucks, boats, aircraft, etc. measures a mere 11 x 5 x 3", weighs less than 6 pounds! Nevertheless, it offers 5 crystal-controlled transmit/receive channels (may be used on all 22), and a range of 10 miles on land, 20 over water!

The CADRE 100-MW Transceiver, \$124.95, fits into a shirt pocket! Weighs 20 ounces, yet receives and transmits on any of the 22 channels...efficiently, clearly...without annoying noise. A perfect "pocket telephone"!

For the time being, it is unlikely that there will be enough CADRE transceivers to meet *all* the demand. Obviously, our dealers cannot restrict their sale to the fields of medicine, agriculture, transportation, municipal services, etc. However, since these CADRE units were engineered for professional and serious commercial applications—and cost more than ordinary CB transceivers—we believe that as "water finds its own level," CADRE transceivers will, for the most part, find their way into the hands of those who really need them.

Write for complete information and detailed specifications.



## CADRE INDUSTRIES CORP.

Endicott, N. Y.

Prices appearing in this advertisement are suggested retail prices

# COLUMBIA HAS MOVED!

**NOW! One of the largest combination retail store-warehouses on the coast! Send in for FREE Bargain Bulletin!**

**MN-26-S RADIO DIRECTION FINDER**  
150-1500 Kc. Makes F.B. long-wave receiver. Has built-in 28 V. dyn. Complete. Excellent. \$8.95

**"X" BAND RADAR SIGNAL GENERATOR**  
This is the TS-13/AF Model actually worth \$150! With A.L. tubes, incl. Klystron, and built-in 110 V. 60 cycle power supply. Excellent. \$29.95

**VIBRATOR POWER SUPPLY:** for Navy TBV Walkie-Talkie. New \$3.95

**BC-611 WALKIE-TALKIE CHASSIS**  
Single channel, 3-6 Mc. Transmitter-Receiver. Less tubes, coils and crystals. Terrific for building your own walkie-talkie. Easily converted to other frequencies. Brand new. \$6.95  
**COILS & CRYSTAL SET:** for above. New. \$2.49

**PRC-6, -8, -9, & -10 BATTERIES**  
BA-270/U for PRC-6 Handle Talkie. New. Ea. \$1.00  
BA-279/U for PRC-8, -9, -10 Walkie-Talkie. New. Ea. \$1.00  
Quantity Discounts Available

**APR-1 & APR-4 TUNING UNITS**  
TN-1/APR-1: 200-300 Mc. Excellent. \$14.95  
TN-2/APR-1: 400-500 Mc. Excellent. \$14.95  
TN-3/APR-1: 300-1100 Mc. Excellent. \$19.95  
TN-17/APR-4: 7-1300 Mc. Excellent. \$19.95  
TN-19/APR-4: 975-2200 Mc. Excellent. \$49.95

**TCS 12V DYNAMOTOR**  
Output: 410 V. @ 200 MA.  
Brand new. ONLY \$4.95

**RA-94 AC POWER SUPPLY**  
110 V. For Super-Pro Receiver. In excellent condition. \$9.95

**BC-669 TRANSMITTER-RECEIVER**  
Freq. 1080-1450 Kc. 7.5 W. AM Transmitter. 6 crystal controlled, preset channels, on both Xmit. and recvr., as well as VFO control. F.B. for marine or home use. Built-in speaker. Full set of controls on front panel. Power requirements: 12 V. filament, 264 V. @ 100 MA. for Heavy 550 V. @ 400 MA. for Xmit. Orig. designed by Hal-liforters for marine use. Excellent. cond. PE-110 Power Supply for above. \$49.95  
110 V. Excl. \$3.50  
CDS15 Connecting Cable for above. Excl. \$3.50

**EE-8 FIELD TELEPHONE**  
Operates up to 10 miles with use of 2-transistor wire! BUILT-IN RINGER! Works like a charm on 2 flashlight batteries. Excellent. \$12.50  
2 for \$22.50. Each

**TUBES! ALL NEW! ALL SPECIALS!**  
4-65A ..... \$7.50 1N250B ..... \$20.00  
4-125A ..... 12.95 1N101A ..... \$7.00  
4N150A ..... 7.95 1-1000A ..... 7.50  
Buffs of Other Tubes! Tell us your needs!

**DM-35 DYNAMOTOR:** 12 V. output 0.25 V. @ 225 MA. Brand new w/spare brushes. \$7.95

**VRC-2 FM TRANSMITTER-RECEIVER COMBO!**  
30-10 Mc. A terrific 6 Volt installation! Consists of 30 W. transmitter and dual conversion receiver, both crystal controlled! This is the Army equivalent to Motorola Model FM 30-1D. Excellent cond. Special CLOSE-OUT! Per combo only. \$29.95

**SCR-625 MINE DETECTOR BARGAIN**  
Locate that hidden pipe, metal, treasure! Use for parts! With case. Excellent. \$22.50

**ARC-5 VHF & UHF EQUIPMENT SPECIALS!**  
R-28 ARC-5 RECEIVER: 100-150 Mc. 4-channel. Crystal controlled. Excellent. cond. Only \$19.95  
T-23 ARC-5 TRANSMITTER: Companion to above. Same freq. 4-chann. crystal controlled. \$12.95  
R-23 ARC-5 RECEIVER: 100-555 Kc. Excellent. This is the Q-700! \$9.95  
R-25 ARC-5 RECEIVER: 1.5-3 Mc. Excellent. \$14.95  
R-26 ARC-5 RECEIVER: 3-8 Mc. Excellent. \$7.95  
R-27 ARC-5 RECEIVER: 6-9 Mc. Excellent. \$7.95  
T-18 ARC-5 TRANSMITTER: 2-1.9 Mc. Excellent. \$4.95  
T-19 ARC-5 TRANSMITTER: 3-4 Mc. Excellent. \$7.95  
T-20 ARC-5 TRANSMITTER: 1.5-3 Mc. Excellent. \$4.95  
T-21 ARC-5 TRANSMITTER: 5-10.7 Mc. Excellent. \$4.95  
T-22 ARC-5 TRANSMITTER: 7-9 Mc. Excellent. \$8.95  
MD-7 ARC-5 MODULATOR: For all of the above Transmitters. Excellent. Bargain @ only \$4.95

**IMPORTERS! EXPORTERS!**  
**BC-375 100 W. TRANSMITTER**  
Ideal for domestic use, as well as export marine and mobile! Freq.: 200-12,500 Kc. with proper tuning unit. CW or MCW. Like new condition. Only \$14.95  
ABOVE, but in good condition \$9.95  
PE-73 DYNAMOTOR FOR ABOVE: Input 21 V. Output 1000 V. @ 300 mA. W. filtering base. Excellent. \$7.95. Good cond. \$4.95.  
BC-306 ANTENNA TUNER for above BC-375: Excellent. \$1.95  
**TUNING UNITS TO COVER ABOVE FREQS:** TU-5, TU-6, TU-7, TU-8, TU-9, TU-10. Excellent. Ea. \$1.95  
**PLUGS:** For any of above. Each only \$0.50  
**RACKS:** For any of above. Each \$1.50

All orders FOB Los Angeles. 25% deposit required. All items subject to prior sale. NOTE MINIMUM ORDER \$3.00. WRITE TO DEPT. R.

**Columbia ELECTRONICS**  
4365 WEST PICO BLVD.  
LOS ANGELES 19, CALIF.

# Hamming in Britain

By PATRICK HALLIDAY

**Amateur operations in England differ widely from our practices. Here's how some 9000 British hams work.**

THE first DX calls logged by many American hams and SWL's are from Britain, yet the background of British ham licenses, which differs considerably from American ones, is known to few.

There are about 9000 British amateurs, about 1000 of them also holding the separate permits needed for mobile operation and almost 100 with television transmitting licenses for 420 mc. and above. To obtain an amateur license, issued by the British Post Office, it is necessary to pass a three-hour written examination in elementary radio theory and amateur operating as well as a 12 w.p.m. Morse test.

Only one class of license is issued for normal operation, authorizing phone and c.w. operation on all the bands with an input of 150 watts (except on 1.8 mc. which is also used for maritime radio services and on which only 10 watts input may be used). No novice or technician licenses are issued and, as soon as a license has been granted, the newcomer is on equal footing with all other amateurs.

To hold a transmitting permit costs the British amateur \$5.60 a year in fees; if this becomes overdue he may have to take another Morse test before the license is renewed.

British amateurs are not allowed to handle third-party traffic hence cannot legally accept messages from the States for anyone other than himself or from anyone other than the amateur he is working. Because of the lack of any reciprocal licensing agreement with the

FCC, American service personnel stationed in the United Kingdom cannot obtain transmitting permits, but there are arrangements for Canadian amateurs in Britain to obtain local licenses, usually without taking any further examinations.

The British authorities do not attempt to impose any division of bands between phone and c.w. but most European amateurs voluntarily keep the low-frequency portions of the main high-frequency bands for c.w. only. As recommended by the Region 1 Bureau of the International Amateur Radio Union, 3500-3600, 7000-7050, 14,000-14,100, 21,000-21,150, and 28,000-28,200 kc. are kept clear of phone stations.

There is no equivalent of the Citizens Band, although two-way mobile v.h.f. licenses are issued for "business radio" purposes.

Interests are spread widely with keen enthusiasm for most forms of hamming, including ragchewing, DX contests, RTTY, and a strong contingent of v.h.f. adherents, working mostly on 144 and 420 mc. There is also a special band—available in other parts of Europe—between 70.2 and 70.4 mc., in place of the 50 mc. band which falls inside one of the British TV channels and is not normally available. On 144 mc. a zone system is operated by the Radio Society of Great Britain to encourage amateurs in different parts of the country to use different sections of the band, to prevent weak DX signals from being swamped by local stations.

## REGULATOR CIRCUIT FOR MINIATURE MOTORS

By GEORGE ERICKSON

MOTORS used in battery powered circuits have an inherent tendency to slow down as the battery becomes weak. Wanting a constant-speed motor for use in portable equipment, this is how the author got around the problem.

Normally, a d.c. motor's speed is directly proportional to its supply voltage; but if this voltage can be regulated, the motor's speed will remain constant. This circuit is then merely a series-transistor voltage regulator. The 2N307 power transistor is controlled by the 2N617 "n-p-n" transistor which is biased by battery B<sub>2</sub>. B<sub>2</sub> should be a mercury battery because of its constant voltage output despite age. B<sub>2</sub> supplies very little power and will outlast many of the larger batteries.

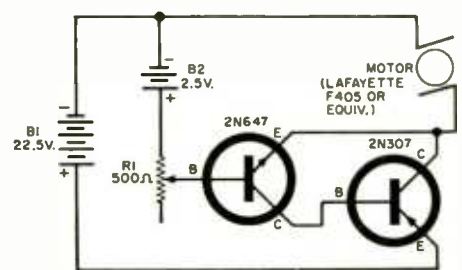
In the author's circuit, B<sub>2</sub> was a Mallory mercury battery TR-132R, 2.5 volts, and R<sub>1</sub> was 500 ohms. R<sub>1</sub> was adjusted to give a speed of 1500 rpm, which varied less than 2% as the battery voltage dropped from 22½ volts to 3 volts—a

better than 700% change in supply voltage.

A word of caution. This particular motor draws approximately 100 ma., so the 2N307 should have an adequate heat sink.

The regulation feature of this circuit might also be useful to stabilize a transistor circuit by replacing the motor with the circuit.

A simple circuit for motor regulation.



**D**ESPITE THE FACT that some people consider the recording industry in the doldrums and a bit moribund, an amazingly large number of good recordings in both mono and stereo are being offered to the public. In order to keep you abreast of the new offerings which I think you will enjoy, here is a magnum serving of reviews.

**MOZART**

**CLARINET CONCERTO IN A MAJOR HORN CONCERTO #1 IN D MAJOR HORN CONCERTO #3 IN E FLAT MAJOR**

Gervase de Peyer, clarinetist; Barry Tuckwell, horn with London Symphony Orchestra conducted by Peter Maag. London Stereo CS6178. Price \$5.98.

A superlative musical experience on all counts, this is the kind of stereo that should be demonstrated to newcomers to the field as an example of how stereo can enhance the quieter, less athletic type of music.

The outstanding item is the clarinet concerto wherein de Peyer favors us with virtuoso playing reminiscent of that of Reginald Kell. The tone is full and rich, with intelligently used vibrato which never obscures the musical line. His is a very facile technique and the more difficult fingerings are traversed with ease.

Tuckwell is first-rate in the Horn concertos, with a big opulent tone to his credit, but he lacks just a shade in meeting the technical refinements of the late Dennis Brain.

Throughout the three works Peter Maag furnishes a completely knowledgeable and sympathetic accompaniment. Soundwise, this is one of *London's* best, with superb balance being maintained between good orchestral detail and just the right amount of reverberation to lend rounded spaciousness. Stereo effects are well realized, with both soloists placed securely in the ghost center-fill middle. All is clean and bright and surfaces were pleasantly quiet. A real winner, this!

**BEETHOVEN SYMPHONY #9**

Joan Sutherland, soprano; Norma Proctor, contralto; Anton Dermota, tenor; Arnold van Mill, bass with two choruses and L'Orchestre de la Suisse Romande conducted by Ernest Ansermet. London Stereo CS6153. Price \$5.98.

Any Beethoven "Ninth" commands a review because of its musical eminence and, in most cases, a company marshals its best forces for the recording. *London* has certainly assembled an illustrious cast and, to gild the lily, offers the complete stereo recording of this "Ninth" on one record! The press blurb that came with this record pointed out the advantage of a single stereo disc of the "Ninth," especially as to selectivity and cost, and also claimed that in spite of the single disc there was no "groove crowding" or compromise of sound quality.

Now I have a great deal of respect for *London*. They have to their credit some of the finest recordings ever made and they have the happy faculty of being consistently good in their recordings. But with this one I take sharp issue. Frankly, I am unable to understand why *London* would release this kind of a recording for surely they have good playback equipment and good ears.

To begin with, on one side alone is crammed almost 36 minutes of music! This is about 10 minutes beyond what most cutting engineers feel is the limit of quality. To go beyond 25 minutes on a stereo disc, it becomes necessary to compromise one or more facets of quality. Inevitably, the engineer must lower the over-all volume or reduce the bass response, or do both. He may also have to resort to limiting which compresses the dynamic range.



## CERTIFIED RECORD REVUE

On this disc, in comparison with competing versions, the level is down as much as 4 to 6 db. Bass response appears to have been greatly boosted—out of balance—and the result is too prominent and boomy.

The general effect is of an orchestra and chorus constrained by artificial bonds . . . the strings sound weak and thin, the woodwinds are often obscured, as is the brass. The choral lines get blurred at times and the articulation of the singers and their balance against orchestra and chorus is often out of kilter. Oddly enough, the tympani and bass drum have been projected well forward and, at times, are very prominent.

All this is a pity for the soloists give a fine rendering. Ansermet's idea of the score is very different than most others. It has moments of great excitement, but for the most part he varies tempi so greatly and indulges in other mannerisms as to fall short of the efforts of most of his contemporaries.

This is probably the most severe criticism I have ever leveled against a *London* record, but unless I just happened to get an extremely bad copy, and I don't believe this is the case, I feel my remarks are justified. I can only repeat in conclusion that I cannot fathom why a company with *London's* background and reputation would issue this record in the first place.

**GOULD**

**FALL RIVER LEGEND (Ballet Suite) SPIRITUALS FOR ORCHESTRA**  
Eastman Rochester Orchestra conducted by Howard Hanson. Mercury Stereo SR90263. Price \$5.98.

Here are two of the best works Morton Gould has written, given exemplary performances by Howard Hanson. The "Fall River Legend" is based on the famous Lizzie Borden murder case and was rather freely translated by Gould and his choreographer, Agnes de Mille. The ballet was first presented by the Ballet Theatre in 1948 and has survived with success to this day.

In a Prologue, Seven Scenes, and an Epilogue, the ballet unfolds the story. Gould has written some very effective music for each section, not wholly derivative or programmatic but utilizing many folk themes and religious motifs as well as some strictly "Gouldian" dissonances. The result is a very interesting score, with some of the writing very stark and dynamic.

"Spirituals" has enjoyed increasing popularity in recent years, probably because it is an ideal vehicle for spectacular "hi-fi" treatment. And, believe me, it gets the "treatment" on this disc. The stereo aspects are superbly realized, but it is the clangorous, thunderous percussion and the overwhelming dynamic range that stands out in one's mind.

The "Legend" is equally well recorded. Hanson performs both works with a great deal of zest and spirit and, as a whole, this is an outstanding production.

**PROKOFIEV**

**ROMEO AND JULIET (Ballet Suite)**  
Czech Philharmonic Orchestra conducted by Karel Ancerl. Parliament Stereo PLPS132. Price \$5.98.

I recently received a batch of "Iron Curtain" recordings, some of which were made in Russia itself, but most of which were produced in the "satellites." This *Parliament* recording is an example of Czech activity and was actually made by the *Supraphon* company which, before the War, was a highly esteemed label.

Before going any further, permit me to point out that I am as rabidly anti-communist as any American, but I also happen to feel that music is a universal language and as long as these recordings in no way reflect or propagandize their ideologies, they should be judged solely on their merits.

In this recording of "Romeo and Juliet," Ancerl has extracted ten of the most representative scenes from the ballet and integrated them into a sort of "tone poem." The first thing one notes is that the orchestral playing is of very high order . . . there is great precision and great tonal beauty. The first and second strings are outstanding for their quality and their ensemble work and the brass is very big and accurate.

Ancerl is a first-rate conductor and it is obvious he knows this score. He evokes from his orchestra an eloquent and passionate reading of great intensity and certainly this is one of the best performances . . . topped only by the ultra-sonorous, lushly sensuous masterpiece by Stokowski.

Now as to matters of sound, Russian tapes have not enjoyed a very high repute for quality and this is, in general, justified since they have turned out some real "dogs." This is the first stereo I have heard from an "Iron Curtain" country and, as I suspected, they appear to be using the M/S type of stereo recording or some variant thereof. The best way to describe the sound here is "variable." There are some splendidly recorded sections, nice and clean and in good acoustic balance. They seem to do very well on low percussion, tympani and bass drum being reproduced with good weight and clarity. The miking can be described as moderately close and the acoustics are good except for a tendency to become reverberant.

They attempt to use wide dynamic range and while they succeed to a certain degree, this is also their downfall. High percussives such as cymbals, especially if the score calls for any weight, are generally distorted. And, as the dynamics build up, they suffer severe

Unheard of low price on EE-8 FIELD TELEPHONES \$24.95 PAIR NEW, Army surplus in original packing. Just add two flashlight batteries and connecting wire for operation. The sets are compact, rugged, and portable, and in performance equals the best present day commercial phones. Instruction manual included. Ship. wt. 35 lb.

RM52 remote control unit for the Macy's Special Phone Patch as described in the radio magazines. Only \$1.75 ea. Ship. wt. 5 lb.

Crystal box 6 inches long x 2 inches wide—holds 10 crystals—gray metal. 29¢ ea. one wt. 8 ounces.

Model railroads special SELENIUM RECTIFIER 24 V., 3 amp size 1 3/4 x 1 3/4 x 5/4. New \$1.95. Ship. wt. 2 lb.

BC 357 Marker Beacon Receiver containing tubes and sensitive relay for operation on 75 mc. Removed from equipment but in good condition. \$2.95 each. Ship. wt. 5 lb.

RT-18 ARC 1 TRANSMITTER AND RECEIVER UNIT 100-156 mc. crystal controlled 10 channel. Complete with remote control, antenna, and mounting base. \$49.50 Ship. wt. 120 lb.

BC 652 RECEIVER 2-6 mc. An eight tube superheterodyne \$24.95 good condition. Ship. wt. 50 lb.

BC 653 TRANSMITTER \$19.95 good to excellent condition. Ship. wt. 200 lb.

DM 40 12 V. dynamotor \$3.95 for receiver. ship. wt. 10 lb.

DM 41 24 V. dynamotor \$3.95 for receiver. ship. wt. 10 lb.

DM 42 12 V. dynamotor \$14.95 for transmitter ship. wt. 30 lb.

DM 43 24 V. dynamotor \$7.95 for transmitter ship. wt. 30 lb.

BC 604 TRANSMITTER NEW 30 watt 20-27.9 mc 10 channel push button \$4.95 each. Tubes and meter supplied worth this price. ship. wt. 100 lbs.

DM 37 24 V. dynamotor for BC 604 \$4.95. Ship. wt. 15 lb.

DM 35 12 V. dynamotor for BC 604 \$9.95 Ship. wt. 15 lb.

PE 237 6-12-24 volt vibrator power supply. USE for BC 1306, BC 604, etc. Input 6 V. 36 amp., 12 V. 17 amp., or 24 V. 9.5 amp. DC output 525 V. .095 amp., 1105 V. 4.2 Ma., 6.5 V. 2 amp., 6 V. 1/2 amp., 1.35 V. 450 Ma. Higher current drain may be obtained with no ill effect. Good condition \$9.95 each. Ship. wt. 119 lbs.

Radio Receiver and Transmitter BC-620. A portable set 20 to 27.9 mc crystal controlled superheterodyne. New in original wood box at this LOW PRICE \$12.95 each. Ship. wt. 30 lb.

PE 97 6 or 12 volt power supply for the BC 620. New \$7.95. Ship. wt. 40 lbs.

ONAN 1250 WATT Light Plant. Brand New with spare parts. This gasoline engine driven generator delivers emergency power for lighting, heating, or battery charging—has 110 volt A.C. 800 cy. and 12 volt 20 amp D.C. outputs. Engine is two cylinder 4 cycle. Cost to government many times our price of \$97.50. Ship. wt. 274 lb.

Please remit shipping charges with all orders. Add 50¢ handling charges for all orders under \$5.00.

**ESSE RADIO COMPANY**  
42 WEST SOUTH ST.  
INDIANAPOLIS 25, INDIANA

## ELECTRONICS

PREPARE FOR A GOOD JOB!  
BROADCAST ENGINEER  
RADIO SERVICING AUTOMATION

TELEVISION SERVICING  
BLACK & WHITE—COLOR

APPROVED FOR VETERANS AND SURVIVORS  
OF VETERANS  
BUILDING AIR CONDITIONED  
SEND FOR FREE LITERATURE  
BALTIMORE TECHNICAL INSTITUTE  
1425 EUTAW PLACE, BALTIMORE 17, MD.

## OUT OF SPACE?



You bet we'd be... if we were to tell you all about AUDION'S 'Out of this World Hi Fi Values'

Write for  
free  
Catalog

**audion**  
25-W Oxford Road  
Massapequa, New York

LEARN TO DRAW; READ BLUEPRINTS, SCHEMATICS, WIRING DIAGRAMS; and to render any Mechanical, Electronics, Architectural & Art Drawing or Drafting.

SELF STUDY COURSES (All Types in One Book) available in simplified form. Plan 1: Send \$2.25 for any one of the above desired "individual" chapters. Plan 2: Send \$5.00 for the "Special Multi Chapters" of our book entitled, "Encyclopedia of Drawing & Design" (for Home Study, School Text, or Drafting Room).  
Publisher: (Author's experience: Chief Draftsman, Art Director, Engineer). LOUIS D. PRIOR, INC., 23-09 169th Street, Whitestone 57, New York, N. Y.

## A NOTE TO THE HI-FI BUYER

AIR MAIL us your requirements for an IMMEDIATE LOWEST PRICE QUOTATION  
Components, Tapes and Records  
SHIPPED PROMPTLY AT LOWEST PRICES

WRITE TODAY FOR FREE CATALOG

**AUDIO UNLIMITED** 190-W Lexington Ave.  
New York 16, N. Y.

overload distortion. For example, in the very last section, "Romeo at Juliet's Tomb," there is a great build-up, with much high strings, cymbals, and trumpets and the wider the dynamics go, the worse the distortion becomes. After a while the blasting and inter-modulation are so bad that one can hardly stay in the same room.

The stereo effects were fairly good in this recording but in others one experiences the lack of directionality and the formlessness that characterizes much M/S style of stereo. To sum up, a beautifully played work, in a recording that is listenable on modest equipment but which, on using top equipment, reveals many flaws.

### RIMSKY-KORSAKOV CAPRICCIO ESPAGNOL RUSSIAN EASTER OVERTURE BORODIN PRINCE IGOR OVERTURE POLOVTSIAN DANCES

London Symphony Orchestra conducted by Antal Dorati. Mercury Stereo SR-90265. Price \$5.98.

Here is an invitation from Mercury to throw your saddle across these spritely war-horses and have a good ride! Familiarity sometimes breeds contempt and there have been endless recordings of all these works. However, hearing them in Mercury's rich, full-bodied stereo is like meeting an old friend. These tired old pieces take on a fresh, youthful vigor that transforms them and makes you realize, after all, why they are so popular and why there are so many recordings.

Dorati is happier in this Russian milieu than in many others and he turns in a powerful, idiomatic reading which is as serviceable as any. Add to this the plus of the superb stereo sound Mercury affords him and the package becomes even more attractive. This is all high-level recording, with great brass, sharp brilliant strings, and thunderous percussion. The directional effects are good and center-fill is ideal. The fine acoustics of Walthamstow Hall in London are used judiciously with the well-detailed mike pickup and the combination has great presence.

My only quibble is that the articulation and intelligibility of the chorus in the "Polovtsian Dances" is somewhat less than ideal. Perhaps cutting down the size of the chorus would have helped, but then we probably would have lost its great impact.

### BLOCH AMERICA

American Concert Choir conducted by Margaret Hillis with Symphony of the Air conducted by Leopold Stokowski. Vanguard Stereo VSD2065. Price \$5.98.

Maestro Stokowski makes his first appearance on the Vanguard label and in a most appropriate fashion too! It is he, who along with four other eminent conductors, awarded the "Musical America" prize to composer Ernest Bloch for the work herein recorded. Maestro Stokowski also conducted the first performance, which was given in Philadelphia in 1928.

The work is in three parts and depicts the progress of America since the Pilgrim Fathers, through the Civil War, and up to 1926. It is frankly programmatic and ultra-derivative, making great use of folk songs, old ballads, religious pieces, and even Indian war chants. But these are all cleverly welded around the central theme of Bloch's song, "America." Thus there is a unity and a purpose to all the many elements and all are embellished with Bloch's unique orchestration. The choral part is small, being the final pages of the work wherein they declaim mightily the "America" theme.

The work is a little slow in getting started, but once under way is a fascinating journey into musical Americana. Particularly in the Civil War section you will recognize fragments of "Old Folks at Home," "Pop Goes the Weasel," "Old Black Joe," "Dixie," "Hail Columbia," and the familiar "John Brown's Body."

In the battle section of the Civil War, there is one of the most thunderous bass drums ever put on record and there is plenty of it. I predict wide use of this to show off speaker systems! The sound throughout the rest of the work is very clean and well balanced, with good directionality and easily discernible center-fill. Depth effects are well maintained and acoustic perspective suitable to the scale of the work. The choir comes over well in its brief appearance. An unusual work that will really grow on you as you listen to it and a worthwhile experience for those of you blessed with a venturesome mind.

### SHOSTAKOVICH SYMPHONY #7 ("Leningrad") Czech Philharmonic Orchestra conducted by Karel Ancerl. Parliament Mono PLP-127. Price \$7.96. Two discs.

This is another "Iron Curtain" job by Ancerl and his fine orchestra. These records may have their shortcomings but choice of repertoire is not one of them. Herewith, the Shostakovich "Seventh" which hasn't been recorded in a month of Sundays. This work had its premiere in America under the baton of Toscanini, no less, at a time when we and the Russians were buddy-buddy. Since the Cold War, it has practically vanished from the American scene.

Most musicologists do not rate this as one of Shostakovich's best works, feeling that it is rather drawn out and a bit tedious. However, they do admit that the writing of the first movement is unique and masterful. If you have been fascinated by the seemingly simple repetitious figures of Ravel's "Bolero," then you'll be equally stimulated by the second half of the opening *allegretto*. After the more or less pastoral-like first half, there begins, *pianissimo*, a simple military ruffle on a snare drum and then an equally simple 5-note melody, which like the "Bolero" is the central theme. The snare drum figure continues, endlessly repeating and ever so slowly building in dynamic scale. At the same time, the central theme is repeated, but each time with variations and transpositions as instrument after instrument is added. All the time, both the rhythm and the theme are building in dynamics until finally there is a gigantic outpouring of sound triple *forte* and the music slowly subsides.

It is one of the most hypnotic and frenetic things in music and Ancerl plays it for all it is worth. His performance is staggering in its blazing intensity and passion. The rest of the symphony has its moments, but never again reaches the level of inspiration of this first movement.

Soundwise, this is a pretty fair mono recording, miked fairly close and with good use of reverb. I don't think the frequency response extends much past 9000-10,000 cycles, but the good acoustic perspective makes up for a lot of this. The dynamic build-up is very considerable but upon reaching the *fortes*, overload and inter-modulation creep in. Outside of that, all is reasonably clean and a tip of the hat to the wonderful strings and the very good sound and projection of tympani and other low percussion. In my opinion, worth the dough for the first movement alone. Now if we could only have that section in a really modern stereo recording . . . ah well, maybe some day!

# ELECTRONIC CROSSWORDS

By **BRUCE BALK**

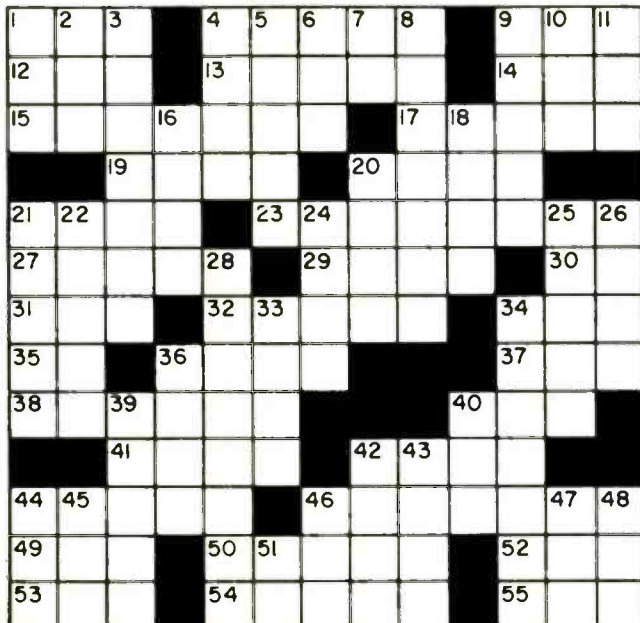
(Answer on page 130)

## ACROSS

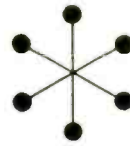
1. Unit of work.
4. U.h.f. tube.
9. Delay.
12. Amperage-voltage-resistance (abbr.).
13. Burn suddenly.
14. Ripen.
15. Pilot.
17. One of the sidebands.
19. Phonograph record.
20. Greek letter (pl.).
21. Boundary.
23. Electronic device for polarizing light.
27. Attempts.
29. Interlace.
30. Products of this equals wattage.
31. Unit of current (abbr.).
32. Dress carefully.
34. Collected miscellaneous data.
35. One of the United States (abbr.).
36. Spring vegetable.
37. Boy's nickname.
38. Hard crust or scab (geol.).
40. Common contraction.
41. Be fond of.
42. Trigger in electronics.
44. Type of modulation.
46. Rotates an antenna.
49. Battering tool.
50. Electronic navigation device.
52. At present.
53. Mischievous child.
54. Tree trunks.
55. Carpenter's tool.

## DOWN

1. Present name for RETMA (abbr.).
2. Clergyman's title (abbr.).
3. Useful ham shack instrument.
4. Sterns.
5. Timepiece.
6. Rowing implement.
7. Means of transportation (abbr.).
8. Atomic particle.
9. Time interval.
10. Era.
11. European country (abbr.).
16. Engineers' organization (abbr.).
18. Treaty.
20. Sea eagle.
21. Element in a complex radio mechanism.
22. Girl's name (pl.).
24. Supplements.
25. In TV, horizontal sweeps.
26. Connecting wire.
28. "Output-ers" of audio amplifiers.
33. Inert or noble gas.
34. Aerial.
36. Greek letter (pl.).
39. D.c. restorer.
40. Citizen of (suffix).
42. Unit of stylus pressure.
43. Ventilates.
44. Transformer winding which receives power from supply circuit (abbr.).
45. Radio operator.
46. Poem.
47. To drag.
48. Dx-er (abbr.).
51. Preposition.



January, 1961



1600 pages



IT'S NEW. Covers all the latest products: • miniature and sub-miniature components • printed circuit components • silicon rectifiers • new transistor types • citizens band, SSB and new mobile ham gear • microwave and telemetering components and equipment • stereo equipment... every new electronic product for servicing, experimenting, design, industrial and military applications.



IT'S THE WORLD'S BIGGEST ELECTRONIC CATALOG. 1600 pages—more than 175,000 items—with specifications, illustrations and prices. Contains hundreds of items not found in smaller catalogs.



IT'S THE EASIEST TO USE. Quickest way to get current catalog data on the products of more than 330 manufacturers. Systematically organized in 32 product sections for rapid reference.



IT'S INDISPENSABLE TO SERVICE MEN, ENGINEERS, HOBBYISTS. If you're a service technician, The MASTER means more profitable operation because it covers all items necessary for radio, TV, audio and industrial servicing. If you're an engineer or buyer, you'll save design and purchasing time. If you're a ham, hobbyist or experimenter, you'll get the right product to do the job best, because you're shopping in the electronic supermarket.

AND IT'S NOW AVAILABLE AT  
YOUR LOCAL DISTRIBUTOR

## 1961 MASTER

\$3.95 at parts distributors  
\$4.95 in Canada

FREE from your distributor: New Foreign Tube Interchangeability Guide, or write direct, enclosing 25c.

RADIO-ELECTRONIC MASTER — 60 MADISON AVE., HEMPSTEAD, N. Y.

# will send you your choice of the world's greatest electronics books for a **7-DAY FREE EXAMINATION**

Here are some of the world's greatest electronics books...chosen carefully by Ziff-Davis Electronics Book Service as among the best in their fields. You'll find top-notch texts and manuals on theory and instruction...important volumes covering radio and TV servicing, electricity and appliances...reference books to help you understand such fields as computers, citizens band, communications, and electronics experimentation.

Each volume is designed to help you get more know-how, greater enjoyment from your electronics specialty—and each is yours for 7 days FREE! Simply write your choices on the coupon below and mail it today. When your books arrive, read and enjoy them for seven full days. If, after that, you don't agree that they are everything you want, return them and owe nothing. Here is the perfect way to build the library every man in electronics must have.

## THEORY AND INSTRUCTION

## RADIO AND TV SERVICING

## ELECTRICITY AND APPLIANCES

Get started in radio, TV, communications, by using these simple basic guides to electronic principles, functions, and operations!

Save time and labor in radio and TV maintenance by referring to professional handbooks!

Brush up on electrical theory, repair any electrical appliance by using these simple manuals!



**2500. BASIC ELECTRONICS, Grob**  
An introductory text on the fundamentals of electricity and electronics for technicians in radio, television and industrial electronics. \$9.25

**2501. ELEMENTS OF ELECTRONICS, Hikey and Villines**

This basic electronics text offers an excellent course for training radio and electronics technicians and for students in television, radar and sonar. \$6.95



**2511. UNDERSTANDING RADIO, 3rd Ed., Watson, Welch and Eby**  
For those with little or no technical knowledge who wish to know the fundamentals of radio theory and servicing. \$8.25

**2522. ELEMENTS OF RADIO, Hellman**

A thorough grounding in all basic principles of radio and radio communications, with a review of electricity and magnetism. Includes chapter on transistors. \$5.50



**2519. HANDBOOK OF BASIC CIRCUITS Mandl**  
A basic guide to circuitry combining comprehensive coverage of major circuits with detailed information on circuits used in TV, FM and AM. Simply written and easy-to-understand. \$7.95

**2512. PRIMER OF ELECTRONICS AND RADIANT ENERGY, 2nd Ed. Caverly**

Clear and simple explanation of electronics and electronic tubes and circuits for all concerned with the manufacture, application, operation of household or industrial electronic devices. \$8.00

**2407 HOW TO GET AHEAD IN THE TELEVISION AND RADIO SERVICING BUSINESS, Marcus**

Shows the easy way to get started as a TV-Radio repairman, how to earn while you learn, how to get and keep customers. \$3.50



**2415. MANDL'S TELEVISION SERVICING, Mandl**

This standard text book in the T.V. servicing field provides clear descriptions of the fundamentals of T.V., and practical instruction on the diagnosis and correction of typical troubles. \$7.50

**2408. ESSENTIALS OF ELECTRICITY FOR RADIO AND TELEVISION, 2nd Ed., S'urzberg and Osterheld**

Provides necessary background of principles for understanding T.V., FM and radio circuits. \$8.25



**2404. FM RADIO SERVICING HANDBOOK, King**

A practical guide to FM V.H.F. receivers, their design, construction, alignment and repair. \$5.00

**2400. PROFITABLE RADIO TROUBLESHOOTING, Marcus and Levy**

Explains in easy-to-understand manner the use of simple and advanced test instruments, opening a radio servicing business, pitfalls, and successful procedures for a full-grown business. \$6.25



**2442. BASIC ELECTRONIC TEST INSTRUMENTS, Turner**

Over 60 instruments described, their uses fully explained and valuable work-saving short-cuts outlined. \$6.25



**2651. MAJOR APPLIANCE SERVICING, Brockwell**  
Gives essential information for a career in major appliance servicing. Explains methods of repairing appliances, organizing and managing a service business. \$5.95

**2653. PRACTICAL ELECTRICITY, Croft**

Shows what electricity is, how it is generated and how it is used. Profusely illustrated and written in simple language with graphic examples. \$8.50

**2667. ELECTRIC MOTOR REPAIR, Rosenberg**

A unique and practical book that explains all details of modern motor repair work; shows what to do—and why. Designed for bench use with duo-spiral binding that lies flat, making text and illustrations visible at same time. \$9.25

**2650. HANDYMAN'S ELECTRICAL REPAIRS HANDBOOK, Hertzberg**

Step-by-step photos and instructions show you how to repair and maintain wiring, home power systems, appliances, air conditioners, motors, etc. Also: how to make three simple and useful appliance testers. \$2.50



**2660. BEGINNING ELECTRICITY, Eaton**  
Principles, construction and operation of basic electrical devices and appliances. A thorough foundation in electricity plus essential details on mechanisms. \$6.00

**2652. HOW TO REPAIR HOME APPLIANCES, Campbell**

For the do-it-yourselfer, a handy, easy-to-read reference book with chapters on all kinds and types of appliances. Concise, thorough instructions with many useful illustrations. \$2.50

Construction  
and  
Experimentation

Communications  
and  
Broadcasting

Special Topics

Wonderful "how-to" books to help you build and enjoy practical electronic devices simply and easily.

Here are books which simplify basic and advanced theory — and open new horizons to you in the field of communications!

Choose any of these practical books—to take advantage of the growing opportunities in the exciting field of electronics!



**2006. ELECTRONIC EXPERIMENTER'S MANUAL, Findlay**

With a few dollars worth of basic tools and this book to guide you, you can explore electronics experimentation more completely than ever before. 10 big sections. \$4.95

**2002. ELECTRONIC KITS DIRECTORY, Ziff-Davis Publishing Company**

New 1960 edition lists over 750 kits, latest models, prices and features for hi-fi, ham radio, SWL, shop improvement, Citizen's Band, fun and education. \$1.00

**2351. RADIO PROJECTS, Marcus**

10 easy to construct radios described in this book cover the field thoroughly and completely, progressing in difficulty from the simple crystal detector to the superheterodyne receiver. \$3.85

**2001. 1960 ELECTRONIC EXPERIMENTER'S HANDBOOK, Ziff-Davis Publishing Company**

40 projects for home and shop, 20 of which are transistorized. Special section on understanding transistor circuits. \$1.00; 2009, cloth \$1.95

**2901. HAM RADIO, Hertzberg**

Tells exactly how to become a "ham"—how to obtain a ham "ticket," how to learn code, how to select receivers and transmitters — everything you need to know is between the covers of this handy guidebook. \$2.50

**2900. BROADCASTING TELEVISION AND RADIO, Kingston, Cowgill, Levy**

A simple, practical introduction to broadcasting, dealing with performance before the microphone and camera. \$8.65



**2008. CLASS D CITIZENS RADIO SANDS**

First complete book on Citizens Radio operation. Covers Class D history, rules, applications, how it works. Many illustrations. \$4.95

**2907. RADIO OPERATING QUESTIONS AND ANSWERS, Hornung & McKenzie**

Presents specific information on radio law, operating practices and theory for those studying to pass the FCC commercial radio operator exams of the various license grades. \$6.25



**2007. COMPUTERS AND HOW THEY WORK, Fahnestock**

A fact-filled guidebook to electronic computers. Explains the workings of every major computer system. Must reading for all who want a more complete knowledge of this important field. \$4.95

**2601. TRANSISTORS IN RADIO, TELEVISION AND ELECTRONICS, Kiver**

A descriptive, non-mathematical text for radio, television, electronics technicians and for those who want a working knowledge of transistors and circuits. \$7.95

**2301. ELECTRONICS & NUCLEONICS DICTIONARY, Cooke & Marcus**

New! A revised, enlarged edition containing authoritative definitions of terms used in radio, television, industrial electronics, nucleonics, sound recording, etc. Bigger and better than ever! \$12.00



**2600. TRANSISTORS, Gillie**

Describes and analyzes semi-conductors and transistors and how they behave. 300 pages, illustrated. \$7.95

*See Your  
Parts Jobber  
Or Use This  
Coupon Today!*

Leading radio and electronics parts jobbers, hi-fi dealers and salons are making their stores headquarters for books on every electronics subject. You can take this list to your favorite dealer for immediate purchase.

If your local parts jobber or dealer does not carry books, use the coupon for prompt delivery from ELECTRONICS BOOK SERVICE, on a 7-day free trial basis.

**ELECTRONICS BOOK SERVICE**

One Park Avenue, New York 16, N. Y.

Please send me the book(s) I have listed below for a FREE 7-day Trial Examination. I understand that if I am not completely satisfied, I may return my selections(s) and I'll owe you nothing. Otherwise, I will send you payment for the book(s) of my choice, plus postage and handling.

NUMBER	TITLE	PRICE
<small>(50% down payment required on all orders over \$20.00)</small>		<b>°TOTAL</b>

°New York City Residents, please add 3% sales tax.

(If you need more space to list other titles, attach a sheet of paper with additional list.)

**SAVE MONEY!** Enclose payment in full for the book(s) of your choice and we will pay shipping charges. Same return privileges and prompt refund guaranteed.

Please send me FREE CATALOG when published.

EF530

NAME \_\_\_\_\_ PLEASE PRINT CLEARLY

ADDRESS \_\_\_\_\_

CITY \_\_\_\_\_ ZONE \_\_\_\_\_ STATE \_\_\_\_\_

(7-Day Free Trial offer good only in U.S.A. and Canada. Foreign customers must enclose payment in full. Satisfaction guaranteed or money refunded.)

# MOBILE-RADIO MAINTENANCE

**CAN MEAN  
A BETTER HOME...  
A BIGGER CAR...  
AND MONEY  
IN THE BANK!**



Mobile radio—already a great and growing business—will grow far larger. The FCC is assigning many more channels . . . and now any type of business or industry can have its own 2-way radio system. Right now there are over 2,000,000 transmitters in the Safety and Special Radio Services. Citizens Radio is exploding. This equipment needs installation . . . maintenance . . . repair . . . and FCC-required checks. Most earn profits for their owners and must be kept on the air 12 months a year (often 24 hours a day)—so this work pays well.

Not many radio and TV servicemen bother to qualify to profit in this booming business—because an FCC operator's license is necessary. A far-sighted few are making big money. To learn how you can be one of these few, mail coupon below for your free copy of the booklet "HOW TO MAKE MONEY IN MOBILE-RADIO MAINTENANCE".

**MAIL THE COUPON NOW—  
THERE'S NO OBLIGATION!**

LAMPKIN LABORATORIES, INC.  
MFM Division, Bradenton, Florida

At no obligation, please send me the free booklet "HOW TO MAKE MONEY IN MOBILE-RADIO MAINTENANCE." Also, technical data on Lampkin meters.

Name \_\_\_\_\_  
Address \_\_\_\_\_  
City \_\_\_\_\_ State \_\_\_\_\_

**Lampkin meters are the preferred  
mobile-radio test equipment!**



LAMPKIN 105-B  
FREQUENCY METER  
RANGE 0.1 TO 175 MC.  
AND UP  
PRICE \$260.00

LAMPKIN 205-A FM  
MODULATION METER  
RANGE 25 TO 500 MC.  
PRICE \$270.00



NEW: the PPM Meter . . . an accessory for the Type 105-B . . . accuracy 0.0001% for split-channel frequency checks. Price \$147.00.

**LAMPKIN LABORATORIES, INC.**  
MFM Division  
BRADENTON, FLORIDA



Model LP100  
**FOR CITIZENS' BAND AND ALL AMATEUR  
BANDS — ONE UNIT!**

- Heavy duty iron core choke type. Suppresses noise down to sub-audio.
- Clearer reception and transmissions.
- Won't effect charging rate. **\$4.95**
- Guaranteed satisfaction.
- 6-12-24 VOLT Plus postage.
- Easy to install.—Model LP100—Shpg. Wt. 2 Lbs.



- Suppresses ignition, motor noise from heater & defroster, instrument, clock, dynamotor whine.
  - Suppresses noise carried to radio equip. by the 6 or 12 V. wiring. **\$3.30**
  - Satisfaction guaranteed.
- Model LP2003— Shpg. Wt. 1 Lb. Plus postage.

**LENDELL PRODUCTS**  
936 S. SEVENTH ST.  
DE KALB, ILL.

## MOVING?

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

**ELECTRONICS WORLD**

434 South Wabash Avenue Chicago 5, Illinois

**TOP  
SILICON**



**HAT  
RECTIFIER**

FROM 250 MA TO 6-12-18 & 35 AMP.

FACTORY DIRECT. Exclusive Distributors for Name Brand. Immediate Delivery. All Types

**750 MA. RECTIFIERS GUAR.**  
Input Working Range RMS ACV Res. or Cap.

PIV RMS	PIV RMS	PIV RMS	PIV RMS
50 35 .15 ea.	100 70 .25 ea.	200 140 .30 ea.	300 210 .40 ea.
400 280 .45 ea.	500 350 .65 ea.	600 420 .75 ea.	700 490 .90 ea.
800 560 .95 ea.	900 630 1.15 ea.	1000 700 1.55 ea.	1100 770 1.75 ea.

**SPECIAL!!!**

All Purpose Rectifier 400 piv @ 250ma  
35 ea. 25 for 7.50

DISTRIBUTORS—OEM—EXPORTERS  
WRITE QTY PRICES

- SPECIALS: 100 Different Pres. Res. 1/2W, 1W-2W 12%, 1%, Tol. Only \$1.70/c NEW
  - 100mA Selenium Rectifiers @ .39 NEW
  - 100 ASST. RADIO & TV KNOBS Push-ons \$1.00 NEW
- All material guaranteed. \$2.00 min. order. Orders F.O.B. NYC. Include check or money order. Shpg. charges plus. C.O.D. orders 25% down.

**WARREN DIST. CO.**

NYC 7, NY 87 Chambers St. WO 2-5727

## Tailor Your Speaker (Continued from page 40)

Fig. 6 is the circuit which produces the curve of Fig. 3. It isn't clever or elegant, but it does the job reasonably well. It is built on a separate little chassis which connects between the preamp and the power amplifier. This provides a convenient place to play without endangering the performance of the whole system.

### Is It Worth It?

Very definitely yes. The system retains the full spacious quality which I particularly wanted, but the bass is now clean and distinct instead of muffled and muddy. Admittedly, I'm in the habit of trying a new speaker system every six months or so but in my acoustically perverse living room, this is the best mono system I have heard to date.

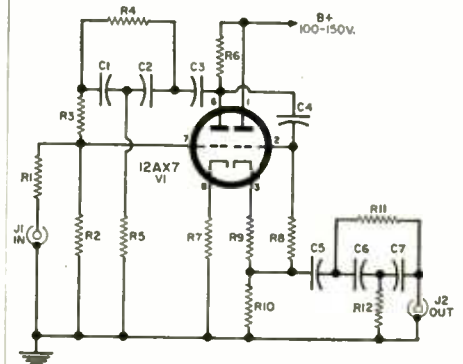
Why not try a similar project in connection with your own hi-fi installation? If you have a fairly small room, chances are that the region between 40 and 300 cps would benefit from equalization.

Corrective equalization can be achieved with a variety of common circuits, depending on what corrective curve is needed and how elaborate a circuit you want to build.

There are, of course, certain things that equalization *can't* do. It won't bring out something the loudspeaker doesn't have. It won't eliminate sharp peaks and it won't clean up muddy transient response. Also, you must be careful not to equalize beyond the overload point of the amplifier or speaker system.

But if you own good equipment, yet the system sounds "thin" or "dull" or "tubby," equalization for room acoustics can do wonders. It should be considered a must for every top-grade component installation.

Fig. 6. Equalization circuit used by author between preamp and amplifier.



- R<sub>1</sub>, R<sub>2</sub>, R<sub>3</sub>, R<sub>4</sub>—100,000 ohm, 1/2 w. res.
- R<sub>5</sub>—1 megohm, 1/2 w. res.
- R<sub>6</sub>—220,000 ohm, 1/2 w. res.
- R<sub>7</sub>—300,000 ohm, 1/2 w. res.
- R<sub>8</sub>—2200 ohm, 1/2 w. res.
- R<sub>9</sub>, R<sub>10</sub>—470,000 ohm, 1/2 w. res.
- R<sub>11</sub>—1800 ohm, 1/2 w. res.
- R<sub>12</sub>—22,000 ohm, 1/2 w. res.
- C<sub>1</sub>, C<sub>2</sub>—0.01 μf., 400 v. capacitor
- C<sub>3</sub>, C<sub>4</sub>—0.2 μf., 400 v. capacitor
- C<sub>5</sub>—0.047 μf., 400 v. capacitor
- C<sub>6</sub>, C<sub>7</sub>—.25 μf., 200 v. capacitor
- J<sub>1</sub>, J<sub>2</sub>—Phono jack
- V<sub>1</sub>—12AX7 tube



**Transistorized Theremin**  
(Continued from page 32)

adjustment ( $C_{12}$ ) and then by setting the pitch adjustment ( $C_1$ ). To set  $C_{12}$ , place your hand near the pitch antenna, in order to produce an audible note. Increase the capacitance of  $C_{12}$  until the note begins to get softer. You will then find that the tone gets softer when you bring your left hand near the volume-antenna, until it is inaudible when your left hand is within an inch or so of the antenna. Now set  $C_1$  so that the pitch oscillator's zero-beat when you stand away from the instrument, but the tone begins when you bring your right hand within eighteen inches or so of the pitch-antenna.

Tuning adjustments set? Then play a song! But if you can't quite manage that on your first try, don't get discouraged. The Theremin, like any other musical instrument, takes some practice to be played correctly. Try these simple exercises:

1. Think of a note. Hum it to yourself. Then play it on the Theremin. Hold it steady for a few seconds. Concentrate on keeping your body motionless and erect, and your arms relaxed.

2. Think of two notes, and hum one and then the other to yourself. Play the first note on the Theremin, then glide to the second note. Glide slowly at first, then make the glides more abrupt as you become more proficient.

3. Practice scales and arpeggios, slowly at first, then faster as you become more efficient.

4. Do exercises 2. and 3., but bring your left hand near the volume antenna to silence the tone when going from one note to another. This exercise teaches you to "feel" where the notes are.

After you have mastered these exercises, try playing some simple songs. At first, special care should be given to playing the notes correctly. Later, shadings can be added with the left hand. A vibrato can be introduced into the tone simply by moving the right hand back and forth a few times a second. This motion should not be more than one-quarter inch, and should be done primarily from the wrist. The vibrato gives the Theremin tone warmth and expressiveness.

Once you become a proficient Thereminist, you will find many opportunities to display your talents. Theremin music is ideal for providing backgrounds for amateur plays, for melodic classical and religious music, or for adding a novel touch to dance bands and vaudeville acts. Even if you never take the time to become an accomplished Thereminist, the instrument will provide you and your friends with hours of entertainment. But whether you use the Theremin for playing "serious" music or just for experimenting, you will have an instrument that evokes as much mystery and fascination today as it did in 1928. In short, you will be able to produce "Music from the Ether."  
-30-

**NON-METALLIC GUY LINE - PERFECT FLEXIBLE INSULATOR - REVOLUTIONIZES HAM RADIO & TV ANTENNA SYSTEMS**

Non-inductive, non-conducting, non-absorbing Glas-Line insulates systems from directional arrays, rhombics, etc.



The new main insulator of W3UCT. The Glas-Line is between the two egg insulators running to the tower. The copper link between the center egg insulator and the upper right egg insulator is for the dead-end feeder of a Zepp antenna.



View of an open thumb and eye bolt for coupling the Glas-Line Guy wire to a tower. GLAS-LINE cannot rot, will not shrink, stretch or sag... has high breaking strength of over 500 pounds with proper use.

100' SPOOL Plus 50c for postage & handling **\$3.75**  
600' REELS Plus \$1.00 for postage & handling **\$17.84**

**'SUPER' GLAS-LINE**  
with 1,000 lb. TENSILE STRENGTH  
with proper use.

100' SPOOL Plus \$1.00 for postage & handling **\$6.95**  
600' REELS Plus \$2.00 for postage & handling **\$34.75**

Announcing New "G-3 50X GLAS-LINE CABLE"  
with 2,500 lb. TENSILE STRENGTH  
with proper use.

100' SPOOL Plus \$1.50 for postage & handling **\$13.90**  
600' REELS Plus \$3.00 for postage & handling **\$69.50**

Send check or M.O. No C.O.D.'s please.  
DEALER & DISTRIBUTOR INQUIRIES INVITED.

**THE GLAS-LINE CO.**

2751 NOSTRAND AVE., Dept. 3, 8'KLYN 10, N.Y. • CL 2-9851

# TRU-VAC 1-YEAR GUARANTEED RADIO and TV TUBES

Factory Used or Factory Second Tubes! TRU-VAC will replace FREE any tube that becomes defective in use within 1 year from date of purchase!

**ALL TUBES INDIVIDUALLY BOXED! CODE DATED & BRANDED "TRU-VAC"**

Partial Listing Only . . . Thousands More Tubes in Stock!

<b>SPECIAL!</b>	<b>6SN7GT</b>	<b>30¢</b>	<b>6W4GT</b>	<b>30¢</b>
-----------------	---------------	------------	--------------	------------

OY4	3CB6	6A6	6AX4GT	6CA8	6M6	6T8	7E6	12A27	12L6	25Z6GT
OZ4	3Q4	6AB4	6AX5GT	6CB6	6J4	6U5	7E7	12B4	12Q7	27
1A7GT	354	6AC7	6BA	6CD6G	6J5	6U8	7F7	12BA6	12R5	35A5
1B3GT	3V4	6AF4	6BA6	6CF6	6J6	6V6GT	7F8	12B47	12S47	35B5
1M5GT	4BQ7A	6AC5	6BC5	6CC7	6J7	6W6GT	7G7	12BD6	12S7J	35C5
1L4	4B5B	6AH4GT	6BC8	6CC8	6K6GT	6X4	7H7	12BE6	12S7K	35W4
1L6	4BZ7	6AM6	6BD6	6CH8	6M7	6X5GT	7M7	12BF6	12S7MT	35Z5
1N5GT	4CB6	6AK5	6BE6	6CL6	6N7	6X8	7Q7	12BM7	12S7Q	36
1R5	SAMB	6AL5	6BF5	6CM6	6Q7	6Y6G	757	12BQ6	12W6GT	38
1S5	SAMB	6AM8	6BQ6G	6CM7	6S4	7A4	7X6	12BR7	12W6GT	39 44
1T4	SAT8	6AN8	6BH6	6CN7	6S7	7A5	7X7	12BY7	12X4	41
1U4	SAV8	6AQ5	6BJ6	6CQ8	6S8GT	7A6	7Y4	12CA5	14A7	12B7 42
1U5	SAZ4	6AQ6	6BK5	6CQ6	6S7	7A7	7Z4	12CNS	14B6	43
1V2	SBR8	6A07	6BK7	6CS6	6S07GT	7A8	12A8	12D4	14Q7	50A5
1X2	SCC8	6AR5	6BL7GT	6CS7	6S7F5	7B4	12AB5	12F5	19AU4GT	50B5
2AF4	SJ6	6AS5	6BN6	6CUS	6S7	7B5	12AQ5	12FB	19BC6G	50C5
2BN4	SR4	6AT6	6BO6GT	6CUG	6S7	7B6	12AT6	12K5	19J6	50L6
2CY5	ST8	6AU6	6BQ7	6D6	6S7	7B7	12AT7	12K7	19T8	56
3A5	SU4	6AU4GT	6BR8	6DE6	6S7	7B8	12AU6	12A7	24A	80
3AL5	SUB	6AUSGT	6BS8	6DG6GT	6S7	7C4	12A7	12A7	24A	84 624
3AU6	SV4C	6AUB	6S7C	6E6	6S7	7C5	12AV6	12A7	17Z3	117Z3
3BC5	SV6GT	6AV6GT	6BZ6	6E5	6S7	7C6	12AV7	12AX7		
3BN6	SK8	6AV6	6BZ7	6E5	6S7	7C7	12AX6GT			
3BZ6	SY3	6AW8	6C4	6E6	6T4	7E5	12AX7			

Any Tube Not Listed Also Available at 35¢ Each!  
BRAND NEW 1-YEAR GUARANTEED TV PICTURE TUBES

Below Listed prices do not include dust Add Additional \$5.00 Deposit on tube sizes to 20", on 21" and 24" tubes—\$7.50. Deposit refunded immediately when dust is returned prepaid. Aluminized tubes—\$4.00 extra.  
Picture tubes shipped only to continental USA and Canada—All tubes F.O.B., Harrison, N.J.

10BP4	7.00	10CP4	11.00	11TP4	16.00	20HP4	17.00	21AP4	17.40	21XP4	17.40
121P4	10.00	121P4	11.00	121P4	16.00	21AP4	21.00	21P4	17.30	21P4	17.40
14R/TP4	11.00	10HP4	11.00	17Q/4	13.00	21AP4	18.20	21P4	18.30	21P4	17.40
18A/4	10.00	17AP4	11.00	17P4	13.00	21AP4	18.20	21P4	18.30	21P4	17.40
10HP4	7.00	10HP4	13.00	10AP4	14.00	21AP4	17.00	21P4	22.30	24TP4	27.70
18Q/4	10.00	17AP4	13.00	21P4	13.00	21P4	18.20	21P4	18.30	24P4	24.70
10HP4	12.10	17TP4	17.00	20HP4	15.00	21AP4	18.70	21P4	17.40		

**ATTENTION QUANTITY USERS!** Big Discounts Are Yours . . . Call or Write For Our 1000 Tube "Private Label" Special Attention Branding Dept. MGR.

Money cheerfully refunded within Five (5) Days, If Not Completely Satisfied!

**TRU-VAC (R) PAYS YOUR POSTAGE**—On orders of \$5 or more in USA and Territories. Send approximate postage on Canadian and foreign orders. Any order less than \$5 requires 25¢ handling charge. Send 25¢ on C.O.D.'s. All orders subject to prior sale. Complying with Federal regulations, the following statement appears in all Tru-Vac advertising: Tubes appearing in this ad may be FACTORY SECONDS or USED tubes and are clearly marked.

**LOOK! 1,000 USED TV'S**  
Costly, famous make console models with little or no tube replacement! Require only minor adjustment. Perfect for resale, or as your own second set! 10", 17" and 19" screens . . . none smaller! Sets shipped FOB, Harrison, N.J.

**\$16.95**  
As is

**Sensational Offer!**  
"Self Service"  
**TUBE CHECKERS**  
**\$37.95** FOB Our Warehouse

Let your customers test their own tubes! These reliable, reconditioned 22-socket tube checkers will return your investment in one week or less with little or no effort on your part! Handsome, field-tested console models COMPLETE WITH KEY FOR BOTTOM DOOR AND NEON-LIGHTED HEAD!

# TRU-VAC

Harrison Avenue • Box 107 • Harrison, N. J. Humboldt 4-9770

January, 1961

125

www.americanradiohistory.com

## TV PICTURE TUBES AT LOWEST PRICES

### ALL ALUMINIZED GLASS TYPES

Tube Type	Price With Old Tube	Tube Type	Price With Old Tube	Tube Type	Price With Old Tube
10BP4	7.95	17BJP4	11.50	21CEP4	21.00
12LP4	8.95	17CDP4	11.50	21CKP4	15.75
14AJP4	14.00	17CK CA	9.25	21DEP4	21.00
14ATP4	14.00	BRP4	17.00	21DFP4	21.00
14B E/CP4	10.00	17DLP4	17.00	21DLP4	21.00
14HP4	11.00	17H RP4	12.50	21DSP4	21.00
14QP4	11.00	17L VP4	12.50	21EP4	14.25
14RP4	11.00	17QP4	11.50	21FP4	14.50
14W ZP4	11.00	20C DP4	13.50	21WP4	16.00
14XP4	11.60	20H MP4	14.50	21XP4	16.50
16DP4	12.00	21AC BS	16.00	21YP4	16.00
16K RP4	9.95	AMP4	15.75	21ZP4	15.50
16LP4	12.50	21AL ATP4	16.75	24C VP4	23.50
16TP4	9.95	21AU AVP4	15.75	24EP4	24.50
16WP4	12.00	21AWP4	15.75	24HP4	24.50
17AT AVP4	12.50	21BTP4	16.75	27EP4	19.95
17BP4	9.95	21CBP4	16.75	27RP4	39.95
				27SP4	40.95

### METAL TYPES

12UP4	12.00	19AP4	16.00
16AP4	13.50	21AP4	19.75
16EP4	14.00	21MP4	20.75

### TEST TUBES

8XP4	16.07	8YP4	16.07
------	-------	------	-------

### 1 year warranty

Prices include the return of an acceptable similar tube under vacuum. These tubes are manufactured from a processed fused glass bulb. All parts and materials including the electron gun are brand new.

ALL PRICES FOB CHICAGO, ILLINOIS. Deposit required, when old tube is not returned, refundable at time of return. 25% deposit required on COD shipments. Old tubes must be returned prepaid. Tubes shipped Rail Express. Shipped only to continental U.S. and Canada.

WRITE FOR COMPLETE LIST

**—PICTURE TUBE OUTLET—**  
2922 MILWAUKEE AVE., CHICAGO 16, ILLINOIS  
Dickens 2-2848

## ELECTRONICS WORLD HAS

### A BUYER FOR YOUR USED EQUIPMENT OR COMPONENTS!

The 245,000 purchasers of ELECTRONICS WORLD are always in the market for good used equipment or components. So if you have something to sell, let EW readers know about it through our classified columns. It costs very little: just 60¢ a word, including name and address. Minimum message: 10 words.

For further information write: Martin Lincoln  
ELECTRONICS WORLD,  
One Park Avenue  
New York 16, N. Y.

## ENGINEERING DEGREE IN SCIENCE MATH 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 quarterly — January, March, June, July, September. Quality education. Graduates employed from coast to coast. Government approved for veteran training. Students from 50 states, 40 countries. 20 buildings; dorms; gym. Campus. Save time and money. Earn board while studying. Write for catalog and complete information.  
911 E. Washington Blvd., Fort Wayne 2, Indiana

## INDIANA TECHNICAL COLLEGE

### PACKAGE HI FI or SINGLE COMPONENTS

You'll find our prices low and service fast.  
Write for our quotation.  
CENTER INDUSTRIAL ELECTRONICS, INC.  
74-L Cortlandt Street, New York 7, N. Y.

## Mac's Service Shop

(Continued from page 60)

with the volume full on. Very often this technique will reveal the location of a break or a loose connection by making the radio burst into song or speech when a particular area is jarred or flexed. In such an event, a concentrated visual search of that area will quickly reveal the cause of the difficulty.

"But if the radio still refuses to talk, or if you are seeking a cause of low volume, distortion, or lack of sensitivity, you may as well get out the v.t.v.m. and start making a systematic check of the voltages your service data says should be found at various points of the circuit. It is most essential that the v.t.v.m. used for this purpose be accurate and that it have a low-voltage range, say 1 or 1.5 volts full-scale. You will be measuring voltage drops produced by small currents through fairly low-ohmage resistors, and very often a difference of only .1 volt can spell the difference between a properly biased transistor and one that will not work at all. Frequently check the v.t.v.m. against a fresh standard-size flashlight cell. It should read close to 1.57 volts."

"You think voltage testing is the best way to shoot trouble in a transistor set?"

"I think it's the best way to start. Later you may have to use signal-injection or signal-tracing. Resistance checking is pretty risky unless you pull all the transistors and are very careful not to subject low-voltage electrolytics to reversed polarity voltage from your ohmmeter probes. Really a high percentage of troubles can be located with a combination of v.t.v.m., Ohm's Law, and a little horse sense. Take this set I was working on, for instance:

"Only the local station could be received, and that was distorted. First I measured current drawn from the battery. It was supposed to be 6 ma, with no signal, but it was 9 ma. Something was drawing too much current and probably upsetting voltages; so I started measuring with the v.t.v.m., beginning with the output stage and working forward. Everything was in order until I reached the first i.f. stage emitter. This read  $-.5$  volt instead of the  $-.15$  volt it should. Unless the emitter resistor had increased in value, emitter current was too high. The base was supposed to read  $-.3$  volt. Actually it was  $-.7$  volt. That explained the too-high emitter voltage, but what was causing the base voltage to be too high? I suspected an 8- $\mu$ mf. neutralizing capacitor between the collector and base of the transistor of being leaky, but I didn't unsolder it immediately.

"Careful examination of the circuit revealed the bottom end of the i.f. transformer winding feeding the base of the first i.f. transistor was connected to the emitter of the mixer transistor, and a resistor of 3900 ohms went from that point to ground. Maybe something was making too much emitter current flow

through this resistor. Checking the mixer base voltage revealed  $-1.0$  volt instead of the  $-.2$  volt that should appear there. A 5000- $\mu$ mf. capacitor connected this base to a tap on the oscillator coil, one end of which was connected to the oscillator transistor collector. I had built up a pretty strong case against that 5000- $\mu$ mf. capacitor; so I unsoldered one lead and checked it with the ohmmeter. It was guilty of a very high leakage. A new capacitor restored the set to normal operation."

Barney ticked the points off on his fingers as he said, "As I get it, you say: 1. Make careful checks with the v.t.v.m. and look for even small deviations from proper potentials; 2. don't be too hasty with the soldering iron when you find a voltage that's off—make additional checks to pin down the defective component beyond any reasonable doubt; and 3. use your brains and Ohm's Law all the time to translate voltages into currents, and *vice versa*."

"You've got the idea. Keep doing that, and transistor servicing becomes easier and easier. The guys steering transistor work our way are doing us a favor, even though that's not their intention. Whenever you see an essential service that is going begging because it has some disagreeable features, you are staring an opportunity squarely in the face.

"An excellent example of this is sewer cleaning. A few years back this was hard, dirty, disagreeable work performed only by unlucky devils who could not find anything else to do. Then someone invented the rotary power-driven sewer cleaner. A couple of fellows I know with good white-collar jobs bought one of these machines when they first came out and started doing sewer cleaning on the side. They made more money in two or three hours each evening using the machine than they did at their regular jobs.

"Of course, in a case like this, others soon get the idea and competition sets in; but for a while it's really wonderful having others' push business on you."

"Yeah," Barney agreed as he slid off the stool; "and even when competition begins you still have a long running start on your competitors. Let me work with you on the transistor sets from now on!"



"All of a sudden, I lost interest!"

## Filing System for Parts

(Continued from page 52)

This system does more than locate tubes quickly. It also shows the owner the condition of his tube stock at a glance. When he sees an empty compartment, he simply consults the reverse side of the hinged index. Here location numbers are listed in sequence, with tube numbers opposite. If stack 3A-3 is empty, the reverse index would tell him, for example, that he doesn't have another 6DN7 on hand. The index numbers are typed on strips of adding-machine paper, about 6 inches long each. They are slipped, top and bottom, through slots cut into the plywood panels of the index. These slots are 8 inches apart. Once every six months, strips are taken down, where necessary, and re-typed to include listings for new tube types. In the intervals, entries for new types are penciled in, like several shown in Fig. B.

On the opposite wall of the shop, DeLaughter has built a similar filing system for small parts—resistors, capacitors, and hardware. Instead of using partitioned shelves, he keeps parts in the widely available, plastic-drawer cabinets (Fig. D) made for that purpose, and stacks them side-by-side. However, the point here is not the container, but the indexing.

Every horizontal row of drawers is visualized as a section, and is identified by a letter accordingly. On the other hand, each vertical column of drawers is numbered. Thus any individual drawer can be identified by the letter-number combination that appears on its card. Separate sections within each drawer, set apart by the conventional metal dividers, are also numbered.

The parts index is similar to that used for tubes. Capacitors and resistors (Fig. E) are listed according to type, value, working voltage, and other pertinent characteristics. Suppose a technician needs a 100,000-ohm, 1/2-watt, carbon resistor. The "file" number listed on the index is "C4-4." The drawer is section (row) C, column 4. The resistor is in the fourth compartment (Fig. F) of that drawer.

The system has saved the five bench men at Ray & DeLaughter hours of valuable time that could not be gained in any other way.

**F**



## 535% IMPROVEMENT FOR YOUR RECEIVER!

C. J. O'Riordan, radio operator, Florida Highway Patrol, wrote us:

"... improved sensitivity and selectivity much more than that... tuning is now razor sharp... the combination is a listener's dream..."

QX-535: Superhet rcvr, 190-550 kc, new, guaranteed, ready to use. RF, conv., 2 stages 85 kc IF, det-BFO, AF, & xfmtr pwr supply. Use as low-freq. converter to your old communications rcvr's IF and couple that IF to ant. post of

QX-535: Adds double conversion for selectivity, and 3 extra ampl. stages for sensitivity. Your old rcvr will amaze you! 15 lbs fob Los Angeles. Collect only... \$37.50 by Rail. Ex. collect only... \$37.50

## NAVY VERSION OF GENERAL RADIO #605-B

LP Microvoltage-Signal Generator has calibrated output 1.2 microvolt to 1 volt, at frequencies (continuous in 7 bands) from 9500 cy to 30 mc, directly calibrated on dial with accuracy of 1%. An 8th band has 300 divisions, tuned by a vernier knob with 135 divisions, for super-accurate logging or for 30-50 mc using the graph furnished. Internal modulator 1000 cy, or ext. mod. jack. Mod. variable 0-50% and 0-10 read on meter. You set built-in VTVM to line on meter, which tells you that you have exactly 1 volt at the 1 V jack, and then accurately attenuate it with calibrated dial and multiplier to get the exact microvolts you want (to 100,000) at the other jack. STABILITY: Terrific! You can set to .005% accuracy with a freq. meter or xtl-controlled xmt, or zero-beat WWV, and come back next day to find drift only a low audio note. Approved by F.A.A. for aeronautical service. Ready to plug into 120 V 60 cy and use. Completely checked out and guaranteed OK. \$179.50



## SCHEMATICS/CONVERSIONS, SURPLUS GEAR

Ask us for your needs; send stamped addressed envelope. Add 25c for chart explaining AN Norrensen's. Examples of available literature: 20-page book on 1-177, with diagram of MX-949 U socket adapter. A tube data compiled to March 1957. \$5.00. RT-18 ARC-1 schem. & tune-up instr. \$2.00.



our own 120 v 60 cy power supply (shown alongside the receiver in the picture) which also furnishes DC to drive the automatic tuning motor in the receiver if you wish to use it. FOB Los Angeles... \$149.50 Time Pay Plan: \$14.95 down & 12 mo. payments of \$12.33.

Hallcrafters R-44 ARR-5 AM-FM receiver cost the Air Force \$900.00. Tunes 27.8 to 143 mc continuous in 3 bands, includes Police, Fire, Aircraft, low TV channels, Amateur 10 and 6 meter bands and the FM Broadcast Band 88-108 mc. In the BROAD switch position, is "hi-fi," with a cathode-follower output at the Video jack to feed your amplifier/speaker setup. It uses Armstrong FM discrimination, has a limiter stage, and the S-meter is also tuning indicator for FM. The oscillator is voltage regulated for stability. Was a 14-tube superhet with 956 reradiation suppressor and 956 RF, but we remove and bypass the first 956, change the circuit slightly, and substitute a 6AK5 for the RF stage. We ship to you aligned, modified, ready to use, with an extra pin jack brought out to the front panel from the last 5.25 mc AM I.F. stage so you can, if you wish, double-superheterodyne into any receiver which tunes to 5.25 mc. We start with BRAND NEW receivers! Includes tuning indicator in the picture) which also furnishes DC to drive the automatic tuning motor in the receiver if you wish to use it. FOB Los Angeles... \$149.50 Time Pay Plan: \$14.95 down & 12 mo. payments of \$12.33.

Free Catalog Now Ready. Send for it.

California Buyers Add 4% Sales Tax

**R. E. GOODHEART CO. P. O. BOX 1220-A BEVERLY HILLS, CALIFORNIA**

## SAY YOU SAW IT IN ELECTRONICS WORLD

### KEEP CANDEE HANDEE!

**FAMOUS Q 5'ER 111**  
This is the fabulous one! 190-550 kc. The receiver you've been looking for... \$9.95  
BC-454: 400 Mc. ... 7.95  
BC-455: 600 Mc. ... 7.95  
MD-7 MODULATOR: Special... 3.95

**A TRIO OF HEADSET BARGAINS!**  
HS-23: Hi Impedance. Leather covered headband. Brand new. Great buy. Only \$4.95  
HS-33: Low Impedance. Leather covered headband. Brand new. A. J. J. Candee Special. 5.95  
HI FI Headset: 15,000 cycles! Brand new with channels cushions. It's terrific! Only 8.95  
CD-307A Headset Extension Cord: Brand new. Approximately 5 ft. length. Only 49c

**APN-1 FM TRANSCIEVER**  
420-160 Mc. Comd. with tubes. Exp. Pa. \$2.95  
Approx. shp. wt. per unit 25 lbs. TWO for \$5.00

**YOU GOT IT! WE WANT IT! LET'S DEAL!**  
We're paying top \$\$\$ for GRC-9; PRC-6, -8, -9, -10; GN-58A; All electronic test equip.

**APX-6 TRANSPONDER**  
A handy warehouse of parts! Blenders, three Voodoo counters, I.P. strips, cavity over 30 tubes, etc. Includes 3E29 tube. Good cond. A SPECIAL AT ONLY \$2 for \$19.00! \$9.95

**R-4A ARR-2 RECEIVER**  
241-258 Mc. 14 tubes. UHF. Amateur receiver. See Aug '59 C.Q. Magazine for conversion. Excellent cond. TWO for \$5.00. Each... \$2.95

All items FOB Burbank, Calif., subject to prior sale. In Calif. add 4%. Min. order \$3.95.

**J. J. CANDEE CO.** Dept. R  
509 No. Victory Blvd., Burbank, Calif.  
Phone: Victoria 9-2411

## YOUR COPIES OF ELECTRONICS WORLD ARE VALUABLE!



Keep them neat... clean... ready for instant reference!

Now you can keep a year's copies of ELECTRONICS WORLD in a rich-looking leatherette file that makes it easy to locate any issue for ready reference. Specially designed for ELECTRONICS WORLD, this handy file—with its distinctive, washable Kivar cover and 16-carat gold leaf lettering—not only looks good but keeps every issue neat, clean and orderly. So don't risk tearing and soiling your copies of ELECTRONICS WORLD—always a ready source of valuable information. Order several of these ELECTRONICS WORLD volume files today. They are \$2.50 each, postpaid—3 for \$7.00, or 6 for \$13.00. Satisfaction guaranteed, or your money back. (Be sure to specify whether you want lettering to be Electronics World or its former title, Radio & TV News.) Order direct from:

**JESSE JONES BOX CORP.**  
Dept. EW  
(Established 1843)  
Box 5120, Philadelphia 41, Pa.

STATEMENT REQUIRED BY THE ACT OF AUGUST 24, 1912, AS AMENDED BY THE ACTS OF MARCH 3, 1933, JULY 2, 1946 AND JUNE 11, 1960 (7-1 STAT. 208.) SHOWING THE OWNERSHIP, MANAGEMENT, AND CIRCULATION OF ELECTRONIC'S WORLD published Monthly at Chicago, Illinois for October 1, 1960.

1. The names and addresses of the publisher, managing editor, and business managers are: Publisher, Ziff-Davis Publishing Company, 434 So. Wabash Ave., Chi. 1, Ill.; Editor, William Stocklin, 1 Park Ave., New York 16, N.Y.; Business manager, Matthew T. Birmingham, Jr., 1 Park Ave., New York 16, N.Y.

2. The owner is: Ziff-Davis Publishing Company, 434 So. Wabash Ave., Chi. 1, Ill.; Estate of William B. Ziff, 1 Park Ave., New York 16, N.Y.; A. M. Ziff, 1 Park Ave., New York 16, N.Y.

3. The known bondholders, mortgagees, and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages, or other securities are: None.

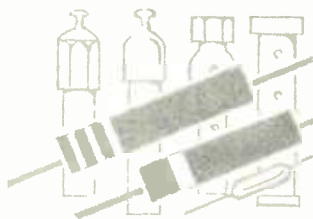
4. Paragraphs 2 and 3 include, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting; also the statements in the two paragraphs show the affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner.

5. The average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the 12 months preceding the date shown above was: 248,280.

MATTHEW T. BIRMINGHAM, JR., business manager, Sworn to and subscribed before me this 6th day of October, 1960.

(SEAL) WILLIAM PROEHMER, Notary Public, (My commission expires March 30, 1962)

## What's



## New in Radio

### THERMO WIRE STRIPPER

*Ungar Electric Tools*, 4101 Redwood Ave., Los Angeles 66, Calif. has announced what it terms a revolutionary



thermo wire stripper. The new tool strips wire insulation while soldering without changing tools. It consists of a clip that slips on the barrel of existing *Ungar* soldering tips or heating units, severs all rubber and plastic insulation from 8- to 24-gauge wire, and will not cut, nick, or score the strands.

The complete stripping cycle takes less than five seconds and requires no additional equipment. For more information, write direct to the manufacturer.

### COMPONENT SUBSTITUTOR

*Mercury Electronics Corp.*, 77 Searing Ave., Mineola, N. Y. has introduced its Model 500 component substitutor which is said to do the work of three or four ordinary substitution devices.



The new instrument provides 44 different substitution values. Operating capabilities include: 20 values of resistance from 33 ohms to 10 megohms; 10 values of capacitance from .0001  $\mu$ f. to .5  $\mu$ f.; 10 values of electrolytics from 4  $\mu$ f. to 330  $\mu$ f.; power rectifiers up to 55 ma.; crystal diodes; power resistance continuously variable up to 5000 ohms; and bias voltages (either polarity) continuously variable up to 15 volts.

### TUBE LISTS FOR CADDIES

*General Electric Co.*'s Receiving Tube Department, Owensboro, Ky. has introduced inventory lists of tubes for stocking service cases available through *G-E* tube distributors. Individual lists cover recommended inventories for three cases. These are ETR-1478 which holds

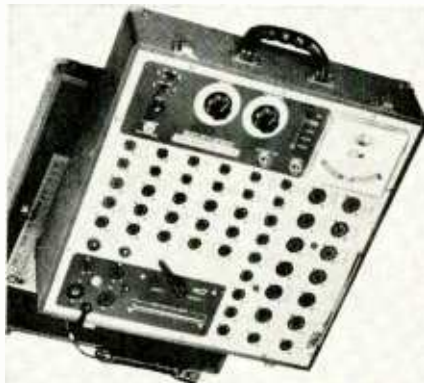
162 tubes; the ETR-1477 which holds 228 tubes; and the ETR-2071 which carries 365 tubes.

In offering the lists with the caddies, the company hopes to help "add to the serviceman's experience in using his service case...and time...most effectively."

### B&K TUBE TESTER

*B&K Manufacturing Co.*, 1801 W. Belle Plaine, Chicago 13, Ill. has announced the availability of its new Model 685 professional-type dynamic mutual-conductance tube tester.

An automatic "Dyna-Quik" type, the Model 685 features the speed of multiple socket testing for existing tube



types plus the flexibility of punch-card testing for new tube types.

Said to be obsolescence proof, the new instrument incorporates many advanced features. Bulletin No. AP16, available from the manufacturer, contains further information on this equipment.

### PACKAGED CIRCUITS

*Centralab*, division of *Globe-Union, Inc.*, 900 E. Keefe Ave., Milwaukee 1, Wis. has announced that a group of 31 new packaged electronic circuits is now available to the replacement market.

Among the new PEC's are three vertical integrators, two tone controls, one video and three audio coupling networks as well as a phase comparator network, a flip-flop network, two yoke balancing networks, and other specialized circuits. The new units have been given part numbers from PC-371 through PC-404.

### TRANSISTORIZED DEPTH FINDER

*Paco Electronics Co., Inc.*, division of *Precision Apparatus Co., Inc.*, 70-31 84th St., Glendale 27, Long Island, N. Y. has introduced a completely transistorized marine depth finder in kit or



## YOU'LL BE AMAZED...

at our low, low hi-fi prices. Write for FREE discount catalog A-12, or send for our special quotations on your component needs.

**KEY ELECTRONICS COMPANY**  
120 LIBERTY ST., NEW YORK 6, N.Y.

**BARGAIN HUNTING?** **TV SERVICEMEN!**  
Write for SENSATIONAL CATALOG  
**HENSHAW RADIO SUPPLY**  
3619 TROOST KANSAS CITY, MO.



## -- then you need us!

GET STARTED RIGHT by writing for FREE 8 page catalog illustrating over 30 business forms and systems designed specifically for TV-Radio Service.

ON SALE AT YOUR PARTS JOBBER

Delrich Publications • 4308 N. Milwaukee • Chicago 41, Ill.

## LEARN THE SHORT-CUTS

# Professional TELEVISION All-Practice TRAINING

Jump your earnings fixing black-and-white and color sets. Get into the top-pay bracket. NRI's concentrated spare time, low-cost training can do it for you. You'll fix sets faster, easier. Special course for Radio and TV servicemen - not for beginners. Full information free. Mail coupon now: **NATIONAL RADIO INSTITUTE, Dept. 1AET, Wash. 16, D.C.**

**NATIONAL RADIO INSTITUTE**  
Dept. 1AET, Washington 16, D. C.

Without cost or obligation send me facts about your Professional All-Practice TV Course.

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

Address.....

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

ACCREDITED MEMBER NATIONAL HOME STUDY COUNCIL



wired form. Designated as Model DF-90, the new device may be operated from a boat's own power source or from low-cost batteries.

It features an oversize reading scale, calibrated in one-foot intervals, and has a range up 120 feet. The circuit uses five transistors and a barium-titanate transducer. Made of aluminum, the DF-90 weighs nine pounds.

#### HICKOK METER

*Hickok Electrical Instrument Co.*, 10514 Dupont Ave., Cleveland 8, Ohio has introduced a new meter featuring an acrylic plastic front. Designated as Model 86H, the new instrument is said to provide clear reading as well as a distinctive modern appearance. The acrylic plastic is also claimed to be rugged and non-fading, allowing maximum light.

The meter, available in all common milliammeter, ammeter, and voltmeter ranges with an accuracy of 1 per-cent full-scale, also features the company's "taut band suspension," said to eliminate friction in the meter movement.

#### SSB RECEIVER

*Hullcrafters Co.*, 4401 W. 5th Ave., Chicago 24, Ill. has announced its model SX-116 receiver, a crystal-controlled, single-sideband communications set for the high-frequency spectrum. According to the manufacturer, the new equip-



ment makes available for the first time the full advantage of SSB operation for commercial and military applications in stationary, vehicular, airborne, or ship-board systems.

For full details, write to the manufacturer.

#### TELEPHONE AMPLIFIER

*Radio Merchandise Sales, Inc.*, 2016 Bronxdale Ave., Bronx 62, N. Y. has announced its new "Ampli-Phone," a device that enables telephone users to talk into, and hear from, a telephone without holding it in the hand.

"Ampli-Phone" consists of an amplifier and a separate 4-inch loudspeaker, both housed in high-impact styrene cab-

inets. It includes a volume control and indicator lights. A parabolic front picks up all voices within a room and directs them into the telephone receiver mouthpiece, making it possible to speak at a distance from the phone. The speaker enables several persons to hear at once from the same telephone.

#### MOBILE RADIO SET

*Aeronautical Electronics, Inc.*, P.O. Box 6527, Raleigh, North Carolina has introduced a 15-watt u.h.f. FM mobile radio set. Called the "Slimline," the new set is less than five inches high and will fit under the dash in any car or truck, including the new domestic compacts or foreign types.

All operating controls are located on the front panel. The sets have provision for a maximum of three transmit and receive channels, and have built-in provision for plug-in installation of "Uni-call," a selective call system which permits sharing of crowded frequencies without interference.

The "Slimline" package includes the radio set, mounting hardware, con-



trolled reluctance microphone, roof-top antenna, 12 feet of coaxial cable with fitting attached, and power cable.

#### SNAP GROMMETS

*G. G. Budwig*, 3400 Bayside Walk, San Diego 8, California has developed a new type of grommet which is suitable for a variety of electronic applications.

The new units are two-piece, snap-together plastic items which the company claims are easier to install and stay in place better than conventional grommets. In addition, the company states that the plastic grommets have excellent dielectric characteristics and are impervious to oils and most chemicals. They are fabricated of polyethylene.

#### MARINE RADIOTELEPHONE

*Pearce-Simpson, Inc.*, 2295 N. W. 14 St., Miami 35, Fla. has introduced its "Imperial 150B Radiotelephone," claimed to provide top performance in compact size. Included is a 150-watt transmitter with local or remote control of 16 pre-tuned channels plus broadcast. Frequency range is 2 to 22 kc., permitting operation on Great Lakes or high seas frequency as well as on normal marine channels. The receiver features an audio squelch and noise limiter.

## R W BARGAINS!

**SCR-528**—20-27.9 MC, FM. BC-603 Receiver, BC-604 Transmitter, 12 or 24 volt Dynamotors, FT-237 Mount, & spare parts. New. . . . . \$43.75

**BC-603** Receiver. New. . . . . \$19.95

**BC-604** Transmitter. New. . . . . \$ 6.95

**BC-923A**—27-38.9 MC NFM Receiver has 16 tubes. Double conversion superhet 4 manually tuned preset channels switch selected. 100KC xtal calibrator. Ready to go on CD & 10 meters—just add power. Easily converted to 50MC. Requires 275vDC @ 150MA and 12 or 24 volts for filaments. New. . . . . \$34.95

**VHF CONVERTERS 38-1000 MC.**  
IF output 30 MC. Each unit has an accurately calibrated vernier tuning dial continuously covering its range. Each converter requires 280vDC and 6.3vAC.  
**TN-1**—38-95 MC. Used, good. . . \$ 9.95  
**TN-2**—80-300 MC. Used, good. . . \$10.95  
**TN-3**—300-1000 MC. Used, good. . . \$11.95

**COMMAND EQUIPMENT**  
**R-23 / ARC-5 (BC-453)** Receiver, 190-550KC, "The Q-5er." Used, good. . . . . \$11.95  
**T-19/ARC-5 (BC-696)** transmitter, 3-4 MC (80 meters). Used, good. . . \$ 6.95  
Write for complete list of Command Equip. & Accessories.

**RCA TV RF Sweep Oscillator WR 94A**  
Channels 1-13, Switched. Used. \$29.95

Send Money Order or Check with order.

Write for Bargain Flyer

## R W ELECTRONICS

2430 S. MICHIGAN AVE., DEPT. N  
Phone: CAIumet 5-1281 Chicago 16, Ill.

SAY YOU  SAW IT IN  
**ELECTRONICS WORLD**



**MAIL COUPON TODAY!**

Find out how you can get this book *free!*

the V.T.V.M. by Rhys Samuel published at \$2.50—contains a wealth of information on how the V.T.V.M. works . . . how to use it. Send for particulars on how to get this valuable book.

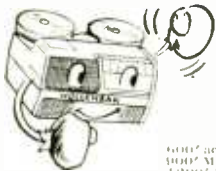
Mail to Dept. EW-1,  
General Techniques, Inc.  
Manufacturers of Quality Electronic Kits  
1270 Broadway, New York City 1, N. Y.

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_

**\* RECORDING TAPE**



\*oxide guaranteed not to pull off or squeak—or money back. Compare ours with other "Bargain" tape. You'll find it's more than just "price" when you deal with us. We are original pioneers in the tape recorder business, and our reputation means everything to us.

- 600' acetate (plastic), 1/2" .75
- 900' MYLAR (polyester), 1/2" .95
- 1200' MYLAR, 1/2 mil, 5" reel 1.28
- 1200' Acetate (plastic), 7" 1.29
- 1200' MYLAR, 1/2 mil (strong) 1.95
- 1800' acetate (plastic), 7" 1.79
- 1800' MYLAR 1 mil thick, 7" 2.69
- 2400' MYLAR, uncoiled, 7" 2.69
- 2400' MYLAR, tensitized, 7" 3.49

Plus Postage  
SEND FOR FREE CATALOG

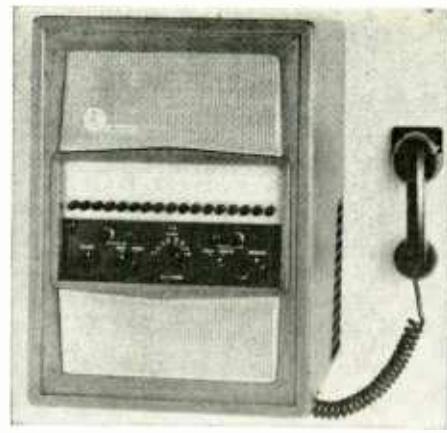
**NORELCO SPEAKERS**

Famous 9777—successor to 9710M, twin-cone 8" speaker, original (list 39.95, usual NET 23.97, NOW, while they last) 1/2 off net... **11.98 plus postage**, (discontinued model). Frequency 10-20,000 c/y. Other S.I.S.S.A. 700M speaker reductions on a first come, first served basis.



SEND FOR SPEAKER SPECIFICATION SHEET.

COMMISSIONED ELECTRONICS CO.  
1776 Columbia Road  
Washington, D. C.

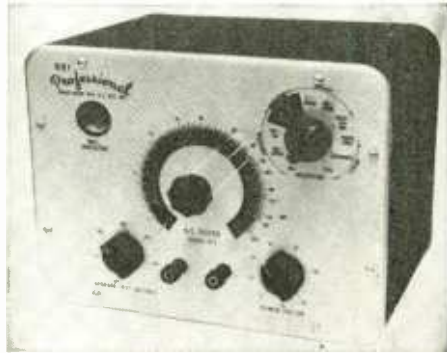


The Imperial 150B comes as a single unit for 12- and 32-volt systems, or with an auxiliary converter for 110-volt a.c. operation.

**NRI TESTER**

National Radio Institute, 3939 Wisconsin Ave., Washington 16 D. C. has announced availability of its professional Model 311 resistor-capacitor tester. This instrument uses a lab-type bridge circuit for measurement of resistance, capacity, leakage, power factor, opens and shorts.

The Model 311 is available in kit or



wired form. For further information, write to the organization, requesting circular SD151.

**REFERENCE BATTERY**

Mallory Battery Co., division of P. R. Mallory & Co., Inc., Indianapolis 6, Ind. has introduced a voltage reference mercury battery.

Said to be the first commercially available low-impedance multi-voltage



reference source, the new device may be used for instrument calibration; for speed, temperature, and voltage measurements; thermistor bridges; bias circuits; pH testing; and supplying stable d.c. output for measuring, telemetering, and control systems.

The battery provides eight outputs

from 0 to 10.80 volts in 1.35-volt increments. Accuracy is listed as  $\pm 1/2$  percent of stated open-circuit voltage.

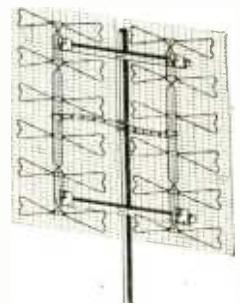
**NEW WESTON INSTRUMENTS**

Weston Instruments Div., Daystrom, Inc., 614 Frelinghuysen Ave., Newark 12, N. J. has announced a new low-cost a.c. panel meter. Designated as Model 1724, the meter employs a moving-iron-vane mechanism and is available as voltmeter, ammeter, and milliammeter. Full-scale value accuracy is stated as  $\pm 2$  per cent.

The manufacturer also has announced improved new models in its 301 panel instrument series, featuring a larger useful dial area, improved readability, and modernized glare-free cases. The 301 line is available in d.c., r.f., and a.c. rectifier types, as well as moving-iron a.c. types.

**U.H.F. ANTENNAS**

JFD Electronics Corp., 6101 Sixteenth Ave., Brooklyn 4, N.Y. announces that it is now in production on three u.h.f. antennas designed especially for translator areas with reception problems.



The new series features a specially designed cardioid dipole for improved broad-band response on channels 70 to 83. The three new models are: TR604, a 4-bay for primary u.h.f. translator locations; TR606, 6-bay for near-fringe areas; and TR612, 12-bay for fringe and far-fringe sites.

Each model includes rigid, heavy-gauge, galvanized, welded-wire rod construction; oversized precision-formed cardioid dipole made of corrosion-proof solid aluminum rod; full-wave horizontal and vertical spacing of bays for higher stacking gain; and solid bus bar multi-stage phasing transformers which maintain constant 300-ohm impedance over u.h.f. translator spectrum.

A bulletin is available on request to the manufacturer.

-30-

Answer to Puzzle Appearing on Page 121

E	R	G	A	C	O	R	N	L	A	G		
I	E	R	F	L	A	R	E	A	G	E		
A	V	I	A	T	O	R	U	P	P	E		
			D	I	S	C	E	T	A	S		
S	I	D	E	K	E	R	C	E	L	L		
T	R	I	E	S	K	N	D	T	I	E		
A	M	P	P	R	E	E	N	A	N	A		
G	A	P	E	A	S			N	E	D		
E	S	C	H	A	R			I	T	S		
			L	I	K	E		G	A	T	E	
P	H	A	S	E		O	R	I	E	N	T	S
R	A	M		R	A	D	A	R		N	O	W
I	M	P		S	T	E	M	S		A	W	L

**MAKE MONEY IN SPARE TIME** Learn at Home to Fix **ELECTRIC APPLIANCES**

Tester Furnished—No Extra Charge. Fix toasters, irons, fans, other electric appliances for friends and neighbors. Make money in spare time or build your own full time business. SAVE cash by repairing your own appliances. Enjoy the security of a skill to fall back on during slack periods, seasonal layoffs, when you retire. NRI will train you at home.

**MAIL COUPON NOW. Sample Lesson and Catalog FREE.** National Radio Institute, Dept. EAT, Wash. 16, D. C. Please send me Electrical Appliance sample lesson and catalog FREE (No Salesman Will Call).

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

**MAIL ORDER HI-FI**  
You can now purchase all your Hi-Fi from one reliable source and be assured of perfect delivery. Carston makes delivery from NY stock on most Hi-Fi. Recorders and Tape within 24 hours. SEND US A LIST OF YOUR HI-FI REQUIREMENTS FOR OUR WHOLESALE QUOTATION and our FREE wholesale catalogue.  
**CARSTON STUDIOS**  
125-TD East 88 St. New York 28, N.Y.

**TAPE RECORDERS**  
**HI-FI COMPONENTS SLEEP LEARN KITS**  
MERITAPE UNUSUAL VALUES  
Low cost, high quality recording tape, in boxes or cans. FREE 1961 Catalog  
DRESSNER, 69-02 RA, 174 St., Flushing 65, N.Y.



**JANUARY 8-12**

Symposium on Thermoelectric Energy Conversion. Sponsored by Joint Technical Society Department of Defense including AIEE, IRE, American Rocket Society, American Nuclear Society, etc. Statler-Hilton Hotel, Dallas, Texas. Dr. G. K. Teal, Texas Instruments Inc., Dallas, Tex. is representing IRE on the committee.

**JANUARY 9-11**

Seventh National Symposium on Reliability and Quality Control. Sponsored by IRE, AIEE, ASQC, and EIA. Bellevue-Stratford Hotel, Philadelphia. Further details and program information from the IRE at 1 East 79th St., New York 21.

**JANUARY 17-19**

Winter Instrument-Automation Conference and Exhibit. Sponsored by Instrument Society of America. Sheraton-Jefferson Hotel and Kiel Auditorium, St. Louis, Mo. Details available from Wm. H. Kushnick, executive director ISA, 313 Sixth Ave., Pittsburgh 22, Pa.

**FEBRUARY 1-3**

1961 Winter Convention on Military Electronics. Sponsored by IRE. Biltmore Hotel, Los Angeles, Calif. Exhibits and technical sessions. Details from Arthur N. Curtiss, IRE Business Office, 1435 S. La Cienega Blvd., Los Angeles 35, California.

**FEBRUARY 1-4**

Second Annual Convention. Sponsored by the Electronic Representatives Association (ERA). Ambassador Hotel, Los Angeles, California. Business sessions and social program. Complete entertainment program for ladies. Contact ERA headquarters, 600 S. Michigan Ave., Chicago 5, Illinois for program details.

**FEBRUARY 10-14**

Washington High Fidelity Music Show. To be produced independently by Music Productions, Inc., the organization of M. Robert Rogers and Margot Phillips. Shoreham Hotel, Washington, D. C. Producers will forward details on reserving space.

**PHOTO CREDITS**

Page	Credit
Cover, 30	Bob Loeb
76, 102	Allied Radio Corp.
84	Motorola Inc.
89	Audio Engineering Society
103	Service Instruments Corp.
104	PACO
105	World Radio Labs
110	General Electric Co.

**INVITATION TO AUTHORS**

Just as a reminder, the Editors of ELECTRONICS WORLD are always interested in obtaining outstanding manuscripts, for publication in this magazine, covering the fields of audio and high-fidelity and radio-TV-industrial servicing. Articles in manuscript form may be submitted for immediate decision or projected articles can be outlined in a letter in which case the writer will be advised promptly as to the suitability of the topic. We can also use short "filler" items outlining worthwhile shortcuts that have made your servicing chores easier. This magazine pays for articles on acceptance. Send all manuscripts or your letters of suggestion to the Editor, ELECTRONICS WORLD, One Park Avenue, New York City 16, New York.



**"MORE EFFICIENT CLEANING IS POSSIBLE!"**



**INJECTORALL  
COMPANY**  
Brooklyn 14,  
New York

... thru the use of  
**INJECTORALL TUNER CLEANER**

**CLEANING** ... our formulation gets contacts sparkling clean. **LUBRICATION** ... our spray leaves a lubricant as a protective coating. **NEEDLE APPLICATOR** ... the 6 inch Injectorall Needle is made of stainless steel, with a special fitting to prevent the needle from blowing out of the can.

Non-toxic, non-inflammable.  
6 oz. spray can with needle ... \$1.95 net.

**Full Color Giant Fold-Out  
Charts Still Available!**

Here's a complete series of colorful, authoritative fold-out wall-charts (originally appearing in the pages of ELECTRONICS WORLD)—yours for only 15¢ each. All in full-color—each suitable for framing.

- Hi-Fi Crossover Network Design Charts:** Tells how to build speaker nets for any crossover frequency. Complete coil-winding data, capacitor values given.
- Color Codes Chart:** Gives you coding for capacitors, resistors, transformers, resistance control tapers—all in easy-to-use form.
- Bass-Reflex Design Charts:** Complete data on building own bass-reflex enclosures for any speaker, including ducted-port enclosures.
- Radio Amateur Great Circle Chart:** For Hams and short-wave listeners—gives complete listing and map of amateur prefixes by calls and countries.

ALSO AVAILABLE:

Reprint of:

- "Build a Citizens Band Transceiver"**—complete details on building an 11-meter transceiver for Citizens Band service.

**IMPORTANT: ORDER BY NUMBER! OUR SUPPLY OF ALL GATEFOLDS AND REPRINTS IS LIMITED. OFFERED ONLY ON A FIRST COME, FIRST SERVED BASIS.**

Send 15¢ per selection to

**ELECTRONICS WORLD, Dept. N 161**  
Box 378, Church Street Station  
New York 8, New York

**TS-100AP 'SCOPE**  
(WORTH \$750) OUR LOW PRICE **\$29.50**

Can be used with linear sweep or general purpose test scope. Cables included. Also used with circular sweep or precision range calibrator. Self-contained in metal case 8" x 12" x 4 1/2" deep. For 110 V 50 to 1200 cycles AC. Excited used, like new, with all tubes including crystals and C.R. Tube. **BRAND NEW \$59.50**

**FAMOUS BC-645 TRANSCEIVER**  
15 Tubes 435 to 500 MC

Can be modified for 2-way communication, voice or code, on ham band 420-450 mc. citizens radio 480-470 mc. fixed and mobile 430-400 mc. television experimental 470-500 mc. 15 tubes (tubes alone worth more than sale price); 4-7F7, 4-7HT, 2-7G5, 2-6X4, 2-05D and 1WE-316A. Now covers 400 to 490 mc. Brand new BC-645 with tubes, less power supply in factory carton. Shipping weight 25 lbs. **SPECIAL! \$19.50**

PE-101C Dynamotor, 12/24V input..... \$7.95  
UHF Antenna Assembly..... 2.45  
Complete Set of 10 Plugs..... 5.00  
Control Box..... 2.25

**SPECIAL "PACKAGE" OFFER:**  
BC-645 Transceiver, Dynamotor and all accessories above. COMPLETE, BRAND NEW, **\$29.50**  
While Stocks Last.....

**LORAN R-65/APN-9 RECEIVER & INDICATOR**

Used in ships and aircraft. Determines position by radio signals from known transmitters. Accurate to within 1% of distance. Complete with tubes and crystal. **Value \$1200.00. Our Price \$79.50**

Used less tubes, crystal and vibrator. **BRAND NEW \$29.50**  
C.R. tube.....  
12 Volt Inverter Power Supply for above. **BRAND NEW \$32.50**  
28V Inverter Power Supply, exc. cond. **\$49.50**  
Shock Mount for above..... **\$2.95**  
Circuit diagram and connecting plugs available.  
We carry a complete line of spare parts for above.

**LORAN APN-4 FINE QUALITY NAVIGATIONAL EQUIPMENT**

Determine exact geographic position of your boat or plane. Indicator and receiver complete with all tubes and crystal.

**INDICATOR ID-68/APN-4, and RECEIVER R-98/APN-4, complete with tubes, exc. used \$49.50**  
Receiver-indicator as above, **BRAND NEW \$88.50**

12V Inverter Power Supply, **BRAND NEW \$32.50**  
28V Inverter Power Supply, exc. cond. **\$49.50**  
Shock Mount for above..... **\$2.95**  
We carry a complete line of spare parts for above.

**ARC-5/R28 RECEIVER**  
2-meter Superhet. 100 to 150 Mc in 4 crystal channels. Complete with 10 tubes, **BRAND NEW \$24.45**  
110V AC Power Sup. Kit for above **\$9.75**

**ARC-5/T-23 TRANSMITTER**  
100-150 Mc Includes 2-832A, 2-1825 Tubes. **BRAND NEW \$21.50**

**SPECIAL** limited quantity ARC-5/T23 transmitters. **OFFER!** Excellent Used, less tubes..... **\$5.95**

MD-7 MODULATOR for T-23, complete with 4 tubes, LIKE NEW..... **\$9.95**

**ARC-5 MARINE RECEIVER-TRANSMITTER**

Navy Type Comm. Receiver 1.5 to 3 Mc **BRAND NEW with 8 tubes..... \$16.95**

Navy Type Comm. Transmitter 2.1-3 Mc **BRAND NEW with 4 tubes and 1A3 MODULATOR for above, new with tubes \$12.45**

**SCR-274 COMMAND EQUIPMENT ALL COMPLETE WITH TUBES**

Type	Description	Used	Like New
BC-453	Receiver 190-550 KC.	\$12.95	\$14.95
BC-454	Receiver 3-6 Mc.	10.45	12.45
BC-455	Receiver 8-9 Mc.	11.50	13.95

110 Volt AC Power Supply Kit, for all 274-N and ARC-5 Receivers. Complete with metal case, instructions, etc. **\$11.50**  
Factory wired, tested, ready to operate.....

**SPLINED TUNING KNOB** for 274-N and ARC-5 RECEIVERS. Fits BC-453, BC-454 and others. Only **49c**

BC-457 TRANSMITTER—4-5.3 Mc. complete with all tubes and crystal. **BRAND NEW \$8.95**

BC-458 TRANSMITTER—5.3 to 7 Mc. Complete with all tubes and crystal. **\$9.75**

BRAND NEW BC-459 TRANSMITTER—7.9-11 Mc. complete with all tubes and crystal. **\$13.95**

T19 TRANSMITTER 14-mc complete with all tubes and crystal. Exc. used..... **\$9.95**

BC 696 TRANSMITTER 3- mc complete with all tubes and crystal. Exc. used..... **\$9.95**

BC-456 Modulator **USED \$3.45 NEW \$5.95**

**ALL ACCESSORIES AVAILABLE FOR COMMAND EQUIPMENT.**

**WILLARD 6-VOLT MIDGET STORAGE BATTERY**

3 Amp. Hour, **BRAND NEW** 3 3/4" x 1 1/2" x 1 1/2" Uses Standard Electrolyte **Only \$2.95**

**2 VOLT BATTERY "PACKAGE"**

1-2V. 20 Amp. Hr. Willard Storage Battery, Model #20-2, 3" x 4" x 2 1/2" high..... **\$2.79**

1-2V. 7 prong Synchronous Plug-in Vibrator..... **1.49**

1-Quart Bottle Electrolyte (for 2 cells)..... **1.45**

**ALL BRAND NEW! Combination Price \$5.45**

**ARC-3 RECEIVER!**  
Complete with All Tubes Exc. Used..... **\$16.95**

Like NEW..... \$21.50  
Used..... \$14.95

Crystal-controlled 17-tube superhet. tunes from 100 to 150 MC. AM., on any 8 pre-selected channels. 28-volt DC power input. Tubes: 1-9002, 6-6A5, 1-125M7, 3-125G7, 1-9001, 1-12M6, 2-125M7, 1-125L7, 1-12A6.

**ARC-3 TRANSMITTER**  
Companion unit for above, tunes 100 to 150 MC on any 8 pre-selected channels. 0 tubes, crystal controlled. provides tone voice modulation. 28V DC Power input. Complete with all tubes: 3-6V6, 2-832A, 1-125H7, 1-6J5. **\$16.95**

2-816, Exc. Used..... Only \$22.50  
Like new condition.....

**AN/ART-13 100-WATT XMTR**  
11 CHANNELS  
200-1500 Kc  
2 to 18.1 Mc

**\$48.50**

Complete with Tubes  
Famous Collins Autotune Aircraft Transmitter, AM, CW, MCW. Quick change to any of ten preset channels or manual tuning. Speech amplifier/clipper uses carbon or magnetic mike. Highly stable, highly accurate VFO. Built in Xial controlled calibrator. PPM's modulate 813 in final up to 90%, class "B". A real "HOT" Ham buy at our low price! **\$48.50**

Orig. cost \$1800. Exc. Used..... 7.95  
0-16 Low Freq. Osc. Coil for ART-13..... 7.95  
24V Dynamotor for ART-13..... 11.95  
Same as above less meter..... 39.50  
We carry a complete line of spare parts for above.

**POWER SUPPLY for BC-620, 659, available for 6, 12 or 24 Volts DC. Specify..... \$8.95**

**BC-659 TRANSMITTER & RECEIVER**  
27 to 38.0 Mc. P.M. Two preselected channels crystal controlled, 5 watts. Complete with speaker, **\$10.95**

tubes. Used.....  
Less tubes, used..... **\$5.95**

**NAVY AIRCRAFT RADIO RECEIVER**

ARB/CNV 46151-190 to 9050 Kc in 4 bands. 6 Tube Superhet communications receiver, with local and remote tuning, band change, S-Wave and broad tuning. AVC, CW. Illuminated dial. Complete with tubes and dynamotor. **BRAND NEW \$34.50**  
Like New..... **\$26.50**  
Power Supply 110 V. AC. Wired **\$8.50**

**BC-906 FREQ. METER—SPECIAL**  
Cavity type. 145 to 235 Mc. **BRAND NEW, complete with antenna. Manual included. OUR LOW PRICE \$10.88**

**SCR-625 MINE DETECTOR**  
Complete portable outfit in original packing, with all accessories. **Brand New \$27.50**

**DYNAMOTOR ASSEMBLY**

Very fine unit, made by Collins Radio. Consists of TWO Dynamotors mounted on filter base.

Dynamotor #1 OUTPUT  
12VDC @ 3.8A 220VDC @ 100 MA.

Dynamotor #2 OUTPUT  
12VDC @ 9.9A 400VDC @ 180 MA.

**BRAND NEW, in original packing, \$7.95**  
shipp. wt. 29 lbs.  
**OUR LOW PRICE.....**

**MOBILE-MARINE DYNAMOTOR**

Model DM35  
Input 12V DC. Output: 625 V DC @ 225 MA. for press-to-talk intermittent operation. Sngl. wt. 14 lbs.

**OUR LOW PRICE, BRAND NEW \$8.95**

**OTHER DYNAMOTOR VALUES: Excellent BRAND**

Type	Input	Output	Used	BRAND NEW
DM-25	12V 2.2A	250V .050A		\$4.50
DA-1A	28V 1.6A	230V .100A		3.25
DM-28	28V	224V .07A	2.75	4.75
DM-32A	28V 1.1A	250V .05A	2.45	4.45
DM-33A	28V 5A	575V .16A		
	28V 7A	540V .25A	1.95	3.75
DM-34D	12V 2A	220V .080A	4.15	5.50
DM-53A	28V 1.4A	220V .080A	3.75	5.45
DM-64A	12V 5.1A	275V .150A		7.95
PE-38	28V 20A	1000V .350A	8.95	14.95
PT-76	28V 1.25A	250V .050A	2.75	3.85

BD-77 DYNAMOTOR Input 14V @ 39A. Output 1000V @ 350A with starting solenoid, Filter Box and Mounting Base..... Like New \$14.95

**SCHEMATIC DIAGRAMS** For any equipment on this page, each..... **65c**

Please include 25% deposit with order—Balance C.O.D., or Remittance in Full. 50c Handling Charges on all orders under \$50.00. All shipments F.O.B. Our Warehouse, N.Y.C. All Merchandise subject to Prior Sale and Price Change.

**G & G RADIO SUPPLY CO.**  
Telephone: CO 7-4605  
51 Vesey St. 75-77 Leonard St.  
New York 7, N. Y. New York 13, N. Y.

**TS-16/APN TEST SET**  
For aligning and calibration of radio allimeters. May be used to check calibration of count or circuits and modulator sweep freq. and bandwidth of transmitter. Audio-oscillator range: 340 to 7250 cycles. 17/14 V. DC input. Complete with tubes connecting cables. Instruction summary. **BRAND NEW \$9.95**

**BC-603 FM RECEIVER**  
20 to 27.9 Mc. **\$14.95**

Excellent Used..... **\$18.95**  
**BRAND NEW.....**

10-channel, pushbutton or continuous tuning. Complete with speaker, squeeze, and ten tubes: 3-6AC7, 1-6A5, 2-128G7, 1-6H6, 1-6X4, 2-6SL7.

EXTRA SET OF 10 TUBES FOR ABOVE brand new in original boxes..... **\$3.95**

12 or 24V Dynamotor for Above.....  
Exc. Used \$4.25..... **Brand New \$5.50**

BC-604 TRANSMITTER—Companion unit for BC-603 Receiver above. With all tubes, **BRAND NEW \$6.95**  
We carry a complete line of spare parts for above.

**SPECIAL! BC-603 FM RCVR CONVERTED FOR ANY FREQUENCY FROM 30 TO 50 MEGACYCLES!**

**BRAND NEW!** Checked out, perfect working condition, ready for operation. Specify Frequency desired (between 30-50 Mc) when ordering. **\$27.50**

**AC POWER SUPPLY FOR BC603, 683**  
Interchangeable, replaces dynamotor. Has On-Off Switch. NO REWIND. CHANGE SPEEDS. Provides 230 VDC @ 80 MA. 24VAC @ 2 Amps..... **\$9.25**

Complete 240-page Technical Manual for BC-603, 604..... **\$3.15**

**AN APR-4 RECEIVER only. 38 to 4000 Mc in 5 tuning unit ranges. High precision laboratory instrument used to monitor or indicate frequency of any signals within its range. Includes wide and narrow band IF strip selected from panel. Outputs provided for attachments to pulse analyzer, panadapter, etc. Input 115 V 60 cy. LIKE NEW..... \$69.50**

Tuning Units: TN16, TN17, TN18..... each \$39.50  
TN19..... each \$89.50

**RECEIVER SPECIALS!**

BC-312 MOBILE RECEIVER 0 Bands, 1500 Kc to 18 Mc. With Tubes and 14V Dynamotor. **\$59.50**

Exc. Used.....  
BC-342 RECEIVER 1.5 to 18 Mc. AC only. Exc. Used..... **\$69.50**

BC-348 SUPERHET Receiver 200 to 500 Kc and 1.5 to 1800 Mc. Voice, tone, CW. Self-contained dynamotor for 24 VDC. Like New..... **\$69.50**

**BC1206-C BEACON RECEIVER**

195 to 420 Kc. made by Setchel - Carlson. Works on 24-28 volts DC. 135 Kc. IF. Complete with 5 tubes. Size 4" x 4" x 6". Wt. 4 lbs. **BRAND NEW \$9.99**

Used less tubes..... \$5.95  
Complete with tubes..... \$29.95  
Used, less tubes..... 2.95

**SCR-522 2-METER RIG!**

Terrific buy! VLF Transmitter-receiver. 100-150 Mc. 4 channels. Xial-antenna modulated voice. They're going fast! Excellent condition.

SCR-522 Transmitter-Receiver, complete with all 18 tubes, top rack and metal case..... **\$29.50**

COMBINATION. Exc. Used.....

**MICROPHONES** Excellent BRAND

Model	Description	Used	BRAND NEW
T-1	Carbon Hand Mike	\$5.45	\$5.45
T-30	Carbon Throat Mike	3.34	5.74
T-45	Army and Navy Lip Mike		1.25
T-59	Handset		3.88
TS-11	Handset		3.95
TS-13	Handset		4.25
RS-38	Staple Type		4.75

**HEADPHONES** Excellent BRAND

Model	Description	Used	BRAND NEW
HS-23	High Impedance	\$2.19	\$4.49
HS-33	Low Impedance	2.69	4.59
HS-30	Low Imp. (featherwt.)		1.65
H-15	High Imp. (2 tone)		3.75

TELEPHONES—High and Low Impedance HEAD-SETS. **BRAND NEW, PER PAIR \$3.25**

CO-307A Cords with PL35 plug and JK26 Jack..... **.99**  
Earphone Adapters for.....

EE-8 ARMY FIELD PHONES. Excellent condition checked out, perfect working order, complete with all parts less battery. Each..... **\$12.85**

**TG-34A CODE KEYS**

Self-contained automatic unit, reproduces code practice signals recorded on paper tape. By use of built-in speaker, reproduces code-practice signals to one or more persons at speeds from 5 to 25 WPM. Checked out, exc. used..... **\$18.95**

Signal Reels of Tape, Each..... **\$1.85**

**BRAND NEW \$22.50**

**5-TUBE AMPLIFIER**

Made by Pioneer Instrument Co. Uses 2-6SN7 1-4X5, 2-6H10 tubes. **VERY SPECIAL \$2.49**

**STANDARD TUBES**

REMOVED FROM BRAND NEW GOV'T EQUIPMENT	REMOVED FROM BRAND NEW GOV'T EQUIPMENT	REMOVED FROM BRAND NEW GOV'T EQUIPMENT	REMOVED FROM BRAND NEW GOV'T EQUIPMENT
6AG5..... 35	125G7..... 75	807..... 95	6X4..... 6.95
12AT7..... 45	6M6..... 55	814..... 2.25	6X5..... 2.15
6AK5..... 40	6SL7..... 8	815..... 2.15	6C5..... 4.45
6AV6..... 38	12A6..... 25	6X4..... 2.25	6AL5..... 2.95
6AC7..... 55	SPECIAL PURP. 1625	6X4..... 2.25	6X4..... 2.25
6J5..... 32	2C39..... 3.50	6072..... 2.50	6V6..... 65
6V6..... 65	3E29..... 4.25	1P25A..... 7.95	

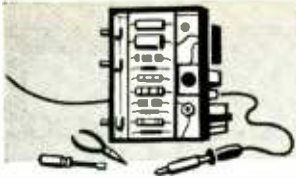
BC-605 INTERPHONE AMPLIFIER **BRAND NEW** Each \$4.95

**234-258 MC RECEIVER**  
AN/ARR-2

BRAND NEW 11-tube UHF Tunable Receiver with schematic. Only a few at this low price!  
Complete with tubes **\$8.88**

Send Name, Address on Post Card for FREE CATALOG of Wonderful Surplus Buys!





# ELECTRONICS MARKET PLACE

RATE: 60¢ per word. Minimum 10 words. March issue closes January 5th. Send order and remittance to: ELECTRONICS WORLD, One Park Ave., N. Y. C. 16, N. Y.

## RADIO ENGINEERING & INSTRUCTION

**ELECTRONICS!** Associate degree—29 months. Technicians, field engineers, specialists in communications, missiles, computers, radar, automation. Start September, February, Valparaiso Technical Institute, Dept. N, Valparaiso, Indiana.

**ENGINEERING Education for the Space Age.** Northrop Institute of Technology is a privately endowed, non-profit college of engineering offering Two-Year accredited technical institute curricula and complete Bachelor of Science degree programs. Students from 50 states, many foreign countries. Outstandingly successful graduates employed in aeronautics, electronics and space technology. Write today for catalog—no obligation. Northrop Institute of Technology, 1183 West Arbor Vitae Street, Ingleswood 1, California.

**USED Correspondence Courses and Books sold and rented.** Money back guarantee. Catalog free. (Courses Bought.) Lee Mountain, Pisgah, Alabama.

## FOR SALE

**BUY War Surplus Direct from the Government—Jeeps; Trucks; Tractors; Boats; Airplanes; Helicopters; Walkie-Talkies; Radar; Electronics; Misc.—Send for Brody's "U.S. Depot Directory & Procedures" \$1.00. Box 425-(RT), Nanuet, New York.**

**GOVERNMENT Surplus Receivers, Transmitters, Snooperscopes, Parabolic Reflectors, Picture Catalog 10¢. Meshna, Malden 48, Mass.**

**TUBES—TV and Radio tubes, Guaranteed—Save up to 80%—Write: Emkay Electronics, P.O. Box 142, Blythebourne Station, Brooklyn 19, N. Y.**

**TUBES—TV, Radio, Transmitting And Industrial Types At Sensibly Low Prices. New, Guaranteed, 1st Quality, Top Name Brands Only. Write For Free Catalog or Call WALKER 5-7000, Barry Electronics Corp., 512 Broadway, New York 12N, N. Y.**

**DIAGRAMS for repairing radios \$1.00. Television \$2.00. Give make, model. Diagram Service, Box 672-RN, Hartford 1, Conn.**

**RADIO and television tubes, brand new, 1st quality, original boxed name brands only. Discounts up to 66 2/3% off list. Positively no seconds. Send for free price schedule. Edison Tube Co., Menlo Park, N. J.**

**RADIO & TV Tubes at Manufacturer's prices! 100% Guaranteed! Brand New! No re-brands or pulls! United Radio, Box 1000-W, Newark, N. J.**

**AUTO Radio Distributor, Selling, Servicing. Becker Blaupunkt, FM-AM, other European, American Sets. Save 30%+. Square Electronics, 150-60 Northern Blvd., Flushing, N. Y.**

**GOLD-Silver Detectors. Largest types. Five models including transistors. Violates for tungsten etc. Geiger counters. No finer instruments anywhere. Free information. Detectron, Dept. 1-N, Sylmar, California.**

**FREE: 1961 catalogs for newest, best electronic bargains available. Stereo, hi-fi, ham radio, 1000 other items. Alco Electronics, Lawrence 7, Mass.**

**FIRE alarm for homes and shops \$9.25 postpaid; additional heat detector \$1.25 each. Kamco Electrochem Co., 2712 N. Magnolia, Chicago 14, Ill.**

**CITIZEN Band Remote Control—Mfg.—Frontier Electronics, Orr, Minnesota. Write.**

**ELECTRONIC Surprise Package! 5 pounds assorted parts, \$25.00 value. Only \$2.98. KPJ Sales, Box 1252-A, Studio City, California.**

**DIAGRAMS For Repairing Radios, Television \$2.00. Give make, model. Diagram Service, Box 672E, Hartford 1, Conn.**

**NEW transistorized signal generator. 150 KC. to 120 MC. on fundamentals. Battery operated. 400 cycle modulation. Send for free information. Dept. EW. Pel Electronics, Box 555, Ridgewood, New Jersey.**

**RDZ Receiver. 200-400 Megacycles, autotune. 110 60 cy. Used, good \$30. Write for flyer. Downs, 906 Allendale, Baltimore 29, Maryland.**

**TRANSISTOR Radio Specialist-To The Trade—\$4 plus parts—Ecuadorian Electronics, 1621 Amsterdam Avenue.**

**SURPLUS capacitors, relays, switches, etc. Write for free brochure. Central Electronics, P.O. Box 6646, Dallas 19, Texas.**

**TRANSISTOR and Tube Pocket Radios. Rejects. Original List \$29.00 to \$39.00. \$5.95—3 for \$14.95. Sold as is. Myers, 623 Gay, Knoxville, Tenn.**

**PARTY Records—Sampler, catalog \$1.00. 3 different \$3.00 postpaid. DRC—11024 Magnolia, No. Hollywood, Calif.**

## WANTED

**WANTED: Electronic tubes, Diodes, Transistors, Military and commercial Lab-grade Test Equipment, Components. Top Prices. Write Details, Bob Sanett, W6REX, V & H RADIO & ELECTRONICS, 2053 Venice Blvd., Los Angeles 6, Calif.**

**CASH Paid! Sell your surplus electronic tubes. Want unused, Clean radio and TV receiving, transmitting special purpose, Magnetrons, Klystrons, broadcast types. Want military and commercial lab test equipment such as G.R.H.P., AN/UPM prefix. Also want commercial Ham Receivers and Transmitters. For a Fair Deal write: Barry Electronics Corp., 512 Broadway, New York 12, N. Y. (Walker 5-7000).**

**WANTED: Teletype Equipment; Parts; Test Equipment; Collins; Receivers. Cash; or Trade for New Ham Gear. Alltronic-Howard Co. Box-19, Boston 1, Mass. (Richmond 2-0048)**

**BUY, Sell or Trade, Short-Wave Ham & Citizens Receivers, Transmitters. Trigger-W91vj 7361 1/2 W. North Ave. River Forest, Ill. Chicago #Tuxedo 9-6429, Mon-Fri, 12N-9PM; Sat. 9AM-5PM.**

## TAPE & RECORDERS

**DON'T Buy Hi-Fi components, kits, tape, tape recorders until you get our low, low return mail quotes. "We Guarantee Not To Be Undersold." Wholesale catalog free. Hi-Fidelity Center, 1797NC First Avenue, New York 28, N.Y.**

**AMPEX, Concertone, Magnecord, Presto, Bogen, Tandberg, Pentron, Sherwood, Rek-O-Kut, Scott, Shure, Dynakit, others, Trades. Boynton Studio, Dept. RT, 10 Pennsylvania Ave., Tuckahoe, N. Y.**

**SELF-Hypnosis tape. New! Free literature. McKinley-Smith Co., Dept. T6, Box 3038, San Bernardino, Calif.**

**RENT Stereo Tapes—over 1,500 Different—all major labels—free catalog. Stereo-Parti, 811-L, Centinela Ave., Inglewood 3, California**

## HIGH-FIDELITY



**DISGUSTED with "Hi" Hi-Fi Prices? Unusual Discounts On Your High Fidelity Requirements. Write. Key Electronics, 120 Liberty St., New York 6, N. Y. Cloverdale 8-4288.**

**RECORDERS. Components. Free wholesale catalogue. Carston 125-R, East 88. N.Y.C. 28.**

**HI-FI From Japan. Finest imported tuners, amplifiers, recorders, etc. Free catalog. KPJ Sales, Box 1252-A, Studio City, California.**

**ARE prices on Hi-Fi components too high? Write Dixie Hi-Fi, 12402 Connecticut Avenue, Silver Spring, Maryland.**

## BUSINESS OPPORTUNITIES

**"GUIDE to the Japanese Electronic Industry." Just published by TechFacts. Describes Japanese manufacturers and products. Shows how amazing savings and profits can be made. \$3.00 Postpaid. TechFacts Publishing, Box 47, Williamsbridge Station, New York 67, N.Y.**

**\$12,500 Yearly Income! Sell your own Tape Recordings as Freelance International Recording Representatives. Present equipment sufficient. Only \$1.00 brings Copyrighted, comprehensive plan. International Recording, Box E, Irvington, New Jersey.**

## SHOPPING GUIDE Classified

A HANDY GUIDE TO PRODUCTS, NOT NECESSARILY ELECTRONIC, BUT OF WIDE GENERAL INTEREST.

## PHOTOGRAPHY—FILM, EQUIPMENT, SERVICES

**OPTICAL—Science—Math Bargains—Request Free Giant Catalog "CJ"—128 pages—Astronomical Telescopes, Microscopes, Lenses, Binoculars, Kits, Parts. Amazing war surplus bargains. Edmund Scientific Co., Barrington, New Jersey.**

## STAMPS & COINS

**FREE! \$1.00 worth, your choice, from first stamp selection. No strings! Adults only. Rush request now. Philatelics, Dept. EMG-F, New Paltz, N. Y.**

**GIGANTIC Collection Free! Includes triangles, early United States, animals, Commemoratives, British Colonies, high value pictorals, etc. Complete collection plus big illustrated magazine all free. Send 5¢ for postage. Gray Stamp Company, Dept. Z2, Toronto, Canada.**

## HELP WANTED

**SELL fire alarms and heat detectors to home, 12 profit per item. Kamco Electrochem Co., 2712 N. Magnolia, Chicago 14, Ill.**

**EARN Extra money selling advertising book matches. Free Samples furnished. Matchcorp, Dept. MD-11, Chicago 32, Ill.**

**HIGH Paying Jobs in Foreign Lands! Send \$2.00 for complete scoop! Foreign Opportunities, Box 172, Columbus 16, Ohio.**

## BUSINESS OPPORTUNITIES

**FREE Book "990 Successful, Little-Known Businesses." Work home! Plymouth-454M, Brooklyn 4, New York.**

**MAKE \$25-\$50 Week, clipping newspaper items for publishers. Some clippings worth \$5.00 each. Particulars free. National, 81-DG, Knickerbocker Station, New York.**

**SUCCESSFUL tax deductible, home business plan. Only \$1.00. Incoplan, 1087 Yorktown, Sunnyvale, Calif.**

## MISCELLANEOUS

**N Gifts and Jokes Galore. Catalog 10¢. Greenland Studios, Miami 47, Florida.**

**WIN contest money. Our Contest Bulletin gives hundreds of tips. Lists current contests, rules. Sample, 25¢. General Contests, 1609-F East Fifth St., Duluth, Minn.**

**ELECTRO-Scribe! Engraves all Metals, \$2.00. Beyer Mfg., 10511-ZD Springfield, Chicago 43.**

**BUY Wholesale. Send for free shop at home catalog today. Dixon Co., Box 836, Hawthorne, Calif.**

**AUTHORS! Learn how to have your book published, promoted, distributed. Free booklet "ZD", Vantage, 120 West 31 St., New York 1.**

**PLENTY Jobs. Nationwide-Worldwide. Hel. Eisinger. Box 12, Detroit 13, Mich.**

**"WINEMAKING." "Beer, Ale." Highest powered methods. Illustrated. \$2.20. Eaton Bookstore, Box 1242-X, Santa Rosa, California.**

**FLYING Saucer Model \$2. Walkie-Talkie \$59.95. Tap6 Recorder \$39.95, Checkwriter \$29.95. Tweco, 155, Indio, Calif.**



# FREE!

## Olson Radio Catalogs FOR ONE YEAR

- ★ 8 Different Issues
- ★ All Bargain Packed



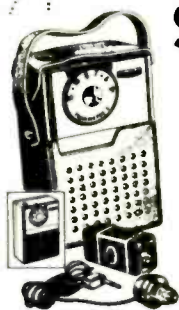
FREE One Year Subscription to OLSON RADIO'S Fantastic Bargain Packed Catalog—Unheard of LOW, LOW WHOLESALE PRICES on Brand Name Speakers, Changers, Tubes, Tools, Hi-Fi's, Stereo Amps, Tuners and other Bargains.

### Another OLSON Bargain!

# 6 TRANSISTOR RADIO

With Battery, Earphone & Case

## \$16<sup>88</sup>



2 for \$32.00  
No. RA-373

6 transistors and germanium diode in powerful super-heterodyne circuit—a total of 7 semi-conductors. Features; push-pull audio output, tunes standard broadcast band. Built-in PM speaker, personal earphone jack, and finest imported leather carrying case. Plays anywhere; plane, train, bus, auto, etc. Size 2-2/3" W x 4-1/2" H.

9 VOLT RECHARGEABLE BATTERY & CHARGER



Recharges Battery Overnight  
Plays 12-15 Hours

## \$2<sup>69</sup>

No. BA-74

### MAIL COUPON TODAY

Fill in coupon below for your FREE one year subscription to Olson's Bargain Packed Catalog. To order above merchandise, simply check quantity desired and send remittance along with coupon. (Include enough for postage or parcel post shipment. Send \$2.00 deposit for C.O.D. orders.)

- FREE Olson Catalogs for One Year
- No. RA-373 Radio @ \$16.88 Ea.
- 2 for \$32.00
- No. BA-74 Battery & Charger \$2.69

NAME \_\_\_\_\_

ADDRESS \_\_\_\_\_

CITY \_\_\_\_\_ ZONE \_\_\_\_\_ STATE \_\_\_\_\_

**OLSON RADIO CORPORATION**

615 S. Forge St., Akron 8, Ohio

## INDEX OF

# Advertisers

JANUARY  
1961

ADVERTISER	PAGE NO.	ADVERTISER	PAGE NO.
Airex Radio Corporation	89	Koss, Inc.	75
Allied Radio	7, 78, 79	Kuhn Electronics	114
Almo Radio Co.	92	Lofoyette Radio Electronics Corp.	81, 82, 83
Arkoy	75	Lompkin Laboratories, Inc.	124
Ashe Radio Co., Walter	85	Lektron	105
Audio Unlimited	120	Lendell Products	124
Audion	120	McGee Radio Co.	104
B & K Manufacturing Co.	65	Micro Electron Tube Co.	88
Baltimore Technical Institute	120	Milwaukee School of Engineering	110
Borrry Electronics Corp.	104	Moss Electronic, Inc.	106, 107
Blonder Tongue Labs	103	National Radio Institute	17, 18, 128, 130
Boeing Airplane Company	10	National Technical Schools	9
Burstein-Applebee Co.	105	North American Philips Co., Inc.	26
Cadre Industries Co.	115	Oelrich Publications	128
Candee Co., J. J.	127	Ohmatsu Electric Co. Ltd.	14
Capitol Radio Engineering Institute, The	98, 99, 100, 101	Olson Radio Corporation	134
Carston Studios	130	Paco Electronics Co., Inc.	12
Center Industrial Electronics, Inc.	126	Peak Electronics Company	96
Channel Master Corp.	108, 109	Picture Tube Outlet	126
Cleveland Institute of Electronics	13	Platt Electronics Corp.	74
Columbia Electronics	116	Prior, Inc., Louis D.	120
Commissioned Electronics Co.	130	R W Electronics	129
Coyne Electrical School	84, 102, 112	RCA Institutes, Inc.	117, 118
Delco Radio Division	1	Rad-Tel Tube Co.	87
DeVry Technical Institute	3	Radio Corporation of America	FOURTH COVER
Dressner	130	Radio-Electronic Master	121
EICO	27, 28, 113	Radio Shack Corp.	114
Editors and Engineers, Ltd.	24	Radio-Television Training School	5
Electro-Voice, Inc.	8	Rohn Manufacturing Company	14
Electronic Chemical Corp.	77	Rutherford Electronics Co.	89, 92
Electronics Book Service	90, 91, 122, 123	Sams & Co., Inc., Howard W.	94, 95
EMCO Electronic Supply Co.	72	Sarkes Tarzian Inc.	24
Esse Radio Company	120	Scott Inc., H. H.	73
Fair Radio Sales	92	Sencore	97
Fisher Radio Corp.	6	Sprague	19
G & G Radio Supply Co.	132	Standard Kollsman Industries, Inc.	16
General Techniques Inc.	129	Superscope, Inc.	114
Glas-Line Co., The	125	Supreme Publications	77
Goodheart Co., R. E.	127	Sylvania Electric Products Inc.	SECOND COVER
Grantham School of Electronics	11	Terado Company	80
Hallicrafters	4	Texas Crystals	76
Heath Company	68, 69, 70, 71	Tri-State College	88
Henshaw Radio Supply	128	Triplett Electrical Instrument Company	THIRD COVER
Holt, Rinehart and Winston, Inc.	22, 23	Tru-Vac	125
Indiana Technical College	126	Turner Microphone Company, The	20
Industrial Instrument Works	130	U.S. Crystals, Inc.	89
Injectorall Company	131	Utah Radio & Electronics Corp.	15
International Crystal Manufacturing Co., Inc.	25	Valparaiso Technical Institute	72
International Radio & Electronics Corp.	75	Van Nostrand Company, Inc., D.	67
Key Electronics Company	128	Warren Dist. Co.	124

# TRIPPLET

# ACTUAL SIZE

## USES UNLIMITED:

- Field Engineers
- Application Engineers
- Electrical, Radio, TV, and Appliance Servicemen
- Electrical Contractors
- Factory Maintenance Men
- Electronic Technicians
- Home Owners, Hobbyists



## MODEL 310

complete  
**VOLT-OHM-MILLIAMMETER**



# World's Largest Selling POCKET SIZE V-O-M

## FEATURES:

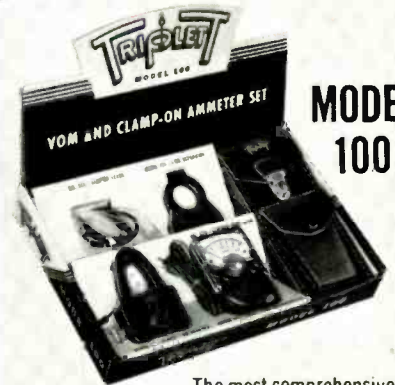
- 1 Hand size and lightweight, but with the features of a full-size V-O-M.
- 2 20,000 ohms per volt DC; 5,000 AC.
- 3 EXCLUSIVE SINGLE SELECTOR SWITCH speeds circuit and range settings. The first miniature V-O-M with this exclusive feature for quick, fool-proof selection of all ranges.

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.

■ Price—only \$34.50; leather case \$3.20.

Available For Immediate Delivery From Your Triplet Distributor's Stock

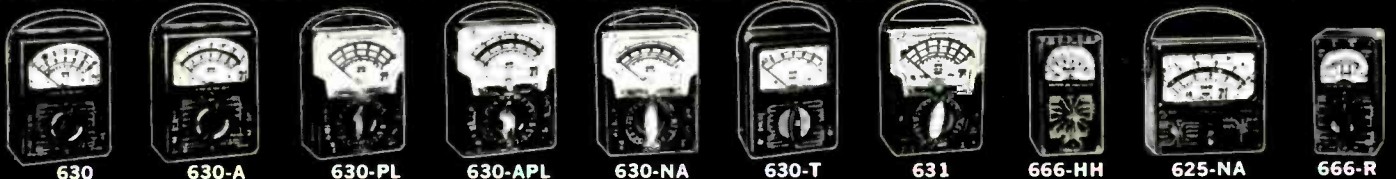
THE TRIPPLET ELECTRICAL INSTRUMENT COMPANY, BLUFFTON, OHIO



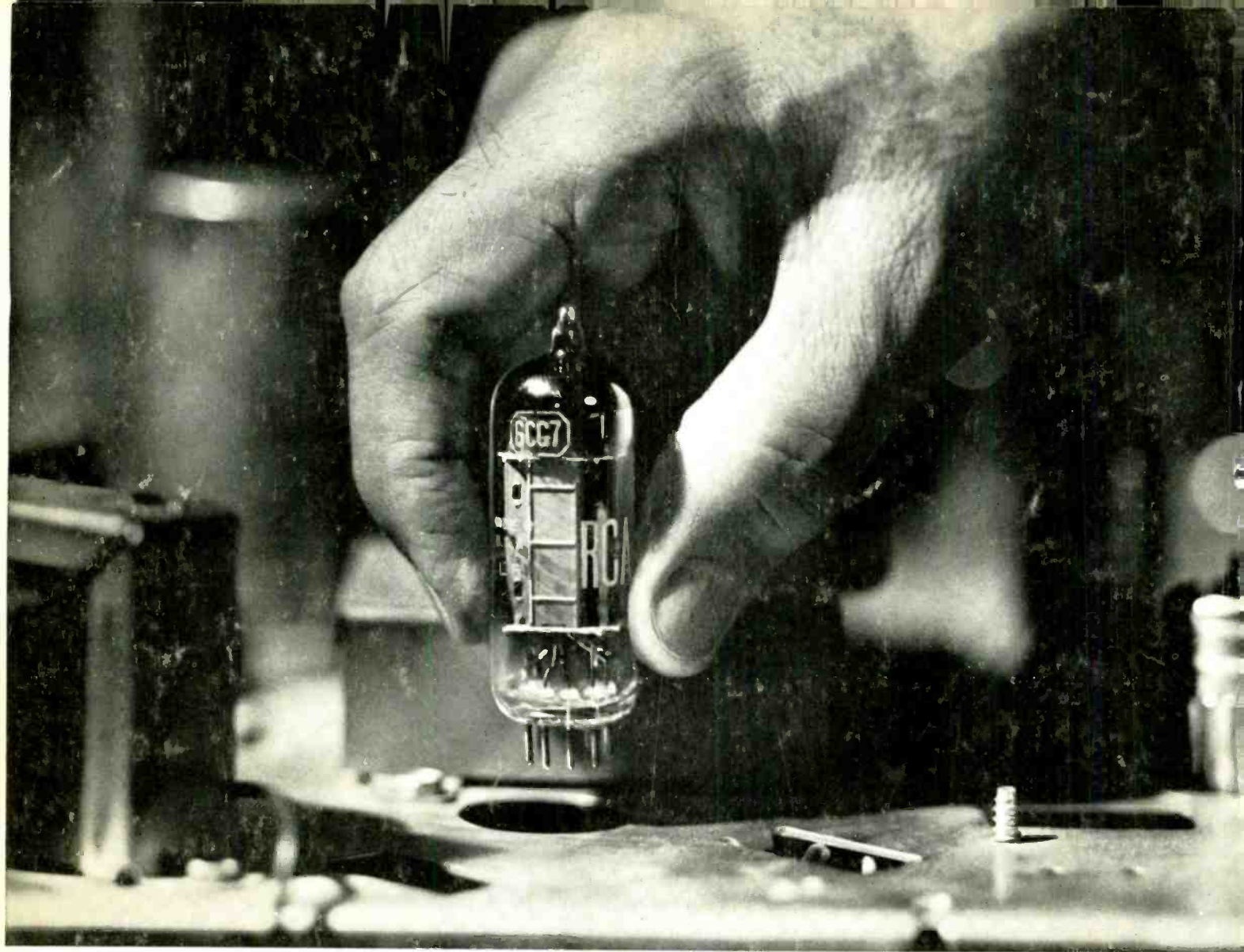
## MODEL 100

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

MANUFACTURERS OF PANEL AND PORTABLE INSTRUMENTS; ELECTRICAL AND ELECTRONIC TEST EQUIPMENT



FOR EVERY PURPOSE—THE WORLD'S MOST COMPLETE LINE OF V-O-M'S



## WHEN YOU REPLACE A TUBE . . .

You have a lot at stake each time you replace a receiving tube in a customer's set. Your professional reputation, your customer's confidence, your day's profits—even future business—all depend on the quality of that replacement tube.

It is RCA's constant aim to provide receiving tubes you can install with confidence. To this end, RCA carefully controls every step of the tube making process from initial design to final test.

**QUALITY BY DESIGN**—Some of the foremost tube experts in the industry collaborate on each new RCA tube design. Engineers, chemists, physicists, metallurgists, production specialists, field representatives, all contribute their own skills and knowledge before a new RCA tube design ever leaves the drafting board.

**IMPROVED QUALITY FROM NEW AND IMPROVED MATERIALS**—All parts and materials in RCA tubes are either *produced* or *processed* by RCA under strictest quality control. Moreover, RCA scientists search constantly for new and better materials which will still further improve performance of RCA tubes. Many tube types you install today benefit from new cathode and plate materials developed in RCA labs.

**QUALITY IN MANUFACTURING**—Because tube construction is just as important as design and materials, RCA maintains a system of supervisory microscopic inspection at key points on every production line to detect any flaw in assembly. And to minimize the chance of human error, RCA has automated certain critical steps in tube production.

**QUALITY BY TESTING AND CONTROL**—Before shipment, *every single RCA receiving tube* is factory-tested for every significant characteristic. *A tube that fails one single test is rejected and destroyed. So there is no such thing as a "second" when you buy RCA.* In addition, thorough aging of tubes and rating-lab tests assure strict adherence to performance specifications.

This is why **YOU CAN REPLACE WITH CONFIDENCE** with RCA tubes . . . and why RCA tubes give you an extra advantage on every service job. Electron Tube Division, Harrison, N. J.



The Most Trusted Name in Electronics  
RADIO CORPORATION OF AMERICA